California Department of Fish and Wildlife
2016-2017 FY
Big Game Grant Applications

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Table 1. Grant Applications Summary

Organization	Proposal Title	Proposal Amount	Year 1 request	Project Duration
CalFauna	Dry Meadow Prescribed Burn - Phase II	$53,970.44	$53,970.44	1 year
CalFauna	White Fire Restoration - Phase II	$68,966.44	$49,421.72	2 years
CAWSF	Characterizing the spread and consequences of respiratory disease for desert bighorn sheep in the eastern Mojave desert	$54,584.00	$54,584.00	1 year (final of 3)
CAWSF	Aerial Surveys of Potential Bighorn Sheep Hunt Zones	$77,500.00	$77,500.00	1 year
CAWSF	Analyses of Habitat Selection and Survival in a Translocated Population of Bighorn Sheep: San Rafael Peak, Ventura County, California	$22,500.00	$22,500.00	1 year
CAWSF	Understanding factors affecting horn size in North American wild sheep: implications for the future of conservation, harvest regulations, and fundraising	$70,000.00	$35,000.00	2 years
CDA	Maintenance and reconstruction of man-made watering devices for wildlife support.	$150,000.00	$150,000.00	1 year
CDA	Eagle Lake Vegetation Mapping	$48,150.00	$48,150.00	1 year
CDA	Eagle Lake Water Resource Inventory	$22,837.00	$22,837.00	1 year
FOD	Field of Dreams Hunting Opportunities	$20,000.00	$20,000.00	1 year
Humboldt	Numbers, distribution, behavior, and disease risks of Roosevelt elk in Humboldt and Del Norte Counties	$401,298.00	$205,349.00	3 years
MCBA	Baseball Wildlife Habitat Improvement Project	$100,000.00	$100,000.00	1 year
MCBA	BLM Paradise Ridge Prairie Maintenance	$60,000.00	$60,000.00	1 year
MDF	Little Rattlesnake Riparian Restoration (Phase 2)	$211,310.00	$80,500.00	2 years
OSU	Characterizing immunogenetic variation, immune system function, and inferring implications for respiratory disease in desert bighorn sheep in the eastern Mojave Desert	$30,597.00	$30,597.00	1 year
OSU	Using VITs to test the effects of pneumonia on desert bighorn lamb survival in the Marble Mountains of the eastern Mojave Desert	$260,466.00	$191,966.00	2 years
RMEF	Northeastern Elk Management Unit Population Dynamics and Recruitment Study, Devil's Garden Area	$74,545.00	$35,205.00	3 years
RMEF	Marble Mountain Elk Management Unit Population Abundance and Dynamics Monitoring	$63,204.00	$34,030.00	2 years
RMEF	Northeastern Elk Population Dynamics and Recruitment Study Pondosa California	$41,348.00	$24,074.00	2 years
RMEF	Marble Mountain Management Unit Population Dynamics and Recruitment Study, Trinity County	$71,815.00	$34,295.00	3 years
SCBS	Water Source Development on State School Lands (Phase II)	$29,222.54	$29,222.54	1 year
SCBS	Water hauling for guzzlers	$82,893.90	$27,631.30	3 years
SWS	Movement patterns and habitat use of American black bear (Ursus americanus) in the southern Sierra Nevada and Tehachapi Mountains, Kern County, California	$451,400.00	$273,800.00	3 years
UNR	Demographic and Distributional Responses to Water Availability by Mule Deer in a Mojave Desert Environment	$740,102.00	$371,297.00	3 years
USFS	Migratory vs. Non-migratory urban deer movements in the Sierra Nevada	$125,298.64	$92,900.67	2 years
Totals		$3332007.96	$2124830.67	

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
BIG GAME GRANT APPLICATION 2016/2017

1. **PROJECT TITLE:** DRY MEADOW PRESCRIBED BURN PHASE II

2. **AMOUNT REQUESTED FOR 2016/2017: $53,970.44**

3. **APPLICANT CONTACT INFORMATION:**

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4. **INTRODUCTION:**

A. SUBJECT AREA: "RESTORATION OR ENHANCEMENT OF BIG GAME HABITATS."

B. Background: In 2015, THE FIRST PHASE OF THE DRY MEADOWS PRESCRIBED BURN PROJECT WAS APPROVED BY THE CA DEPARTMENT OF FISH AND WILDLIFE (DFW) THROUGH THEIR BIG GAME MANAGEMENT ACCOUNT PROCESS. DURING THIS FIRST YEAR OF THE PROJECT, FIRE DESIGN WAS ACCOMPLISHED BY USFS PERSONNEL, AND CAMERA PLOTS WERE ESTABLISHED, AND THE MOTION-SENSOR CAMERAS WERE PLACED IN THE FIELD BY THE GRANTEE. The Dry Meadow Prescribed Burn is part of an attempt by personnel of the Summit District of the Stanislaus National Forest to improve wildlife habitat for native species, including game species deer and black bear, and to reduce fuel loads in the Forest to alleviate the potential of large-scale wildfires. This work should also alleviate potential impacts of insect infestations by improving tree stand health within the study area. It is well documented that deer and bear respond favorably when there is a mosaic of habitat types juxtaposed over a landscape. A prescribed burn can develop this heightened "edge effect" for deer and bear at a very reasonable per acre cost.

This portion of the Stanislaus Forest is only a few miles from the catastrophic Rim Fire of 2013. In fact, two weeks prior to the start of the Rim Fire, the Power Fire began in Beardsley Canyon. Fire conditions were severe at the site, and yet the Power Fire only consumed 1,070 acres, as compared to the huge Rim Fire. The relatively small size of the Power Fire was attributed primarily to the head of the fire hitting a previously treated area (thinning of ladder fuels followed by a prescribed burn). This region is also only about 15-20 air miles to the southeast of the 70,000+ acre Butte Fire that burned in 2015. This influenced fire behavior witnessed during

the Power Fire, gave fire fighting forces time to "catch" the fire and stop forward spread of the Power Fire. No such work was conducted in the region of the Rim Fire or the Butte Fire. The Power Fire, although a wildfire, acted more like a prescribed fire, and benefited deer, bear, and many other forest wildlife. The same cannot be said about the Rim or Butte Fires.

C. Goals and Objectives: Broad ecological restoration to this portion of the Stanislaus Forest is the over-riding goal of this project. Bringing fire back into the landscape of a mixed conifer forest will increase forage conditions for deer and bears, plus many non-game species. In a forest which has been allowed to reach the upper levels of habitat succession, important forage species such as mountain whitethorn, deer brush, buckbrush, and black oaks are crowded out by encroaching pines and firs. Having multi-age stands also aids in the resiliency of the forest. Not only will this work defend against devastating wildfires, but it can also assist in the slowing of beetle infestations, a subject that might have a bigger negative impact on our Sierran National Forests than these noted wildfires. The main objective of this project is to conduct the fire prescription over the complete 1,500 acres in this plan. Due to the inherent unpredictability associated with accomplishing prescribed burns, it is proposed to allow this project to last up to three years..

5. PROJECT DESCRIPTION:

1. Location: The whole project area lies within the Summit Ranger District of the Stanislaus Forest in Tuolumne County. It is within Deer Hunt Zone D-6 and within the statewide general bear zone. The whole project area lies within the Summit Ranger District of the Stanislaus Forest of Tuolumne County. Portions of the treatment area are adjacent to the Calaveras Ranger District. Main access to treatment area is via FS Road 5N02. In T4N R17E, sites cover ground in Sections 2, 3, 4, 5, 8, 9. In T5N R17E, sites cover ground in Sections 23, 28, 32, 33, 34, and 35. There are six distinct burn zones within the Dry Meadow Prescribed Burn area, creating a true mosaic of habitat seral stages within Beardsley Canyon.

A. Grantee Staffing:

Grant Administrator: Responsibilities include: grant acquisition; oversight of general grant dealings; monitoring of sites which will include establishing a network of study points to describe pre-and post fire habitat conditions and use by wildlife, plus writing bi-annual progress reports;

Grant Documents Manager: Responsibilities include: invoice management; project budgets; sending of all progress reports to CDF&W; correspondence creation, delivery, and acceptance between grantee, grantor, and subcontractor.

B. Subcontractor Staffing: Aside from monitoring work conducted by Grant Administrator, all field work will be accomplished by the subcontractor, namely full-time and hourly employees of the Stanislaus National Forest.

Burn Boss: 1
Resource Advisor: 2
Heavy Wildland Engine Operators: 3
Hand Crews: 1 Team of 10 personnel

C. Implementation Plan: Once all pertinent forms are signed by Grantor and Grantee, the Implementation Plan looks like this (includes Completion Timeline):

1. Establish photo-monitoring sites on Project Area. Ten permanent monitoring sites will be established on the Project Area—three in the two larger burn zones, and one each in the four smaller zones. At each of these sites, one motion-triggered camera will be placed, along with a three-foot tall piece of rebar to designate the site for taking still camera photos of the site. All sites will be GPS marked. Monitoring sites will be identified and established within the first three weeks of grant approval (weather dependent). Motion cameras will be placed at this time, as well as the first series of still images. **Accomplished in 2015**
2. Establish Fire Prescription Plan. Subcontractor will develop the Fire Prescription Plan within eight weeks after official grant approval within standards established by USFS. Once this protocol is developed, subcontractor will send this to Grants Documents Manager, who will then forward to Grantor. **Accomplished in 2015**
3. Once Fire Prescription Plan has been approved by USFS, the subcontractor Resource Advisor will begin monitoring burn conditions for appropriate burn windows. Pre-fire fieldwork to isolate burn zones will have already been established for containment purposes (this work not included in this grant proposal). When burn window and weather conditions permit, USFS subcontractor will conduct fires on burn zones. Hold harmless forms will be in place to protect Grantor and Grantee. Burns could occur in Years 2 or 3 of the grant period. If a certain portion of the 1500 acres are not burned within this two-year window, the grant invoice will be accordingly smaller. To be completed in 2016/17, according to fire prescription windows and staffing.
4. For the duration of the project, Grantee will write a minimum of two reports annually to describe progress. Photographs of sites from motion sensor cameras and the still camera will also be provided bi-annually. Cameras are currently in the field. The first downloads of photos is expected to be done by May 1, 2016 for all camera locations. Access is limited during winter/ early spring months due to road closures and snow.

D. Materials and Equipment: All materials needed for the photo capture segment of the grant have been purchased under last year's grant program,

aside from needing fresh batteries for the cameras. USFS subcontractor needs drip fuel for initiating fire activity.

E. Timeline for Task Completion: Included in Implementation Plan (D) above.

F. Explanation of Work Suitability: The work proposed here is directly in line with goals and objectives presented in the introductory portion of this proposal. Prescribed burns have long been known to improve conditions for deer, bear, and other species that prefer low- and mid-successional habitat stages in a forest environment. All aspects of accomplishing this prescribed burning project are clearly stated and verifiable.

G. Proof of environmental permitting compliance: NEPA Environmental Assessment: Dry Meadow Decision Notice #53301

6. EXPECTED BENEFITS:

This project will create low-successional habitat stages in a mosaic pattern within the Stanislaus National Forest. A prescribed burn project of this size should dramatically increase habitat value for the deer and bears that utilize this portion of the Stanislaus Forest. Since this work is being conducted in a state Game Refuge, no hunting is allowed at these prescribed burn sites. Nevertheless, sportspersons appreciate and understand the importance of having refuge areas established within hunting zones. The idea behind these refuges in the state, the source-sink theory still holds true for wildlife management. CDF&W biologist Nathan Graveline approves of this project. According to USFS publication PNW-GTR-763, there are 33 million forested acres in CA, and the USFS owns 47.4% of forested lands in CA. Using these figures, the USFS owns over 15.6 million acres of forestlands in our state. This project is another step in the growing momentum of the USFS managing their lands for healthy and resilient wildlife habitat conditions, and not merely for timber production. Approving this grant encourages the USFS to continue this trend of enhancing their lands with wildlife and especially game species in mind.

Bibliography:

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Gruell, George C., 2001. Fire in the Sierra Nevada Forests- A photographic Interpretation of Ecological Change since 1849. Mountain Press Publishing Co., Missoula, Montana. 239 p.

North, Malcolm; Stine, Peter; O'Hara, Kevin; Zielinski, William; Stephens, Scott. 2009. An ecosystem management strategy for Sierran mixed-conifer forests. Gen. Tech. Rep. PSW-GTR-220. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 49 p.

7. ITEMIZED BUDGET:

Line Item Description for Dry Meadow	Project Total
Personnel Expenses - CalFauna	**FY 2016/2017 & 2017/2018**
Monitoring Professional: 120 hours @ $50.15/hr	$6,018.00
Grant Document Manager: 80 hrs @ $30.09/hr	$2,407.20
Personnel Subtotal	$8,425.20
Operating Expense - CalFauna	
Camera Batteries - 10 @ $15.09	$150.90
Per diem - 13 days @ $25/day	$325.00
Mileage - 13 trips (140 miles round-trip) @ $0.54/mile	$982.80
Operating Expense Subtotal	$1,458.70
Subcontractor (USFS)	
Burn Boss (1) 10 Days GS9 @ $289/day	$2,890.00
Hand Crew: 10 crew members. 5 days @ $2,500/day	$12,500.00
+ 40 hours OT @ $250/hour for crew	$10,000.00
2 Resource Advisors - 5 days burn GS 11@ $388/day	$3,880.00
3 Heavy Wildland Engines - 5 Days Burning @ $820/Day	$12,300.00
Drip Fuel	$1,000.00
Subcontractor Subtotal	$42,570.00
Grant Administration (@18%)	$1,516.54
Total Project Cost	**$53,970.44**

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
BIG GAME GRANT APPLICATION 2016/2017

1. **PROJECT TITLE:** WHITE FIRE RESTORATION- PHASE II

2. **AMOUNT REQUESTED FOR 2016/2017: $49,421.72**

3. **APPLICANT CONTACT INFORMATION:**

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4. **INTRODUCTION**

A. SUBJECT AREA: "RESTORATION OR ENHANCEMENT OF BIG GAME HABITATS."

B. BACKGROUND: IN 2015, THE FIRST PHASE OF THE WHITE FIRE RESTORATION PROJECT WAS APPROVED BY THE CA DEPARTMENT OF FISH AND WILDLIFE (DFW) THROUGH THEIR BIG GAME MANAGEMENT ACCOUNT PROCESS. IN THAT FIRST YEAR, PHOTOGRAPHIC PLOTS WERE ESTABLISHED, CAMERAS WERE PLACED IN THE FIELD, AND PROJECT IMPLEMENTATION DESIGN WAS ACCOMPLISHED. ALL PRE-TREATMENT ACTIVITIES HAVE BEEN ACCOMPLISHED ACCORDING TO OUR APPROVED GRANT FOR 2015/16. IN THE 2015/16 BUDGET, THE LARGEST EXPENSE WAS THE PURCHASE OF NINE RECONYX TRAIL CAMERAS TO MONITOR DEER, BEAR, AND OTHER WILDLIFE SPECIES BEFORE AND AFTER THE GTR 220-DRIVEN TREATMENT. THIS YEAR'S LARGEST EXPENSE IS ACTUAL MAN-DAYS IN THE FIELD CONDUCTING THE TREATMENT OF REMOVING CONIFERS ON THIS REFORESTATION, PLANTATION SITE. THE WHITE FIRE BURNED 200 ACRES OF USFS LAND WITHIN THE STANISLAUS FOREST BETWEEN AUG 19, 2001 AND AUGUST 23, 2001. THE CURRENT CONDITION OF THIS SITE IS BEST DESCRIBED AS A DENSE CONIFER PLANTATION IN THE SAPLING/POLE STAGE. IF SUCCESSION IS TO BE ALLOWED TO CONTINUE UNABATED, THE CONIFERS WILL SOON OUT-COMPETE THE BLACK OAK (*QUERCUS KELLOGGII*) AND NATIVE SHRUB COMPONENT THAT WAS FORMALLY CO-DOMINANT ACROSS THIS LANDSCAPE. DEER RELY ON SHRUBS AND OAK MAST CROPS FOR FORAGE IN THIS HABITAT TYPE. THIS PROJECT PLAN DESCRIBES THE COMPLETE PROJECT THROUGH FINAL IMPLEMENTATION IN 2017/18, BUT THIS GRANT

PROPOSAL IS ASKING FOR FUNDING FOR WORK TO BE ACCOMPLISHED IN FY 2016/17 ONLY.

C. GOALS AND OBJECTIVES: THIS PROJECT PROPOSES TO MECHANICALLY REMOVE THE CONIFERS THAT CONSTITUTE THE ARTIFICIAL PLANTATION STRUCTURE THAT IS CURRENTLY PRESENT. BY REMOVING THESE CONIFERS WE EXPECT TO INCREASE FOREST HETEROGENEITY AND RESILIENCY. THIS WORK WILL ALSO RELEASE OAK AND DEER BROWSE REGENERATION AND GROWTH. IMPORTANT DEER BROWSE IN THIS SIERRAN MIXED CONIFER FOREST INCLUDE MOUNTAIN WHITETHORN (*CEONOTHUS CORDULATUS*), DEERBRUSH (*CEONOTHUS INTERGERRIMUS*), AND WILD ROSE (*ROSA CALIFORNICA*). IN ADDITION TO THE GOAL OF PROVIDING QUALITY FORAGE FOR THE STANISLAUS DEER HERD AND OTHER ASSOCIATED GAME SPECIES, THIS PROJECT WILL BREAK UP THE CONTINUOUS CANOPY AND LADDERS OF FUELS THAT CAN CONTRIBUTE TO LARGE, DESTRUCTIVE WILDFIRES. THE STANISLAUS WATERSHED IS PARTICULARLY IMPORTANT TO TREAT AT THIS TIME- BEING SANDWICHED BETWEEN THREE RECENT MEGAFIRES, THE RIM FIRE TO THE SOUTH, AND THE KING FIRE AND THE BUTTE FIRE TO THE NORTH. CONTINUOUS CANOPY FUELS OF YOUNG PLANTATIONS HAVE BEEN IDENTIFIED AS A CONTRIBUTING FACTOR TO THE DEVELOPMENT OF THESE SO-CALLED "MEGAFIRES."

IN THE 200-ACRE PROJECT AREA, WE WILL BE PUNCHING "HOLES" OR "GAPS IN THE DENSE CONIFER AREAS. THIS WILL BE ACCOMPLISHED BY HAND CUTTING WITH CHAINSAWS BY HAND CREWS HIRED BY THE USFS, A SUBCONTRACTOR TO THIS GRANT. EVERY ACRE OF THIS TREATMENT AREA WILL BE AFFECTED BY THIS "SWISS CHEESE" APPROACH. THIS WILL RESULT IN THE FINE-SCALE HETEROGENEITY DESCRIBED IN GTR 220. THE TREES WILL THEN BE STACKED AND PILED. THESE PILES WILL SUBSEQUENTLY BE BURNED BY THE SUBCONTRACTOR.

5. PROJECT DESCRIPTION

A. LOCATION: THIS PROJECT IS TOTALLY WITHIN THE SUMMIT RANGER DISTRICT OF THE STANISLAUS NATIONAL FOREST. A VAST MAJORITY OF THIS SITE SITS IN SECTION 25 T5N R17E IN TUOLUMNE COUNTY. THE MAIN ACCESS IS VIA FS ROAD 5N95. THIS SITE IS ALSO WITHIN THE DFW'S BOUNDARY OF THE TUOLUMNE STATE GAME REFUGE. SOME MIGHT ARGUE THAT DOING HABITAT WORK FOR A GAME SPECIES WITH A GAME REFUGE MAY NOT BE BENEFICIAL TO THE STATE'S SPORTING PUBLIC. WE CONTEST THAT BELIEF. THESE GAME REFUGES HAVE BEEN IN PLACE FOR DECADES AND HAVE PROVIDED AN IMPORTANT COMPONENT TO THE

SOURCE/SINK CONCEPT OF SPECIES CONSERVATION. ADDITIONALLY, THE STANISLAUS DEER HERD IS A MIGRATORY HERD, AND USES THIS IMPORTANT TRANSITION ZONE HEAVILY. LOCAL CF&W BIOLOGIST NATHAN GRAVELINE SUPPORTS THIS PROJECT.

B. STAFFING: GRANTEE PERSONNEL WILL INCLUDE EXECUTIVE OFFICER GORDON LONG AND OFFICE MANAGER DANA SIMPSON. GORDON WILL BE DESIGNATED THE GRANTEE ADMINISTRATOR OVERSEEING THE GRANT PROCESSES FOR THIS PROJECT. HE WILL WRITE ALL REPORTS ASSOCIATED WITH THIS PROJECT. MR. LONG WILL ALSO CONDUCT THE MONITORING ASPECT OF THE PROJECT. MS. SIMPSON WILL BE RESPONSIBLE FOR GRANT DOCUMENTATION AND SCHEDULING OF REQUISITE REPORTS.

C. SUBCONTRACTORS: THE ONLY SUBCONTRACTOR ON THIS PROJECT IS PERSONNEL OF THE SUMMIT RANGER DISTRICT OF THE STANISLAUS NATIONAL FOREST. ADAM RICH, USFS DISTRICT BIOLOGIST IS THE LEAD CONTACT UNDER OUR SUBCONTRACTOR AGREEMENT. MR. RICH WILL BE RESPONSIBLE FOR MANAGING ALL ASPECTS REGARDING THE HAND CREWS THAT WILL BE CONDUCTING THE CONIFER REMOVAL AND BURNING OF MATERIAL PILES ON THE PROJECT SITE.

D. IMPLEMENTATION PLAN: IF THIS GRANT RECEIVES APPROVAL BY JULY 1, 2016, IT IS EXPECTED THE CONIFER REMOVAL BY USFS HAND CREWS WILL BE ACCOMPLISHED BY NOVEMBER 15, 2016. THIS FY 2016/17 PROJECT IS THE SECOND PHASE OF THE THREE PHASE IMPLEMENTATION PLAN. PHASE 1 HAS BEEN COMPLETED. IT INVOLVED PLACING A GRID OF NINE MOTION-SENSOR CAMERAS WITHIN THE STUDY SITE TO RECORD WILDLIFE ACTIVITY AT THE PROJECT SITE DURING THE LENGTH OF THE PROJECT. THIS YEAR'S WORK, PHASE 2, INCLUDES THE CUTTING DOWN OF THE CONIFERS AT THE SITE AND PLACING THE MATERIAL IN PILES TO BE BURNED AT A LATER DATE. THE SUBCONTRACTOR EXPECTS THAT APPROXIMATELY 300 PILES WILL RESULT FROM THIS WORK. THE HAND CREWS OF THE SUBCONTRACTOR DOING THE CONIFER REMOVAL WILL LIKELY OPERATE IN FY 2016/17 DUE TO TYPICAL USFS SCHEDULING. THE LAST YEAR OF THE PROJECT, PHASE 3, INVOLVES THE BURNING OF THE PILES THAT WERE ESTABLISHED DURING PHASE 2. PHASE 3 WILL LIKELY OCCUR DURING FY 2017/18. FOUR PROGRESS REPORTS TO THE CF&W GRANT ADMINISTRATOR WILL BE FILED FOR THIS PROJECT, PLUS ONE FINAL REPORT. ONE PROGRESS REPORT WILL BE FILED AFTER THE COMPLETION OF PHASE 1 IN FY 2015/16. BIANNUAL PROGRESS REPORTS WILL BE FOR FY 2016/17, AND THE FOURTH WILL BE DELIVERED PRIOR TO PHASE

3 INITIATION. THE FINAL REPORT THAT WILL DESCRIBE ALL ASPECTS OF THE PROJECT WILL BE SENT TO THE CF&W GRANT ADMINISTRATOR WITHIN FIFTEEN WORKDAYS OF COMPLETION OF PHASE 3. CF&W GRANT ADMINISTRATOR AND/OR STAFF WILL BE INVITED TO TOUR SITE AFTER THE TREES ARE REMOVED AND AGAIN AFTER THE PILES ARE BURNED TO INSURE WORK ACCOMPLISHED FOLLOWED THE PROTOCOL ESTABLISHED IN THIS GRANT PROPOSAL IS ADEQUATE.

E.

EQUIPMENT	**PURPOSE**	**WHO PROVIDES?**
CHAINSAWS/ FUEL/OIL ETC	TREE REMOVAL	SUBCONTRACTOR
SAFETY EQUIPMENT	PERSONNEL SAFETY	SUBCONTRACTOR
VEHICLES & SUPPORT	TRAVEL TO & FROM SITE	GRANTEE/ SUBCONTRACTOR
MOTION SENSOR CAMERAS	RECORD ANIMAL USE	GRANTEE
STILL CAMERA	RECORD HABITAT CONDITIONS	GRANTEE
GPS UNIT	RECORD CAMERA SITES	GRANTEE
REBAR/FLAGGING	RECORD CAMERA SITES/ SITE BOUNDARY	GRANTEE

F. TIMELINE FOR TASK COMPLETION: SEE ABOVE D. IMPLEMENTATION PLAN

G. EXPLANATION OF WORK SUITABILITY: THERE ARE NUMEROUS STUDIES THAT HAVE BEEN PUBLISHED OVER THE LAST FIFTY YEARS THAT DESCRIBE THE BENEFITS THAT MECHANICAL TREATMENTS CAN PROVIDE TO SPECIES THAT PREFER EARLY TO MID-SUCCESSIONAL SERAL STAGE CONDITIONS IN CONIFER FORESTS. ONE SUCH PUBLICATION IS CDF&W'S "A SPORTSMAN'S GUIDE TO IMPROVING DEER HABITAT IN CALIFORNIA" (DOC. R5-M8-249, JANUARY 2013). THIS PROJECT WILL ALSO BENEFIT BLACK BEARS THAT INHABIT THIS REGION OF TUOLUMNE COUNTY THIS PROJECT TACKLES THESE TWO IMPORTANT RESOURCE CHALLENGES— INCREASING FOREST HEALTH AND DEER/BEAR HABITAT

CONDITIONS—IN A DIRECT WAY. THESE DOCUMENTS, ESPECIALLY GTR-220 DESCRIBES HOW ACTIVE MANAGEMENT IN THE FOREST CAN BE THE DRIVING FORCE TO REESTABLISHING FORESTS THAT CAN BE BOTH HEALTHY AND HAVE THE ABILITY TO COMBAT "MEGAFIRES". ANOTHER THREAT TO OUR SIERRAN NATIONAL FORESTS IS MASS DIE-OFFS OF THE CONIFERS DUE TO INSECT INFESTATION. THESE LARGE SCALE DIE-OFFS ARE SYMPTOMS OF POOR FOREST HEALTH AND OF OUR CURRENT DROUGHT CONDITIONS.THIS WORK SHOULD ONLY HIGHLIGHT THE BENEFITS OF WORKING TOWARD HEALTHIER, MORE RESILIENT FORESTS. THE USFS NO LONGER IS FULLY VESTED IN GROWING CONIFER PLANTATIONS. AT LEAST THAT CAN BE SAID FOR THE STAFF OF THE STANISLAUS FOREST. THIS ENLIGHTENED VIEW OF HOW THESE FORESTS CAN BE MANAGED FOR MORE THAN JUST TIMBER PRODUCTION NEEDS TO BE CULTIVATED AND HIGHLIGHTED. THE PRESCRIPTION DESCRIBED IN THIS PROPOSAL IS SOMEWHAT NOVEL. INSTEAD OF A TRADITIONAL PRE-COMMERCIAL THINNING PROGRAM THAT WOULD RESULT IN EVEN-SPACED CONIFERS IN A GRID PATTERN, THIS PROJECT WOULD BREAK UP DENSE CONIFER GROWTH TO CREATE FINE-SCALE HETEROGENEITY. BY FOLLOWING THE RESTORATION CONCEPTS IN GTR-220, THIS PROJECT PRESCRIBES THE CREATION OF CIRCULAR OPENINGS WITHIN THE FOREST. THESE CIRCULAR OPENINGS WILL BE 1/16 TO ¼ OF AN ACRE IN SIZE AND LOCATED WITHIN DENSE CONIFER GROWTH CENTERED AROUND PATCHES OF OAKS AND PREFERRED BROWSE SPECIES OF DEER.

H. <u>PROOF OF ENVIRONMENTAL PERMITTING COMPLIANCE: NEPA DOCUMENT: WHITE THINNING DECISION MEMO #27549.</u> THERE WAS A " FINDING OF NO SIGNIFICANT IMPACT (FONSI) FOR THIS PROJECT.

6. EXPECTED BENEFITS: THE USFS HAS A LONG HISTORY OF MANAGING THE FORESTS THEY MANAGE FOR TIMBER PRODUCTION. THIS SINGLE DIRECTIVE HAS DRAMATICALLY IMPACTED THESE FORESTS OVER THE LAST 50-60 YEARS. FOREST HEALTH IS DOWN; HUGE FIRE PROBABILITIES ARE UP, ANIMAL SPECIES DIVERSITY IS DOWN, AND PUBLIC PERCEPTION OF THEIR MANAGEMENT ABILITIES ARE DOWN. GETTING PROJECTS LIKE THIS ACCOMPLISHED IN OUR NATIONAL FORESTS COULD GO A LONG WAY IN PROVING THAT THE USFS HAS TURNED AN IMPORTANT CORNER, AND ARE TAKING A PROACTIVE STANCE IN MANAGING THESE FORESTS FOR MANY DIVERSE VALUES. AS CF&W BIOLOGIST NATHAN GRAVELINE SAID, " …PERHAPS MORE IMPORTANTLY, I AM GETTING SUPPORT FROM THE FOREST SERVICE TO BEGIN DOING PROJECTS THAT ARE MORE FOCUSED ON WILDLIFE HABITAT THAN GROWING TIMBER."

THIS PROJECT WILL ENHANCE AN IMPORTANT WILDLIFE CORRIDOR FOR THE STANISLAUS DEER HERD AS THEY TRANSITION BETWEEN THEIR SUMMER AND WINTER RANGES. IT WOULD BE HARD TO PREDICT HOW MANY ADDITIONAL HUNTER DAYS MIGHT BE REALIZED, BUT SINCE THE D-6 DEER ZONE HAS A THREE WEEK ARCHERY SEASON AND A SIX WEEK RIFLE SEASON, YOU MIGHT WITNESS SOME BENEFITS TO HUNTERS ON NEARBY NON-GAME REFUGE US FOREST SERVICE LANDS. IF THE STANISLAUS DEER HERD IS POSITIVELY AFFECTED BY THE HABITAT RESTORATION WORK DONE HERE, THERE WILL BE AN INCREASE IN DEER NUMBERS, WHICH SHOULD HAVE A POSITIVE IMPACT ON INCREASING OVERALL HUNTING PARTICIPATION ACROSS THE WHOLE STANISLAUS FOREST AND NEARBY PRIVATE LANDS.

PHASE I OF THIS PROJECT WAS APPROVED IN 2015 AND THIS DESCRIBED WORK WAS ACCOMPLISHED ON TIME AND WITHIN BUDGET. GAINING AN APPROVAL FOR THE PHASE II SEGMENT OF THIS PROJECT IS A LOGICAL NEXT STEP. THE INFRASTRUCTURE IS IN PLACE, CAMERAS ARE IN THE FIELD, ENVIRONMENTAL COMPLIANCE IS CURRENT, AND SUPPORT WITHIN THE STANISLAUS FOREST IS AS STRONG AS EVER TO CONTINUE THIS GTR-220 TYPE OF FOREST MANAGEMENT WITHIN THEIR BOUNDARIES.

7. ITEMIZED BUDGET:

Line Item Description for White Fire Restoration	Project Totals	
Personnel Expenses - CalFauna	**FY 2016/2017**	**FY 2017/2018**
Monitoring Professional: 58 hours @ $50.15/hr	$2,908.70	$2,908.70
Grants Documents Manager: 40 hours @ $30.09/hour	$1,203.60	$1,203.60
Personnel Subtotal	$4,112.30	$4,112.30
Operating Expense - CalFauna		
Camera Batteries - 9 @ $15.09/each	$135.81	$135.81
Per diem - 4 days @ $25/day	$100.00	$100.00
Mileage - 4 trips (140 miles round-trip) @ $0.54/mile	$302.40	$302.40
Operating Expenses Subtotal	$538.21	$538.21
Subcontractor (USFS)		
USFS Biologist GS11 @ $388/day	$1,164.00	$776.00
USFS Assistant GS9 @ $289 /day	$867.00	$578.00
Hand Crew: 10 crewmembers. 25 Days @ $20/hour	$40,000.00	
Hand Crew: 10 crewmembers. 8 Days @ $20/hour		$12,800.00
Materials & supplies (fuel, chain saw parts, misc.)	$2,000.00	
Subcontractor Subtotal	$44,031.00	$14,154.00
Grant Administration (@18%)	$740.21	$740.21
Total Project Cost (Amount requested in #1, above)	**$49,421.72**	**$19,544.72**

CA Department of Fish and Wildlife - Application for Big Game Grant FY16/17

1. **Project Title:** **Aerial Surveys of Potential Bighorn Sheep Hunt Zones**

2. **Amount Requested: $77,500**

3. **Contact Information:** California Chapter, Foundation for North American Wild Sheep
dba California Wild Sheep Foundation
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Primary: Mike Borel (mike.borel@contextnet.com;
Phone 925-937-4180)
Administration: Beverly Valdez (forthesheep@gmail.com;
Phone/fax 650-472-3889)

4. **Introduction**:

a. Project Type: Hunter Opportunity

b. Background:

A tragic accident in 2010 has, until 2015, precluded the California Department of Fish and Wildlife (CDFW) from conducting aerial surveys in current hunt zones. Clearly, re-initiation of surveys in those existing zones has been an important accomplishment, and that strategy rightly supersedes opportunities to explore additional bighorn sheep harvest opportunities. This proposal is designed to assist CDFW in its efforts to offer additional hunting opportunity by providing demographic information acquired during aerial surveys of areas currently thought to be capable of providing recreational opportunities. At the very least, the surveys will result in contemporary demographic data in three geographic areas, most of which has not been updated for approximately a decade. In the absence of such surveys, hunter opportunity will remain limited to those zones that already are open to the harvest of bighorn sheep.

c. Specific Goals and Objectives:

The California Chapter of Wild Sheep Foundation (CAWSF) will facilitate aerial surveys in two geographic areas of the central and eastern Mojave Desert of San Bernardino County (Chemehuevi Mountains; Rodman, Newberry, and Ord mountains complex) and one area in the transverse range in Ventura County. The raw data and analysis will be provided to CDFW for use in assessing the populations of bighorn sheep in those three areas to be used for formulating future recommendations for hunting opportunities. Demographic data will become available on these populations for the first time in many years.

Each of these areas is thought to support healthy populations of bighorn sheep (Abella et al. 2011), however CDFW has been unable to conduct recent surveys in any of the proposed areas. A high priority is, understandably, placed on obtaining demographic information on existing hunt zones so that recreational opportunities in those areas will not be jeopardized in the future; thus, surveys of the areas proposed herein may not be implemented by CDFW in the near future. This proposal will provide information to CDFW above and beyond what CDFW may plan to accomplish during the forthcoming fiscal year, and will help re-establish the momentum of California's desert bighorn sheep management program.

5. Project Description:

a. Location: Aerial surveys will be conducted in the Chemehuevi Mountains, the Rodman-Newberry-Ord mountains complex, and in the transverse range in Ventura County.

b. Staffing Requirements: None other than the contractor and subcontractors as outlined below.

c. Contractors and Subcontractors:

The contractor (CAWSF) will provide one current paid independent contractor to handle administrative details associated with development and implementation of subcontracts. CAWSF will subcontract directly with a commercial helicopter operator that meets all CDFW requirements for aerial survey work; subcontracted observers will be experienced professionals employed by the helicopter contractor. A second subcontractor familiar with each of the geographic areas will consult with knowledgeable CDFW personnel and others, and assume responsibility for development and oversight of the aerial surveys, analyses of results and their interpretation, and ensuring that all resulting information is compiled in a final report.

d. Implementation Plan:

Within one month of awarding of the contract, CAWSF will initiate efforts to locate and finalize an appropriate subcontractor to complete the aerial surveys described. In each area, survey intensity will be ≈2.5 minutes/km^2, consistent with established rates for other mountain ranges (Bleich et al. 1997, Wehausen and Bleich 2007). Data will be recorded as effort per survey polygon, groups of bighorn sheep observed, the identifications of bighorn sheep comprising each group, and the initial and subsequent observer, yielding an opportunity to calculate a population estimate and associated confidence intervals for the total area surveyed within each geographic area (Graham and Bell 1989). Additionally, CAWSF will complete a second subcontract for planning and oversight of the aerial survey work, data analysis, and report preparation.

Within 2 months of completion of each aerial survey described herein, CAWSF will submit to the CDFW Wildlife Branch the original data obtained during each survey, maps of areas surveyed, and a final report including the results of analyses and a synthesis of the results obtained during each survey. The availability of an appropriate survey contractor is an unknown at this time, and a schedule must be developed. Nevertheless, even in the event that surveys must be conducted during different years as a result of the survey subcontractor's scheduling requirements, it is anticipated that CAWSF will complete its obligation to CDFW within 18 months of awarding of the grant.

Quarterly reports will be submitted outlining status of project, work completed, and planned efforts for the coming quarter.

e. Equipment Necessary to Implement the Project:

Requisite equipment will include a list of transmitter frequencies for any telemetered animals in the three geographic areas to be surveyed; this information will be provided to CA

WSF by CDFW. Also necessary during each survey effort will be a serviceable programmable scanner-receiver and associated antennae and wiring for use by the pilot and survey crew. To avoid the purchase of replicate equipment it is anticipated that CDFW will loan the necessary hardware to CA WSF on a temporary basis for use in each survey area potentially containing telemetered bighorn sheep. Equipment will be returned to CDFW immediately upon completion of each of the three aerial surveys.

f. Timeline for Completion of Each Task:

Completion of surveys will be contingent upon the date of awarding of the grant to CAWSF and availability of an appropriate subcontractor to implement the aerial surveys. Optimistically, all three surveys can be completed during fall 2016, but completion dates are uncertain.

A report including the results of each survey, analyses of data obtained, and a synthesis of results and implications will be completed within one month of the completion of each of the planned surveys. The contractor, CAWSF will ensure that all results and requisite reports are submitted in a timely manner.

g. Explanation of How This Work Addresses Material in the Introduction

This effort will provide CDFW with information that would not be available if the surveys described herein are undertaken. Thus, they will augment the aerial survey work that CDFW is currently planning for fall 2016, thereby increasing the number of areas that are surveyed in the upcoming fiscal year. Completion of this work will be complementary to CDFW efforts, and will increase the momentum of the bighorn sheep program. Each of these areas has the potential to provide additional hunter opportunity in the future, and results of this work will be an important factor contributing to the establishment of future opportunities should the data be consistent with that objective.

h. Environmental Permitting Needs: None. All surveys will be conducted on public lands managed either the U.S. Forest Service or the Bureau of Land Management. Although flights will occur over designated wilderness, no landing will take place within wilderness areas and, hence, no environmental permitting is necessary.

(1) The Chemehuevi Mountains are located along the Colorado River, 20 km south of Needles, California. Persistent reports of large numbers of bighorn sheep (i.e., groups of 20-30 individuals) being observed in that range warrant investigation, and the range has the potential to provide additional recreational hunting opportunities for the most sought-after big game species in North America. The Chemehuevi Mountains have been the beneficiary of one water development constructed by CDFW and bighorn sheep are known to obtain water along the Colorado River. Bighorn sheep also move between the Chemehuevi Mountains and the Whipple Mountains (Epps et al. 2007), an area in which 3 wildlife water developments have been constructed by CDFW, and to which bighorn sheep were translocated during 1983–1985 (Bleich et al. 1990). The Chemehuevi Mountains comprise a large geographic area, and approximately 8 hours of aerial survey time will be necessary to completely cover the range. The range has been surveyed previously, and established survey polygons will be utilized to facilitate inter-annual comparisons.

(2) The Rodman, Newberry, and Ord mountain ranges extend eastward from Lucerne

Valley to the western edge of the Twentynine Palms Marine Corps Base. CDFW has constructed two wildlife water developments in the Newberry Mountains. The Ord Mountains are well watered with natural sources, and the Rodman Mountains contain at least one reliable source of water. Recent photographic evidence suggests a large number of bighorn sheep occupy the Newberry Mountains, thereby warranting additional investigations of the potential for that range and associated areas to provide additional recreational hunting opportunities.

Bighorn sheep inhabiting the Rodman, Newberry, and Ord mountain ranges previously were considered to represent ≥2 subpopulations of bighorn sheep (Epps et al. 2004), but are now thought to represent a single population (Abella et al. 2011). Hence, this proposal is to survey those ranges as a single unit. This is a very large area, and will require approximately 12 hours of survey time to complete the effort. Parts of the area have been surveyed previously in bits and pieces, and previously established survey polygons will be utilized to facilitate inter-annual comparisons.

(3) There have been no bighorn sheep aerial surveys conducted in the transverse range in Ventura County for many years. Thus, information obtained as a result of this effort will provide an updated assessment of the status of that population and provide a baseline against which future changes can be measured. Previously established survey polygons will be used to the extent possible and results of anticipated habitat selection modeling, along with knowledge of local CDFW personnel will be used to inform the survey strategy.

(4) Survey planning, coordination, and oversight will be provided. CAWSF will work directly with the desert bighorn sheep biologist in Region 6 and the area biologist in Region 5 to ensure all proposed survey polygons meet CDFW specifications. Following completion of each aerial survey, a report will be prepared and submitted to the CDFW Wildlife Branch. Upon completion of the surveys, a final report will be submitted the CDFW Wildlife Branch. Data will be compiled and analyzed, and recommendations based on those analyses will be included in that report.

6. Expected Benefits: There could be enhanced hunting opportunity for big game on public lands as a result of these efforts. CDFW will have the benefit of additional information regarding the status of bighorn sheep inhabiting the three areas to be surveyed. These data will augment the information to be obtained during additional CDFW surveys scheduled to be conducted in existing hunt zones during FY 2016–2017. If adequate populations of bighorn sheep are determined to exist in any of the geographic to be surveyed as a result of this proposal, that information can be used by CDFW to lay the groundwork for future surveys and subsequent recommendations to the California Fish and Game Commission regarding increased hunter opportunity. Data obtained during these surveys can serve as an initial step toward an increased number of areas open to the harvest of bighorn sheep, thereby providing additional recreational opportunities and funding for conservation.

7. Budget: The surveys will be flown by a commercial helicopter operator that meets all CDFW contract requirements for aerial survey work. Observers will be experienced professionals employed by the helicopter contractor. While it is difficult to derive an exact cost for the proposed work, we present below an estimate based on the most recent information available; this estimate is based on similar costs associated with capture work completed recently in the Mojave National Preserve.

Aerial Surveys of Potential Bighorn Sheep Hunt Zones	**Project Totals**
Personnel	
Subcontractor (helicopter, pilot and survey crew [total costs])	$ 63,000
Subcontractor (survey oversight, analyses, report preparation)	$ 6,000
Contractor (contract oversight and administration)	$ 1,000
Total Personnel Expenses	$ 70,000
Operating Expenses	
Travel (subcontractor for field supervision and survey oversight)	$ 7,500
Total Operating Expenses	$ 7,500
Subtotal Personnel & Operating Expenses	$ 77,500
Administrative Overhead	$ 0
Total Project Cost	**$ 77,500**

Literature Cited:

Abella, R., V. C. Bleich, R. A. Botta, B. J. Gonzales, T. R. Stephenson, S. G. Torres, and J. D. Wehausen. 2011. Status of bighorn sheep in California — 2011. Desert Bighorn Council Transactions 51:54–68.

Bleich, V. C., and A. M. Pauli. 1990. Mechanical evaluation of artificial watering devices built for mountain sheep in California. Pages 65–72 *in* G. K. Tsukamoto and S. J. Stiver, editors. Wildlife water development. Nevada Department of Wildlife, Reno, USA.

Bleich, V. C., R. T. Bowyer, and J. D. Wehausen. 1997. Sexual segregation in mountain sheep: resources or predation? Wildlife Monographs 134:1–50.

Bleich, V. C., J. D. Wehausen, K. R. Jones, and R. A. Weaver. 1990. Status of bighorn sheep in California, 1989 and translocations from 1971 through 1989. Desert Bighorn Council Transactions 34:24–26.

Epps, C. W., J. D. Wehausen, V. C. Bleich, S. G. Torres, and J. S. Brashares. 2007. Optimizing dispersal and corridor models using landscape genetics. Journal of Applied Ecology 44:714–724.

Graham, A., and R. Bell. 1989. Investigating observer bias in aerial survey by simultaneous double-counts. Journal of Wildlife Management 53:1009–1016.

Wehausen, J. D., and V. C. Bleich. 2007. Influence of aerial search time on survey results. Desert Bighorn Council Transactions 49:23–29.

Wehausen, J. D., and M. C. Hansen. 1986. Impacts of cattle grazing on bighorn sheep. Unpublished report. California Department of Fish and Game, Sacramento, USA.

CA Department of Fish and Wildlife - Application for Big Game Grant FY 16/17

1. Project Title: Analyses of Habitat Selection and Survival in a Translocated Population of Bighorn Sheep: San Rafael Peak, Ventura County, California

2. Amount Requested: $22,500

3. Applicant Contact Information:

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4. Introduction:

(a) Project Type: Analysis of Existing Data

(b) Background: In 1985 and 1987, the California Department of Fish and Game (now California Department of Fish and Wildlife; CDFW) completed two separate translocations of bighorn sheep from the San Gabriel Mountains in Los Angeles County to the Transverse Range in the Los Padres National Forest (LPNF), Ventura County (Bleich et al. 1989). The animals translocated to Ventura County are the progenitors of all animals currently comprising the population of bighorn sheep occurring on the Los Padres National Forest. Based on observations of 64 bighorn sheep reported by CDFW wildlife biologist Christine Thompson, it is clear that a substantial, albeit unknown, number of bighorn sheep currently survive in the Sespe Wilderness and nearby areas of the Los Padres National Forest. Thus, the translocation appears to have resulted in the successful restoration of bighorn sheep to this historically occupied area.

To facilitate the establishment of this newly translocated population, CDFW personnel prepared a management plan (Bleich and Kimple 1990). This project proposes to finalize the analyses of habitat selection gathered from telemetered bighorn sheep that were released in the aforementioned translocations, and is consistent with the existing, albeit dated, management plan.

Twenty-eight of the translocated individuals were equipped with VHF collars. Locations of all collared individuals were monitored by personnel from the California Department of Fish and Game or U.S. Forest Service on a regular basis using traditional aerial telemetry from 1985 to 1989, with the result that 809 total telemetry locations—collected at approximately 2-week intervals throughout the year—were obtained from the radio-collared individuals ($\bar{x} \approx 29$ locations/individual). Habitat attributes associated with each telemetry location, have been determined, and the analyses and interpretation of those results should be undertaken. Among the habitat attributes that will be considered is fire history, which has played a very important role in understanding the distribution and population ecology of bighorn sheep in other portions of the transverse ranges in Los Angeles and San Bernardino counties (Bleich et al. 2008; Holl and Bleich 1983, 2010; Holl et al. 2004, 2012). Additionally, the cause and date and of death were determined for all animals that died during the investigation, providing a source of information on mortality factors and survival rates of the translocated individuals, and a comparison will be made between the two translocation efforts.

The purpose of this proposal is to provide funds to complete the analyses of the existing data gathered from 1985 to 1989 in order to provide insight into the initial distribution and habitat selection by the translocation animals, as well as survival analyses of individuals comprising each of the translocated groups of sheep. The resulting conclusions are meaningful for several reasons: (1) they will provide information on initial areas occupied by bighorn sheep as a baseline for future comparisons in the Sespe Wilderness and elsewhere on the Los Padres National Forest; (2) they will provide the only analyses of habitat selection by the translocated animals, which is important information in the absence of contemporary investigations; (3) they will provide an opportunity to assess shifts in habitat selection over a period of approximately 30 years by comparison with results obtained during future investigations; (4) they will provide important information on survival rates and mortality, which will be useful when contemplating additional translocations or for comparison with results from future investigations of this population; and, (5) they will provide information on how best to survey the current population..

(c) Specific Goals and Objectives:

(1) Use existing data to calculate habitat selection by male and female bighorn sheep translocated to the transverse ranges of Ventura County, and important the results in the context of their relevance to this population of bighorn sheep (i.e., describe the value of the various habitat attributes to the potential distribution of bighorn sheep in the transverse ranges of Ventura County).

(2) Use existing data to describe the initial distribution of bighorn sheep from the first translocation, and compare it to the distribution of newly translocated bighorn sheep following the second translocation.

(3) Use existing data along with subsequent publications (Holl and Bleich 1983, Bleich et al. 2008) to compare and describe habitat use by the translocated bighorn sheep to habitat use by the source population of bighorn sheep in the San Gabriel Mountains.

(4) Use existing data to compare and describe habitat selection or use by male and female bighorn sheep during periods of sexual segregation and sexual aggregation, a frequently overlooked aspect of ungulate ecology.

(5) Use existing data to assess and compare survivorship (Cox and Oakes 1984, Pollock et al. 1989) of animals comprising both translocations, and to describe and compare cause-specific mortality among individuals comprising the two translocations.

5. Project Description

a. Location: Sheep were translocated to San Rafael Peak from the San Gabriel Mountains; the analyses will take place in an office setting but will include one field visit.

b. Staffing Requirements: The California Chapter of Wild Sheep Foundation proposes to subcontract the analyses and preparation of a final report to an appropriate, highly qualified scientist who will serve as the Principal Investigator and work collaboratively with the individuals previously involved with the acquisition and development of data to be used in the analyses (Dr. Diego Sustaita, Brown University; Ms. Rebecca Barboza, CDFW) and most familiar with the current status of the population of bighorn sheep being investigated (Ms.

Christine Thompson, CDFW). CAWSF will pay an existing staff member to oversee contract administration, report distribution, and payment of invoices.

c. Contractors and Subcontractors:

(1) The contractor for the proposed work is the California Chapter of Wild Sheep Foundation. Realizing the importance and relevance of analysis of these existing data to the conservation, management, and potential for hunter opportunity represented, CAWSF will ensure that all reporting and other requirements are met.

(2) The data syntheses, analyses, and formal report preparation will be carried out by a Principal Investigator subcontracted by CAWSF. The PI, Dr. Vern Bleich, will work collaboratively with academic and agency personnel having a stake in data acquisition, data management, and data application, all of whom will be contributors to the final report and resulting professional paper.

d. Implementation Plan:

(1) Using existing data, complete the initial resource selection function analyses and develop preliminary survival analyses.

(2) Develop and report the final Resource Selection Functions and resulting survival analyses.

(3) CAWSF will submit to CDFW a final report in the format of a manuscript suitable to be considered for publication in a professional journal; the manuscript will be the final report to be submitted to CDFW.

e. Materials and Equipment: Existing data have been organized and are ready for analysis. No other data collection or equipment is necessary for this project to move forward.

f. Timeline for Completion of Each Task:

—Quarterly reports will be submitted to include:
—Within 6 months a report as outlined in Implementation Plan (1) above
—Within 9 months a report as outlined in Implementation Plan (2) above
—Within 12 months a final report as outlined in Implementation Plan (3) above

g. How This Work Addresses Items Described in the Introduction: These analyses will provide an in-depth look at habitat use and habitat selection as well as survival of bighorn sheep translocated to establish a new population of that species in the transverse range of Ventura County. The analyses will also provide information on where the translocated sheep established home ranges at first and allow a comparison to the home ranges of animals later in the studies. Both of these are questions that remain unanswered and have implications for any future translocations. This population appears to be performing well, but these results will provide the only information currently available to begin to understand the ecology of this recently established population, and will provide an opportunity for future investigators to compare changes in habitat selection as the population increased in size and distributes itself across the landscape. This population has some potential to provide additional hunter opportunity and, thus, is important to CAWSF. For the time being, however, this is an opportunity to make meaningful

inferences about the results of the initial translocations that will help in planning additional translocations and future survey work.

h. Environmental Compliance: None necessary for this project to be completed. All environmental compliance was completed and approved by the U.S. Forest Service prior to implementation of the translocation projects.

6. Expected Benefits: There will be an understanding of the way that bighorn sheep translocated to this location initially used the landscape, an opportunity to make comparisons between habitat selection at that time, and any shifts that have occurred over time with respect to selection and distribution. The results of this analysis also have implications for future translocations to historically occupied areas in the transverse ranges by providing analyses of cause-specific mortality and habitat selection that will be useful in determining the suitability of additional areas for establishing bighorn sheep. This population appears to be doing well, and has the potential to provide increased hunter opportunity as more is learned about it.

7. Budget:

Habitat Selection and Survival Analyses of an Introduced Population of Bighorn Sheep, Ventura County, California	**Project Totals**
Personnel	
Principal Investigator (Dr. Vern Bleich)	$ 19,000
Contract Administration and Oversight (CAWSF)	$ 1,000
Total Personnel Expenses	$20,000
Operating Expenses	
Publication Charges	$ 1,000
Travel	$ 1,500
Total Operating Expenses	$ 2,500
Subtotal Personnel & Operating Expenses	$ 22,500
Administrative Overhead	$ 0
Total Project Cost	**$ 22,500**

Literature Cited

Bleich, V. C., and S. B. Kimple. 1990. Bighorn sheep management plan: San Rafael Peak Management Unit. California Department of Fish and Game, Sacramento, USA.

Bleich, V. C., J. D. Wehausen, K. R. Jones, and R. A. Weaver. 1990. Status of bighorn sheep in California, 1989 and translocations from 1971 through 1989. Desert Bighorn Council Transactions 34:24–26.

Bleich, V. C., H. E. Johnson, S. A. Holl, L. Konde, S. G. Torres, and P. R. Krausman. 2008. Fire history in a chaparral ecosystem: implications for conservation of a native ungulate. Rangeland Ecology and Management 61:571–579.

Cox, D. R. and D. Oakes. 1984. Analysis of survival data. Chapman and Hall, New York, USA.

Holl, S. A., and V. C. Bleich. 1983. San Gabriel mountain sheep: an analysis of management alternatives. San Bernardino National Forest, San Bernardino, California, USA.

Holl, S. A., and V. C. Bleich. 2010. Responses of large mammals to fire and rain in the San Gabriel Mountains, California. Northern Wild Sheep and Goat Council Proceedings 17:139–156.

Holl, S. A., V. C. Bleich, B. W. Callenberger, and B. Bahro. 2012. Simulated effects of two fire regimes on bighorn sheep: the San Gabriel Mountains, California, USA. Fire Ecology 8(3):88–103.

Holl, S. A., V. C. Bleich, and S. G. Torres. 2004. Population dynamics of bighorn sheep in the San

Gabriel Mountains, California, 1967–2002. Wildlife Society Bulletin 32:412–426.
Manly, B., L. McDonald, and D. Thomas. 1993. Resource selection by animals. Chapman and Hall, New York, USA.
Pollock, K. H., S. R. Winterstein, C. M. Bunck, and P. D. Curtis. 1989. Survival analysis in telemetry studies: the staggered entry design. Journal of Wildlife Management 53:7–15.

CA Department of Fish and Wildlife - Application for Big Game Grant FY 16/17

1) Project Title: Characterizing the spread and consequences of respiratory disease for desert bighorn sheep in the eastern Mojave Desert (**Continuation-Year 3 of 3**)

2) Amount Requested: $54,584

3) Applicant Contact Information:

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Administration: Beverly Valdez (forthesheep@gmail.com; Phone/fax 650-472-3889)

4) Introduction (Project type: Research)
A recently discovered (May 2013) outbreak of epizootic pneumonia caused a substantial die-off of desert bighorn sheep in one of the largest populations in California (Old Dad Peak, Mojave National Preserve [MOJA]). This outbreak was likely caused by pathogens transmitted originally from domestic sheep, then by bighorn-bighorn contact, and led to the temporary closure of the Old Dad Peak hunt zone. This region of the Mojave Desert supports a large metapopulation of desert bighorn sheep, central to the most extensive array of naturally-persisting bighorn herds in North America. Until 2013, pneumonia epizootics in this region were unknown. After the discovery of the die-off, bighorn sheep captured in 9 populations in or near MOJA tested positive for *Mycoplasma ovipneumoniae* (hereafter, *M. ovi*.), one of several pathogens involved in bighorn sheep pneumonia (Besser et al. 2012). Although significant adult mortality has been detected only at Old Dad Peak, persistent high lamb mortality may occur system-wide (Cassirer and Sinclair 2007). Managing other stressors in the system (nearby renewable energy developments, water availability), including managing population connectivity (Creech et al. 2014), requires a clear understanding of the demographic impacts and potential spread of the new disease process.

This study builds on an existing collaborative response to the outbreak involving Oregon State University (Clint Epps, PI), National Park Service, and CDFW. It uses both existing and new data to 1) establish the demographic consequences of the current disease outbreak and environmental variation by evaluating adult survival and lamb recruitment over multiple years across populations where *M. ovi.*, 2) augment a study of seasonal movements of rams and ewes to infer how and when disease is most likely to spread, and 3) support ongoing efforts to recharacterize population genetic structure and genetic diversity for bighorn sheep populations in the affected area. Our findings will clarify the impacts of disease on demography in a highly variable desert ecosystem, use movement analyses and updated gene flow estimates to characterize potential for pathogen spread, and provide management recommendations. This proposal is to support the third year of the project and matches the dollar amount originally proposed for year 3 at the project's initiation.

Objectives:
Objective 1) Investigate the current extent and impact of the disease on survival and reproduction while accounting for environmental variability;
Objective 2) Analyze ewe GPS collar data and collar rams with high-resolution GPS collars to establish how seasonal movements may influence disease spread;
Objective 3) Expand genetic analyses from blood and fecal samples to update estimates of genetic structure, gene flow, current connectivity, and genetic diversity.

5) Project Description

Location: Mojave National Preserve and nearby ranges of the eastern Mojave Desert, 9 focal populations (Clipper Mountains, Marble Mountains, South Bristol Mountains, Old Dad Peak, North Bristol Mountains, Cady Mountains, South Soda Mountains, Hackberry Mountains, Wood Mountains), including 3 CDFW bighorn sheep hunt zones.
Staffing requirements: None outside of subcontractors (below)
Subcontractors: CA-WSF has subcontracted work to Oregon State University and will do so again for Year 3. This subcontract will include 0.5 month's salary for PI Clinton W. Epps (project oversight), 6 months (two terms) of support for Daniella Dekelaita (Ph.D. student) who leads field efforts and analysis of data, and 3 months' total summer stipend for undergraduate students assisting with field and lab work.
Timelines: Research is proceeding and field work is underway 2014-2017; Year 3 will be initiated July 1 2016 and end June 30 2017. Current status of each objective's work is detailed below.
Materials necessary to implement project: Year 3's budget includes salary for project personnel, travel support, minor field and lab supplies, publication costs.
Environmental compliance/permitting: Epps maintains an Animal Care and Use Protocol with the National Park Service as well as National Park Service research permits allowing ongoing research activity in the study area.
Detailed explanation of how the work addresses the objectives:

Objective 1 Methods—Part A—seasonal adult female survival: Adult female survival will be estimated for seasonal or shorter periods over a 4-year period (2013-2017) using known-fate survival analysis in Program Mark (e.g., Smith et al. 2014). Survival rates will be related to disease presence and environmental variation (forage, precipitation, diet quality- see Objective 1B). We have ongoing mortality and location data from >160 bighorn sheep that were collared during 2005-2009 (n=10) or in November 2013, 2014, and 2015 across 9 focal populations, as well as smaller sample sizes in Newberry Mountains and Granite Mountains. 2013-15 collaring efforts largely employed satellite upload GPS collars ideal for known-fate survival analysis.

Current status: We have coordinated with CDFW to maintain a database of animals, and with NPS and CDFW to recover mortalities and test for disease, as well as conduct monthly aerial telemetry flights to monitor mortality signals for VHF collars for animals with GPS collars that have released or failed. Limited additional collaring of adults is planned for Fall 2016 to bolster sample sizes and support a proposed project evaluating lamb survival in the Marble Mountains (Epps & Dekelaita). If that project is funded, those collared ewes (up to 30) will be incorporated into survival estimates for this project as well. Adult survival since November 2013 has been high in most populations, excepting a small pulse of mortality in winter of 2015-2016.

Objective 1 Methods—Part B—lamb recruitment: Following adult mortality during initial outbreaks of pneumonia, lamb recruitment may suffer for years after (Cassirer and Sinclair 2007, Cassirer et al. 2013). The persistence and impacts of respiratory disease in desert ecosystems is essentially unknown. However, lamb survival in desert regions is strongly influenced by environmental conditions, particularly positive effects of winter rainfall on forage (Wehausen et al. 1987, Rubin et al. 2000). Even without disease, lamb survival in the Mojave varies greatly with precipitation: e.g., summer lamb:ewe ratios at Old Dad Peak varied from 10-60:100 before the outbreak (Wehausen 2005). Thus, any assessment of disease in lambs must include weather and forage conditions as covariates.

We propose to continue assessing summer lamb:adult ewe and yearling:adult ewe ratios for the remainder of 2016 and summer 2017 (4 years in total including summer 2014, see below), using remote cameras at waterholes and supplemented by ground observations, within the 9 focal populations. These methods are well-established in this system (Wehausen 2005), and the extremely remote, rugged terrain it very difficult and costly to collar lambs for direct estimates of survival. Cameras are placed in populations where there are a small number of point water sources allowing essentially all females and associated lambs to be sampled repeatedly. Lamb: and yearling:adult ewe ratios can thereby be determined in each

population over short time periods during the hot season when bighorn sheep routinely use water (~May-September). We will use mixed-effect models to model lamb: and yearling:adult ewe ratios in *M. ovi.*-positive populations as a function of elevation, forage quality, precipitation, and other variables. To describe forage quality, we use a) fecal nitrogen (FN), which has been estimated monthly in two populations (Marble and Old Dad) since 1984 and is a well-established metric in this system (Wehausen 2005), and b) an index of forage quality based on NDVI (Creech et al. 2016). Maximum elevation predicts both persistence (Epps et al. 2004) and genetic diversity (Epps et al. 2006) of populations. Lamb survival increases with winter-spring diet quality except in very wet years (Wehausen 2005). In 3 populations (Old Dad Peak, Marble, South Bristol), lamb:ewe ratios prior to the outbreak were assessed by helicopter surveys (CDFW, annual before 2010), ground counts, and remote cameras (J. Wehausen, unpub. data). Using those data, we will contrast pre- and post-outbreak lamb:ewe ratios across multiple years using a) mixed-effect models including environmental factors described above, and b) comparison of means and 95% confidence intervals for all years or years with similar forage conditions.

Current status: Two years of camera data have been collected (2014-2015), two more are planned (2016-2017), with preliminary screening of photos from first two years largely complete. Analysis of Wehausen's data has been initiated in years 1&2 of this project. Very low ewe:lamb ratios have been observed across most of the study populations, although timing of lamb disappearance appears to vary among years.

Objective 2 Methods—ram and ewe movement: During the initial 2013 outbreak at Old Dad Peak, strategies considered for containing the spread of the disease were hampered by lack of knowledge on movement. Most radiotelemetry data in the system have been collected sporadically and from ewes, with the exception of a radio-telemetry study at Old Dad Peak 1981-1990 that found males and females aggregated during the rut and males were willing to move farther from water and steep terrain (Bleich et al. 1997). Until now, no high-resolution spatial data have been available to analyze daily movements

We will analyze movement of males and females as a function of forage quality, season, age, and mating condition. In years 1 and 2, we supplemented planned bighorn sheep captures by CDFW (focused on ewes) by adding 30 rams (mix of young and mature) fitted with GPS collars capable of producing high resolution data (e.g., 1 location/hour). GPS collar data from ~145 ewes, 1-6 points per day, will allow assessing female movements. We will analyze movement and habitat selection as influenced by water, terrain, forage conditions (NDVI) during short and long-distance movements using path-based analyses to assess differences between available versus used movement paths (Cushman et al. 2010). We will contrast daily movement rates (Cushman et al. 2005) and movement among ewe groups in different seasons. Any inter-population movements will be contrasted with gene flow models (Obj. 3; see Epps et al. 2007). We predict that rams will make long-distance movements more frequently before or during the rut, inter-population movements will show exploratory movements unlikely to result in gene flow, and young rams and ewes will make more long-distance movements.

Current status: Ram collars funded by NPS and years 1 & 2 of this project have already provided evidence of multiple movements among populations (e.g., Old Dad Peak-North Bristol Mountains, Granite-North Bristol Mountains, Marble Mountains-South Bristol Mountains, Marble Mountains-Clipper Mountains, South Soda-Cady Mountains, and more), and individuals crossing Interstate 40 between the Marble and Granite Mountains.

Objective 3 Methods—population genetic structure and genetic diversity: Previous analyses of genetic structure and gene flow in this system offered unparalleled understanding of movements among populations (Epps et al. 2005, Epps et al. 2007, Epps et al. 2010), but must be linked to actual movement data: individuals may move but not breed, transmitting disease but not genes. However, gene flow analyses inform relative risk of spread. Since the previous analyses, newly colonized and expanded populations within the study area may have caused dramatic shifts in genetic structure. Therefore, we proposed to use genetic samples from captures and ongoing fecal DNA collections to reevaluate gene flow among populations in the study area.

Current status: Epps/OSU has completed genetic sampling of the focal study area and nearby

study areas in 2015 and is preparing a manuscript (Epps and Crowhurst in prep) detailing striking changes in genetic structure within the last 12 years, caused by 1) apparently colonization of the North Bristol Mountains largely from the Cady Mountains, thereby linking the Cady and Old Dad Peak populations to the Granite Mountains and other parts of the system, and 2) bighorn sheep learning to cross Interstate 40 between Marble and Granite Mountains, likely using an existing underpass for at least some movements. Those movements have resulted in a strong increase in gene flow between metapopulations of desert bighorn sheep north and south of Interstate 40, and have been confirmed both by GPS collar data, population genetic analysis, and detection of a single ram's genotype in both ranges from fecal and capture genetic samples. Those movements also correspond with the distribution of the Mojave strain of *Movi.* We anticipate submission of this manuscript for publication in summer 2016, as well as an unpublished report currently in preparation describing genetic structure in the Sheephole-Bullion-Newberry Mountains metapopulation and implications for managing water developments.

6) Expected Benefits: This project will enhance understanding of population dynamics, habitat selection, and disease and will provide improved population survey data. We anticipate 1) scientific publications regarding the effects of pneumonia in this unique desert ecosystem, and 2) management recommendations regarding maintaining or enhancing population connectivity and water developments (as proposed in the draft Desert Bighorn Management Plan, CDFW) based on our description of likely routes, timing, and patterns of disease spread and the demographic effects of the disease. Products to date include a peer-edited publication in Mojave Science News describing the disease outbreak and subsequent response (Epps et al. 2016), a manuscript in preparation (Epps & Crowhurst in prep) describing gene flow and genetic structure, and a report in preparation on gene flow between Sheephole and Newberry Mountains (Epps, in prep).

7) Itemized Budget (includes CAWSF maximum allowed indirect rate of 25% for OSU work).

- Years 1 and 2 have already been funded, so this proposal requests only funds in Year 3 column ($54,584).
- If granted, the entire amount would be considered an operating expense of CAWSF, as the research project will be again subcontracted to OSU.
- Breakdown of that subcontract's expenses is provided here.

Subcontract Expense	**Year 1**	**Year 2**	**Year 3**	**Total**
Personnel (salary and benefits) (Total)	**$28,929**	**$29,956**	**$29,752**	**$88,638**
PI Salary- Epps- 2 weeks/year	$6,353	$6,543	$6,543	$19,440
Graduate student (Ph.D., 6 months/year)	$18,090	$18,927	$18,585	$55,602
Lab tech (2 months total)	$4,486	$4,486	$0	$8,972
Undergraduate field/lab assistant (3 months total)			$4,624	$4,624
Operating expense (Total)	**$44,954**	**$25,235**	**$24,831**	**$95,021**
Telemetry receivers, antenna, ram collars	$14,000			$14,000
4WD vehicle lease and mileage	$1,590	$1,590	$7,950	$11,130
Travel to field sites and meetings for project personnel	$4,100	$4,800	$1,500	$10,400
Field supplies (food, GPS, optics, software)	$4,690	$1,690	$2,890	$9,270
Lab work/supplies (genetic, immuno, nitrogen work)	$3,600	$3,600	$1,600	$8,800
Housing during field work- Granite Mtn Reserve	$600	$600	$600	$1,800
Subcontractor-Wehausen-Analyze past demographic data	$2,500	$2,500	$0	$5,000
Publication charges	$0	$360	$360	$720
OSU indirect- CaFWS allowed rate (25%)	$13,874	$10,095	$9,931	$33,901
Total cost	**$73,883**	**$55,192**	**$54,584**	**$183,658**

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CA Department of Fish and Wildlife - Application for Big Game Grant FY16/17

1. **Project Title:** **U**nderstanding factors affecting horn size in North American wild sheep: implications for the future of conservation, harvest regulations, and fundraising

2. **Amount Requested: $ 70,000**

3. **Contact Information:** California Chapter, Foundation for North American Wild Sheep
dba California Wild Sheep Foundation
TIN #68-0481140
423 Broadway #617
Millbrae, CA 94030-1905
Primary: Mike Borel (mike.borel@contextnet.com;
Phone 925-937-4180)
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4. **Introduction**:

a. Project Type: Hunting Opportunity and Population Management

b. Background:

Despite the contribution of well-regulated hunting and resulting funds that have contributed overwhelmingly to the conservation of bighorn sheep and other species of wildlife, the harvest of large mammals for recreational purposes—and in particular the harvest of trophy animals—is coming under increasingly frequent attack. Indeed, "trophy hunting" has become a primary target of the anti-hunting community. Wild sheep are especially vulnerable to attacks on trophy hunting because of the misperception that sheep hunting is a purely "rich man's sport" and horn size is all that matters to those participants. In addition to attacks from increasingly vocal anti-hunting organizations, the appropriateness of trophy hunting—especially with respect to wild sheep—is being questioned extensively in the professional literature (e.g., Coltman et al. 2003, 2008; Whitfield 2003; Festa-Bianchet 2003; Darimont et al. 2011; Hedrick 2011; Hengefeld and Festa-Bianchet 2011; Pelletier et al. 2012, 2014; Festa-Bianchet et al. 2014).

The large horns of wild sheep appeal greatly to many hunters, and the desire to harvest males that exhibit large horns has increased substantially in recent decades (Sudbeck 1993, Festa-Bianchet and Lee 2009). This increased interest in harvesting individuals with large horns has fostered a need to identify factors that affect the size of those structures (Festa-Bianchet and Lee 2009). In particular, substantial controversy has arisen over the potential effects of harvest (especially trophy hunting) on size of horns and antlers in hunted populations (Festa-Bianchet et al. 2014).

Funding for wild sheep conservation programs in North America is largely dependent on hunter fees, and especially on special fundraising opportunities offered by wildlife conservation agencies (Festa-Bianchet and Lee 2009), such as the California Department of Fish and Wildlife. Further, hunting remains the cornerstone of the North American model of wildlife conservation and management, and efforts to conserve wildlife populations and their habitats historically have been led by hunter-conservationists. Therefore, it is critically important that ecologists and management agencies have a firm understanding of the factors influencing the size of horns and horn-like structures, and be able to convey effects of

different management regimes and harvest strategies to stakeholders and the general public. Failure to do so will have important biological, sociological, and economic implications for continued harvest of "trophy" wild sheep and, as a result, for the conservation of habitat and populations of those iconic animals.

c. Specific Goals and Objectives:

Our overall goal is to provide a rigorous evaluation of harvest data to assess long-term trends in horn size and age of wild sheep at a regional level, and to quantify the general relevance of trophy records that have been recorded by conservation organizations and wildlife conservation agencies from California and throughout western North America. Monteith et al. (2013) utilized records obtained from the Boone and Crockett Club in an initial assessment of the effects of trophy hunting on the size of horns and horn-like structures across 19 trophy categories, and assessed trends in size and factors responsible for those patterns on a regional basis; however, the data in the study did not include ages of animals. The objective here is to provide a more robust test of hypotheses and to evaluate the effects of specific management practices on horn size and will include age data along with additional information as collected on wild sheep harvested in California and elsewhere by agency biologists representing ≈20 state and provincial management jurisdictions combined. Available evidence (Monteith et al. 2013) strongly supports the hypothesis that high harvest rates, and not impacts to evolutionary processes (i.e., genetic impacts) resulting from selective harvest of trophy animals—as proposed by some investigators—is likely the factor most responsible for the small declines in horn size observed. Nevertheless, others continue to criticize results reported by Monteith et al. (2013). Indeed, Festa-Bianchet et al. (2015) argue that record books were an inappropriate source of data analyzed by Monteith et al. (2013). The results of our work will alleviate these objections by including <u>all</u> available recorded age information, size data, and other information associated with wild sheep harvested to date in California and throughout North America. The end result will be an analysis of the trends in horn size, shifts in population age structure of the harvest, and a synthesis of the effects of various harvest strategies on wild sheep, providing information that can be used to better explain observed trends in the size of harvested animals and provide management agencies with additional information regarding population responses to harvest rates.

5. Project Description:

a. Location of Project: This project will be carried out at the University of Wyoming through a subcontract with the California Chapter of Wild Sheep Foundation (CAWSF), and will involve the accumulation of thousands of records of wild sheep harvested throughout North America. Travel to some jurisdictions to record data not yet in electronic format will be involved, and that need is reflected in the budget. Otherwise, all work will be completed at the University of Wyoming.

b. Staffing Requirements: No additional staffing requirements will be required of CDFW. The applicant, CAWSF, will address the details of contract administration and preparation of a subcontract to carry out the proposed work.

c. Contractors and Subcontractors: CAWSF will subcontract the proposed research with the University of Wyoming, which will provide the expertise of a current UW graduate student to complete the project. The subcontractor will be responsible for carrying out all professional activities including data acquisition, analyses, syntheses, and reporting of results. CAWSF will ensure that all aspects of the subcontract are met, and ensure timely submission of quarterly updates and the final report to CDFW.

d. Implementation Plan:

This is a continuation of a project that has been underway since 1 January 2015, and the first year of this 3-year effort has been completed. The graduate student working on the project (Ms. Tayler Lasharr) has contacted wildlife agencies throughout the U.S. and Canada, and has begun to assemble the data into a usable format.

Continuing in year 2, the student will travel extensively to review records available from agencies that have not yet computerized the needed information, and to conduct interviews with agency biologists regarding historical and historical harvest strategies. Working under the guidance of her major professor, Dr. Kevin Monteith, and with other collaborators, she will begin data analysis, with the intent that all initial analyses are completed prior to the onset of year 3.

During year 3, the student will finalize any remaining analyses and complete the final report, which will be Ms. Lasharr's M.S. thesis. The report will be in the format of one or more publications suitable to be submitted to be considered for publication in the professional literature. The thesis will be provided to the CDFW Wildlife Branch and as publications appear, they will be forwarded to the Branch.

e. Necessary Materials or Equipment:

None are needed for this project. We have discussed the proposed project with the Wild Sheep Working Group and have received support for collaboration and data provision. As a result of those efforts, we currently are compiling information from several states and provinces and finalizing arrangements to obtain the requisite information from others.

f. Timeline for Completion of Each Task:

Upon being awarded the contract, CAWSF will reach an agreement with the University of Wyoming to complete the work objectives outlined in this proposal.

Each year of the two-year contract, the University will provide CAWSF with quarterly progress reports outlining accomplishments as of the date of the report, and work anticipated to occur during the upcoming quarter. As the primary contractor, CAWSF will provide those reports to the CDFW Wildlife Branch.

It is anticipated that the obligations of the subcontractor (University of Wyoming) will be fulfilled by 31 December 2017, and a final report will be submitted to CDFW no later than that date.

g. How This Work Addresses Material in the Introduction

Fulfillment of this contract will provide the information needed to understand more fully the impact of 'large horn trophy hunting' and counter arguments that the harvest of large male ungulates has potentially disastrous evolutionary implications if that is incorrect—as we suspect it is. Understanding the impacts of harvest intensity, age at harvest, and size at harvest is critically important to countering increasingly frequent arguments that "trophy hunting is bad." The results of this research will provide information can be used to defend ongoing harvest, conservation, and fundraising programs for bighorn sheep in California and across western North America. In the absence of information with which to counter arguments to the contrary, regulatory bodies in the western United States and Canada and,

particularly in California. Results of this project will provide information to help defend the harvest of bighorn sheep and other ungulates; in the absence of this research, anti-hunting organizations that have been emboldened by recent successes will increase their attacks on sport hunting of large mammals, resulting in loss of revenue for conservation programs and, ultimately, lower populations of the animals they are trying to defend.

h. Expected Benefits:

Results of an earlier analysis of data from Records of North American Big Game indicated that the average size of trophy horn-like structures has declined for most trophy categories over the past 50-100 years (Monteith et al. 2013). Nevertheless, our ability to draw strong conclusions about cause was limited in part by the nature of the Boone and Crockett dataset that was used. A much larger sample and a wider range in minimum size as specified by jurisdictions across North America makes those data extremely valuable for more rigorously testing hypotheses affecting horn size in wild sheep. Furthermore, inclusion of data on sheep harvest across state and provincial agencies will provide a rigorous assessment and synthesis of valuable information that has been collected by many agencies for decades, and yield the opportunity to evaluate the relevance of trophy records maintained by conservation groups. Such information is invaluable to wildlife managers formulating management decisions and in the context of the myriad of factors that can affect size of animals sought after by hunters. Understanding the consequences of harvest intensity, age at harvest, and size at harvest are factors that are critically important to fending off the general criticism that "trophy hunting is bad." The results of this project will provide information needed to better counter the prevailing notion that the harvest of large, dominant males has potentially disastrous consequences, and can further be used to defend ongoing harvest, conservation, and fund-raising programs for bighorn sheep in California and elsewhere. Finally, because we intend to conduct the proposed work with a MSc student, it will provide the opportunity to mentor and train a young, aspiring biologist to prepare her for a meaningful career in wildlife biology.

7. Budget: The itemized budget reflects contract costs and travel associated with the proposed research assessing those factors affecting horn size in North American wild Sheep.

Understanding factors affecting horn size in North American wild sheep: implications for the future of conservation, harvest, and fundraising	**Year 1**	**Year 2**	**Project Totals**
Personnel			
Contractor (CAWSF Administration and Grant Oversight)	$ 500	$ 500	$ 1,000
Subcontractor (University of Wyoming Graduate Research Assistantship; $23,000/year × 2 years)	$23,000	$23,000	$ 46,000
Subcontractor (U. Wyoming Technical Support; 1,500/year × 2 years)	$ 1,500	$ 1,500	$ 3,000
Total Personnel Expenses			$ 50,000
Operating Expenses			
Travel ($10,000 year 1; $6,000 year 2)	$10,000	$ 6,000	$ 16,000
Page Charges (Year 2)		$ 4,000	$ 4,000
Total Operating Expenses			$ 20,000
Subtotal Personnel & Operating Expenses			$ 70,000
Administrative Overhead			$ 0
Total Project Cost For Two Year Project			**$ 70,000**

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Pelletier, F., M. Festa-Bianchet, J. T. Jorgenson, C. Feder, and A. Hubbs. 2014. Harvest refuges do not buffer wild sheep from selective hunting. Ecology and Evolution 4: 3375–3382.

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1. **Project Title**: Eagle Lake Vegetation Mapping

2. **Amount Requested**: $48,150

3. **Applicant Contact Information**:

California Deer Association, Taxpayer ID 93-1220467
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4. **Introduction**:

After four years of drought the year 2015 brought a record number of wildfires to California. The response to the damage taking place was immediate and resulted in Governor Brown declaring a state of emergency for the Valley and Butte fires, which burned through 146,935 acres collectively.[1] Amid the after-math of 6,000 state-wide fires, including these examples of large-scale devastation evident in the Valley and Butte fires, it is imperative that wildlife populations are sustained both through restorative and preventative efforts.

The California Department of Fish and Wildlife (DFW) has recently invested significantly on efforts to mitigate fire damage in the wake of several years of devastating fires since the start of California's ongoing drought. During the past two Big Game Management Account grant funding cycles, DFW awarded the California Deer Association (CDA) one $33,333 grant and one $66,666 grant to restore habitat effected by the Rush Fire, which destroyed 271,711 acres in Northern California in 2012.[2] While these funds will provide much needed forage and shelter for wildlife, there are opportunities to accurately record the current vegetation in habitats that may be effected by future fires as California potentially enters its fifth year of drought. These efforts will ensure that rehabilitation projects are best reflecting the pre-fire conditions of burned habitats, ensuring that wildlife have access to resources they are accustomed to as soon after a fire as possible.

Vegetation mapping aids in management decisions before a wild fire occurs. By better understanding the types of current fuels present in a track of land certain measures, such as prescribed burns, can be undertaken to either reduce the potential size of a wildfire or prevent one altogether in fire adapted areas such as

[1] October 30 3015, *California Valley Fire and Butte Fire*. www.fema.gov/disaster/4240
[2] August 30 2012, *Rush Fire Incident Information*.
http://cdfdata.fire.ca.gov/incidents/incidents_details_info?incident_id=715

California.[3] This applies specifically to the Rush Fire as it was caused by a lightning strike and lead to the second largest California wildfire[4]. It could have been a smaller incident if this kind of proposed vegetation map was available to the land manager (BLM) prior to drought conditions.

In the case that wildfires cannot be prevented, vegetation mapping is highly valuable as a post fire management tool. Once land managers fully understand the structure of vegetation as it exists in pre-fire conditions, immediate efforts can be made to restore the area to as close to the same conditions as possible. This increases the likelihood that wildlife in the area, which includes big game animals such as mule deer and pronghorn antelope[5], will be able to maintain healthy populations as soon as possible after habitat destruction.

By providing the means to conduct a vegetation mapping survey to a land manager (BLM), the grantor (DFW) will be providing a multi-use tool that will be instrumental in making both pre and post fire management decisions.

Project Description:

Objectives: The primary objective of this proposal is to:

1) Provide Great Basin Institute (GBI) crews to compile the vegetation mapping of the land left intact after the Rush Fire in the BLM Eagle Lake Field Office.

Location: This project will take place in the Eagle Lake BLM Field Office.

Project Set Up: A data collection and mapping protocol will be developed to best fit management needs for effective data to best understand the current mosaic of different plant communities. The selected contractor (GBI) will be required to provide crews with plant identification and navigational knowledge to access areas and record dominant vegetative structure using GPS units. A report will be generated and provided to grantor including results of the survey.

Materials: All materials and equipment required to perform the work will be supplied by a private subcontractor hired by the grantee.

Project Implementation: Grantee will be responsible for the following tasks under this project:

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[3] *Vegetation Mapping Primer*. October 2002 California Department of Parks and Recreation. www.parks.ca.gov/pages/734/files/vegmap_primer.pdf.

[4] *Top 20 Largest California Wildfires.* September 11, 2015 CalFire. www.fire.ca.gov/communications/downloads/fact_sheets/20LACRES.pdf

[5] *Rush Fire Emergency Restoration and Stabilization*. November 2012 U.S Department of the Interior Bureau of Land Management. www.blm.gov/style/medialib/blm/ca/pdf/eaglelake/final_rush_fire_ea.Par.88873.File.dat/FINAL_Rush%20Fire%20Restoration_EA_RSN_11-27-12.pdf.

Task 1) Consult with land manager (BLM) to identify those land tracts most suitable for this project;

Task 2) Select land tracts to be surveyed and report this information to grantor;

Task 3) Selected contractor (GBI) will perform the vegetation mapping and oversee their efforts;

Task 4) Collect information pertaining to existing plant species in the selected land tracts; and

Task 5) Report mapping results to grantor.

Expected Benefits: Funding of this project will provide much needed information to land managers regarding the current vegetative structure of their land, which they will used to implement effective fire mitigation in the future.

Itemized Budget:

Line Item Description	Project Totals
Subcontractor costs (GBI – Vegetation Data Collection)	$38,400
Supplies (GPS Units)	$4,400
Administrative overhead (@ 12.5%)	$5,350
Total Project Cost	$48,150

1. **Project Title**: Eagle Lake Water Resource Inventory

2. **Amount Requested**: $22,837.00

3. **Applicant Contact Information**:

California Deer Association, Taxpayer ID 93-1220467
Kaliela Ikelman, Grants Manager
kaliela@caldeer.org
c: 916-607-7781
o: 916-575-7745

4. **Introduction**:

Although California has received more rain during this year's El Nino weather pattern than it has in the past four years, it is still experiencing severe drought. The State Water Board has adopted to keep water restrictions in place through October 2016. [1] State Water Resources Control Board Chair Felicia Marcus reminds us that, "We can't count on El Nino to save us."[2] With this in mind, efforts to protect and restore any natural water resources currently in California should be undertaken for the health of wildlife populations.

The California Department of Fish and Wildlife (DFW) has recently invested significantly on efforts to provide adequate water resources for deer and other wildlife in the northeast portion of California. During the past two Big Game Management Account grant funding cycles, DFW awarded the California Deer Association (CDA) two $200,000 grants to survey, repair and install man-made watering devices (guzzlers). While these funds will provide much needed water for wildlife, there is a need to understand, protect, and restore natural water resources where ever possible. In some areas, drought effects are compounded by overuse from cattle and wild horses leading to degradation and overall loss of the resource. In these situations overgrazing results in loss of plants and other wildlife, which in turn, reduces the ability of the water resource to be sustained due to erosion. Full knowledge of the condition of these water sources is needed before appropriate action to protect them can be taken. [3]

[1] February 16, 2016, *Emergency Conservation Regulation*. http://www.waterboards.ca.gov/water_issues/programs/conservation_portal/emergency_regulation.shtml
[2] February 25, 2014, *Californians Save 1.1 Million Acre-Feet of Water, Urged to Stay Focused on Conservation*. http://ca.gov/drought/topstory/top-story-56.html
[3] *New Mexico Watershed Management: Restoration Utilization, and Protection*. November 2001 New Mexico Water Resources Research Institute. www.wrri.nmsu.edu/publish/watcon/proc46/wood.pdf

This grant application proposes to enhance the water conservation efforts already underway in the northeast portion of California by surveying water resources. This information will allow land managers to better sustain these water sources through educated undertaking of restoration projects, livestock management, and wild horse/burro management.

Project Description:

Objectives: The primary objective of this proposal is to:

1) Provide crews through the Great Basin Institute (GBI) to compile information about condition, estimated flow, evidence of use, and dominant riparian plant species for known and suspected water sources in the BLM Eagle Lake Field Office.

Location: This project will take place in the Eagle Lake BLM Field Office.

Project Set Up: A data collection and mapping protocol will be developed to best fit management needs for effective data to best understand the current conditions of known and suspected water sources. The selected contractor (GBI) will be required to provide crews with water condition, plant identification, and navigational knowledge to access areas, then identify and record condition, estimated flow, evidence of use, and dominant riparian plant species using GPS units and photographs. A report will be generated provide to grantor including results of the survey.

Materials: All materials and equipment required to perform the work will be supplied by a private subcontractor hired by the grantee.

Project Implementation: Grantee will be responsible for the following tasks under this project:

Task 1) Consult with land manager (BLM) to identify all known and suspected water resources suitable for this project;

Task 2) Select land tracts to be surveyed and report this information to grantor;

Task 3) Selected contractor (GBI) will perform the water resource inventory and oversee their efforts;

Task 4) Collect information pertaining to condition, estimated flow, evidence of use, and existing plant species in the selected water resources; and

Task 5) Report survey results to grantor.

Expected Benefits: Funding of this project will provided much needed information to land managers regarding the current water resources in their land, which will be used to implement resource management to the overall betterment of available habitat for wildlife.

Itemized Budget:

Line Item Description	Project Totals
Subcontractor costs (GBI – Water Resource Inventory)	$19,200
Supplies (GPS units)	$1,100
Administrative overhead (@ 12.5%)	$ 2,537.00
Total Project Cost	$22,837

1. **Project Title**: Maintenance and reconstruction of man-made watering devices for wildlife support.

2. **Amount Requested**: $150,000

3. **Applicant Contact Information**:

California Deer Association, Taxpayer ID 93-1220467
Kaliela Ikelman, Grants Manager
kaliela@caldeer.org
c: 916-607-7781
o: 916-575-7745

4. **Introduction**:

Man-made water devices (guzzlers) are found throughout California to provide wildlife with drinking water. Guzzlers are water-holding tanks made of various materials including metal, concrete, plastic or fiberglass. These tanks may or may not be buried underground. Different materials are used to channel rain water into the tanks including sheet metal, fiberglass and hypalon mats. The grantor's (DFW) Northern Region has developed a database of these guzzler locations and the condition of these guzzlers is currently being inventoried. Some of these guzzlers may be non-functional or may pose drowning hazards to wildlife. In addition, it is not clear what criteria were used for site selection as some guzzlers appear to be located within close proximity to another. It is possible that some guzzlers may need to be removed, repaired, replaced or relocated. Multiple years of drought in California are likely having a negative effect on California's deer and other big game species, and reliable water sources could help sustain deer and other wildlife. Most of the guzzlers in the region have not been regularly inspected (if at all), and a consistent assessment of the condition of the guzzlers as well as the fencing and habitat surrounding them is needed.

This submission continues year three of a multi-year grant awarded to the grantee during the last funding cycle. The prior awards were provided to use the Grantor's Northern Region database to identify and assess the condition of guzzlers and make needed repairs in the Northern Region, a critical habitat for California's deer herds. This proposed grant furthers these efforts by allowing Grantee to continue this important work uninterrupted, while continuing to consult with Grantor to determine which additional guzzlers need to be repaired, removed or replaced. Inventory and removal/installation of guzzlers have been performed by the Grantee.

In the event that funds remain after the repair, removal, or relocation of guzzlers within the Northern Region, the Grantee will use any remaining funds to conduct similar work within other critical areas throughout the state in need of similar work (as identified and prioritized in consultation with the Grantor).

The California Deer Association is uniquely positioned to oversee and implement this grant. As a non-profit conservation organization operating solely within California for the past 18 years, CDA and our members have either directly repaired hundreds of guzzlers throughout the state, or managed the repair performed by others.

This proposal furthers the purposes of Fish and Game Code Section 3953, by conducting a habitat conservation project benefitting big-game species throughout California. Additionally, this proposal meets the objectives of the current funding cycle: "Maintenance of existing and/or construction of new water source (eg guzzlers, spring development) projects."

Project Description:

Objectives: The primary objectives of this proposal are to:

1) Consult with the Grantor to develop a priority list of guzzlers that need to be removed or repaired using information gathered from previously conducted guzzler inventory;
2) Repair, relocate, or remove a minimum of fifteen (15) guzzlers, including fencing surrounding each guzzler; and
3) Assess and record the condition of each repaired guzzler and the surrounding environment;

Location: This project will take place in northern California (Grantor's Northern Region) where guzzlers have been previously installed for wildlife. If funds remain after completing the objectives within the Grantors Northern Region, Grantee will consult with Grantor to determine other critical locations throughout the state in need of similar work and begin efforts within those areas.

Project Set Up: Grantee will consult with Grantor to develop a priority list of guzzlers for removal, repair, or relocation. Grantee staff consisting of three (3) field technicians and volunteers will conduct guzzler repair, relocations, and removals. Grantee will also conduct site visits to assess type and condition of guzzlers as well as surrounding fencing and environment.

Materials: Repair or removal of guzzlers may require (but not limited to) PVC pipe, concrete, apron repair supplies, and fencing materials. Other materials may include cameras, GPS and personal protective equipment.

Project Implementation: Grantee will be responsible for the following tasks under this project:

Task 1) Meet with Grantor to establish priority list of guzzler repair/replacement sites;

Task 2) Repair, relocation, or removal of existing guzzlers. People performing these work will wear protective clothing;

Task 3) Update current inventory with new condition of the guzzlers including fencing and surrounding habitat; and

Task 5) Grantee will submit a final report to Grantor at the conclusion of the above tasks. The report shall contain the locations where work was conducted, including GPS coordinates, land ownership, type and condition of each guzzler, and description of work conducted.

Expected Benefits: Funding of this grant will help ensure opportunities for California's wildlife to access water during an extended period of unprecedented drought.

Itemized Budget:

Line Item Description	Project Totals
Salaries and Wages:	
3 Field Technicians: 960 hours each @ $14/hour	$40,320.00
Benefits (@ 25%)	$10,080.00
Subtotal Salaries and Wages	$50,400.00
Operating Expenses:	
Mileage: 3,000 miles per month, for 6 months @ $0.54/mile	$9,720.00
Per diem: 6 months @ $5/day (5 x 3 staff =15, 15 x 180 days=$2,700)	$2,700.00
Cameras, GPS, personal protective equipment, hand tools	$10,000.00
Guzzlers, tanks, repair materials and supplies (concrete, PVC pipe, fencing)	$77,180.00
Subtotal Operating Expenses	$99,600.00
Total Grant Request	**$150,000.00**

900/8

Grant Proposal

1. **Project Title- 2016 Field of Dreams, Inc. California Hunting Opportunities**
   The Field of Dreams, Inc. provides outdoor opportunities to U.S. veterans, children of our fallen, and special needs children. These funds, if granted, would help us make these opportunities possible for our guests.

2. **Amount Requested- $20,000**
   We are requesting a maximum amount of $20,000 to help us with our big game hunts that will be out of state this year. We hold around 50-60 hunts in California and about 180 of our guests spend their time hunting with us in California.

3. **Applicant Contact information:**
   a. Field of Dreams, Inc. 501(c)(3) Tax ID Number: 27-2464658
   b. Tom Dermody
   c. (530) 383-7819
   d. info.fieldofdreamsinc@gmail.com
   e. Tom Dermody

4. **Introduction:**
   a. Big Game Hunts
      i. We will be providing hunter opportunity for various types of game in California on private lands.
   b. Due to increased number of applicants and the increased cost of licenses and tags for resident and nonresident applicants a tremendous amount of expenses of our own budget goes towards offsetting the cost of the licenses and tags we purchase.
   c. Our goal to achieve with this grant is to provide quality outdoor experiences for the veterans and disabled children. We also want to be able to educate our guests on the proper methods of hunting and fishing and instill in them how critical wildlife management is.

5. **Project Description:**
   a. A majority of our trips/projects are held in Glenn and Colusa County.
   b. All board members are actively involved on each trip and we utilize our local Fish & Game to guide us on the amount of game that will be taken off of each ranch.
   c. N/A
   d. All of the programs are implemented by the Board of Directors annually.
   e. Through the program we provide all of the gear for each hunter and each event that is held.
   f. All of these events will be held before December 31, 2016.

g. To provide outdoor opportunities to our veterans and kids and to not discriminate against their physical limitations.
h. N/A

6. Expected Benefits:

We believe that this will benefit by introducing new sportsmen to the outdoors and properly educating them to the great opportunities that the great outdoors has to offer. Also, we would be showing them that you can be successful even with physical limitations.

7. Budget:

Field of Dreams, Inc. California Big Game Budget	**Project Totals**
Personnel	
Subcontractor- N/A	N/A
Total Personnel Expenses	**$0**
Operating Expenses	
Fuel	**$6,750.00**
Resident Pig Tags (for 40 Guests)	**$896.00**
Non Resident Pig Tag (for 20 Guests)	**$1,546.80**
Resident Hunting License (for 90 Guests)	**$4,231.00**
Non Resident 2 Day Hunting License (for 90 Guests)	**$4,231.00**
Upland Stamps (for 30 Guests)	**$238.00**
Federal Stamps (for 30 Guests)	**$750.00**
California Validation Stamps (for 30 Guests)	**$616.00**
Resident Deer Tag (for 4 Guests)	**$126.00**
Non Resident Deer Tag (for 4 Guests)	**$1,104.00**
Food (for 3 day events feeding 180 guests total at end of the year)	**$35,000.00**
Total	**$55,488.80**

******In Section 2 the amount requested is for $20,000.00. We do receive donations throughout the year as well as hold a fundraiser. We do not expect to receive funds of $55,488.80.**

1. Project Title: Numbers, distribution, behavior, and disease risks of Roosevelt elk in Humboldt and Del Norte Counties

2. Amount Requested: We are requesting support for a three-year project.

Year 1:	$205,349
Year 2:	$101,799
Year 3:	$94,150
Total requested:	$401,298

3. Applicant Contact Information:

a. Humboldt State University Sponsored Program Foundation, Tax ID number 94-6050071
b. Drs. Tim Bean, Rick Brown, Micaela Gunther
c. 707-826-3658, 707-826-3320, 707-826-3520
d. E-mail: tim.bean@humboldt.edu, rick.brown@humboldt.edu, micaela.gunther@humboldt.edu
e. Steve Karp, Executive Director, HSU Sponsored Program Foundation, 1 Harpst St, Arcata, CA 95521; 707-826-4190; karp@humboldt.edu

4. Introduction

a. **Project type:** Research
b. **Background of the issue/problem; and the need for the project**:

North American elk (*Cervus elaphus*) are perhaps the most iconic game species in the United States (Toweill and Thomas 2002). Enormous herds once roamed throughout California but due to overexploitation were nearly extirpated in the early 1900s (Harper et al. 1967). Even after a century of impressive conservation efforts, hunting opportunities for elk in California still lag far behind demand. Recent work and anecdotal evidence suggest that elk in the Northwestern Hunt Zone have increased dramatically over the past two decades, with some even calling the population "irruptive" (Starns et al. 2014). In 2015, over 10% of all elk tags available in California were offered in the Northwestern zone. Despite the unique hunting opportunities available in this rugged part of our state, continued increase in elk numbers has caused conflicts with private landowners throughout Humboldt and Del Norte Counties. While multiple stakeholders see a clear need for increased take of this iconic species, little data exist on which to make basic management decisions outside of the Prairie Creek herd. Collecting data on these herds are particularly difficult due to the complex terrain and thick canopy cover. It is therefore vital to both collect baseline data and develop more robust, efficient methods for monitoring these iconic herds.

c. **Specific goals and objectives grant is designed to achieve, in a logical order**:

The main objective of this work is to collaborate with CDFW on increasing the efficiency of methods used to determine population demographics of Roosevelt elk (*Cervus elaphus roosevelti*) in northwestern California. With this overarching goal in mind, our study includes several complementary components, listed below and described in detail following list:

i. GPS collar 20 elk in each county (Del Norte and Humboldt) over two years [All]

ii. Collect scat from herds to conduct capture-recapture estimates using fecal DNA, then compare to visual surveys of collared herds [All]. These samples will also be evaluated for abomasal and intestinal parasites [RB & student].

iii. Use t-LoCoH and behavioral change point analysis to identify important habitat areas [TB & student].

iv. Use GPS data, informed by (iii), to model habitat suitability at 2nd, 3rd and 4th order [TB & student].

v. USe GPS data to evaluate herd composition, social associations, movement between herds, etc. [MSG & student].

vi. Weekly herd counts and behavioral observations by students in field [All]

vii. Collect blood, ectoparasites, hair, interdigital skin scrapings, and scat at capture for genetics and health assessments, and collect fecal samples from domestic cows and calves raised near elk (5 farms; 20 animals per farm) for comparison with elk samples.

vii. Work with CDFW and collect samples; run fecal samples for parasite ID and extract DNA and RNA. Use PCR to amplify DNA or RNA; phylogenetic analysis of DNA sequences matching the agents causing cryptosporidiosis, paratuberculosis, leptospirosis, bovine viral diarrhea, and foot abscesses and laminitis (reported recently from WA) will be performed [RB & student].

Movement and demography lie at the core of any game management program. Here, we propose to attach GPS collars on up to 20 elk. We are collaborating with the newly hired CDFW elk biologist, Carrington Knox, to monitor elk in northwestern California. CDFW has allotted funding for 20 GPS collars for Del Norte county elk, and we are proposing here to supplement the collaring effort to include the elk of Humboldt County to the South (an additional 20 individuals). There are several reasons for this. Mainly: 1) We have cursory knowledge of where at least some elk herds roam in both of these counties and we want to understand movements of these, and less-well known herds, in both counties; and 2) There may be movement between the herds in the two counties, which we want to document. We expect to collar at least three cows and two bulls per herd in up to eight herds. Novel GPS collars include tri-axial accelerometers and video cameras to record fine-temporal scale behavior. In addition, collaring individuals across multiple herds will allow us to test multiple monitoring techniques (e.g., validating non-invasive capture-recapture estimates from scat surveys with comparison to subset of blood samples collected, as in Spiering et al. (2009)).

Of the three subspecies found in California, Roosevelt elk may be the least understood. Work by Weckerly (2005) revealed a population tied to coastal prairies in the California Coast Range, with habitat selection driven mostly by relative grass abundance. In the Oregon Coast Range, Roosevelt elk preferred brushy clearcuts but relied on older seral stands for cover during hot summer days (Witmer and deCalesta 1983). In the Hoh Valley, WA - a system driven more strongly by cold winter dynamics - elk habitat selection was strongly associated with alluvial flats where browse was more abundant (Jenkins and Starkey 1984). In short, studies of Roosevelt elk habitat selection have been surprisingly limited, and habitat preferences appears to be strongly idiosyncratic throughout their range. Further, traditional use-availability studies of habitat selection that rely on VHF locations - or fecal counts (e.g., Weckerly & Ricca 2000) - can overlook areas seldom used but critical to animal survival or reproduction (Powell & Mitchell 2012).

GPS collars today provide unprecedented amounts of data to describe fine-scale animal movement, which can offer novel insight into critically important habitat. However, GPS data is not simply “VHF on steroids” - that is, the analytical techniques appropriate to understanding habitat selection collected through triangulation once per day are not appropriate for analyzing thousands of occurrence records collected once per hour over the course of a year or more. Novel analytical approaches (e.g., Lyons et al. 2013) can provide spatial metrics complementary to traditional habitat suitability models (Bean et al. 2016). Rather than focusing exclusively on areas of high use, the t-LoCoH method can identify areas where animals visit only once but with a long visit duration (e.g., calving grounds) or areas visited frequently but with short duration (e.g., movement corridors). In traditional habitat selection studies, both of these areas might be overlooked as infrequently used.

Behavioral change point analysis (Gurarie et al. 2009) allows for even finer-scale understanding of animal movement decisions. This technique classifies patterns of movement across multiple temporal scales, allowing for a quantitative, objective approach to classifying elk behavior (e.g., resting, grazing, directed movement). Combined, these two approaches in concert with traditional use-availability studies can provide powerful tools for managers to make decisions. In coordination with students at HSU, Bean will use the GPS data collected from individual elk across herds to study habitat selection by Roosevelt elk at multiple spatial and temporal scales in Del Norte and Humboldt Counties, resulting in publications in scientific journals and management guidance about road construction, timber harvest, and other herd-specific approaches. For example, a current proposal for the Smith River

Bottoms herd may involve harassment to push elk off of productive rangeland into timber harvest areas and Federal Land east of US-101; this project will generate tools to predict areas most likely to be used by elk when moving between the two areas.

Some observations on the behavior of elk in this region were conducted several decades ago (Franklin et al. 1975, Bowyer 1981). CDFW is interested to learn more about the herds that range in this region. Behavioral studies will range from indirect evaluation of herd structure and movement, which may be determined by GPS location data and fecal DNA analysis, to direct observation herds that will help us understand interactions among individuals on a finer scale. Some questions we aim to answer include: 1) What is the recruitment in this population? More specifically, a) what proportion of females produce calves each year, and b) what mortality factors influence calf survival? We can address these questions by observing mother-calf pairs and monitoring calf movements via regular herd observations. 2) What proportion of males obtain mating opportunities during the rut? Understanding how many males breed with females in a single season can help inform harvest quotas. These data can be obtained with direct observation of individually-identifiable bulls as well as with confirmation via genetic parentage testing of calves via fecal DNA methods, already proposed here. Information may exist for these parameters in other populations of elk, but unique habitat features (more forested environment), temperate climate and human-wildlife interactions in Humboldt and Del Norte Counties require special focus on these resident herds.

Using DNA extracted from feces is growing in popularity as a useful, non-invasive method of capture-mark-recapture to estimate population sizes of wildlife (Luikart et al. 2010). Work of this nature has been conducted at Humboldt State University on other local species in Humboldt County (Brzeski et al. 2010). While microsatellite DNA has been used as a tool to evaluate genetic structure of elk populations in other areas (e.g., Lenny Williams et al. 2002, Aycrigg et al. 2014), fecal DNA as a tool to estimate population size and structure (male:female ratios) has not been used. We think it will be an efficient and cost-effective tool to assess populations of elk in northern California, especially as many herds are forest-dwelling and elusive and may be mainly sampled by collecting scat samples deposited earlier by a potentially shy herd. These samples will also be evaluated for intestinal and abomasal parasites both to assess herd health and to evaluate risks of spillover to cattle.

Beyond demography and parameters of population health, managers also deal with issues related to depredation and impacts on people and their lands. Elk jump fences and interact with livestock, and that overlap with cattle adds to the risk of pathogen spillover and spillback between the species (zu Dohna et al. 2014). This study will investigate the potential risks experienced and posed by elk that overlap spatially with cattle.

Although high-profile diseases such as brucellosis luckily do not occur in northwestern California, other pathogens cause more cryptic influences on populations. In Washington state, elk have been diagnosed with a spirochete that causes hoof lesions (Clegg et al. 2015). Roosevelt elk in northwestern California originated from northwestern Oregon and we will determine whether this pathogen occurs in elk in our area. Other pathogens are notorious for causing deaths, poor weight gain or poor milk yields in cattle; including those that cause paratuberculosis, bovine viral diarrhea, and cryptosporidiosis. This study will evaluate the prevalence of these pathogens in elk and cattle in a preliminary attempt to determine risks of spillover and spillback among these species.

5. Project Description: a detailed description of work to be performed, including the following:

a. **Location of the project:** Humboldt and Del Norte Counties, California

b. **Staffing requirements (including titles) and responsibilities of each**.

William “Tim” Bean (Assistant Professor); Richard N. Brown (Associate Professor); Micaela Gunther (Associate Professor) will oversee the project. Tim Bean will oversee the spatial modeling components; Micaela Gunther will oversee the behavioral components; Rick Brown will oversee the disease components; and all three will collaborate on the genetic capture-mark-recapture approach. Each will mentor graduate students and field assistants.

c. **Implementation plan** (timelines)

We propose to complete this work over a 3-year period, with personnel Bean, Brown and Gunther tackling complementary components of the proposed work over the same time period. This collaborative effort will ensure that the ambitious goals proposed here can be completed in time frame allotted. A timeline for completion of each task is listed below in section e.

d. **Material/equipment necessary to implement the project**

- 20 GPS Collars will be purchased; these collars will be deployed for approximately one year. These collars will be subsequently collected from the elk, batteries replaced and possibly re-deployed in Year 2.
- We request support for supplies required to conduct field surveys and to collect and analyze fecal, blood and other samples. These supplies include bags for fecal sample collection, syringes, needles and related supplies for taking blood, exam gloves, notepads and clipboards, DNA extraction kits for feces and blood, and reagents for amplifying DNA from pathogens. Genetic identification of elk will be contracted with a commercial laboratory (Wildlife Genetics International, Nelson, BC). Rick Brown and his graduate student will conduct extractions and analyses for disease studies at HSU (supplies and reagents will be purchased, but all equipment is already available.

e. Timeline for completion of each task to include expected completion dates

Task	JA16	SO16	ND16	JF17	MA17	MJ17	JA17	SO17	ND17	JF18	MA8	MJ18	JA18	SO18	ND18	JF19	MA19	MJ19
Collar elk																		
Data collection																		
Habitat and movement analysis																		
Genetics work																		
General parasitology and PCR																		
Assessment of risks for elk and cattle																		
Prepare reports																		
Publish manuscripts																		

f. Explanation of how this work addresses items in the Introduction Statement

Numbers of elk will be counted visually and estimated with genetic mark-recapture analysis. Distribution, movement, social structure, and habitat use will be evaluated with GPS collars. Behavior will be assessed visually and by fine-temporal scale videography. Comparison of multiple methods for estimating numbers will assist managers making decisions based on any single method. Knowledge of distribution and demographics will allow informed management of future harvests. Assessment of pathogens that overlap with cattle will inform concerns of spillover and spillback between these species and may provide insight into demographic patterns observed.

6. Expected Benefits

This project will produce data central to proper management of Roosevelt elk in northwestern California. Not only will we provide critical information on population numbers, movements and habitat utilization on which to base current management decisions, we will provide robust, inexpensive methods for collecting data to secure hunting opportunities into the future. We also aim to reduce human-elk conflict by better understanding animal movements and documenting depredation events on private land, creating and maintaining respectful relationships with local private landowners. Furthermore, we propose to utilize a novel combination of monitoring techniques (DNA mark-recapture, GPS tracking with t-LoCoH, behavioral studies, and disease evaluation) that will serve to establish more efficient data collection protocols and inform scientists on the successful use of these techniques, as transmitted through peer-review journal articles that are certain to be products from this research and management program. Finally, we plan to train both undergraduate and graduate students in field research and monitoring techniques that will prepare them for agency and other related wildlife jobs, promoting the next generation of wildlife biologists.

7. Budget:

EXPENSE	DESCRIPTION	Yr 1 - Total Requested	Yr. 2- Total Requested	Yr 3 -Total Requested	Total Requested
PERSONNEL					
Bean summer salary ($41.44/hr*80hrs)	Salaries Non benefited	$ 3,315	$ 3,415	$ 3,514	$ 10,244
Gunther summer salary ($48.26/hr*80hrs)	Salaries Non benefited	$ 3,861	$ 3,977	$ 4,092	$ 11,930
Brown summer salary ($48.26/hr*80hrs)	Salaries Non benefited	$ 3,861	$ 3,977	$ 4,092	$ 11,930
Grad summer salary (2 @$14/hr*9wks*40hr/wk)	Salaries Non benefited	$ 10,080	$ 10,080	$ 10,080	$ 30,240
Undergrad summer salary (1@$12/hr*9wks*40hrs/wk)	Salaries Non benefited	$ 4,320	$ 4,320	$ 4,320	$ 12,960
Grad students (2 @ $14/hr*43wks*20hr/wk)	Salaries Students AY	$ 24,080	$ 24,080	$ 24,080	$ 72,240
Salaries Total		**$ 49,517**	**$ 49,848**	**$ 50,179**	**$ 149,544**
BENEFITS	Calculated according to actual tax rates				
Benefits Total	15.02% - except students AY - 7.37%	**$ 5,595**	**$ 5,645**	**$ 5,695**	**$ 16,935**
TRAVEL					
Domestic Travel In-state	$0.54/mi*80mi/trip*52trips	$ 2,246	$ 2,246	$ 2,246	$ 6,739
Travel Total		**$ 2,246**	**$ 2,246**	**$ 2,246**	**$ 6,739**
SUPPLIES					
Sampling supplies:	syringes, needles, Vacutainer tubes, Whirl-pac bags, exam gloves, storage vials, freezer boxes, etc.	$ 1,000	$ 500	$ 500	$ 2,000
Misc. supplies	notepads, clipboards, pencils, sharpies, exam gloves, baggies for fecal samples collected from the ground, etc.	$ 500	$ 500	$ 500	$ 1,500
DNA extraction kits and supplies for feces and blood	QIAamp cador Pathogen mini kit ($220 for	$ 440	$ 220	$ 220	$ 880
DNA extraction kits and supplies for feces	QIAamp DNA Stool Mini Kit ($240 for 50 / b	$ 480	$ 480	$ 480	$ 1,440
PCR Reactions	Est. @ $10 per pathogen X 5 pathogens / sample (including reruns, multiple genes when necessary, and optimization = $50 / sample)	$ 7,500	$ 7,500	$ 10,000	$ 25,000
DNA Sequencing	$20/sample w shipping	$ 2,000	$ 2,000	$ 3,000	$ 7,000
Elk Genotyping	$50/sample	$ 5,000	$ 2,500	$ 2,500	$ 10,000
GPS Collars	$4,000/collar 8 20 collars	$ 80,000			$ 80,000
Supplies Total		**$ 96,920**	**$ 13,700**	**$ 17,200**	**$ 127,820**
OTHER EXPENSES					
Contractual Services	Genetic and disease testing ($100/sample*100)	$ 10,000	$ 10,000		$ 20,000
Other Expenses Total		**$ 10,000**	**$ 10,000**	**$ -**	**$ 20,000**
TOTAL DIRECT COSTS		**$ 164,279**	**$ 81,439**	**$ 75,320**	**$ 321,038**
INDIRECT COSTS	25%	**$ 41,070**	**$ 20,360**	**$ 18,830**	**$ 80,260**
TOTAL COSTS		**$ 205,349**	**$ 101,799**	**$ 94,150**	**$ 401,298**
MTDC		$ 164,279	$ 81,439	$ 75,320	**$ 321,038**

"Modified Total Direct Costs (MTDC) consists of all salaries and wages, fringe benefits, materials, supplies, services, travel and subgrants and subcontracts up to the first $25,000 of each subgrant or subcontract (regardless of the period covered by the subgrant or subcontract). Modified total direct costs shall exclude equipment (hardware which exceeds the unit cost of $5000) capital expenditures, charges for patient care tuition remission, rental costs of off-site facilities, scholarships, and fellowships as well as

PO Box 1057, Willits, CA 95490

March 8, 2016

California Department of Fish and Wildlife
Chief, Wildlife Branch
ATTN: BGMA Grant Proposal
1812 9th Street
Sacramento, CA 95811

Project Title:
Baseball Wildlife Habitat Improvement Project

Funding level: $ 100,000.00

Applicant contact information:
Mendocino County Blacktail Association (MCBA)
501(c)3 non-profit corporation, Federal EIN # 26-4060023
PO Box 1357
Willits, CA 95490
www.mcbadeer.com

Authorized signer(s) and contacts:

Paul Trouette, President	Hal Wagenet, Secretary
707-489-9663	707-391-5101
mendodeer@yahoo.com	hal@mcbadeer.com

Introduction:
This is a hunter opportunity, wildlife habitat improvement project in partnership with the US Forest Service, Mendocino National Forest.

Baseball Wildlife Habitat Improvement Project

Project Background

The Baseball Wildlife Habitat Improvement Project is a project area, where the US Forest Service has identified needs to improve forest health, protect resource values by minimizing the risk of a large, destructive wildfire, and improve and /or rehabilitate

existing watershed and wildlife habitat conditions in the area nearby Atchison Campground on the Covelo Ranger District, Mendocino National Forest.
See Figure 1: map of the Baseball Project.

The forest conditions within the project area are currently overstocked, carrying high tree densities and high fuel loading, resulting in stands of reduced vigor that are more susceptible to insects, disease, and catastrophic wildfires. Pockets of insect infestation have been found within the project where ponderosa pines have been impacted by bark-beetles and trees have been infested with mistletoe.
See Figure 2: Current Condition. - map

Due to excessive stand stocking levels and ecological succession, coupled with the absence of fire, the hardwoods, especially the oak components in this project are also being encroached on by conifers, are becoming senescent with little recruitment of younger age classes of oaks and are at risk of being lost from the stands as a viable, healthy component that contribute to habitat functionality. Large portions of the project areas fall within key deer ranges and oaks play an important part for deer where acorns from oaks provide important food for deer in late summer, fall and early winter. Browsing on oak leaves and twigs is also very important for deer from spring to fall, especially in early spring when the new growth is emerging.
See Figure 3: Current Condition.- photos

Project Proposal

The US Forest Service and MCBA propose to mechanically treat the identified units in the Baseball Wildlife Habitat Improvement Project area. The Forest Service has begun implementing parts of the project and no additional planning is needed for project implementation. The volume of work needed makes the hiring of forestry professionals the most practical option for completing the work.

The work proposed for the Baseball Project would consist of mechanical treatments (Mastication) with a prescription that would consist of thinning conifer and mixed hardwood trees less than 10 inches DBH to a leave tree spacing of 15-25 ft. The thinning would strive to leave the biggest and most desirable trees, trees that are free from disease, insects, and/or mechanical damage.

The goals of the mechanical treatments are to reduce inter-tree competition, prevent stagnation and increase the growth of the native oak species, and thus increase winter acorn mast for Ungulates. Fuel reduction decreases loading and ladder materials, and decreases the risk of key winter range habitat loss due to large-scale insect infestations, sudden oak diseases, and decadent late successional habitat. Mitigating these factors improves and /or rehabilitates existing watersheds, improve wildlife habitat conditions in key deer range, and increases the retention and enhancements of Quercus Lobata, Quercus Kellogii,Quercus Douglasii,Garryana, and Agrifolia, oak hardwoods, which are vital winter & summer food sources for Deer.

The Forest Service has also planned to reintoduce fire into this landscape through prescribed burns after the mechanical treatments are completed.

Budget

The funding request to DFW is for $100,000.00. The US Forest Service has already completed several phases of the Baseball Wildlife Habitat Improvement project. The Forest Service has mechanically treated 150 acres and spent $103,730.00 so far on the project starting in 2012. The estimated costs are derived by using the going contractor rate of $700 to $1000 per acre. The Forest Service plans to issue additional mechanical treatment contracts with future funds for the completion of the Baseball Project. This proposed phase of the Baseball Wildlife Habitat Improvement project along with future phases once completed would bring the total acres treated for this area to over 500 acres. The Forest Service will also provide staff for oversight and contract implementation.

MCBA Funding Request to DFW (15% Admin included)…….. $100,000.00

Forest Service Funds previously expended…… $103,730.00

Hinda Darner, Fuels Specialist
Mendocino National Forest
10025 Elk Mountain Rd
Upper Lake, CA 95485
707-275-1446
707-275-0676 fax
hindadarner@fs.fed.us

Hal Wagenet, MCBA Secretary

PO Box 1057

Willits, CA 95490

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hal@mcbadeer.com

Figure 1. Map of the Baseball Wildlife Habitat Improvement Project

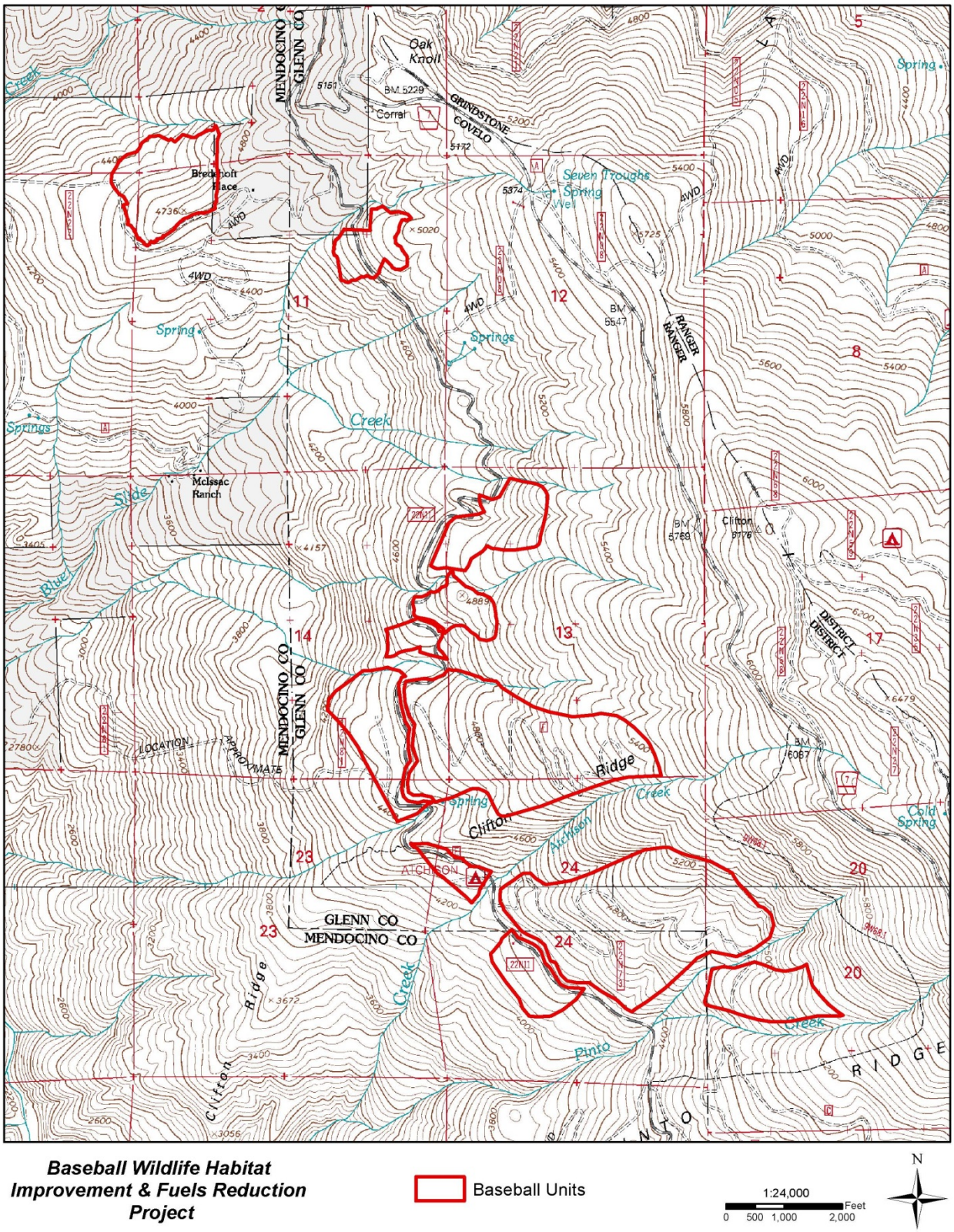

Figure 2. Current Condition- High Tree Densities / High Fuel Loading

Figure 3. Current Conditions- Confier Encroachement

PO Box 1057, Willits, CA 95490

March 8, 2016

California Department of Fish and Wildlife
Chief, Wildlife Branch
ATTN: BGMA Grant Proposal
1812 9th Street
Sacramento, CA 95811

Project Title:
BLM Paradise Ridge Prairie Maintenance

Funding level: $ 60,000.00

Applicant contact information:
Mendocino County Blacktail Association (MCBA)
501(c)3 non-profit corporation, Federal EIN # 26-4060023
PO Box 1357
Willits, CA 95490
www.mcbadeer.com

Authorized signer(s) and contacts:

Paul Trouette, President	Hal Wagenet, Secretary
707-489-9663	707-391-5101
mendodeer@yahoo.com	hal@mcbadeer.com

Introduction:
This is a Hunter Opportunity, wildlife management, habitat improvement project in partnership with BLM, Eureka.

Paradise Ridge Prairie Maintenance

Project Background

Coastal prairies throughout northern California have been shrinking for decades as a result of fire suppression and development. Deer populations has also been declining in recent decades for a number of reasons including development, increased predation,

decreased logging, disease outbreaks, and rapid expansion of the black market marijuana industry. Individually none of these factors would likely cause severe decline in deer populations. However, all of these factors have occurred simultaneously and may be accellerating.

Some factors, such as changes in logging practices, are likely to change substantiallly in the near term in ways that will positively effect deer. However, diseases tend to be cyclical or sporadic, such as the recent bout of hair loss syndrome. Development, which now includes wide spread marijuana cultivation, is likely to continue to degrade deer habitat into the foreseeable future.

The Bureau of Land Management (BLM) is committed to providing high quality deer habitat on public lands by managing for healthy landscapes. A return to natural fire regimes would probably be the most beneficial prescription for the long term health of blacktail deer populations. Unfortunately rural development makes implementing natural fire regimes technically difficult and politically unpopular. As a result, the BLM has implemented prairie and oak woodland restoration in a methodical way that ultimately returns fire to the landscape in small prescribed burns after a series of mechanical treatments. Fortunately, the soils and climate of the north coast are condusive to rapid vegetative regrowth after restoration treatments have been implemented.

Project Proposal

The BLM proposes to complete the restoration project on Paradise Ridge in the King Range National Conservation Area. Figures 1 and 2 are maps of the Paradise Ridge Project. The BLM has begun the project and no additional planning or permits are needed for project implementation. The volume of work needed makes the hiring of forestry professionals the most practical option for completing the work.

The work consists of cutting down and bucking encroaching fir trees, followed by piling them for subsequent burning. Due to the remoteness of the site and the lack of neighbors, broadcast burning is possible at the site. Douglas fir trees have been cut down on approximately 10 acres of the area, but another 50 acres of saw work remains thourghout the 102 acre project area. Piling for the entire 102 acre project area is also needed.

Budget

The funding request to DFW is for $60,000.00. The BLM has spent $10,000.00 so far on salaries for the project and the Humboldt Chapter of the Mule Deer Foundation contributed $10,000.00 in 2011 to start the project. The estimated costs were derived by using the going contractor rate of $500.00 per acre. The costs include would cover cutting down all the remaining Douglas firs in the project area, bucking, and piling. The BLM will return to burn the piles the following year. The broadcast burn of the area will also be scheduled for a later date after the pile burning is complete. The BLM will issue a contract with contributed funds for completion of the forestry work. The BLM will provide equipment and staff for the pile burning and broadcast burn in addition to contract oversight.

MCBA Funding Request to DFW (15% Admin included)……$60,000.00

Additional BLM Contributions…….....$30,000.00

BLM Funds previously expended……...$10,000.00

Humboldt Mule Deer Chapter 2011 contribution…….$10,000.00

Project Total…….$110,000.00

Jesse Irwin, Wildlife Biologist
Bureau of Land Management
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Hal Wagenet, MCBA Secretary
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707-391-5101
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Figure 1. Paradise Ridge is approximately 5.5 mile north of Shelter Cove, Calfiornia

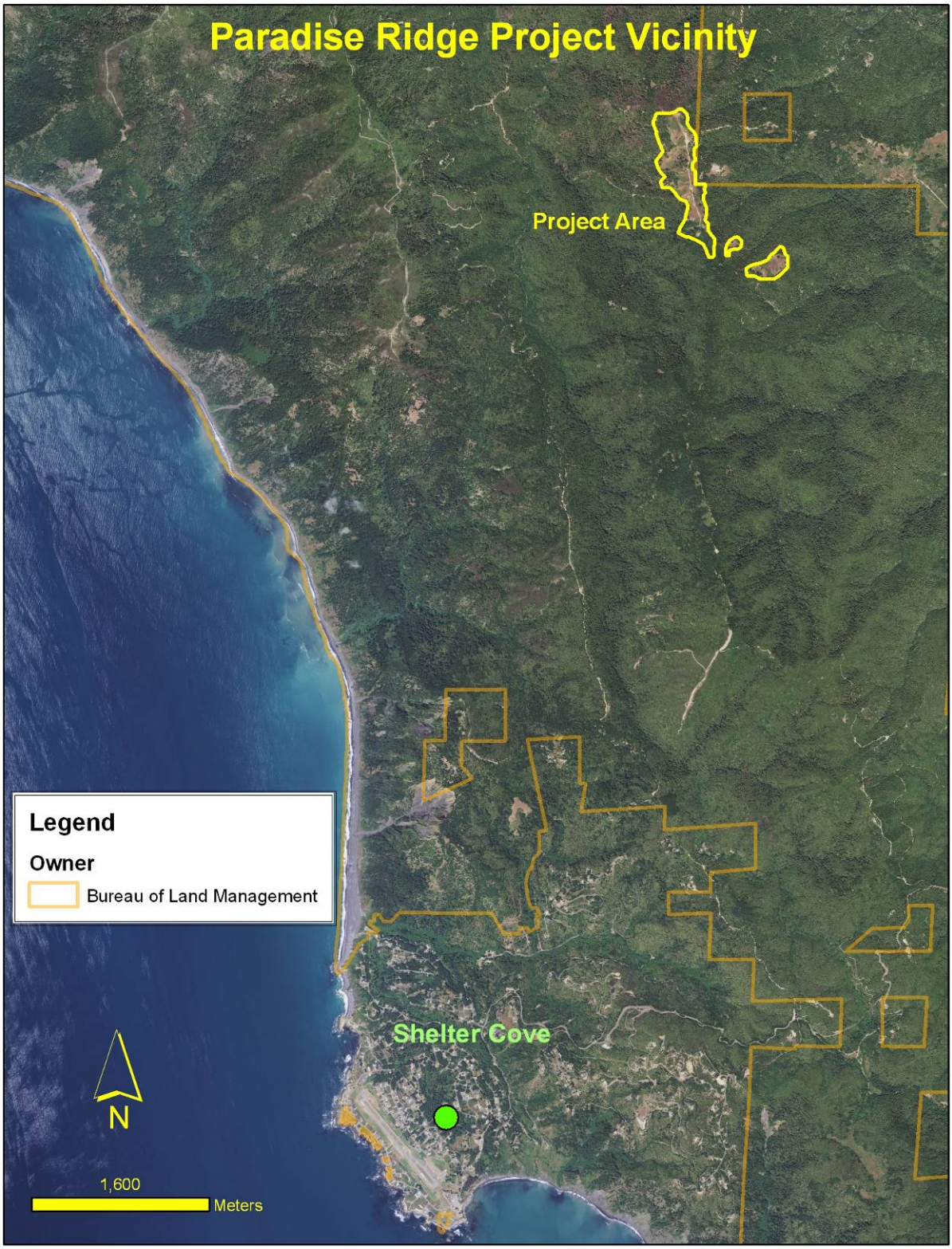
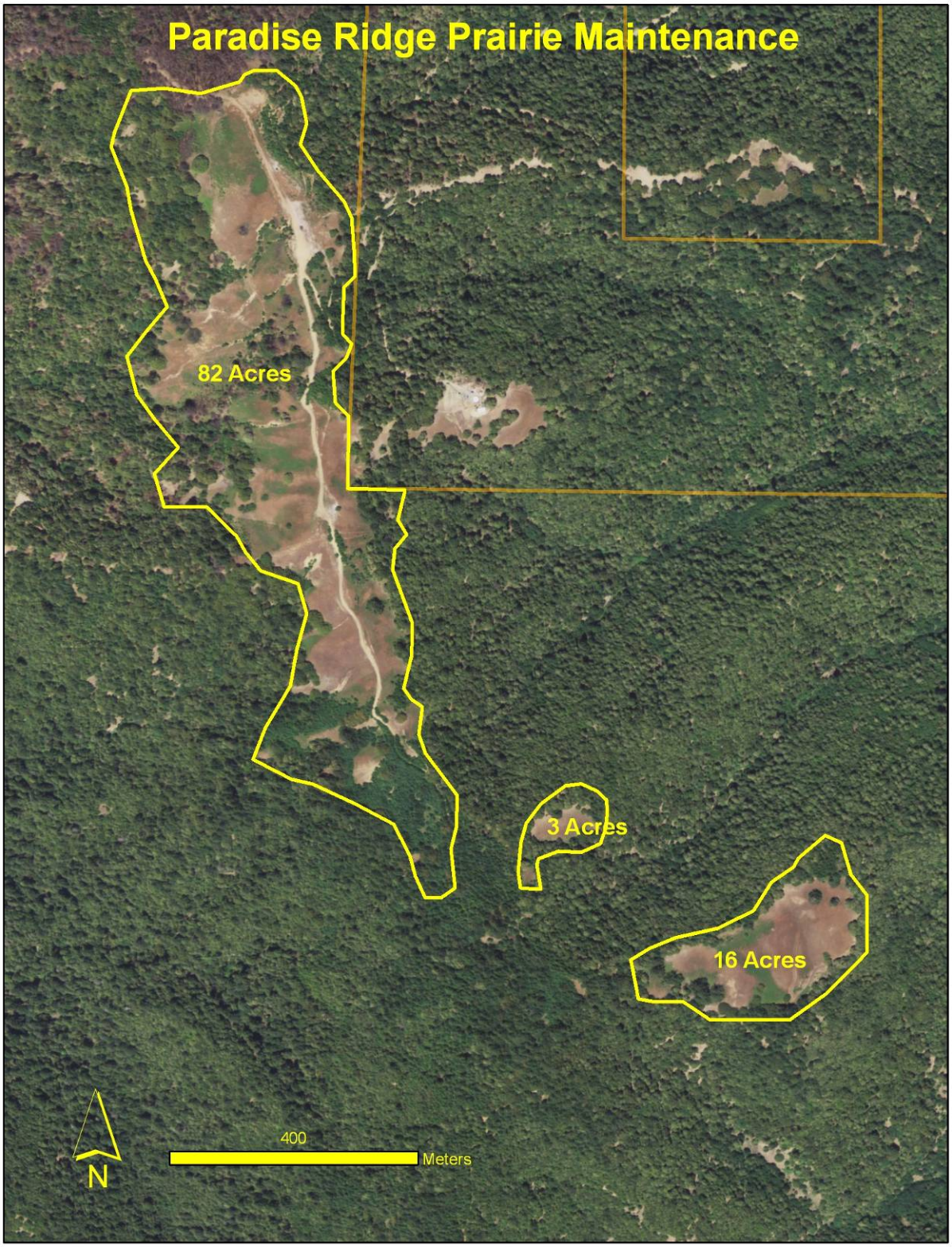


Figure 2. Paradise Ridge Prairie and small satellite prairies.



Over 50,000 native grass plugs have been planted in the project area in recent years in an effort to replace the annual grasses with higher quality forage. In addition to providing more nutritious grasses, the prairies are surrounded by a ring of black oaks, live oaks, and tan oaks. Removing the encroaching Douglas firs will protect the oaks from shading competition since the firs currently overtop the oaks. The acorn crop from oaks trees is an important food source for blacktail deer during the fall.

Figure 3. Project demonstration photo

This blacktail deer was found in one of the newly planted native grass areas on Paradise Ridge. The dots on the ground ahead of the deer are grass plugs. Encroaching Douglas firs are at the top of the picture.

California Department of Fish & Wildlife

Big Game Account Project Proposal

1. Project Title: Little Rattlesnake Riparian Restoration (Phase 2)
   The project is designed for forest ecosystem restoration and includes improvement of the riparian system, aspen regeneration, and reduction in forest fuels.

2. Grant Request Amount**: $211,310.00**

This is the second of three phases of the project. The initial phase was funded by a grant from the CDFW Big Game Account in 2015 at $80,500.00

3. Applicant Contact Information:

Organization: Mule Deer Foundation
Name: Randy Morrison
Phone#: (707) 829-5904
Email: randy@muledeer.org

Introduction:

a. Project type: Hunter Opportunity – Habitat Improvement

b. The project will be implemented through a Stewardship Project Agreement between the US Forest Service and the Mule Deer Foundation. This is the second phase of a multi-year project. This project is being proposed to correct degradation of the riparian ecosystem caused by past over grazing, drought, flash floods, conifer encroachment, and unauthorized recreational activities. The grazing and unauthorized recreation use are now under control and this project will lend more control of these concerns.

c. The project is phase 2 of a three year project designed with the overall goal of restoring a healthy/functioning ecosystem in the Rattlesnake watershed.

The specific objectives are:

1. To increase the aspen component by conifer removal from the forest stands
2. To reduce soil erosion and improve water quality by stabilizing the stream course
3. To restore the Aspen Meadow system by conifer removal from the natural meadows
4. To restore and protect special aquatic features
5. To lower the risk of wildfire by reducing the tree density (forest fuels) in unmanaged plantations and in natural stands.

Project Description:

a. The project is located on the Calaveras Ranger District, Stanislaus National Forest. The specific area of the proposed project is at SW ¼ of section 30 and NW ¼ of section 31, T6N, R17E. The treatment area consists of approximately 600 acres and includes 20 acres of Aspen Meadow Restoration, 8 acres of protection of special aquatic features (FENS), 1 acre of filling and planting a gully in a tributary of Little Rattlesnake Creek, and road decommissioning. It covers approximately 1 mile of stream, 100 acres of mastication, and 400 acres of mechanical thinning.

b. Staffing requirements (include titles) and responsibilities of each. Describe all Grantee personnel in the budget and their roles in the project.

Randy Morrison, MDF California Regional Director, Grant Administrator
Dave Wilson, MDF Consultant, Stewardship Agreement Quality Control
Stan Baker, MDF Stewardship Coordinator, Stewardship Program Manager
Kim Brooks, MDF Accountant, Stewardship Agreement Financial Management

c. Contractors for the project will include

i. Timber removal contractor for removal of conifer species, meadow restoration, road decommissioning, and biofuels removal ,
ii. Hand crew for treatment of aquatic features including fencing, planting, and hand falling conifer when needed.
iii. Masticator for plantations where smaller diameter conifer will be masticated and left on the forest floor.

d. Implementation Plan

The MDF will administer the project and with the technical assistance of the Forest Service, will provide oversight and quality control of contract work. The initial phases of implementation for the project are planned to start in the fall of 2016 with a projected completion date of September 2017. MDF will award the timber removal to a local subcontractor and initiate logging in the fall of 2016. Contracting with a hand crew will occur during the same time frame. The "headcut" restoration and road decommissioning will be accomplished upon competition of the timber sale. Protective fencing will be installed after the riparian work is complete. Mastification will be done immediately following completion of the timber sale.

e. Materials/equipment

i. Timber removal by sub-contractor equipment; Feller Buncher, Log Loader, Processor, Log Trucks, Rubber tired skidder, and Grader.
ii. Sub-contractor hand crew will use chainsaws, fencing tools, tree planting tools, and other hand tools needed
iii. Masticator by sub-contractor will use a specialized tractor with a mastication head.

f. Timelines for Completion
Riparian Restoration: Start date of April 2017, completion by August 2017
Fens, Springs, Wet Meadows: Start date of April 2017, completion by August 2017
Masticator work: Start dates of Sept. 2016, completion by Aug. 2017
Timber removal: Start date of Sept. 2016, completion by Aug. 2017

g. Explanation of how work addresses the Introductory Statement Goal and Objectives:

Riparian Restoration

A headcut within an unnamed, intermittent stream has caused the channel to down-cut (8 – 10 feet) and widen (8 - 15 feet) along an approximately 400 foot length of channel. The headcut (located 450 feet upstream from the stream's confluence with Little Rattlesnake Creek) is still actively eroding and will cause channel incision and widening to continue to propagate upstream into currently stable reaches. The ground water table has dropped in response to the lowering of the streambed elevation due to downcutting and has likely caused portions of the stream above the headcut to dry earlier in the year than it once did. A lowering of the ground water table has also resulted in riparian areas becoming unsuitable for riparian hardwoods dependent on shallow ground water (e.g. alder, cottonwood, willow). The gullied channel is no longer in connection with its floodplain, further worsening channel erosion and dewatering.
In addition, the ongoing erosion within this stream is providing a chronic source of excess fine sediment that is delivered to Little Rattlesnake Creek and may degrade aquatic habitat there.

Restoration activities are proposed along the affected stream reach in order to improve the stability and hydrologic function of the stream and its riparian areas. The gullied channel segment will be filled-in with earthen materials, reshaped, and held in place by a series of rock grade stabilizers imbedded in the channel at intervals. Channel restoration will raise the streambed to its pre-incision elevation; restore connectivity with the floodplain, cause the ground water table to rise, and increase the extent and vigor of riparian vegetation.

Fens, springs, wet meadows

Three fen/spring complexes were evaluated by an interdisciplinary team in early November 2010 using the Proper Functioning Conditions survey protocols for lentic areas and fens. Conditions at all three features were determined to be "Functional-at-risk" due primarily to hydrologic alteration resulting from extensive pocking and trailing caused by cattle.

Construction of barriers around these features is being proposed to exclude livestock and other potential disturbances such as motor vehicles in order to move these features towards desired conditions.

Aspen Meadow Restoration

20 acres of thinning of encroaching conifers and mechanically severing lateral roots from parent trees to promote Aspen regeneration

Road Decommissioning

Decommissioning of 1 mile of road and planting native seeds (Grass and Forbes) for wildlife habitat improvement and reduce future human traffic.

Mastication of Plantations

Masticate 100 acres of plantations trees up to 10 inches in diameter at a 10 by 10 foot spacing. Species consideration along with diversity in stand will determine priority.

Forest Thinning/Conifer Removal

Included in the project, is a total of 400 acres of commercial timber harvest of conifers and aspen. Total harvest volume is estimated to be about 5,000 CCF of sawtimber. Species removed are White Fir, Red Fir, Incense Cedar, Sugar Pine, and Jeffery Pine. All timber would be logged with ground-based tractor systems. Total value of harvested timber at appraised rates is $15,000. The receipts for the timber sale will be applied to the project costs by MDF.

6. Expected Benefits:

Enhance the general health of forested stands by reducing susceptibility to insect, diseases, and drought-related mortality by improving and promoting stand and individual tree growth and vigor. Reduce future fire intensity and severity to federal land by reducing surface fuels, increasing the height to canopy, decreasing crown density, and retaining large, fire-resistant tree species. Improve watershed condition by reducing sediment generated by the road system and delivered to streams and special aquatic features through improvement of road drainage features.

Maintain or enhance the hydrologic, geomorphic, and biological characteristics of special aquatic features (springs, seeps, meadows, and fens). Implement restoration actions to maintain, restore or enhance water quality and maintain, restore or enhance habitat for riparian and aquatic species. Maintain and enhance important wildlife habitat, mature forest ecosystem values, and connectivity of mature forest stand.
Improved forest conditions and improved wildlife habitat will increase both hunter and non-hunter recreation opportunity.

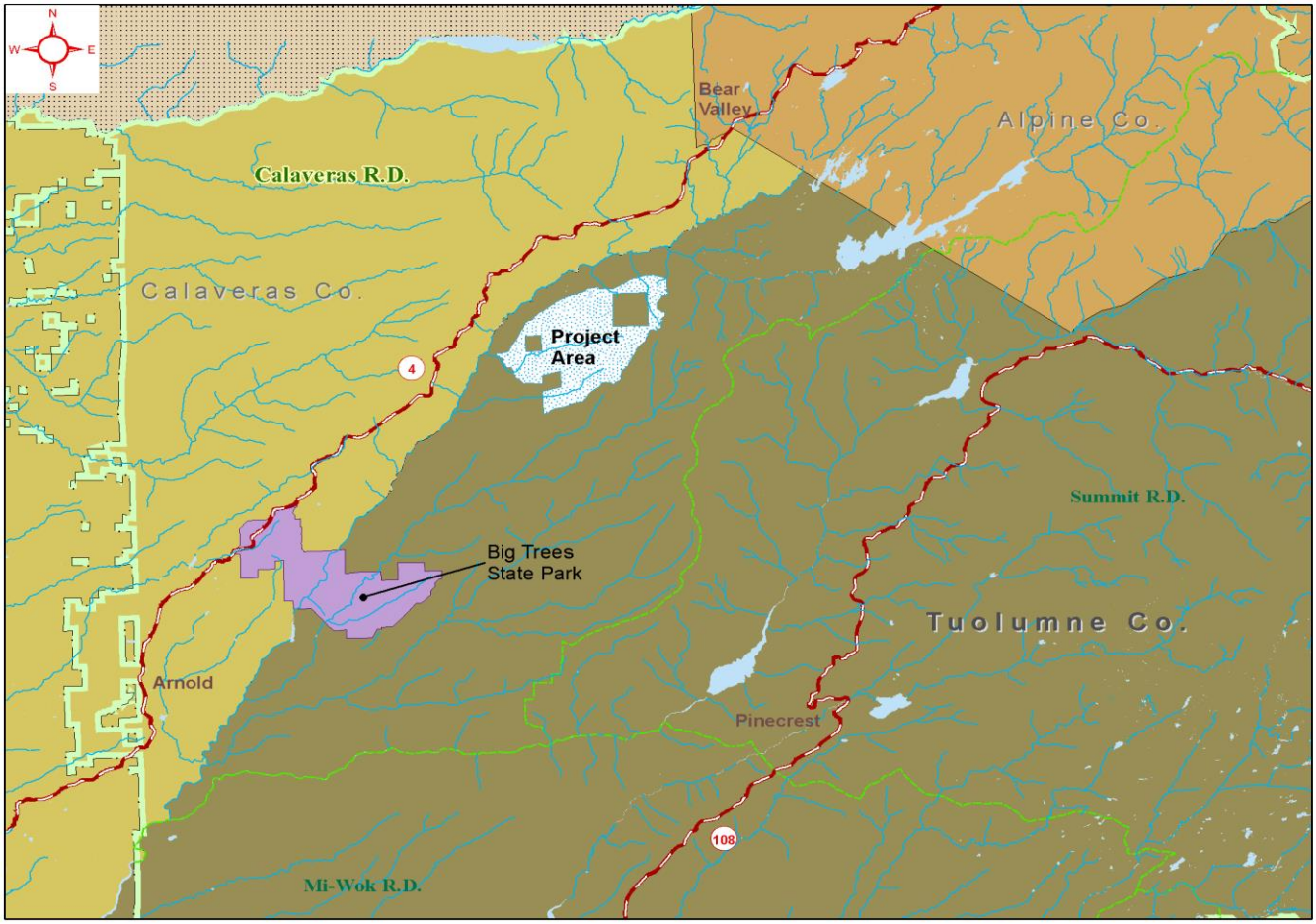
Little Rattlesnake Budget	**Project Totals**
Personnel	
Subcontractor	$2,500
MDF Project Manager (5 days @ $320/day)	$1,600
Total Personnel Expenses	$4,100
Operating Expenses	
Equipment and hours needed to restore channel; Excavator and labor 40 hrs @$1000/hr	$40,000
Fencing and labor for Fens 1000 ft @$7.50- for fence Labor cost- $20/hr @ 250 hrs	$15,000
Biomass removal for Aspen Meadow Restoration. $1,000/ Acre @ 20 acres.	$20,000
Road Decommission $3,000 for seedling and planting labor, $15,000 for road decommissioning costs.	$18,000
Masticator 100 acres @ $1,500 acre	$150,000
	Total minus Timber Value= $247,100

Partnership Contributions:

USFS	$40,000
Mule Deer Foundation	$15,000
Subtotal of funds needed:	$ 192,100
Grant Administration Expense: (10%)	$ $19,210
TOTAL BIG GAME ACCOUNT GRANT REQUEST:	**$ 211,310**

Cross Agency sign off:

United States Forest Service	Kevin Zeman	(209) 813-7054


N
W
E
S
Bear Valley
Alpine Co.
Calaveras R.D.
Calaveras Co.
Project Area
4
Big Trees State Park
Summit R.D.
Tuolumne Co.
Arnold
Pinecrest
108
Mi-Wok R.D.

Stream Headcut

Fen damaged by cattle

Epps- Immunogenetics- Application for FY16/17 BGMA funding

1) Grant Name/Project Title: Characterizing immunogenetic variation, immune system function, and inferring implications for respiratory disease in desert bighorn sheep in the eastern Mojave Desert
2) Amount requested: $30,597 (year 1 of a one-year agreement)
3) Applicant Contact Information: Oregon State University
Authorized Signer: Patricia Hawk, Assistant Vice President for Research, Oregon State University, A312 Kerr Administration Building, Corvallis, OR 97331-2140. 541-737-4933, sponsored.programs@oregonstate.edu
Principal Investigator Contact Information: Clinton W. Epps, 541-737-2478, clinton.epps@oregonstate.edu [email preferred through July 2016]

4) Introduction (*Project type: **Research***)
Background: A recently discovered (May 2013) outbreak of epizootic pneumonia caused a substantial die-off of desert bighorn sheep in one of the largest populations in California (Old Dad Peak, Mojave National Preserve [MOJA]) (Epps et al. 2016), central to the most extensive array of naturally-persisting bighorn herds in North America. Until 2013, pneumonia epizootics in this region were unconfirmed. After the discovery of the die-off, bighorn sheep captured in 9 populations in or near MOJA tested positive for *Mycoplasma ovipneumoniae* (hereafter, *M. ovi*.), one of several pathogens involved in bighorn sheep pneumonia (Besser et al. 2012). As observed in Rocky Mountain bighorn sheep (Cassirer and Sinclair 2007), lamb survival and recruitment appears to be low in most populations in the region since the disease outbreak (D. Dekelaita & C. Epps, unpublished data), but also appear to vary among populations. An ongoing study (Epps, PI) is quantifying demographic parameters in 9 populations and investigating the influence of environmental factors. However, another hypothesis to explain this variation is that the genetic diversity and makeup of populations differ, and those differences influence how animals' immune systems respond to respiratory disease.

A research team from Oregon State University (OSU), consisting of Clint Epps (Associate Professor, Fisheries and Wildlife), Anna Jolles (Associate Professor, College of Veterinary Medicine, Brian Dolan (Assistant Professor, College of Veterinary Medicine), Brianna Beechler (Research Assistant Professor, College of Veterinary Medicine), and several OSU graduate students, has collected samples as part of the last three capture operations to determine functional immune responses from blood samples, as well as isolated DNA and mRNA for genetic analysis. In addition, CDFW veterinarians have collected samples for complete blood cell counts and biochemistry to determine the infection status of the individual animals, testing for *M. ovi* by PCR detection of the pathogen itself and by measuring serum antibodies present that were reactive to *M. ovi* (CDFW, unpub. data). We now have an extensive sample and data set (>160 bighorn sheep sampled and collared to track survival) that will allow us to test whether genetic and phenotypic differences explain susceptibility to *M .ovi* infection, and, over time, determine how populations may shift genetically in response to the disease. Our preliminary data suggest diversity at markers linked to immune genes is associated with *M. ovi* infection (Fig. 1). Populations of bighorn with greater diversity of microsatellites located near genes with known immune function (hereafter, "immune-linked microsatellites") have lower levels of infected individuals (Fig 1A). We also have documented that populations with high *M. ovi* prevalence have reduced innate anti-bacterial immune responses, as measured by the ability of an individual animal's plasma to prevent the growth of bacteria in culture (Fig.1B). Furthermore, there appears to be an association between innate immune response and population connectivity: those populations which are highly connected (and thus have greater genetic diversity, Epps et al. 2005)have enhanced innate immune responses (Fig.1C).

The study proposed here will use both existing and new data to further characterize genetic variation at immune system genes (MHC Class II) and expression of those genes (i.e., whether those genes are "turned on" in individual bighorn sheep at time of sampling), further assess genetic variation at microsatellite markers linked to MHC and other immune system genes (e.g., Nickerson 2014), and further assess how immune systems of captured bighorn sheep react to different stimuli. This research uses blood samples from captured animals in 11 study populations where captures have occurred since 2013, and, while planning to take advantage of future (2016) captures, will not require new captures. By completing

those analyses, and linking them with an ongoing demographic study monitoring survival of those captured individual bighorn sheep and assessing lamb:ewe ratios across 9 focal populations (Epps, Dekelaita, CDFW, NPS, WSF), we will be able to establish whether immune system genetic variation, expression of those genes, and assays of immune function are correlated with individual bighorn sheep *M. ovi* infection, infection, survival, and population characteristics such as elevation, habitat quality, connectivity, and neutral genetic diversity (Epps and Crowhurst in prep). The proposed study builds on an existing collaborative research program involving Oregon State University (Clint Epps, PI), National Park Service, CDFW, and CA-Wild Sheep Foundation. We have already self-funded three years of efforts to prepare samples and generate data from the three recent captures in the study area: with this proposal, we seek funding to complete this work. Our findings will evaluate links between DNA, immune systems, gene expression, and respiratory disease outcomes in bighorn sheep. We hypothesize that certain immune-genotypes will provide better protection for individuals, and those populations with advantageous genotypes, higher genetic diversity, and stronger responses in immune assays will be less susceptible to *M. ovi*-related mortalities and population declines. We address a key management question: is it better to maintain and foster connections between populations, despite the risk of disease spread, because enhanced genetic diversity enables better survival in the face of exposure to the disease, or is individual and population-level response to disease uncorrelated with genotype or genetic diversity ?

Objective #1: Relate MHC class II genotypes and expression of those alleles to *M. ovi* infection and individual and population characteristics in 11 desert bighorn sheep populations.
Objective #2: Relate diversity at 9 immune-linked microsatellites to *M. ovi* infection and population characteristics in 9 to 11 desert bighorn sheep populations.
Objective #3: Assess immune system function using established assays, relate to MHC Class II genotypes, expression, immune-linked microsatellites, *M. ovi* infection, and individual and population characteristics in 9 to 11 desert bighorn sheep populations.

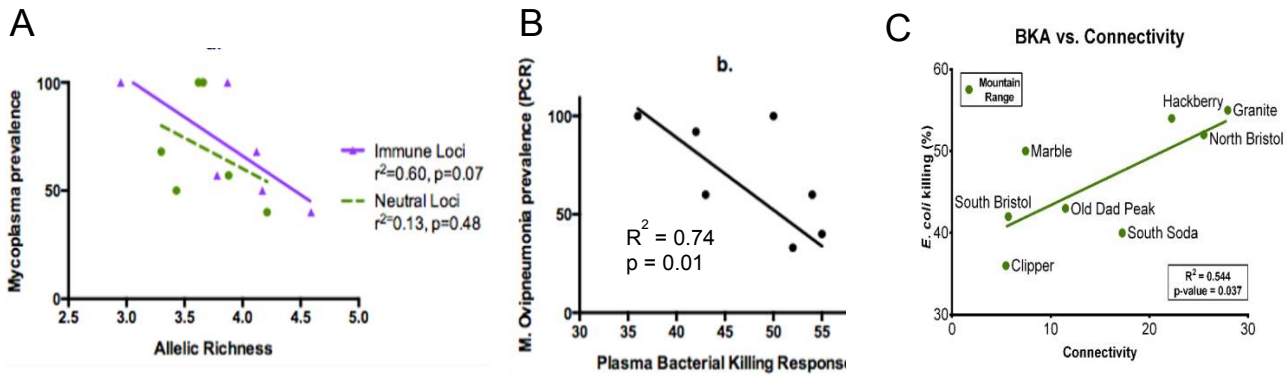


Figure 1. Immunogenetics and functional immune responses in different DBH populations in response to *M. ovi* infection. A. *M. ovi* prevalence in a population was measured as a function of allelic richness, as measured by microsatellite diversity. Increased genetic diversity at immune-related genes is associated with a population's ability to resist infection. By contrast, allelic richness at neutral genetic loci does not correlate with *M. ovi* prevalence, suggesting that immunogenetic diversity is essential for combating infections. B and C. Plasma contains many proteins with bactericidal activities and the sum total of these innate immune molecules can be captured by measuring the ability of an animal's plasma to kill laboratory strains of *E. coli.* The average bacterial killing capability of plasma from multiple individuals within a DBH populations was compared to bacterial prevalence as measured by qPCR for *M. ovi* (B), while the average bacterial killing levels of plasma from different populations of DBH was plotted as a function of genetic connectivity (C). These data indicate that increased immunogenetic diversity of DBH populations may increase innate, anti-bacterial plasma factors and lead to a decrease in the prevalence of *M. ovi.*

5) Project Description

Location: Field work (i.e., collection of samples using mobile laboratory equipment and team of 3-4 Oregon State PIs and graduate students) will take place in the Mojave Desert of California. Lab work and analysis will be conducted at OSU in laboratories maintained by Epps, Dolan, Jolles, and Beechler.
Personnel: PIs (Epps, Jolles, Dolan, Beechler) and graduate students associated with this project will continue to volunteer their time for this work, but we request two weeks of salary B. Beechler to organize

and supervise field laboratory crew during fall 2016 bighorn sheep capture, and 2 weeks' salary for an Epps lab technician to complete genotyping of capture samples 2013-2016 at 9 immune-linked genetic markers. Dolan will supervise and conduct MHC genotyping, Epps will supervise and conduct immune-linked genotyping, Jolles & Beechler will supervise and conduct immune assays, Beechler & Epps will supervise and conduct field laboratory operations, and all will supervise graduate students engaged with the research (B. Dugovich, L. Peruffo, R. Simmons) and assist with manuscripts.

Contractors/subcontractors: NA

Implementation plan/timelines: Work on MHC genotyping and immune-linked microsatellite genotyping would begin immediately, field-based sample preparation in mobile laboratory would occur in Nov 2016 during scheduled CDFW bighorn sheep capture in the eastern Mojave, completion of immune assays and genotyping would occur subsequently. We anticipate completing datasets within the one-year timeframe of this project (by June 30 2017), but associated manuscripts (part of graduate dissertations) likely will not be completed until the following year.

Materials/equipment: OSU will purchase additional laboratory supplies but already has all needed laboratory equipment. During capture operations, OSU will rent a vehicle and trailer to carry lab equipment and set up mobile lab in a tent or in hotel rooms as in the 2013-5 captures. CDFW will provide access to blood samples obtained during capture operations.

Environmental compliance/permits: Previous and planned 2016 capture work conducted by CDFW and collaborators is already permitted; laboratory work needs no additional compliance/permitting.

Detailed explanation of how work addresses Objectives 1-3:

Objective #1: Determine the MHC class II genotypes present in 11 desert bighorn sheep populations. We currently have both DNA and RNA samples isolated from the leukocytes of over 100 individual animals from 11 distinct populations within the Mojave Desert, including 9 that are focal populations for the associated demographic study. MHC class II genes are the most polymorphic genes in vertebrates (Murphy et al. 2007) and this diversity is necessary to ensure adequate adaptive immune responses (present pathogenic peptides to T helper lymphocytes), including the generation of immunological memory. We will therefore determine which MHC class II alleles are (1) present in the genome of each animal and (2) which alleles are functionally expressed (i.e., which genes are "turned on" at the time of sampling). We will then relate MHC II genotypes to disease status of individuals (as assessed at time of capture), and determine whether some populations are likely to be more resistant to *M. ovi* infection.

We suspect that certain MHC class II alleles will be associated with resistance to *M. ovi* infection, and bighorn MHC will closely mimic domestic sheep. We have designed primers based on known sheep and cattle MHC class II genes to amplify DBH sequences (Herrmann-Hoesing et al. 2008). Furthermore, unique primer sets have been created that target either cDNA (expressed genes) or genomic DNA sequences; the fragments of DNA we amplify will contain the sequences which confer the critical amino acid substitutions that alter how a given MHC class II protein binds to pathogens. Thus, we are able to determine the functional changes to MHC class II genes that are most likely to have an impact on T helper cell responses. Additionally, we are able to determine which genes are expressed at the mRNA level to ensure that newly identified sequences are not pseudogenes (false copies). We will employ next generation sequencing (NGS) and DNA barcoding to quickly and efficiently determine MHC genotypes for several hundred individuals. In a recent experiment using MHC gene *DQB* cDNA, we identified 13 unique DNA sequences from 67 bighorn sheep captured in 2013, evaluated phylogenic relationships among those alleles, number of alleles expressed per individual, and determined that the distribution of alleles differs among populations affected in the Mojave disease outbreak. Many of the nucleotide substitutions we detected indicated functional changes to T cell responses. Thus, we are confident that we can generate sequence data for all four MHC class II genes and accurately determine the MHC genotype of animals in our study. Subsequently, we will attempt to determine whether MHC diversity or specific alleles are associated with individual disease status or survival as assessed by Dekelaita & Epps.

Objective #2: Relate microsatellite diversity at immune genes to *M. ovi* infection.

Our preliminary data indicate that populations with greater diversity of immune-linked microsatellites (e.g., Worley et al. 2006, Luikart et al. 2011) have lower incidence of *M. ovi* infections (Fig. 1). However,

this analysis was done only on the population level using samples collected 2000-2004 (Nickerson 2014), and not for captured individuals in the current study. We will therefore complete measuring the microsatellite diversity and immune-related alleles for all individuals within our study to determine if allelic richness correlates with protection from disease at the individual level. We will complete genotyping of 9 immune-linked microsatellites (Nickerson 2014) linked to the immune-system associated genes. We can then compare an individual's genetic diversity at immune-related genes (and at neutral loci already genotyped, Epps & Crowhurst in prep) to infection status. Thus, we will determine if 1) high allelic richness, or 2) particular microsatellite genotypes are correlated with differences in innate anti-bacterial immune responses (see Objective 3) or disease resistance (based on a snapshot of disease status at time of capture, i.e., not exposed, infected, or recovered), as well as population characteristics. These experiments may provide clues about functional immune responses other than MHC diversity.

Objective #3: Complete immune function assays for Fall 2016 capture

For the upcoming Fall 2016 capture, as in previous captures, we will measure immune function using 4 techniques that assess a range of immune responses to general pathogens and pathogens specific to bighorn sheep pneumonia. All assays will be run *in vitro* using a single blood sample per individual. *White Blood cell counts:* We will estimate total leukocytes and perform differential leukocyte counts using standard microscopy techniques (Beechler et al. 2012). *Anti-microbial activity of blood and plasma:* We will quantify the ability of whole blood and plasma to lyse bacteria in vitro using blood collected during the cohort study. We will test general antibacterial ability of whole blood using the typical strains of *E. coli* and *S. aureus*, and specific disease specific killing ability with *M. ovi* obtained from Dr. Tom Besser of Washington State University, as well as *Mannheimia haemolytica* and *Pasteurella multocida* obtained commercially. *Lymphocyte proliferation assay:* we will measure lymphocyte proliferation in response to *in vitro* stimulation with B and T cell mitogens (LPS, conA) using a modified version of Cory et al.'s colorimetric LPA, currently in use in desert bighorn sheep (Dugovich, in prep), as well as disease specific lymphocyte proliferation ability with an ovine pneumonia vaccine containing antigens from *Mannheimia haemolytica* and *Pasteurella multocida* and a separate vaccine for *M. ovi*. *Cytokine profiles:* Cytokines are messenger molecules produced by immune cells, which orchestrate the immune response to pathogen challenge. We will quantify production of several proinflammatory cytokines known to be important in response to infection with Mycoplasma using a cytokine array designed for sheep from RayBiotech (product QAO-CYT-1). Circulating levels will be quantified in the plasma, while general production will be quantified using whole blood with a technique we used successfully during the 2014 bighorn capture (Dugovich et al, in prep). Production of the same cytokines will be assessed in response to specific stimulation with pneumonia vaccine (containing antigens to *P. multocid*a and *M. haemolytica*) and killed *M. ovi* in oil adjuvant obtained from T. Besser.

6) Expected Benefits

Addressing each objective will give us greater awareness of how immune-system function and individual and population-level immune genotypes help to determine disease outcomes. Our preliminary data are intriguing, but we are missing key information which we propose to acquire as described above. Expected benefits are: 1) 2-3 manuscripts describing links between immune and immune-linked genotype and genetic diversity, immune gene expression, immune function, and disease outcomes of desert bighorn sheep; 2) ability to link these data as predictors in an ongoing study of bighorn demography (Epps & Dekelaita, BGMA 2014-2016) and a proposed study of bighorn lamb survival using VITS (Epps & Dekelaita, BGMA this cycle).

7) Budget: Includes 2 weeks' salary for Dr. Beechler (Ph.D., DVM) to manage mobile laboratory for DNA and RNA extraction and immune function assays in Fall 2016 capture, lab supplies for that effort (assume up to 60 samples), salary for lab technician (R. Crowhurst, Epps laboratory) to genotype immune-linked microsatellites for 160 bighorn sheep captured 2013-2016 plus 90 fecal samples collected 2013-15, completing genotyping of MHC Class II genes (under supervision of Dr. B. Dolan), travel for setting up mobile laboratory and processing samples obtained during Fall 2016 capture, and indirect costs at OSU's federally negotiated on-campus research rate of 47% of modified total direct costs.

Epps- Immunogenetics- Application for FY16/17 BGMA funding

Budget Category/Item	Unit	Cost ea.	Quant.	Total
Personnel Costs				
Brianna Beechler, Research Assistant Professor, salary (2 weeks during 2016 capture)	1 Mo. FTE	$5,834.00	0.5	$2,917
Rachel Crowhurst, Senior lab technician (FRA), salary (2 weeks to complete genotyping)	1 Mo. FTE	$3,301.15	0.5	$1,651
Beechler benefits @ 51%	1 Mo. FTE	$2,975.34	0.5	$1,488
Crowhurst benefits @ $1935/mo actual	1 Mo. FTE	$1,935.00	0.5	$968
Total Personnel Expenses				**$7,023**
Operating Expenses				
Lab Reagents (ethanol, water)	bottle	$36.40	2	$73
Reagents for immune function assays of 60 new capture samples	Per sample	$25.00	60	$1,500
Laboratory Supplies for linked microsatellites	Per sample	$11.89	250	$2,972
MHC Class II genotyping (160 samples)	total			$5,000
Genotyping at the CGRB for linked microsatellites	Per sample	$5.63	250	$1,406
Travel: Leased OSU motor pool 3/4ton 4wd pickup for Nov 2016 capture	month rate	$390	1	$390
Travel: OSU Mileage charges on leased vehicle	miles	$0.30	3500	$1,050
Travel: Leased cargo trailer for mobile lab equipment, Nov 2016 capture	2 weeks	$200	1	$200
Travel: Lodging for field staff during capture (3 rooms, 5 nights)	room-night	$80	15	$1,200
Total Operating Expenses				**$13,791**
Subtotal Personnel & Operating Expenses				**$20,814**
Grant Administration: OSU on-campus rate (47%)	0.47			**$9,783**
TOTAL Project Cost				**$30,597**

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Epps & Dekelaita- Lamb Survival - Application for FY16/17 BGMA funding

1) Grant Name/Project Title: Using VITs to test the effects of pneumonia on desert bighorn lamb survival in the Marble Mountains of the eastern Mojave Desert
2) Amount requested: $260,466 (Year 1: $191,966; Year 2: $68,500)
3) Applicant Contact Information: Oregon State University
Authorized Signer: Patricia Hawk, Assistant Vice President for Research, Oregon State University, A312 Kerr Administration Building, Corvallis, OR 97331-2140. 541-737-4933, sponsored.programs@oregonstate.edu
Principal Investigator Contact Information: Clinton W. Epps, 541-737-2478, clinton.epps@oregonstate.edu [email preferred through July 2016]

4) Introduction (*Project type: Research*)
We propose to expand research on the impacts of epizootic pneumonia in the Marble Mountains by using vaginal implant transmitters (VITs) on pregnant ewes and collaring newborn lambs in 2016-2017, to track lamb health and survival. This study will tie into research on pneumonia impacts to bighorn sheep in the Mojave Desert that is currently underway and funded by BGMA (Project Title: Characterizing the spread and consequences of respiratory disease for desert bighorn sheep in the eastern Mojave Desert), and involves an existing collaboration between Oregon State University (Clint Epps, PI), National Park Service (NPS), and California Department of Fish and Wildlife (CDFW).

Background of the Issue/Problem – Following the pneumonia outbreak and subsequent die-off at Old Dad Peak in May and June of 2013, symptoms of pneumonia were observed in lambs and adults in the Marble Mountains located approximately 50 km southeast. Clinical symptoms included coughing, dyspnea, wheezing, snotty nose, head-bobbing, and general physical weakness (B. Gonzales, CDFW, personal communication). Since 2013, adult bighorn sheep in the Marble Mountains and other ranges in the Mojave Desert have tested positive for the pneumonia pathogen *Mycoplasma ovipneumoniae* (*M. ovi*), and signs of pneumonia have continued to be observed in adults and lambs. Whether pneumonia is currently contributing to higher rates of adult and lamb mortality in the Marble Mountains and other populations, however, remains unclear.

The die-off that occurred in Old Dad Peak was the only die-off documented in the Mojave Desert system from 2013 to the present. Between November 2013, 2014, and 2015, CDFW collared and tested a total of 161 adult bighorn sheep in the following 12 ranges: S. Soda, Old Dad Peak (Kelso Mountains), Granite, Hackberry/Wood, N. Bristol, S. Bristol, Clipper, Marble, Cady, Newberry, and Old Woman Mountains; with the exception of the Newberry Mountains, *M. ovi* was detected in all populations. Despite these results, adult mortality appeared minimal across ranges in the Mojave Desert in 2013-2014 based on collar survival data and other known mortalities, suggesting that system-wide disease impacts among adults may not be as severe as those observed at Old Dad Peak. In 2015, however, adult mortality appeared to increase in some ranges in late summer through winter (3 mortalities at Old Dad Peak and 3 mortalities in the Cady Mountains) compared to the previous year. Swab and tissue samples were collected from these mortalities and are being tested for disease pathogens.

Recent testing indicates that infection rates among captured adult bighorn may also be dropping in some ranges. For example, in the Marble Mountains 8 of 14 adults (57%) tested positive for active *M. ovi* infection in 2013, compared to 3 of 11 adults (27%) in 2015. We are currently collecting known-fate collar data and testing animals for the presence of disease pathogens at time of capture and at death to examine the effects of pneumonia on adult survival in the Mojave Desert; the effect of pneumonia on lamb survival will be more difficult to assess, but in other systems increased lamb mortality has typically been observed in subsequent years following an outbreak (Cassirer et al. 2013).

In 2014, 5 mortalities were detected in the Marble Mountains (4 adults and 1 lamb), and only 1 animal, a lamb, tested positive for *M. ovi* based on polymerase chain reaction analysis (PCR) of swab samples. Between 2013 and 2014, sick lambs were only observed in the Marble Mountains; few lambs were seen in other ranges, except in the S. Sodas where lambs appeared healthy. In 2015, sick lambs were also observed in the S. Sodas. Ground surveys performed in the Marble Mountains in May of 2012, and June of 2013 and 2014 indicated that lamb mortality had increased substantially from previous years based on observed lamb to ewe ratios (J. Wehausen, unpublished data). In May and June of 2015, ground surveys indicated that lamb to ewe ratios were higher than those for the same months in 2012-2014 (CDFW, unpublished data). In July and August of 2015, however, camera data from the Marbles suggested a marked drop in lamb survival, with observed lamb to ewe ratios falling approximately 35-40% between June and August (Dekelaita and Epps, unpublished data).

Lambs in pneumonia-infected herds typically contract pneumonia 2-3 weeks after birth and die within the first 3 months of life (J. Colby, CDFW, personal communication). We assume that the increase in mortality observed in lambs in the Marbles is the result of respiratory infection, but lambs often do not exhibit signs of chronic respiratory disease when observed in the field (B. Gonzales, CDFW, personal communication). Given that lambs are likely to die within 3 months of contracting the disease, lambs presumably experience different stages as the disease gets progressively worse, with symptoms becoming more apparent in the final stages before death occurs. For this reason, it is difficult to assess the condition of lambs in the field unless they are observed at the right time. Furthermore, we have not been able to verify the probable connection between disease and increased lamb mortality (Cassirer et al. 2013), as we have not been able to recover dead lambs systematically (2 were recovered in the Marble Mountains opportunistically) and collect samples post-mortem for pneumonia pathogen testing, or rule out other factors such as poor nutrition and predation. While we are currently evaluating lamb survival and recruitment with respect to nutrition and other environmental factors, a more focused evaluation of lamb mortality is needed to address the direct effects of disease and determine whether factors such as timing of birth or group association may also be influencing disease exposure and mortality risk.

Objectives – We propose to determine whether pneumonia is a contributing factor in higher rates of lamb mortality in the Marble Mountains. Our objectives are to document the disease status of lambs at time of birth and death (Obj. 1), visually monitor collared lambs for symptoms of pneumonia to track morbidity (i.e., signs of illness or infection) during the lambing and post-lambing season (i.e., January-October; Obj. 2), and estimate the effect of pneumonia on lamb survival in the Marble Mountains in 2017 (Obj. 3).

5) Project Description

Location and Description of Work – In November 2016, we propose to fit 30 pregnant ewes with GPS and VHF collars and vaginal implant transmitters (VITs) in the Marble Mountains; we will subsequently collar associated lambs shortly after parturition to rigorously track lamb survival in 2017 and monitor for disease. Ewe GPS locations will be monitored daily online following capture, and in January we will begin intensive daily field monitoring as well. When VITs are expelled, ewe Vectronic GPS collars will notify field staff (via satellite communication) that parturition has occurred. Newborn lambs will be hand-captured between 3 to 48 hours following parturition (Smith et al. 2014); neonatal lambs will not be handled at < 3 hours old to minimize risk of interference with mother-young bonding and subsequent abandonment (Livezey 1990). Lambs will be weighed, sexed, and aged, and will receive expandable UHF-tag collars which are made of elastic and designed to drop-off within 5-6 months after deployment; these collars are remotely linked to ewe collars that will provide GPS locations for lambs and mortality

alerts when lamb collars are inactive for more than 2 and 6 hours. Radiocollared lambs will be monitored remotely everyday from time of capture until mortality occurs or collars drop off; lambs and ewes will also be visually observed every week to monitor for signs of disease. Lambs and ewes will be promptly recovered post-mortem.

Blood and swab samples will be collected from all individuals at time of capture and during post-mortem recovery for disease and genetic testing. Lung tissue samples will be also collected from deceased animals < 12 hours post-mortem for further testing of respiratory pathogens and disease status. Additionally, mortality site investigations will be conducted by examining the condition of the carcass (i.e., lacerations, bite marks, broken bones, body position, color of bone marrow) and inspecting surrounding areas for evidence (i.e., predator tracks, drag marks, cache sites), to determine whether predation, poor health, falling, or other potential causes may have contributed to mortality.

Personnel –

1) Clint Epps, Associate Professor, Oregon State University: Principal Investigator
2) Daniella Dekelaita, PhD Student, Oregon State University: Project Lead
3) Field Assistants (2): Will provide support with daily field activities.

Contractors/subcontractors – NA

Implementation plan (timelines) –

November 2016: Collar and VIT deployment on 30 pregnant ewes
December 2016 – October 2017:
--Daily online and field monitoring of pregnant ewes
--Lamb retrieval, collaring and disease status assessments
--Recovery of lamb mortalities, collection of samples for disease testing
November 2017 – October 2018: Process samples, analyze data, and report results

Materials/equipment necessary to implement the project and who provides –

Provided by OSU: 30 Vectronic GPS ewe collars with remotely linked VITs and VHF lamb collars, 3 telemetry receivers, 3 yagi antennas, 3 garmin GPS units, 1 smart phone with 1 year data plan for immediate satellite data downloads, 1 vehicle, housing and food stipend for 2 field assistants (January through November 2017), miscellaneous capture supplies (e.g., lubricant and disinfectant for VITs and applicators, weigh scale for lambs, materials for disease and genetics sampling).

Provided by CDFW: Additional field personnel and capture supplies/equipment (e.g., helicopter, capture crew, flight time for capturing 30 pregnant ewes in the Marble Mountains, additional VHF collars and ear tags, materials for disease and genetics sampling, ultrasound machine).

Environmental compliance/permits –

We have an approved IACUC from NPS for ongoing research associated with the proposed study, and we will seek an amendment for VIT implementation and lamb handling if the study is approved by CDFW. We will also apply for a Scientific Take permit with the US Fish and Wildlife Service and CDFW. Project feasibility has been discussed with Dr. Ben Gonzales (Senior Wildlife Veterinarian, CDFW) and Regina Abella (Bighorn Sheep Program Coordinator, CDFW), and all activities associated with this project will be undertaken according to CDFW regulations.

Detailed explanation of how work addresses Objectives 1-3 –

Obj. 1 (documenting disease status of lambs): We will collect nasal and tonsillar swabs from newborn lambs at time of capture, and we will collect nasal, tonsillar, inner ear swabs as well as lung tissue samples from lambs post-mortem to test for disease pathogens including *M. ovi*. We will also

collect blood samples to test for pathogen antibodies, and to evaluate whether genetic variation correlates with disease outcomes and survival (see current proposal by Epps to BGMA on immunogenetics).

Obj. 2 (estimating morbidity): Lambs will be monitored visually throughout the lambing and post-lambing seasons (January – October) to assess disease status based on observable symptoms. We will use this information to estimate morbidity rates (i.e., the rate at which lambs become sick or display symptoms of pneumonia) at regular intervals for the duration of the study.

Obj. 3 (quantifying the effect of pneumonia on lamb survival): We will use known-fate data from lamb collars and observations over the study period to model survival (White and Burnham 1999) based on effects of nutrition, sex, age, pathogen presence, birth date, group association, and presence of pneumonia as confirmed through visual observation of symptoms. To test the effect of nutrition, birthweight and maternal nutrition will both serve as a surrogates (Mech et al. 1991, Carstensen et al. 2009); maternal condition will be scored at capture by measuring maternal body fat via ultrasound (Stephenson et al. 1998). Cox-proportional hazards (Cox 1972, Breslow 1975), Markov chain models (Gilks et al. 1996) and Bayesian inference (Gelman 2003) will be incorporated to assess effects of time-varying covariates (e.g., visual presence of clinical symptoms) and effects of contingency parameters (e.g., pathogen detection at time of death). We will also account for imperfect state assignments and variable disease detectability following Cooch et al. (2012).

6) Expected Benefits

The proposed study will verify whether respiratory infection in lambs has contributed to higher rates of lamb mortality in the Mojave, and estimate morbidity risk for newborn lambs in the Marble Mountains during the first 5 to 6 months of life in 2017. Such findings can elucidate to what extent respiratory disease is contributing to current lamb mortality rates, and whether timing of birth plays a role in severity of impacts. This information will help us gain a better understanding of disease dynamics among lambs, and may help us identify critical factors influencing current population trends, providing insight to improve future management of bighorn populations threatened by pneumonia. The proposed study will also strengthen ongoing research on adult survival and recruitment across 9 populations in the study area.

7) Budget: Personnel costs (1 week salary for PI Epps in year 2 when working with graduate student to analyze results, 2 quarters of graduate stipend/fees (not tuition) in year 2 for Daniella Dekelaita when analyzing results, operating expenses (telemetry receiver for field tech, leased 4WD vehicle, travel to and within field site, housing during field work at Granite Mtn Reserve, 2 field assistants [hired via temp agency not OSU, so considered an operating expense by OSU], 30 sets of Vectronic GPS collars for ewes, linked lamb collars to allow satellite notification of lamb mortality, and linked VITS to allow satellite notification of birth of lamb, monthly contract on internet-enabled phone to check collar locations while hiking in on animals during 12 months in the field, misc capture, field, publication costs), and Grant Administration costs (OSU indirect rates- Federally-negotiated oncampus indirect rate of 47% applies to PI and grad salaries and travel to 1 professional meetingt, offcampus rate of 26% applies to all remaining costs).

Personnel Costs	**Year 1**	**Year 2**	**Total**
Epps (PI) salary, 1 week years 1&2	$2,371	$2,442	$4,813
Dekelaita (Ph.D. student), 2 terms stipend Yr 2 (tuition waived)	$0	$11,742	$11,742
Benefits, Epps, $3433/mo	$901	$928	$1,829
Benefits & fees, Dekelaita (Ph.D. student)	$0	$1,887	$1,887
Total Personnel Expenses	**$3,272**	**$16,999**	**$20,270**

Operating expenses			
Telemetry receiver and antenna	$1,000	0	$1,000
Field & misc. capture supplies	$2,190	$190	$2,380
Publication costs	$0	$350	$350
Ewe/lamb Vectronic GPS collars and VITS	$92,557	$0	$92,557
Data charges for GPS collars (Iridium link)	$4,320	$6,480	$10,800
Internet capable phone for checking collar locations in field	$800	$400	$1,200
Field assistant (Temp agency for flexibility, not OSU employee, so no benefits)	$25,950	$15,570	$41,520
Housing, food during field work- Granite Mtn Reserve	$10,800	$6,000	$16,800
4WD vehicle lease and mileage, 5.5 months/year	$7,920	$3,960	$11,880
Travel to field sites for project personnel	$3,000	$1,000	$4,000
Travel to scientific meeting for grad student to present research	$0	$500	$500
Total Operating Expenses	**$148,537**	**$34,450**	**$182,987**
Grant Administration			
OSU indirect- rates 47% on campus (gray shaded items), 26% off campus Note- off-campus rates apply for long-term field work	**$40,157**	**$17,051**	**$57,209**
Total Project Cost	**$191,966**	**$68,500**	**$260,466**

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Rocky Mountain Elk Foundation

Big Game Account Project Proposal

Project Title: Marble Mountain Elk Management Unit Population Abundance and Dynamics Monitoring

Organization: Rocky Mountain Elk Foundation
Name: Mike Ford
Phone: 530-604-3600
Email: mford@rmef.org

Project start and completion dates by State Fiscal Year: July 01, 2016 to June 30, 2018. This project is proposed to be a two year project. Total project request for the two year period is $63,204.

California Department of Fish and Wildlife Region and location of proposed project: Region 1, Marble Mountain EMU, Siskiyou County, CA.

Issue/Problem Statement:
Baseline population information and monitoring of elk populations to detect key population parameters in Siskiyou County, within the Marble Mountains Elk Management Unit (EMU) is not occurring at this time.

Numerous CDFW management plans and documents (Draft Elk Management Plan, Draft Wolf Plan, Environmental Document - Elk Hunting) call for data to be collected on elk abundance, recruitment, cow/calf ratios, bull/cow ratios, etc. and used to help make critical management decisions on elk population management; predator / prey management; and elk hunting opportunities.

Elk information on abundance, recruitment, cow/calf ratios, bull/cow ratios in the Marble Mountain Elk herds is hard to find. Vegetative cover and topography has made aerial surveys difficult to use in determining elk abundance, recruitment, cow/calf and bull/cow ratios and as such we are looking for alternative ways to collect this information.

The collection of baseline information on abundance, recruitment, cow/calf ratios, bull/cow ratios is critical and urgent given the changing predator situation in Siskiyou and Trinity Counties. The issues of data collection are furthered by the patchy nature of elk herds and the low population numbers.

Project Description:
RMEF will work with the Klamath and Shasta Trinity National Forest, McBroom Outfitters and local volunteers to organize and conduct the study.

In 2015 McBroom Outfitters and Packers surveyed approximately 220 sq. miles of the Marble Mountain EMU for elk. Surveys were conducted on foot and by horseback. Videos were taken of elk where possible. Elk were divided into groups: bull, spikes, cow, calves and unknown animals. Efforts were made not to double count elk, thus obtaining an estimate of the abundance of elk within this section of the Marble Mountain EMU, as well as gathering information on cow/calf ratios; bull/cow ratios and recruitment. These surveys were funded by the Rocky Mountain Elk Foundation and McBroom Outfitters.

In this proposal, we propose to recreate that same survey for two additional years. Transects that were traveled in 2015 will be replicated and information gathered and classified in the same manner.

10 new cameras will be purchased to photograph elk use of trails, meadows and water sources at points during the summer and fall to help validate observations.

Data will be reviewed and assessed by West Inc. Environmental and Statistical Consultants. A report with findings on elk abundance, cow/calf ratios, bull/cow ratios, and recruitment will be prepared and presented to CDFW at the end of the second year. Progress reports with raw data will be presented at the end of each year.

Expected Benefits:

- Provide reliable information on elk recruitment, cow/calf ratios, bull/cow ratios and elk distribution from which to make critical management decisions on elk population management; predator / prey interactions; and elk hunting opportunities.
- Collection of data over the three year period will provide temporal comparisons of recruitment and distribution on the property. This data will be used to establish baseline information on population, distribution and herd composition on this portion of the Marble Mountain elk herd.
- Data collected from this monitoring effort is representative of approximately half of the habitat within the Marble Mountain EMU, and could be applied on a broad basis to management decisions within other areas of the EMU. If project funding can be secured for a camera project within the Trinity County area, we believe that the two studies would represent information that would apply to the entire Marble Mountain EMU.

Proposed Budget: 2016

Project Title	**Marble Mountain Elk Herd Abundance and Population Dynamics**					
Budget Line Item #	Work/Item Description	Count	Units		Cost/Unit	
Labor						
1	Run Transects in Marble Mountain EMU, Photograph herds where possible	480	Hours	@	$45.50	$21,840.00
2	Place Trail Cameras	40	Hours	@	$45.50	$1,820.00
3	Review Video Footage	60	Hours	@	$45.50	$2,730.00
4	Assess Data Analysis	1	Assessment	@	$2,500	$2,500.00
	Labor Subtotal					**$28,890.00**
Operating Expenses						
4	cameras, security boxes, cable locks	10	cameras		$300	$3,000.00
5	memory cards	20	16 gig SD card		$20	$400.00
6	batteries	60	AA lithium batteries		$1	$60.00
7	mileage	3000	miles	@	$0.56	$1,680.00
	Operating subtotal					**$5,140.00**
Project Cost 2016						**$34,030.00**

Proposed Budget: 2017

Project Title	**Marble Mountain Elk Herd Abundance and Population Dynamics**					
Budget Line Item #	Work/Item Description	Count	Units		Cost/Unit	
Labor						
1	Run Transects in Marble Mountain EMU, Photograph herds where possible	480	Hours	@	$45.50	$21,840.00
2	Place Trail Cameras	8	Hours	@	$45.50	$364.00
3	Review Video Footage	60	Hours	@	$45.50	$2,730.00
4	Assess Data Analysis	1	Assessment	@	$2,500	$2,500.00
	Labor Subtotal					**$27,434.00**
Operating Expenses						
6	batteries	60	AA lithium batteries		$1	$60.00
7	mileage	3000	miles	@	$0.56	$1,680.00
	Operating subtotal					**$1,740.00**
Project Cost 2017						**$29,174.00**

Rocky Mountain Elk Foundation

Big Game Account Project Proposal

Project Title: Marble Mountain Management Unit Population Dynamics and Recruitment Study, Trinity County

Organization: Rocky Mountain Elk Foundation
Name: Mike Ford
Phone: 530-604-3600
Email: mford@rmef.org

Project start and completion dates by State Fiscal Year: July 01, 2016 to June 30, 2019. This project is proposed to be a three year project. Total project request for the three year period is $71,815.

California Department of Fish and Wildlife Region and location of proposed project: Region 1, Marble Mountain EMU, Trinity County, CA.

Issue/Problem Statement:

Baseline population information collection and monitoring of elk populations to detect key population parameters in Trinity County, within the Marble Mountain Elk Management Unit (EMU) is not occurring at this time.

Numerous CDFW management plans and documents (Draft Elk Management Plan, Draft Wolf Plan, Environmental Document - Elk Hunting) call for data to be collected on elk abundance, recruitment, cow/calf ratios, bull/cow ratios, etc. and used to help make critical management decisions on elk population management; predator / prey management; and elk hunting opportunities.

Elk information on abundance, recruitment, cow/calf ratios, bull/cow ratios in the Marble Mountain Elk herds is hard to find. Vegetative cover and topography has made aerial surveys difficult to use in determining elk abundance, recruitment, cow/calf and bull/cow ratios and as such we are looking for alternative ways to collect this information.

The collection of baseline information on abundance, recruitment, cow/calf ratios, bull/cow ratios is critical and urgent given the challenges to CDFW management direction and changing predator situation in the Marble Mountain EMU. The issues of data collection are furthered by the patchy nature of elk herds and the low population numbers.

Trail cameras were used successfully in 2015 in the Pondosa area to detect cow/calf and Bull/cow ratios. The Trinity County area and Pondosa area support similar habitats and thus the monitoring issues are similar. After review of the project by West Inc. confirmed the validity and effectiveness of this type of data collection, we would like to move forward in the Devil's Garden area. As in the Pondosa area, the issues are furthered by the patchy nature of elk herds and the low population numbers.

Project Description:

RMEF will work with the Shasta-Trinity National Forest, Sierra Pacific Industries, California Department of Fish and Wildlife and local volunteers to organize and lead a group of volunteers and biologists who will identify sites to place cameras and collect the data.

40 new cameras will be purchased to photograph elk use of trails, meadows and water sources throughout the course of the summer and fall in 2016. 40 cameras were requested so that we could cover a larger area and test numerous locations for long term monitoring efforts. Capturing elk use on as many days as we can will strengthen our data set and as such we will need to test numerous sites in the identification of long term monitoring locations.

RMEF will work with knowledgeable local residents to place cameras in locations that are thought to support higher numbers of elk. By fall we expect to have a minimum of 20 sites identified that we will be used as long term camera sites. Cameras will be placed in these same locations in 2017 and 2018, while continuing to look for better sites.

The deployment of cameras at water sources and meadows where herds and individual elk can typically be seen will provide visual record of elk use throughout the area and provide documentation of the number of cows and calves from June 1 thru Oct. 31st. More than one camera may be placed at a given water source or meadow to better capture information on population composition. Cameras will be installed as soon as snow melt allows access to the areas. Cameras will be checked approximately every two weeks to change memory cards and check battery levels. Prior to the first major snowfall, the cameras will be removed or turned off for the winter. Every effort will be made to capture as many elk sightings as possible on each camera and within the study area to improve our confidence levels.

Detections per camera days will be grouped into monthly intervals at each camera station between June 1 and Oct 31st. Videos will be reviewed to determine bulls, spikes, cows, calves, and unidentifiable animals. In addition, cow:calf; bull:cow and recruitment information will be assessed within each period and the ratios monitored for the study period.

Once field data collection has been completed the information will be shared with Western Ecosystems Technology, Inc. (West Inc.) who are Environmental & Statistical Consultants to conduct analysis of the information. Information on recruitment, cow/calf ratios, bull/cow ratios will be assessed and a determination made of the results and strength of the data.

A final report will be provided to CDFW on the findings.

Expected Benefits:

- Provide reliable information to make critical management decisions on elk population management; predator / prey interactions; and elk hunting opportunities.
- Monitor elk populations as defined in various CDFW documents where the Department does not have the level of data they desire.
- Determining cow:calf and bull:cow ratios over a three year period that will allow for comparisons of whether the number of calves is increasing, remaining the same or decreasing in an efficient manner.
- Collection of data over the three year period will provide temporal comparisons of recruitment and distribution on the property. This data will be used to establish baseline information on population, distribution and herd composition on this portion of the Egg Lake elk herd.
- Once information has been collected as part of this proposal and the similar information from the Marble Mountain study, we believe that the two studies are representative of the entire EMU and can be used to make management decision for the entire EMU.

Proposed Budget: 2016

Project Title	**Marble Mountain EMU, Trinity County**					
Budget Line Item #	Work/Item Description	Count	Units		Cost/Unit	
Labor						
1	Installation and Maintenance of Cameras, Data Chip Retrieval	200	hours	@	$45.50	$9,100.00
2	Photo analysis and archiving	170	hours	@	$45.50	$7,735.00
3	Data Analysis	1	Assessment	@	$2,500	$2,500.00
	Labor Subtotal					**$19,335.00**
Operating Expenses						
4	cameras, security boxes, cable locks, camera posts	40	cameras		$300	$12,000.00
5	memory cards	80	16 gig SD card		$20	$1,600.00
6	batteries	720	AA lithium batteries		$1	$240.00
7	mileage	4600	miles	@	$0.56	$1,120.00
	Operating subtotal					**$14,960.00**
Project Cost 2016						**$34,295.00**

Proposed Budget: 2017

Project Title	**Marble Mountain EMU, Trinity County**					
Budget Line Item #	Work/Item Description	Count	Units		Cost/Unit	
Labor						
1	Installation and Maintenance of Cameras, Data Chip Retrieval	130	hours	@	$45.50	$5,915.00
2	Photo analysis and archiving	170	hours	@	$45.50	$7,735.00
3	Data Analysis	1	Assessment	@	$10,000	$2500.00
	Labor Subtotal					**$16,150.00**
Operating Expenses						
6	batteries	240	AA lithium batteries		$1	$240.00
7	mileage	2000	miles	@	$0.56	$1,120.00
	Operating subtotal					**$1,360.00**
Project Cost 2017						**$17,510.00**

Proposed Budget: 2018

Project Title	**Marble Mountain EMU, Trinity County**					
Budget Line Item #	Work/Item Description	Count	Units		Cost/Unit	
Labor						
1	Installation and Maintenance of Cameras, Data Chip Retrieval	130	hours	@	$45.50	$5,915.00
2	Photo analysis and archiving	170	hours	@	$45.50	$7,735.00
3	Data Analysis	1	Assessment	@	$5,000	$5,000.00
	Labor Subtotal					**$18,650.00**
Operating Expenses						
6	batteries	240	AA lithium batteries		$1	$240.00
7	mileage	2000	miles	@	$0.56	$1,120.00
	Operating subtotal					**$1,360.00**

Project Cost 2018	**$20,010.00**

Rocky Mountain Elk Foundation

Big Game Account Project Proposal

Project Title: Northeastern Elk Management Unit Population Dynamics and Recruitment Study, Devil's Garden Area

Organization: Rocky Mountain Elk Foundation
Name: Mike Ford
Phone: 530-604-3600
Email: mford@rmef.org

Project start and completion dates by State Fiscal Year: July 01, 2016 to June 30, 2019. This project is proposed to be a three year project. Total project request for the three year period is $74,545.

California Department of Fish and Wildlife Region and location of proposed project: Region 1, Devil's Garden Area, Modoc County, CA.

Issue/Problem Statement:

Baseline population information and monitoring of elk populations to detect key population parameters in Modoc County, within the North East Elk Management Unit (EMU) are not occurring at this time.

Numerous CDFW management plans and documents (Draft Elk Management Plan, Draft Wolf Plan, Environmental Document - Elk Hunting) call for data to be collected on elk abundance, recruitment, cow/calf ratios, bull/cow ratios, etc. and used to help make critical management decisions on elk population management; predator / prey management; and elk hunting opportunities.

Elk information on abundance, recruitment, cow/calf ratios, bull/cow ratios in the North East Elk herds is hard to find. Vegetative cover and topography has made aerial surveys difficult to use in determining elk abundance, recruitment, cow/calf and bull/cow ratios and as such we are looking for alternative ways to collect this information.

The collection of baseline information on abundance, recruitment, cow/calf ratios, bull/cow ratios is critical and urgent given the need to make population management decision on things such as hunting opportunities changes and changing predator situations in Modoc County. The issues of data collection are furthered by the patchy nature of elk herds and the low population numbers.

Trail cameras were used successfully in 2015 in the Pondosa area to detect cow/calf and bull/cow ratios. Field data was submitted for analysis to Western Ecosystems Technology, Inc. (WEST), Environmental &

Statistical Consultants. WEST is a well-respected analytical firm who deals regularly with wildlife population data. West Inc. was asked to review the project design and assess the quality of the data. After their review of the study design and data they stated that "we (WEST) have determined that the current study design, protocol for reviewing the videos, and data summarization is an efficient means to estimate calf/cow ratios in the region, either on a monthly or seasonal basis. We suggest that data continue to be collected in this manner for at least 1-2 additional years to evaluate calf/cow ratio trends over time". It is our proposal to conduct similar monitoring efforts in the Devils Garden area as was conducted in the Pondosa Tract area in 2015.

Project Description:

RMEF will work with the Modoc National Forest, USFS, Surprise Field Office, BLM, California Department of Fish and Wildlife and local volunteers to organize and lead a group of volunteers and biologists who will identify sites to place cameras and collect the data.

40 new cameras will be purchased to photograph elk use of trails, meadows and water sources. 40 cameras were requested so that we could cover a larger area and test numerous locations for long term monitoring efforts. Capturing elk use on as many days as we can will strengthen our data set and as such we will need to test numerous sites in the identification of long term monitoring locations.

Throughout the course of the summer and fall in 2016 project proponents will identify and place cameras in locations where they can capture as many elk photos as possible. RMEF will work with knowledgeable local residents to place cameras in locations that are thought to support higher numbers of elk. By fall we expect to have a minimum of 20 sites identified that we will be used as long term camera sites. Every effort will be made to capture as many elk sightings as possible on each camera and within the study area to improve our confidence levels.

Cameras will be monitored approximately every 2 weeks from June 1st to Oct. 31st. Chips will be replaced and assessed. More than one camera may be placed at a given water source or meadow to better capture information on population composition.

Detections per camera days will be grouped into monthly intervals at each camera station between June 1 and Oct 31st. Videos will be reviewed to determine bulls, spikes, cows, calves, and unidentifiable animals. In addition, cow:calf, bull:cow and recruitment information will be assessed within each period and the ratios monitored for the study period.

Once field data collection has been completed the information will be shared with Western Ecosystems Technology, Inc. (Environmental & Statistical Consultants) to conduct analysis of the information. In the final report we will provide information on elk population dynamics including recruitment, cow/calf ratios, bull/cow ratios and distribution of elk use on the Devils Garden area.

Cameras will be placed in the areas identified as long term monitoring sites in 2017 and 2018, while continuing to look for better sites.

Expected Benefits:

- Provide reliable information on elk recruitment, cow/calf ratios, bull/cow ratios and elk distribution from which to make critical management decisions on elk population management; predator / prey interactions; and elk hunting opportunities.
- Collection of data over the three year period will provide temporal comparisons of recruitment and distribution on the property. This data will be used to establish baseline information on population, distribution and herd composition on this portion of the Egg Lake elk herd.
- Monitor elk populations as defined in various CDFW documents where the Department does not have the level of data they desire.
- Data collected from this monitoring effort is representative of approximately half of the habitat within the NE EMU, and could be applied on a broad basis to management decisions in those other areas. Thus between the Pondosa Tract Study and this project elk population dynamics for cow/calf ratios, bull/cow ratios, recruitment, and distribution could be applied to the entire EMU.

Proposed Budget: 2016

Project Title	**NE California Elk Herd Composition, Modoc County**					
Budget Line Item #	Work/Item Description	Count	Units		Cost/Unit	
Labor						
1	Installation and Maintenance of Cameras, Data Chip Retrieval	220	hours	@	$45.50	$10,010.00
2	Photo analysis and archiving	170	hours	@	$45.50	$7,735.00
3	Data Analysis	1	Assessment	@	$2500	$2,500.00
	Labor Subtotal					**$20,245.00**
Operating Expenses						
4	cameras, security boxes, cable locks, camera posts	40	cameras		$300	$12,000.00
5	memory cards	80	16 gig SD card		$20	$1,600.00
6	batteries	240	AA lithium batteries		$1	$240.00
7	mileage	2000	miles	@	$0.56	$1,120.00
	Operating subtotal					**$14,960.00**
Project Cost Year 1						**$35,205.00**

Proposed Budget: 2017

Project Title	**NE California Elk Herd Composition, Modoc County**					
Budget Line Item #	Work/Item Description	Count	Units		Cost/Unit	
Labor						
1	Installation and Maintenance of Cameras, Data Chip Retrieval	150	hours	@	$45.50	$6,825.00
2	Photo analysis and archiving	170	hours	@	$45.50	$7,735.00
3	Data Analysis	1	Assessment	@	$2500	$2,500.00
	Labor Subtotal					**$17,060.00**
Operating Expenses						
4	batteries	240	AA lithium batteries		$1	$240.00
5	mileage	2000	miles	@	$0.56	$1,120.00
	Operating subtotal					**$1,360.00**
Project Cost Year 2						**$18,420.00**

Proposed Budget: 2018

Project Title	**NE California Elk Herd Composition, Modoc County**					
Budget Line Item #	Work/Item Description	Count	Units		Cost/Unit	
Labor						
1	Installation and Maintenance of Cameras, Data Chip Retrieval	150	hours	@	$45.50	$6,825.00
2	Photo analysis and archiving	170	hours	@	$45.50	$7,735.00
3	Data Analysis	1	Assessment	@	$5,000	$5,000.00
	Labor Subtotal					**$19,560.00**
Operating Expenses						
4	batteries	240	AA lithium batteries		$1	$240.00
5	mileage	2000	miles	@	$0.56	$1,120.00
	Operating subtotal					**$1,360.00**
Project Cost Year 3						**$20,920.00**

Rocky Mountain Elk Foundation

Big Game Account Project Proposal

Project Title: Northeastern Elk Population Dynamics and Recruitment Study
Pondosa California

Organization: Rocky Mountain Elk Foundation
Name: Mike Ford
Phone: 530-604-3600
Email: mford@rmef.org

Project start and completion dates by State Fiscal Year:
July 01, 2016 to June 30, 2018. This project is proposed to be a two year project. Total project request for the two year period is $41,348.

California Department of Fish and Wildlife Region and location of proposed project:
Region 1, Roseburg Resources Pondosa Tract.

Issue/Problem Statement:
Baseline population information and monitoring of elk populations to detect key population parameters in Pondosa, within the North East Elk Management Unit (EMU) is not occurring at this time.

Numerous CDFW management plans and documents (Draft Elk Management Plan, Draft Wolf Plan, Environmental Document - Elk Hunting) call for data to be collected on elk abundance, recruitment, cow/calf ratios, bull/cow ratios, etc. and used to help make critical management decisions on elk population management; predator / prey management; and elk hunting opportunities.

Elk information on recruitment, cow/calf ratios, bull/cow ratios in the North East Elk herds is hard to find. Vegetative cover and topography has made aerial surveys difficult to use in determining elk abundance, recruitment, cow/calf and bull/cow ratios and as such we are looking for alternative ways to collect this information.

The collection of baseline information on abundance, recruitment, cow/calf ratios, bull/cow ratios is critical and urgent given the challenges to CDFW management direction and changing predator situation in the Pondosa Tract. The issues of data collection are furthered by the patchy nature of elk herds and the low population numbers.

Trail cameras were used successfully in 2015 in the Pondosa area to detect cow/calf and bull/cow ratios. Field data was submitted for analysis to Western Ecosystems Technology, Inc. (WEST), Environmental &

Statistical Consultants. WEST is a well-respected analytical firm who deals regularly with wildlife population data. West Inc. was asked to review the project design and assess the quality of the data. After their review of the study design and data they stated that "we (WEST) have determined that the current study design, protocol for reviewing the videos, and data summarization is an efficient means to estimate calf/cow ratios in the region, either on a monthly or seasonal basis. We suggest that data continue to be collected in this manner for at least 1-2 additional years to evaluate calf/cow ratio trends over time".

Further conversations with West Inc. provided information on how to strengthen the quality of our data and how we might design further camera studies in other locations.

Project Description:

RMEF will continue to work with Roseburg Resources Inc. to organize and lead a group of volunteers and biologists who will conduct the study. One year of information has been collected on cow/calf, bull/cow and recruitment population parameters.

20 new cameras will be purchased to photograph elk use of trails, meadows and water sources throughout the course of the summer and fall. Some of these cameras and those purchased as part of our first year efforts will be placed at the same 19 sites that were established in 2015 so that the information collected can be compared from year to year. This is the second year of this monitoring effort.

The original placement and study design of the camera project was reviewed by West Inc. to maximize precision and reliability of information from the study. One of West Inc. recommendations was to attempt to gather as many sightings as possible in a given period. In response to this suggestion we will continue to try to identify new locations of high elk use, and to try to expand camera sites to areas off the Pondosa Tract so that we might capture more information closer to the calving and wintering areas.

Additional camera locations will be established as sites are identified to try to increase the sample size to allow analysis of herd composition data in months when elk are not as numerous in the study area. The deployment of cameras at water sources and meadows where herds of elk can typically be seen will provide visual record of elk use throughout the property and provide documentation of the number of cows and calves for a period of time. More than one camera may be placed at a given water source to better capture information on herd composition. Attempts will be made to locate additional sites off the Roseburg property that capture calving information, and data later into the fall.

The Rocky Mountain Elk Foundation has provided funding to collar elk within the Pondosa Tract area. Once placed on elk by CDFW, these collars will be used to locate elk use throughout the year. The presence of marked animals, coupled with easily identified animals within the population will be used to test if elk abundance can be determined. That assessment will be dependent on the number of animals easily identified and the number of re-sightings that we get for each of those animals each year.

Cameras will be installed as soon as snow melt allows access to the areas. Cameras will be checked approximately every two weeks to change memory cards and check battery levels. Prior to the first major snowfall, the cameras will be removed or turned off for the winter. It is expected that the survey period will be from approximately June 1 until November 1 each year.

Detections per camera days will be grouped into monthly intervals at each camera station between June 1 and October 31st In addition, cow:calf; bull:cow and recruitment information will be assessed within each period and the ratios monitored for the study period.

Once field data collection has been completed the information will be shared with WEST, to conduct analysis of the information as to recruitment, cow/calf ratios, bull/cow ratios and habitat use. A final report will be prepared and submitted to California Department of Wildlife following WEST's. assessment.

Expected Benefits:

- Provide reliable information on elk recruitment, cow/calf ratios, bull/cow ratios and elk distribution from which to make critical management decisions on elk population management; predator / prey interactions; and elk hunting opportunities.
- Collection of data over the three year period will provide temporal comparisons of recruitment and distribution on the property. This data will be used to establish baseline information on population, distribution and herd composition on this portion of the Egg Lake elk herd.
- Data collected from this monitoring effort is representative of approximately half of the habitat within the NE EMU, and could be applied on a broad basis to management decisions in those other areas. If project funding can be secured for a similar camera project within the Devils Garden area, we believe that the two studies would represent information that would apply to the entire NE EMU.

Proposed Budget: 2016

Project Title	NE California Elk Herd Composition, Pondosa					
Budget Line Item #	Work/Item Description	Count	Units		Cost/Unit	
Labor						
1	Installation and Maintenance of Cameras, Data Chip Retrieval	104	hours	@	$45.50	$4,732.00
2	Photo analysis and archiving	144	hours	@	$45.50	$6,552.00
3	Data Analysis	1	Assessment	@	$5,000.00	$5,000.00
	Labor Subtotal					**$16,284.00**
Operating Expenses						
4	cameras, security boxes, cable locks	20	cameras		$300	$6,000.00
5	memory cards	40	16 gig SD card		$20	$800.00
6	batteries	150	AA lithium batteries		$1	$150.00
7	mileage	1500	miles	@	$0.56	$840.00
	Operating subtotal					**$7,790.00**
Project Cost						**$24,074.00**

Proposed Budget: 2017

Project Title	NE California Elk Herd Composition, Pondosa					
Budget Line Item #	Work/Item Description	Count	Units		Cost/Unit	
Labor						
1	Installation and Maintenance of Cameras, Data Chip Retrieval	104	hours	@	$45.50	$4,732.00
2	Photo analysis and archiving	144	hours	@	$45.50	$6,552.00
3	Data Analysis	1	Assessment	@	$5,000.00	$5,000.00
	Labor Subtotal					**$16,284.00**
Operating Expenses						
4	batteries	150	AA lithium batteries		$1	$150.00
5	mileage	1500	miles	@	$0.56	$840.00
	Operating subtotal					**$990.00**
Project Cost						**$17,274.00**

CA Department of Fish and Wildlife - Application for Big Game Grant FY 16/17

Project Title: Water Source Development on State School Lands (Phase II)

Amount Requested: **$29,222.54**

Contact Information: Society for the Conservation of Bighorn Sheep
501(c)(3) TIN 237113312
4904 Reynolds Road
Torrance, CA 90505
Primary Contact and Responsible Party:
Steve Marschke, President (stevemarschke@gmail.com; 310-339-4677)

Introduction:

(a) Project Type: Wildlife Habitat Enhancement and Hunter Opportunity

(b) Background: The Society for the Conservation of Bighorn Sheep (SCBS) is working cooperatively with the State Lands Commission (SLC) to gain approval for leasing parcels from SLC for the siting of wildlife water developments to benefit bighorn sheep and other species of wildlife. Property available for wildlife water development is generally encumbered with complex and tedious federal regulations. This project allows for use of state lands for habitat development as the CEQA process and State Land Commission is generally less intensive than the federal process. Phase 1— the biological evaluation necessary to comply with California Environmental Quality Act (CEQA) — of this effort was completed in 2015; to fully comply with CEQA, however, SLC is requiring an archaeological clearance of site-specific locations prior to approval of any leases (Appendix I).

(c) Objectives: The objective is an archaeological clearance for parcels that have been identified for lease by SCBS for placement of wildlife water developments. These developments will ensure the availability of limited resources for bighorn sheep and other species, enhance the likelihood of metapopulation function, help to ensure the viability of populations of bighorn sheep throughout the deserts of southeastern California, and enhance hunter opportunity for bighorn sheep and other game species that will benefit from these developments.

Specific to this proposal, SCBS will subcontract with a Registered Professional Archaeologist that will complete the necessary literature review (or site visits if deemed necessary as a result of the literature review and review of museum records) and other consultations to ensure compliance with CEQA requirements. SCBS will extend our subcontract with our biological consultant to ensure that the archeological assessments are integrated into our original CEQA application to SLC. Completion of the archaeological clearance and subsequent report will allow SLC staff to accept the lease application as complete and finish the requisite environmental review of the proposed project. When recommended by SLC staff the lease will be forwarded to the State Lands Commission for final review and approval.

Following approval of the proposed leases, SCBS will become the lessee, thereby ensuring the availability of the approved parcels for placement of wildlife water developments. SCBS will initiate the development of water sources on the parcels upon approval of the leases as detailed in the lease application.

Project Description:

(a) Location: All parcels proposed for archaeological evaluation (n = 90) prior to lease from SLC are 2.5 acres in size and are located in bighorn sheep habitat in either the Mojave Desert or Sonoran Desert of California. A compilation of the specific parcels is available on request, but inclusion herein is beyond the scope of this application.

(b) Staffing: The applicant, SCBS, will oversee development of the archaeological clearance through qualified subcontractors and coordinate with our original biological consultant to ensure consistency of the biological and archeological assessments. SCBS has no paid employees and all work is done by volunteers. Travel to meet with subcontractors and SLC is expected.

(c) Contractors: SCBS will prepare necessary logistical or administrative support to ensure subcontractors are compliant with the SLC requirements and ensure the timely completion of the evaluations. Further, SCBS will provide results of the assessments to SLC to allow its environmental staff fully to assess the potential impacts of the proposed water developments on archaeological resources associated with each of the proposed development locations.

(d) Implementation: The work proposed by SCBS in this application for funds will be completed and submitted to SLC in compliance with its request for additional information by 31 December 2016. Please see (f), below, for specific details.

(e) Materials: Not applicable to this specific proposal

(f) Timeline: *Assuming a start date of 1 July 2016*, SCBS will within 1 month initiate subcontracts to complete the evaluations required by SLC prior to approval of the leases (to be completed by 1 August).

The consultants will, within 2 months, provide SCBS with an evaluation of the potential for archaeological resources to be impacted by water source development at each of the locations proposed for lease; these evaluations will meet the stipulations proposed by SLC as necessary to comply with the CEQA, as requested in correspondence to SCBS from SLC dated 17 September 2015: "Please submit a Cultural Literature Search covering the entire project area...". The subcontractor is expected to complete the necessary tasks by 1 October 2016.

Following receipt of the requisite information, SCBS will review, approve, and provide the requisite cultural literature search to SLC by 31 December 2016, thereby fulfilling the requirement stipulated by SLC in its correspondence requesting this information. It is expected that SCBS personnel will have to travel at least once to visit each subcontractor but no overnight is expected. SCBS personnel will travel once to Sacramento to meet with SLC staff and overnight accommodations will be required.

State Lands Commission staff will then proceed with the formal evaluation of the application for lease of state lands submitted by SCBS for the purposes of placing wildlife water developments on those parcels. The completion date for such evaluation and approval of the lease will be contingent upon SLC time constraints.

(g) Consistency: This is a continuation of work started under grant P1380017. Completion of this phase of

the project will comply with the SLC request to provide the information necessary to comply with CEQA requirements, as described in their request for information on archaeological resources potentially associated with each parcel. In the absence of such information, CEQA requirements will not have been met, the proposed lease will receive no further consideration, and SCBS will not be able to lease SLC parcels on which to place wildlife water developments. Thus, it is essential that the archaeological evaluations be completed for the proposed work to move forward.

(h) Compliance: The biological assessments needed to meet CEQA requirements have been completed and submitted to SLC. Completion of this project will meet the request for additional information required by SLC to ensure compliance with CEQA that is necessary before parcels on which proposed water developments can be fully evaluated in the context of CEQA and forwarded for approval by SLC.

Expected Benefits: Ultimately, approval of leases proposed by SCBS to the SLC will authorize construction of water developments on specific parcels managed by SLC. These parcels were selected by personnel knowledgeable about the distribution of and habitat selection by desert bighorn sheep, and anticipated benefits to the conservation of bighorn sheep by (1) allowing bighorn sheep to make use of otherwise suitable habitat that lacks surface water; (2) increasing the probability of emigrating or immigrating bighorn sheep encountering conspecifics; (3) enhancing survival rates of individuals during periods of thermal stress or drought; (4) increasing the potential for new populations to become established; and, ultimately, (5) enhancing metapopulation function consistent with CDFW conservation objectives as identified in the draft Bighorn Sheep Management Plan. Enhanced bighorn sheep metapopulation as a result of these additional water developments will preserve, and probably increase, hunter opportunity for many years to come.

Budget:

Water Source Development on SLC Lands (Phase II)	**Project Totals**
Personnel	
Grantee (SCBS volunteers)	0.00
Subcontractor, archeology	24,682.84
Subcontractor, biology	3,675.00
Total Personnel Expenses	28,357.84
Operating Expenses	
Transportation (personal vehicles, 1074 miles @ $0.55/mile)	590.70
Per Diem (3 days @ $54)	162.00
Lodging (1 day @ $112)	112.00
Subtotal Operating Expenses	864.70
Grant Administration (20% of Operating Expenses)	**172.94**
Total Project Cost	**$ 29,222.54**

CA Department of Fish and Wildlife
Application for Big Game Grant FY 16/17, FY 17/18 and FY 18/19

Project Title: Water hauling for guzzlers

Amount Requested: **$ 82,893.90 ($27,631.30 /year for 3 years)**

Contact Information: Society for the Conservation of Bighorn Sheep
501(c)(3) TIN 237113312
4904 Reynolds Road
Torrance, CA 90505
Primary Contact and Responsible Party:
Steve Marschke, President (stevemarschke@gmail.com; 310-339-4677)

Introduction: This project will provide water to manually refill artificial developments that historically run dry each year due to heavy use, deferred maintenance or lack of rainfall.

(a) Project Type: Hunter Opportunity through habitat maintenance. Nearly all wildlife species benefit from keeping the water developments full, including several game species: desert bighorn, quail, mule deer and dove.

(b) Background: SCBS and DFW have partnered in creating and maintaining numerous artificial water developments throughout the California deserts for over 40 years. These systems are designed to collect natural rainfall and store it so that it may be available for wildlife during the summer months. Many of these systems are in areas now under jurisdiction of the National Park Service or are within BLM wilderness. Some of these systems do not provide water all summer for a variety of reasons: insufficient rainfall, mechanical failure, and heavy use by wildlife. Long term solutions for many of these problems have been proposed by SCBS but have not been authorized by NPS or BLM. Since mechanical improvements and significant repairs have not (yet) been allowed, SCBS replenishes these systems by hauling water by truck. Previously, DFW provided 2 or 3 trucks to Camp Cady that were used for this purpose (among other projects.) Those trucks are no longer available and SCBS and our volunteers have been doing it all.

(c) Objectives: To supply 5 BGG systems with water each year for 3 years. Typically 10,000 gallons are required each year for the systems that are accessible by truck.

Project Description:

(a) Location: Several developments systems within Mojave Preserve and BLM wilderness in the following mountain ranges: Cady Mtns, Old Dad, Newberry Mtns, Orocopia Mtns, Marble Mtns, South Bristol Mtns. Only systems that are accessible by wheeled vehicles are included in this grant request. Several other systems can only be reached by helicopter flight. There are approximately 9 developments that we can reach by truck, usually at least 5 of them will need to be refilled each summer.

(b) Staffing: SCBS volunteers provide all the labor to organize, schedule and perform these tasks. A typical hauling project of 2000 gallons requires 12 volunteers and 120 man hours per hauling event.

(c) Contractors: SCBS expects to hire a subcontractor to interface with NPS to ensure Categorical Exclusion is issued in a timely manner. BLM generally allows water hauling without

need for any permits.

(d) Implementation: SCBS has a 1 ton 4x4 flatbed truck, additional 4x4 trucks are provided by volunteers. Portable 250 gallon water tanks are installed in each volunteer's truck. In order to completely fill each system, we aim for 10 vehicles or a total of 2500 gallons. We obtain the water from local community services. A high pressure fire-fighting style pump is used along with 1.5 inch diameter fire hoses to deliver the water from the trucks into the water development system. Most developments require between 100 and 500 feet of hose to reach from the trucks to the tank. In lieu of pay, meals during the project are provided for the volunteers. Typical mileage for a single hauling event is about 200 miles per vehicle, or 2000 miles per project.

(e) Materials: Water, 4x4 trucks, water pump, fire hoses, meals, satellite monitoring system.

(f) Timeline: This is a 3 year request. Each year is essentially the same. We have satellite communications based remote monitoring systems on 12 developments that give us daily updates on the water level in the tanks. We use the information to closely monitor the water level in the systems. When we project a dry system, we plan an event and notify our volunteers. The projects are normally scheduled during June, July and August of each year. Hauling normally has to be done in the hot summer months; earlier and the systems usually still have some remaining water, too late and they may run dry.
Each hauling event typically is a one-day project. We generally gather the volunteers the previous evening, load the equipment into the trucks, and get up before dawn to beat the heat. Even though we really only work one day, we have to have the equipment available the day before. On the project day, we fill tanks from local community services agency, then drive to guzzler site. This usually requires highway miles followed by several miles of off-road travel. The off road portion requires 4x4 trucks but a full load of water is a very heavy load (up to 4000 lbs) so our speed is very slow. Once at the site, we lay fire hose from truck tanks to guzzler tank, then use pump to move water.
We perform 5 or more of these hauling projects every summer, usually on weekends.

(g) Consistency: By keeping these system full of water during the summer months, desert wildlife including bighorn sheep, that are dependent on free water will not be in peril due to lack of sufficient rainfall, maintenance or competition.

(h) Compliance: For the systems within NPS land, SCBS will hire a subcontractor to interface with NPS personnel to obtain Categorical Exclusion (the typical requirement) for this work. For BLM lands, water hauling is considered within our normal scope of operations and does not require any special permits.

Expected Benefits: Each water development system provides enough water for up to 50 desert bighorn sheep during the hottest part of the summer, which is typically 100 days. Numerous other species also utilize this water sources. Sheep from a radius of more than 5 miles are known to utilize these sources. Affected area of just 5 systems is in excess of 400 square miles.

Budget:

Water Hauling, 5 Events per Year	**Project Totals**
Personnel	
Grantee (SCBS volunteers, 120 hrs/event x $0)	0.00
Subcontractor, biology (40 hours x $50/hr)	2,000.00
Total Personnel Expenses	**2,000.00**
Operating Expenses	
Water (2000 gal/event x $0/gal x 5 events)	0.00
Remote monitoring fees (12 systems x $127/year)	1,524.00
Transportation (personal vehicles, 1800 miles/event x $0.55/mile x 5 events)	4,950.00
Truck use (4x4x 1 ton, 2 days/event x $1450/day x 5 events)	14,500.00
Food (for volunteers, $125/event x 5 events)	625.00
Pump use(2 days/event x $156.25/day x 5 events)	1562.50
Hose use (2 days x 500 ft x $10.50/50 ft /day x 5 events)	1,050.00
Subtotal Operating Expenses	**24,211.50**
Grant Administration (20% of Operating Expenses, except equipment and subcontractors)	**1,419.80**
Total Project Cost, per year	**$ 27,631.30**
Total for 3 years	**$ 82,893.90**

Project Title: Movement patterns and habitat use of American black bear (*Ursus americanus*) in the southern Sierra Nevada and Tehachapi Mountains, Kern County, California

Amount Requested: $451,400.00

Applicant Contact Information:
Southwestern Wildlife Survey, Inc., 47-4418883
Contact Person: Charles J. Randel, III, PhD
Phone Number: 626/799-0259
E-mail: southwesternwildlife@gmail.com

Introduction
Project type: **Research**
Black bear research in California has primarily been conducted in the northern portions of the state, with the majority of studies published conducted in Yosemite National Park (Graber and White 1983, Greenleaf et al. 2009, Harms 1980, Hastings et al. 1986, Keay and Van Wagtendonk 1983) or Sequoia/Kings Canyon National Park (Ayers et al. 1986, Graber 1990, Mazur 2008, Zardus and Parsons 1980); with additional studies in northwestern California (Kellyhouse 1980, Matthews et al. 2008) and Tahoe National Forest (Grenfell and Brody 1986). Few studies on black bear biology and ecology are peer-reviewed for the central and southern portions of the state with activity patterns of urban bears (Lyons 2005) and landscape genetics (Brown et al. 2009) being the primary focus.

To meet CDFW's primary black bear (*Ursus americanus*) management goal of maintaining a viable and healthy black bear populations, additional data (e.g., movement patterns and habitat use) are needed for areas of occupied black bear habitat underrepresented in the scientific literature. One such underrepresented geographic area is the southern Sierra Nevada, Kern County, California. Based on a review of peer-reviewed and gray literature there is limited information on basic biological and ecological parameters for black bears form Sequoia National Park's southern boundary south through the Sierra Nevada and into the Tehachapi and Transverse Mountain ranges (Kern, Ventura, and Los Angeles counties). This geographic region represents the linkage corridor between the Sierra Nevada and Southern California black bear subpopulations.

Our overall research goal is to document and analyze spatial and temporal movement patterns habitat use of black bear in the southern Sierra Nevada Mountains, California. Our research objectives in support of the stated research goal are to: (1) delineate and quantitatively describe black bear habitat use by month and season; and (2) compare daily, seasonal, and annual movement patterns of male and female black bears.

Project Description
Project Location: Southern Sierra Nevada and Tehachapi Mountains, Kern County, California

Staffing requirements: One (1) wildlife biologist will be responsible for coordinating with CDFW staff on capture/collar efforts, and have the additional responsibility for weekly data download, analysis, and report/publication preparation/submittal.

Implementation Plan

Activity	*Anticipated Date*
Estimated project award	5/31/2016
Capture/Collar	TBD
Data collection	1/16/2017–12/31/2020
Report preparation	1/1/2021
Final report submission	3/31/2021

The Southwestern Wildlife Survey will coordinate with CDFW staff on timing, methods, and location of capture and collar activities to ensure compliance with existing CDFW policies and practices. It is anticipated that capture and collaring activities may occur on both public and private lands within the proposed study region. The Southwestern Wildlife Survey will prepare, submit, and secure appropriate land owner access permits prior to initiation of any capture activities.

To meet the state research goals and objective outlined above we will fit 50 black bears (25 males and 25 females) with with programmable Iridium Global Positioning System (GPS) collar (Vertex Plus Iridium, Vectronic Aerospace, Berlin, Germany) scheduled to collect one GPS location every hour for a period of three years. GPS collars were selected over conventional VHF radio-collars to obtain adequate relocations to quantify black bear home range, movement patterns, and habitat use (Belant and Follman 2002). GPS location data will be downloaded weekly, imported and stored in a database, post-processed, and plotted in a geographic information system (GIS) platform (ArcGIS 10.2, ESRI, Redlands, California). Macro- and micro-habitat classifications used in all proposed analyses will be based on available USFS and CDFW habitat systems.

Black bears are known to have extensive movement patterns in relation to seasonally abundance food sources, which requires an evaluation of habitat use at multiple temporal and spatial scales (Obbard et al. 1995. Schoen 1990). The majority of black bear research has relied on an examination of first and second order habitat selection models (Johnson 1980), which may confound interpretation of results in overall habitat use (Obbard et al. 1995). To address these issues, the Southwestern Wildlife Survey will use a multiscale approach to examining second-order (home range) and third-order (use of specific habitat components within each home range) habitat use (Krausman 1999) and use t-tests or ANOVA statistical analyses to determine differences between male and female black bear. We will calculate individual fixed kernel home range (annual and seasonal) estimates using the 'kde' function in Geospatial Modelling Environment (GME; Beyer 2012). We will use paired t-tests and ANOVA statistical tests to compare male and female home range estimates within and between years, respectively.

To quantify third-order habitat selection, as well as, daily, seasonal, and annual movement patterns we will use Brownian bridge movement models (BBMM; Horne et al. 2007). BBMM are based on the concept of Brownian bridges and will estimate the probability of an animal

being within a specified area based on the elapsed time between sequential location (Bullard 1999). Sawyer et al. (2009) and Takekawa et al. (2010) both suggested the use of BBMM as a preferred analysis method for estimating migration and movement patterns for mammals exhibiting long distance movement patterns. We will test for differences in male and female black bear daily, seasonal, and annual movement patterns using ANOVA statistical analyses.

Expected Benefits

The primary benefit of our research is providing detailed documentation and analysis of black bear spatial and temporal movement patterns in the mountain ranges of Kern County, California. These data will also be used to determine seasonal habitat use, home range, and individual movements between the southern Sierra Nevada and Southern California subpopulations through the Transverse Ranges. Our research will provide scientifically based information which can be used to inform CDFW black bear management plans and adaptive management practices for this under studied region.

Research results will be presented at suitable scientific meetings and published in peer reviewed scientific journals where CDFW will be acknowledged as the major funding source.

Budget

Movement patterns and habitat use of American black bear (*Ursus americanus*) in the southern Sierra Nevada Mountains, Kern County, California Budget	**FY17**	**FY18**	**FY19**	**Project Totals**
Personnel				
Wildlife Biologist ($4,000/month)	$12,000.00	$12,000.00	$12,000.00	$36,000.00
Total Personnel Expenses	$12,000.00	$12,000.00	$12,000.00	$36,000.00
Operating Expenses				
50 Vertex Plus Iridium collars ($3700/unit)	$185,000.00			$185,000.00
Data fee ($1500/collar/year)	$75,000.00	$75,000.00	$75,000.00	$225,000.00
Total Operating Expenses	$260,000.00	$75,000.00	$75,000.00	$410,000.00
Subtotal Personnel & Operating Expenses	$272,000.00	$87,000.00	$87,000.00	$446,000.00
Overhead at 15%	$1,800.00	$1,800.00	$1,800.00	$5,400.00
Total Project Cost	$273,800.00	$88,800.00	$88,800.00	$451,400.00

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CA Department of Fish and Wildlife - Application for Big Game Grant FY 16/17

1. Project Title: Demographic and Distributional Responses to Water Availability by Mule Deer in a Mojave Desert Environment

2. Amount Requested: $ 740,102 (Year 1: $371,297, Year 2: $299,045, Year 3: $69,760)

3. Applicant Contact Information:

a) Board of Regents, NSHE, obo University of Nevada, Reno
b) Dr. Kelley M. Stewart, Associate Professor
c) 775-784-4314
d) kstewart@cabnr.unr.edu
e) Charlene R. Hart, Assistant VP, Research Administration, Office of Sponsored Projects, 1664 North Virginia Street, 204 Ross Hall/Mail Stop 325, Reno, NV 89557-0325; Tel: (775) 784-4040; Fax: (775) 784-6680; email: ospadmin@unr.edu

4. Introduction:

(a) Project Type: Hunter Opportunity and Applied Research on Benefits of Water Development

(b) Background: This proposal is for funding the final phase of a long-term collaborative effort between The University of Nevada Reno (UNR), California Department of Fish and Wildlife (CDFW), and the National Park Service (NPS) to investigate the demographic responses and habitat selection of mule deer in response to the provision of wildlife water developments in Mojave National Preserve (MNP). During this final stage, 6 additional water sources will be added in a previously water-limited area (New York Mountains), and the responses of mule will be evaluated and compared with demography and habitat selection by mule deer in a reference area in which no manipulations occurred (Cima Dome), and an area in which 23 water sources have been maintained on a permanent basis (Mid Hills) since the onset of the project. These areas are located within MNP and receive intense hunter use within Deer Zone D-17 (Bleich and Pauli 1999).

Following the challenges posited by Rosenstock et al. (1999), we are testing 4 hypotheses related to responses of mule deer to provision of water, effects of deer use on habitat conditions adjacent to those water sources, and the availability and quality of forage for mule deer with available water compared with similar areas where water sites had been removed (see Marshal et al. [2006] for review). These hypotheses center on demography (survival, reproduction, and physical condition), habitat selection, and movement patterns, and influences of ungulate use on habitat associated with point sources of water. We are making these comparisons among 3 large study areas inhabited by mule deer — one with consistently available perennial sources of surface water, one from which previously available surface water was removed but is being restored in this phase of the investigation , and one area that serves as reference area.

Recent changes in the administration at MNP portend a shift in the cooperative nature of MNP with respect to the continuation of water provisioning within MNP for the purposes of wildlife habitat enhancement and, particularly, as they relate to attitudinal shifts toward the provisioning of water for game species, particularly mule deer, bighorn sheep, and upland game birds. Completion of this project, which was implemented cooperatively with MNP, is necessary to effectively evaluate the influence of available surface water on the demography and distribution of mule deer within MNP. Nevertheless, changes in the administration at MNP indicate a shift in attitude toward provisioning of water. For example, the current superintendent has indicated that there will be no manipulation of water sources until the MNP "water management plan" is completed. Moreover, an apparently re-invigorated emphasis on adherence to Service policies suggests that the very concept of sport harvest within MNP could be threatened if NPS determines that impacts to other species occur as a result of ongoing harvest management (NPS 2006). NPS policy states that harvest will only be allowed when "...the Service has determined that, "... harvesting will not unacceptably impact park resources or natural processes, including the natural distributions, densities, age-class distributions, and behavior of [the] harvested species [in this case, mule deer], native species that the harvested species use for any purpose, or native species that use the harvested species for any purpose [e.g.,

mountain lions, bobcats, or coyotes]" (NPS 2006). To further complicate these issues, recent genetic evidence has resulted in a call for the introduction of Mexican wolves to MNP (Clarke 2016).

Given the emphasis on Service policy, the potential for the Service to demand that CDFW provide evidence supporting the importance of surface water to mule deer and other species of wildlife are not having a negative influence within MNP, results of this project will ensure that CDFW is better-positioned to provide defensible information should the Service elect to question the relevance or importance of the availability of surface water as a management prescription.

The vast majority of deer harvested from Zone D-17 are taken on lands managed by MNP, and that was part of the Service's original motivation to collaborate in this project. Deer Zone D-17 encompasses most of the Mojave Desert in eastern California, and the 3 primary areas being investigated are largely representative of occupied habitat within that ecosystem. Thus, completion of the project will provide not only information useful in maintaining surface water for mule deer and other wildlife within MNP, but has implications for other federal lands throughout the Mojave Desert. This information is especially relevant given projections of increasing temperatures and shifts in the distributions of plants and animals predicted to occur as a result of a changing climate.

Importantly, there is new-found potential for Service personnel to question the consistency of the Department's management programs with Service policy. Data obtained during this effort will provide a baseline against which to measure future changes in demography or distribution, are consistent with the draft CDFW mule deer management plan, and lessen the potential for challenges to the Department's wildlife conservation strategies as they relate to management of mule deer in arid ecosystems. Further, continuation or expansion of availability of surface water include the potential for increased hunter opportunity in terms of either increased male harvest or implementation of female harvest, opportunities that have the potential for implementation not only within MNP, but across the entirety of zone D-17. Completion of this investigation will augment results published earlier (Simpson et al. 2011, McKee 2012, Bush 2015, McKee et al. 2015) in that the final phase will incorporate the manipulation of water sources and evaluation of mule deer to that change.

(c) Specific Goals and Objectives: This proposal will enable completion of the original, long-term evaluation of the demographic and distributional responses of mule deer to provision of water in a Mojave Desert environment. Initially, the project was funded largely by Safari Club International Foundation, and then through LMAC project NC800123 during FYs 2013, 2014, and 2015. Specifically, we will

(1) Assess the demographic and distributional responses of mule deer inhabiting the eastern Mojave Desert to the provision of water at locations where it had been, but is no longer, available.

(2) Compare the demography and distribution of mule deer in the final treatment to the demography and distribution of mule deer in two other areas in which (a) no water manipulation has occurred (i.e., a control area), and (b) to those in an area having no permanent surface water available to mule deer.

(3) Address interactions between mule deer and vegetation as influenced by availability of water.

(4) Provide management recommendations for provision of surface water as a conservation tool for mule deer inhabiting the eastern Mojave Desert.

5. Project Description

a. Location: Mojave National Preserve, San Bernardino County, California (Deer Zone D-17)

b. Staffing Requirements:

(1) Mr. Levi Heffelfinger (Graduate student)

(2) Dr. Kelley M. Stewart, Associate Professor and Principal Investigator, and Dr. Vernon C. Bleich, Adjunct Professor and Co-Principal Investigator.

c. Contractors and Subcontractors:

(1) The contractor for the proposed work will be the University of Nevada Reno. The project will complete the final portion of the ongoing investigation of behavioral and demographic responses of mule deer to provision of water sources in the eastern Mojave Desert, assuming that this proposal is approved for BGMA funding. The availability of these telemetered mule deer and existing marked animals will

facilitate the development of population estimates and a sightability model described in a companion proposal. In the absence of funding for this project, the latter proposal will not be implemented.

(2) An appropriate and qualified subcontractor meeting all CDFW requirements for capture operations will be selected to implement and oversee the captures. The subcontractor (experienced pilot and crew) will capture deer under the combined direction of the Co-PIs in cooperation with CDFW and the CDFW Veterinarian assigned to the capture project.

(3) The Co-PIs will oversee field activities, project design, implementation and quality control, ensure completion of the project, and ensure preparation of requisite reports and preparation of manuscripts to be submitted for publication in a professional journal. Dr. Stewart serves as Mr. Heffelfinger's or any graduate student on the project's major advisor, and Dr. Bleich is a member of Mr. Heffelfinger's graduate committee at UNR.

d. Implementation Plan:

Year 1 (FY 2017): In August of year one, water will be provided at the sites of 6 springs, seeps, or wells at which it previously had been removed, thereby completing the final manipulation planned for this long-term project. Water will be available at these locations for the duration of the project.

In February of year one, project personnel will place 45 GPS telemetry collars on female mule deer, to be distributed across three treatment areas with 5 extra collars in the New York Mountains where the 6 water sites will be restored within Mojave National Preserve (Cima Dome, New York Mountains, and Mid Hills); each female will be confirmed to be pregnant and then fitted with a vaginal implant transmitter (VIT) to facilitate locating of birth sites and capture of neonates. The capture event will again be directed by the Co-PIs in cooperation with the CDFW Wildlife Veterinarian assigned to the capture project. During May and June, the graduate student and technicians will monitor radio frequencies assigned to VITs, and locate birth sites, capture and collar fawns, and record parameters associated with birth sites. The protocol will be the same as that in place for the previous 3 years. Preliminary data analyses will commence, and requisite reports will be prepared and distributed.

Year 2 (FY 2018): During July and August of year two, the graduate student will monitor the fates of neonates and record data on parameters associated with birth site selection. During November of year two, the incoming graduate student will retrieve all telemetry collars that drop off of the collared cohort that have not yet been retrieved. Collars will be refurbished for deployment on 50 additional animals to be captured in February of year 2, which will again receive VITs if determined to be pregnant. The capture event will again be directed by the Co-PIs in cooperation with the CDFW Wildlife Veterinarian assigned to the capture project. During May and June, the graduate student and technicians will monitor radio frequencies assigned to VITs, and locate birth sites, capture and collar fawns, and record parameters associated with birth sites. The protocol will be the same as that in place the previous year. Analysis of the complete data set will commence, and requisite reports will be prepared and distributed.

Year 3 (FY 2019): During November of year three, the graduate student will retrieve all telemetry collars that drop off of the prior year's collared cohort that had not yet been retrieved. Beginning in December, data will be analyzed, and the student will work toward completion of his degree. Concomitant with preparation of the thesis, the final manuscripts summarizing the survivorship of adult and juvenile mule deer, habitat selection by adult females, birth-site selection by females, and influences of water availability on demography and habitat selection will be completed and submitted to be considered for publication in professional journals. No additional requests for financial support from CDFW, but in the event the student is not able to complete the requisite thesis by the end of FY 2019, a request for a six-month extension would be submitted.

e. Materials and Equipment: The subcontractor will provide the helicopter and capture crew to complete the aerial survey work. In year one, it will be necessary to refurbish 30 GPS collars and purchase an additional 20 GPS collars, as well as 50 VITs and 100 fawn collars. In year two, it will be necessary to

refurbish 50 GPS collars as well as purchase an additional 50 VITs and 50 fawn collars. The University of Nevada Reno will provide one vehicle, office space, computer resources, GIS resources, and guidance to the graduate student working on this project for the duration of the project. The PI and Co-PI will provide project oversight and quality control, and ensure completion of the project as described.

f. Timeline for Completion of Each Task: Details are presented in item 5(d), immediately above. A progress report including the results of the initial survey efforts will be completed and submitted to the California Department of Fish and Wildlife on the results of work completed in 2016 by 30 June 2017. A second progress report, including analyses of the survey results from years 1 and 2 will be submitted to CDFW by 30 June 2018. A final report, prepared in the format of several professional papers will be completed and submitted to CDFW by 30 June 2019.

g. How This Work Addresses Items Described in the Introduction: Rosenstock et al. (1999) emphasized several areas where research should focus with respect to water developments, including (1) effects of water developments on population performance; (2) distribution and habitat use of game and non-game wildlife species; and, (3) secondary effects of water developments on adjacent plant communities. Specifically,

(1) Conclusions obtained as a result of completion of this project will provide the first evaluation of demographic consequences for mule deer of the provisioning of water sources in the Mojave Desert with implications for water management in the Mojave National Preserve and throughout the Mojave Desert.
(2) Similarly, conclusions will provide additional information on the role of water availability and its influences on the distribution and resource selection by mule deer in Mojave National Preserve and throughout the Mojave Desert.
(3) Results have the potential to lessen the likelihood of NPS, concerned individuals, or concerned non-governmental organizations will bring forth successful challenges to deer habitat enhancement and deer hunting in Mojave National Preserve, as well as two additional national monuments recently declared in areas adjacent to the preserve, all of which are located within Deer Zone D-17.
(4) We anticipate that results obtained during this project will form the basis for one chapter of a graduate thesis for a graduate student at the University of Nevada Reno. These data will supplement the results of ongoing work in D-17 that assesses demographic responses of mule deer to the provision of wildlife water developments.

h. Environmental Compliance: Dr. Stewart currently holds an approved research permit from NPS that is in place through Dec 31, 2018; all field work will have been completed by that time. All environmental documentation necessary to carry out the proposed work has been completed, and field capture activities have been approved by the University of Nevada Reno (IACUC approval #00538).

6. Expected Benefits: This project will yield meaningful and defensible data useful in deterring challenges to the provisioning of water sources for mule deer in Mojave Desert habitats throughout Deer Zone D-17. It will provide definitive results with respect to the benefits or consequences of water provisioning and, thereby, guide future management options for mule deer in desert ecosystems. Further, it will reduce the potential for future challenges to deer hunting within portions of D-17. Such a scenario appears to be increasingly plausible given the recent change in administration at MNP and what appears to be a strict adherence to NPS policies, the recent declaration of two additional national monuments within Deer Zone D-17, and what will become an increasingly frequent call for the introduction of Mexican wolves to MNP based on recent DNA evidence (Clarke 2016).

The Department also will be better positioned to counter challenges to deer management objectives and recreational hunting, and better able to justify habitat management prescriptions for mule deer. Additionally, the Department will enjoy greater support from the sporting community, the majority of whom have lost a great deal of confidence in the willingness of CDFW to support their interests. Additionally, the results have the potential to increase hunter opportunity as a result of a better understanding of the demography of the deer population, either as a result of increased opportunity for the harvest of male deer, or implementation of female harvest. Finally, the project will provide the opportunity for the Department to play a meaningful role in the mentoring and training of aspiring young biologists, thereby preparing them for careers in wildlife biology, the frequency and benefits of which are becoming less with a changing political climate.

7. Budget:

Demographic and Distributional Responses to Water Availability by Mule Deer in a Mojave Desert Environment	**Project Totals**
Personnel	
UNR Graduate Student ($20,400/yr + 15% fringe × 3 years)	$ 70,380
Tuition per UNR requirements (12 units/yr @ $187.04/unit × 3 years)	$ 6,734
Field Technicians (3 technicians, 4 months/yr @ $12.53/hr + 3.15% fringe × 2 yrs)	$ 63,272
PI Salary (Dr. Stewart, 5 days/yr @ $559.29/day + 4% fringe × 3 years)	$ 8,725
Co-PI salary (Dr. Bleich $6,000/year × 3 years)	$ 18,000
Personnel Expenses (without subcontracts)	$167,111
Subcontract for Aerial Capture Team ($42,500/year × 2 years)	$ 85,000
CDFW Aerial Telemetry Support ($7,000/year × 2 years)	$ 14,000
Total Personnel Expenses	$266,111
Operating Expenses (UNR)	
Travel (Transportation, Per Diem, and Lodging; $8,000/year for 3 years)	$ 24,000
Rental 4-WD Vehicle (2 vehicles @ $7,500, 7 total months each in yrs 1 & 2 only)	$ 30,000
UNR vehicle fuel, repair, and maintenance ($6,000/yr, years 1 and 2 only)	$ 12,000
Housing for Field Personnel ($1,000/month for 4 months/year in years 1 & 2 only)	$ 8,000
Refurbish 80 adult GPS Collars ($800/collar - 30 year 1 and 50 year 2)	$ 64,000
Purchase 30 adult GPS Collars ($1,835/collar for year 1 only)	$ 55,050
Field supplies including radio telemetry and sampling gear ($5,000/yr, years 1 & 2)	$ 10,000
Purchase 150 Fawn Collars ($226/collar 100 year 1, 50 year 2)	$ 33,900
Purchase 100 VITs ($367/each 50/year to be used years 1 and 2, respectively)	$ 36,700
Page Charges for Publications (60 Total Pages in year 3 only)	$ 6,000
Total Operating Expenses	$279,650
Subtotal UNR Personnel & Operating Expenses (without subcontract)	$446,761
Overhead (UNR rate of 43.5% applied to UNR Personnel and Operating expenses only, without subcontract costs**)**	$194,341
Subcontracts	$ 99,000
Total Project Cost over 3 years	**$740,102**

Literature Cited

Bleich, V. C., and A. M. Pauli. 1999. Distribution and intensity of hunting and trapping activity in the East Mojave National Scenic Area, California. California Fish and Game 85:148–160.

Bush, A. P. 2015. Mule deer demographics and parturition site selection: assessing responses to provision of water. M.S. Thesis, University of Nevada, Reno, USA.

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McKee, C. J. 2012. Spatial Patterns and Population Performance of Mule Deer: Responses to Water Provisioning in Mojave National Preserve, California. M.S. Thesis, University of Nevada, Reno, USA.

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Rosenstock, S. S., W. B. Ballard, and J. C. deVos. 1999. Viewpoint: benefits and impacts of wildlife water development. Journal of Range Management 52:302-311.

Simpson, N. O., K. M. Stewart, and V. C. Bleich. 2011. What have we learned about water developments for wildlife? Not enough! California Fish and Game 97:190–209.

1. **Project Title: Migratory vs. non-migratory urban deer movements in the Sierra Nevada.**

2. **Amount requested: Total: $125,298.64** (Year 1: $92,900.67, Year 2: $32,397.97)
3. **Applicant Contact Information:**
   a. United States Forest Service
   b. Eric Abelson **c**. 530-759-1726 **d**. eabelson@fs.fed.us
   e. Authorized signer: Patricia Manley, pmanley@fs.fed.us, 530-621-6882

4. **Introduction:**
   a. **Project type:** *Research*

   b. **Background of the issue/problem; and need for the project:**

Deer (*Odocoileus hemionus*) play important roles for humans ranging from being an ecological keystone species to connecting the public with nature through wildlife watching and hunting. Unfortunately, there is much unknown about deer in the Sierra Nevada mountain range in California, and these unknowns have many consequences. An important life history strategy splits deer into *migratory* populations and *non-migratory* populations. While many migratory individuals move between urban and non-urban areas depending on season, non-migratory populations are generally year-round residents in close proximity to urban and suburban areas.

The deer populations of interest in this study are those in the West Side Sierra and Valley Foothill Deer Conservation Unit (DCU) and specifically fall approximately 35 km (21 mi) on either side of highway 80 between Truckee and Auburn. These two populations present a natural experiment to examine deer movement and behavior. This proposal will address three foci to benefit conservation efforts, human safety and wildlife research tools. The three research areas include:

Research area	Research need	Implications
Mitigation and conservation	Deer migratory paths are unknown	Migratory paths are important to identify parts of the landscape important for conserving. Landscape features can lead to areas where many migration paths converge [1] – these areas may particularly important as conservation/restoration targets. Locations where movement paths intersect with roads leave deer and motorists vulnerable for collisions [2] and are possible locations for highway mitigation.
Baseline data for DCU	Life-history/movement data (e.g. fawning grounds, home ranges) are either partially unknown or out-of-date for deer in this DCU	Landscape areas essential for deer natural history (i.e. fawning grounds or migration paths) can be used for land acquisition strategies. For example, urban wildlife have been found to shift activity patterns to avoid conflict with humans [3]; it is currently unknown if urban deer are "street-smart" and, for example, avoid roads during rush-hour. This may lead to differential management techniques depending on the deer population of interest.
Wildlife movement research and within species variation	Landscape connectivity approaches depend heavily on resistance-surface-based modeling techniques at the species level. However, little research has been done to examine the role that differences in within-species movement patterns (i.e. migratory vs. non-migratory) makes on movement corridor predictions.	If migratory deer generally use the landscape differently than non-migratory urban deer, but are modeled as a single population (often the case) then predicted movement corridors will be wrong. This is important because these movement corridors are heavily relied upon. For example 1. identifying where to install road mitigation (i.e. fencing and underpasses) to reduce deer-vehicle collisions and 2. conservation lands to target.

Landscape connectivity models are commonly based on demonstrated habitat preferences exhibited by individuals within a *species* (e.g. resistance surfaces parameterized using resource selection functions) [4,5]. Individuals within a sub-population may make drastically different movement choices than individuals in other same-species sub-populations. For example, dispersing individuals might move across the landscape differently than territorial adults [6]. An assumption of modeling wildlife movement is that sampled individuals reflect the species at large (or at least the populations that the movement corridors will be applied to). While there have been concerns, in the literature, that this assumption may be violated [7] it has rarely been statistically tested. I will identify differences in predicted movement corridors by treating these two deer populations as one vs. treating them as two (i.e. migratory vs. non-migratory).

Deer-vehicle collisions (DVCs) are traumatic, expensive, and potentially fatal to motorists [2] ; DVC incidents are not uncommon [8] (and believed to be increasing) on Sierra Mountain roads. Yearly in the US, over a million wildlife-vehicle

collisions result in tens of thousands of human injuries, hundreds of human fatalities and over a billion dollars in property damage; across the country, human fatalities from these collisions are increasing at an alarming rate [8]. Our ability to reduce wildlife-vehicle collisions rests largely upon the ability to predict where wildlife will come into contact with, and ultimately try to cross, roads. Modeling deer movement, and therefore locations where deer movement corridors intersect with roads, can be strengthened by a deeper understanding of migratory vs. non-migratory deer movement ecology.

Modeled deer movement is critical to landscape level conservation efforts and land-acquisition strategies. We will collect baseline data for 40 deer in the study area to identify movement related landscape characteristics including migration paths, fawning grounds, response to the human dominated landscape and home ranges. These data can be used for a number of deer management and conservation purposes including prioritizing the acquisition of lands for connectivity, assessing unique challenges of mitigating for migratory vs. non-migratory deer and identifying stretches of road with higher probabilities of DVCs.

c. **Specific goals and objectives the grant is designed to achieve:**

We will fit migratory and non-migratory deer with GPS collars; data from GPS collars will be used to 1) identify migratory routes; 2) describe deer landscape use (e.g. fawning grounds, home range); 3) Working with Melanie Gogol-Prokurat (CDFW), and the CDFW Krause et al. 2015 report [9] titled "Wildlife connectivity across the northern Sierra Nevada foothills," I hope to apply collected GPS collar data to interpret results from the extensive modeling exercises performed in the 2015 report; 4) describe locations and timing of road crossing events; 5) predict deer road crossing locations broadly across the landscape using GPS-collared deer to parameterize models 6) assess differences in resistance-surface-based model predictions for migratory and non-migratory deer movements; 7) develop collaborations to leverage the genetic data we collect and examine if there are genetic differences between migratory and non-migratory populations as well as examining if the two populations are interbreeding.

5. **Project description:**

a. **Location of the project:**

We will place GPS collars on 40 deer in Placer and Nevada counties, located in the California Sierra Nevada. We will focus on deer in the West Side Sierra and Valley Foothill DCU that are approximately 35 km (21 mi) on either side of highway 80 between Truckee and Auburn. GPS collars will be placed during the summer months when it is possible to differentiate between migratory and non-migratory individuals. We will target 24 migratory deer across 3 herds and 16 non-migratory deer that inhabit urban areas year round (total: 40 deer over two years). Non-migratory deer will be collared in/near Nevada City, Grass Valley, Rollins Lake and along highway 174 between Colfax and Grass Valley. Migratory deer herds include individuals from the Blue Canyon herd that summer just south of Highway 80 and those from the Nevada City/Downieville Herd that summer around Lake Spaulding and Bowman Lake.

b. **Staffing requirements (titles and responsibilities):**

This project strengthens a recently begun wildlife movement collaboration between USFS, Caltrans and CDFW.

-Eric Abelson (USFS, Research Wildlife Biologist): E. Abelson will lead the analysis of data and write resulting manuscripts. E. Abelson has experience working with GPS collar data processing/analysis in addition to parameterizing resistance-surfaces using resource selection functions for connectivity models. E. Abelson also has road ecology experience examining wildlife behavior and movement near and across roads. Four months of salary provided by this grant (over the course of two and a half years) will go to the following: finalizing details of study plan; purchase of collars; data cleaning, processing and analysis; writing peer-reviewed manuscript(s); production of GIS spatial layers and providing final descriptive report to CDFW (migration corridors, prioritized deer road-crossing locations, fawning grounds, home ranges, constriction points across the landscape for migrating individuals etc.). This project will be a synergistic part of Caltrans funded research (that will fund E. Abelson's salary not covered here) to examine wildlife movement in the Sierra and to assess mitigation strategies to reduce the impacts of transportation infrastructure on wildlife.

-Sara Holm (CDFW, Wildlife Biologist): Salary is provided by other funds, not from this grant. S. Holm (CDFW), and CDFW team, has radio collaring experience, equipment/supply funds, permitting and a field team to GPS collar deer. This will involve darting deer and affixing collars as well as acquiring drugs, capture equipment/kits and permits over the course of two years.

-Suzanne Melim (Caltrans, Acting Chief, Planning and Modal Programs & Biologist): Salary is provided by other funds, not from this grant. S. Melim will assist in determining feasible transportation mitigation strategies. S. Melim and S. Jacobson (below) have initiated a synergistic multi-year project that will partially fund E. Abelson's time. S. Melim and S. Jacobson are skilled and experienced in utilizing wildlife science in effecting change to protect people and wildlife on roads.

-Sandra Jacobson (USFS, Wildlife Biologist): Salary is provided by other funds, not from this grant. S. Jacobson will assist in determining feasible transportation mitigation strategies, write reports and communicate results.

c. **Describe contractors/subcontractors and their responsibilities**: None, not applicable.

d. **Implementation plan (timelines)**:

Collaring: GPS collars will be affixed to migratory deer starting no later than October 2016, before the archery season starts. Resident deer will have GPS collars affixed starting in Mid-October 2016. These collars will stay on for one 12 month period. After approximately 12 months the collars will be programmed to drop off the host animal, they will be refurbished and affixed to 20 deer that hadn't been previously collared. At the time of capture we will collect blood, hair and scat samples from each animal.

Data Analysis: Data analysis will begin once all the collars have been collected and data have been compiled – December of 2017. Analyses will be designed and coded using the statistical programming program R [10]. Having the first year's analyses and code, the second year's movement data will be combined with the first year and will be analyzed using the established statistical framework.

GPS collar data will be used to identify deer migration routes and identify where deer movement intersects with roads. GPS collar data will also be used to predict deer movement corridors across the landscape using resistance-layers parameterized from resource selection functions (RSF) [4]. RSFs will be used to generate three resistance layers for deer: migratory deer alone, non-migratory deer alone and migratory & non-migratory deer taken together. We will then model deer movement corridors (least cost corridor/circuit theory [5]) and identify where those movement paths cross roads. The degree of overlap between modeled road crossing locations will identify if parameterizing models based on migratory status is important for conservation/mitigation endeavors. To assess the possibility that "urban" deer are avoiding human-deer conflict by shifting hours of activity, collected GPS collar data will be analyzed for differences in crossing time of day between migratory and non-migratory individuals using cluster and discriminant analyses. We will utilize methods described by Murray and Claire 2015 [3].

e. **Material/equipment necessary to implement the project and who provides**:

This grant will be used by the US Forest Service to purchase a total of 20 GPS radio collars in the first year of the study. We estimate that two collars will be lost during the first year; we have included funds to purchase two additional GPS collars the second year. We also have included funds to refurbish 5 of the units by the manufacturer and an additional 15 batteries for S. Holm and CDFW team to refurbish 15 GPS collars in the second year.

f. **Timeline for completion of each task (including expected completion dates)**:

Using tasks described in section 4c, please see full task description above. GPS collars will be installed starting in October 2016, and again in October of 2017. Data is estimated to be available for analysis in December 2017 and all data by December 2018. Abbreviations: first year (FY) and both years (BY). 1) migratory routes [January 2017 FY data, January 2018 BY data]; 2) describe deer landscape use [January 2017 FY data, January 2018 BY data]; 3) Krause et al. 2015 report "ground-truthing" [June 2018]; 4) locations and timing of road crossing events [March 2017 for FY data, March 2018 for BY data]; 5) predict deer road crossing locations broadly across the landscape [[June 2018]; 6) assess resistance-surface-based models predicting that group migratory and non-migratory deer [June 2018]; 7) examine genetic differences between migratory and non-migratory populations [June 2018].

g. **Explanation of how this work addresses items in the introduction statement**:

This work will address the items in the introduction statement by empirically gathering data on migratory and non-migratory (urban) deer. These data will be used to identify fundamental questions of where, and when, deer are located on the landscape at a fine-landscape-scale. Deer landscape-ecology and behavior will be summarized to support habitat conservation and restoration management decisions. Movement data, both empirical and modeled, will be used to identify areas where deer movements intersect with roads – with the hopes of identifying mitigation opportunities to reduce dangerous road conditions that lead to the loss of deer (effecting ecological roles and hunting opportunities of deer). Finally, an important question in landscape ecology is if systematic differences in sub-species level movement behavior might influence conservation outcomes when using resistance-surface-based models. Migratory and non-migratory deer in the Sierra provide an excellent natural experiment to assess this question. If models parameterized on migratory deer RSFs yield different movement corridors than models parameterized on non-migratory deer RSFs then it is important not to lump all deer populations in a single model for deer.

h. **Proof of environmental permitting compliance**: not necessary, not applicable

6. **Expected Benefits**

Three major tangible outcomes will result from this research: 1) GIS layers for CDFW and deer conservation organizations depicting deer migratory routes (important for population management and land conservation planning). 2) Locations where deer road crossing locations are most frequent (parsed by migratory and non-migratory subpopulations); potential

locations for future mitigation. 3) Novel contributions, in the form of a manuscript, to wildlife movement-ecology modeling on the importance of considering subpopulations within a species when modeling wildlife movement.

***Deer movement, activity patterns and conservation planning*:** Deer management is benefited by identifying migratory routes to assist in connecting habitat, prioritizing lands to protect, and managing populations. In addition to addressing these goals, this study will make novel contributions to landscape ecology and wildlife biology that will aid efforts to protect human safety through a deeper understanding of migratory and deer movements. After collecting scat, hair and blood samples from each captured individual, we will work to collaborate with geneticists to examine if migratory and non-migratory deer are interbreeding. We also hope to collaborate with other ongoing CDFW projects looking at deer genetics by sharing our collected genetic data along with accompanying movement data. We also aim to incorporate movement data, and resulting RSFs, to further parameterize models proposed for deer by Krause et al. 2015 [9].

Novel contributions to the landscape movement ecology discipline will come by answering two main questions: 1) Are non-migratory deer avoiding human conflict by shifting hours of activity? 2) How does within-species population-level movement variability influence resistance-surface-based movement models? Urban deer may, for example, be more "street-smart" and shift hours of activity to non-peak traffic hours. Not all road crossings are equally dangerous; those during rush hour endanger deer and motorists more than those occurring in the quiet of night. Understanding how non-migratory deer use the landscape differently than migratory deer will help identify population-specific management goals. In addition, identifying population-level differences in connectivity modeling would be a major advance for conservation-planning.

DVC's and deer movement: Deer are important to people for their aesthetic, ecological and food values. Unfortunately, DVCs are a frequent human-deer interaction. Negative impacts of DVCs include fatalities, injuries, property damage, and costs of emergency services, road crews and infrastructure repair; a goal of this work is to reduce these negative interactions while maintaining the positive ones. Developing knowledge of where deer cross roads is important to road mitigation aimed at providing safe passage to deer and humans. Differences between migratory and non-migratory deer potentially complicate planning efforts, such as poor road crossing location predictions leading to ineffective mitigation. The proposed work will contribute to protecting motorist safety by identifying *de facto* road crossing locations as well as producing higher quality modeled deer movement predictions for DVC reduction mitigation projects.

References:

1. Loft, E. R., Menke, J. W. & Burton, T. S. 1984 Seasonal Movements and Summer Habitats of Female Black-Tailed Deer. *J. Wildl. Manag.* **48**, 1317–1325. (doi:10.2307/3801792)

2. Bissonette, J. A., Kassar, C. A. & Cook, L. J. 2008 Assessment of costs associated with deer-vehicle collisions: human death and injury, vehicle damage, and deer loss. *Hum.-Wildl. Interact.* , 61.

3. Murray, M. H. & Clair, C. C. S. 2015 Individual flexibility in nocturnal activity reduces risk of road mortality for an urban carnivore. *Behav. Ecol.* **26**, 1520–1527. (doi:10.1093/beheco/arv102)

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5. Wade, A. A., McKelvey, K. S. & Schwartz, M. K. 2015 Resistance-surface-based wildlife conservation connectivity modeling: Summary of efforts in the United States and guide for practitioners.

6. Elliot, N. B., Cushman, S. A., Macdonald, D. W. & Loveridge, A. J. 2014 The devil is in the dispersers: predictions of landscape connectivity change with demography. *J. Appl. Ecol.* **51**, 1169–1178. (doi:10.1111/1365-2664.12282)

7. Beier, P., Majka, D. & Jenness, J. 2007 Conceptual steps for designing wildlife corridors. *CorridorDesign Ariz. USA*

8. Huijser, M. P., McGowen, P. T., Fuller, J., Hardy, A. & Kociolek, A. 2007 Wildlife-Vehicle Collision Reduction Study: Report to Congress.

9. Crystal M. Krause, Melanie Gogol-Prokurat & Simon Bisrat 2015 Wildlife connectivity across the northern Sierra Nevada foothills. , 334.

10. R Core Team & R Foundation for Statistical Computing 2012 *R 3.1.1: A Language and Environment for Statistical Computing*. Vienna, Austria.

7. **Budget:**

Migratory and non-migratory urban deer movements in the Sierra Nevada

	Budget		**Project totals**
YEAR 1	**Personnel**		
	Research Wildlife Biologist, Eric Abelson (2 months X $7,781.60)	$	15,563.19
	Total Salary	$	15,563.19
	Staff Benefits @ 0% ($15,563.19 X 0.00)	$	-
	Total Personnel Expenses	$	15,563.19
	Operating Expenses		
	Deer GPS radio collars (qty 20 @ 3750.15)	$	75,003.00
	Total Operating Expenses	$	75,003.00
	Subtotal Personnel & Operating Expenses		
	Overhead at 15%	$	2,334.48
	TOTAL YEAR 1	$	92,900.67

YEAR 2	**Personnel**		
	Research Wildlife Biologist, Eric Abelson (2 month X $7,781.60)	$	15,563.19
	Total Salary	$	15,563.19
	Staff Benefits @ 0% ($15,563.19 X 0.00)	$	-
	Total Personnel Expenses	$	15,563.19
	Operating Expenses		
	Deer GPS radio collars (qty 2 @ 3750.15)	$	7,500.30
	Refurbishing Deer GPS radio collar by manufacturer (qty 5 @ 800)	$	4,000.00
	Deer GPS radio collar battery & parts for CDFW refurb (qty 15 @ 200)	$	3,000.00
	Total Operating Expenses	$	14,500.30
	Subtotal Personnel & Operating Expenses		
	Overhead at 15%	$	2,334.48
	TOTAL YEAR 2	$	32,397.97

Project Totals	**Personnel**		
	Total Personnel Expenses	$	31,126.38
	Total Operating Expenses	$	89,503.30
	Total Overhead (15%)	$	4,668.96
	Total Project Cost (Amount requested in section 2 of grant template)	$	125,298.64