Project Title: Central Region Deer Hair-loss Syndrome Studies

Project Location: Central Region with focus on the Jawbone portion of the Tuolumne Deer Herd
Project Leadership: Greg Gerstenberg, Senior Environmental Scientist

Proposed Start and Completion Date

November 15, 2012 – June 30, 2016

Statement of Need <FIND STATEMENT IN ORIGINAL – COMPLEX RELATIONSHIP REFERENCE?>

In 2009, the exotic biting louse, *Bovicola tibialis*, was found on deer in Tuolumne and Merced counties. A three year pilot study was started in the fall of 2009. Surveillance since 2009 has found that two species of exotic louse (*Bovicola tibialis*, and *Linognathus africanus*) are present in Tuolumne, Merced, Mariposa and Madera counties. Louse infested deer can exhibit clinical signs of hair loss most often during late winter through spring. Initial studies regarding louse presence and abundance through the winter, rate of infection through the winter, monitoring migration routes and summer use areas to determine where louse spread is likely to occur, and the relationship between exotic lice and micronutrients have been completed (final reports are in preparation).

During 2011-2012, a pilot investigation examining the effects of exotic lice on deer survival was started. Forty-seven fawns were captured on the winter range. Twenty-three were treated for exotic lice and 24 remain untreated for use as a control. Mortality through the winter has been monitored to determine if the mortality in the treated group differs from the control group. The results of this investigation, in conjunction with the proposal under consideration, will help direct future investigations to more fully understand the relationship of exotic lice on deer populations.

This proposal is for the continuation of research in a louse-infested deer population, and surveillance of other deer herds within the Central Region. Continuation of the over-winter survival with an expansion of the deer-predator relationship, louse micronutrient relationship, habitat relationships, spread and the impacts of exotic lice in deer populations are needed to understand and provide management measures to mitigate the effects of these exotic louse species on deer populations. Three distinctive needs in the understanding the impacts of exotic lice at a population level.

The goal of this project is to determine whether exotic lice impact survival, determine methods to lessen the impact of exotic lice on louse-infested deer populations, and to reduce the spread of exotic lice to non-infested deer populations. Secondarily, the U.S. Forest Service Stanislaus National Forest has several landscape scale projects that will be proposed within the next five years on the winter and transitional ranges. The distribution data collected under this project can be used to assist in the implementation of habitat projects intended to benefit deer populations.

Introduction

Exotic louse infestations on North American deer have been sporadically reported prior to 1995. During 1995 hair loss in black-tailed deer (*Odocoileus hemionus columbianus*) was noticed in west-central

Washington, and by 1998, it had spread to Oregon (Brunetti and Cribbs 1971, Westrom et. al. 1976, Bildfell et.al. 2004). A severe infestation with exotic lice, later identified as an indeterminate species of Damalinia (Cervicola), was consistently demonstrated in the hair loss deer..

Black-tailed deer infestation by the louse *Damalinia* (Cervicola) in Oregon results in preclinical signs in December and January and typically results in fawn losses during this period followed by increasing clinical signs peaking in April with additional fawn losses (D. Cottam, per com). Preclinical signs do not have any hair loss, have a "wet" appearance, and the hair darkens to a shadow effect. Clinical signs include missing patches of fur, bare skin, and skin rubbed raw. When preclinical signs start, grooming behavior is often evident. Bender and Hall (2004) used fall and spring composition counts to show that decreased over-winter survival in hair-loss syndrome affected areas was not supported. It was suspected that reduced recruitment prior to fall counts may have occurred, as 5 of 8 game management unit-year combinations were inadequate to maintain population size.

In 2004, hair loss was observed on deer in central Washington. In 2005 the louse species injfesting these central Washington deer was identified as *Bovicola tibialis*, which is also an exotic louse species. Washington estimated a 50% decline in the deer population within the affected herds in central Washington. Murphie (2010) found that black-tailed deer fawns exhibiting hair loss syndrome spent a higher proportion of time scratching and reduced proportion of time feeding compared to non-hair loss syndrome fawns, with higher survival in non-hair loss syndrome fawns.

During the spring of 2009, the louse *B. tibialis* was confirmed on mule deer in seven western states. California mule deer (*Odocoileus hemionus californicus*) on the Jawbone Ridge portion of the Tuolumne deer herd were found to be infested with this louse species. Two fawns were collected during April 2009 and both were heavily infested with lice (thousands per fawn). Observation of deer in April 2009 revealed that many of the deer had hair loss and were obsessed with grooming. No indication of hair loss or excessive grooming was observed in December 2008.

Previous Research of the Jawbone Ridge Deer

The Tuolumne deer herd is migratory with the Jawbone Ridge area as one portion of the winter range (Figure 1). Other major diseases known to have historically occurred in the Tuolumne deer herd include Foot and Mouth Disease (Keane 1927) and deer adenovirus (Woods, et al. 1996). The only completed study on the Jawbone Ridge portion of the Tuolumne deer herd was accomplished in 1951 (Leopold et al., 1951), prior to the use of telemetry equipment. Leopold, et al.(1951) trapped and tagged 150 deer on the Jawbone Ridge. Few locations were provided outside of the winter range area. Between 1966 and 1968, 120 deer were captured in Yosemite National Park and marked with a combination of collars, bells, tags and or streamers (King 1981). Observations by park visitors, agency personnel, and hunters were used to determine use areas. One location was found that could have resulted in movement from Aspen Valley in Yosemite National Park to the Jawbone winter range. All work on deer from the Jawbone Ridge portion of the Tuolumne deer herd and throughout the Yosemite deer herd had been completed prior to radio transmitter use. Two radio-collared deer from the Stanislaus fawn survivorship pilot study appeared to be moving toward the Jawbone Ridge, but resulted in mortality before reaching the winter range (DFG unpublished data). Use of telemetry on the Stanislaus deer herd showed that deer movement outside the defined deer herd boundaries occurs on a regular basis (Loft, et al. 1989, Gerstenberg 2008). Summer range of the Tuolumne deer herd is known to overlap with the Stanislaus, Railroad Flat, Walker and Yosemite deer herds and may overlap with the Mono, and Carson deer herds. The degree of overlap and mixing with other deer herds is unknown and the potential for lice to spread into other west slope and east slope herds is unknown.

Due to the potential impact of exotic lice can on deer , the lack of information on exotic lice, and the potential for spread into other deer herds, the Central Region initiated a 3-year pilot investigation in the fall of 2009 to examine baseline information needs in the Jawbone Ridge portion of the Tuolumne deer herd. Preliminary data from the Jawbone Pilot Study has shown that some deer cross the boundary between the Jawbone Ridge portion of the Tuolumne deer herd and the Yosemite deer herd. Summer range use areas are shown to overlap with east slope deer herds and west slope herds to the north and south. Data collected from 2009-2013 from G.P.S. collars and VHF ear tag transmitters will be used to assess the herds that could potentially be impacted. The timing of infestation through the winter, rate of infection, and when hair loss can be observed will be used to define the infestation process. Preliminary results from mortality, health assessment, and biological samples will be used to determine the potential effects on the deer population.

Based on data from 2009-2012, young of the year (YOY) survival on the winter range is poor. During 2009-2010, mortality of deer captured in December, February, and April combined was 50% prior to migration off the winter range (sample size 18). During 2010-2011, mortality of deer captured in December, February, and April combined was 24% prior to migration off the winter range (sample size 29). Spring fawn ratios in April 2010 were 27F/100D and in April 2011 the fawn ratio was 21F/100D. Adult female mortality has exceeded 20% per year, which requires at least 45F/100D in the spring to maintain the population. Survival to recruitment into the population is insufficient to maintain the population. Hair loss observed in April and mortality throughout the two years was higher on Clavey side with 18-31% exhibiting hair loss and 50-67% mortality. On the Cherry side, the hair loss was 12-22% and the mortality was 7-22%.

Deer susceptibility to louse infection and the impact of the louse infection (hair loss) has been correlated to the age and sex cohort of the deer (preliminary DFG data). Young of the year are most susceptible to louse infestation and have the highest amount of hair loss. Yearling deer have high louse loads, followed by adult females. Adult males havie a low incidence of louse infestion and no detectable hair loss. Behavioral changes appear to be in direct proportion to the abundance of lice.

Micronutrients play a major role in animal health, reproduction, immune defense, and growth. Selenium deficiencies can cause white muscle disease, poor growth in juvenile animals, low fertility, and poor milk production. Copper deficiencies can cause nerve disorders, immune system disorders, weak bones, poor growth in lambs and calves, dull coat, and diarrhea.

Deer blood samples collected in Tuolumne County have shown that at least 80% are selenium deficient, when compared with base-line levels developed for livestock. Studies of deer to determine the levels of clinical and sub-clinical selenium deficiencies have not been completed. Using livestock standards, the "adequate" values of blood selenium is 0.08-0.5 ppm. Selenium is an integral part of the enzyme system glutathione peroxidase which is an antioxidant defense system. Results from 17 deer captured on Jawbone Ridge in April suggest a correlation between blood selenium levels and louse abundance. Flueck (1994) found that selenium enhancement of study deer in a selenium deficient deer population increased preweaning fawn survival from 0.32 fawns/female to 0.83 fawns/ female. Changes in environmental selenium availability can be effected by soil acidification, soil contamination with heavy metals, fertilizer effect, plant community composition, rate of biomass removal and fire (Flueck and Flueck 1990).

Copper deficiency was found in deer sampled at Pine Mountain Lake, Tuolumne County. Insufficient samples have been collected on the migrant Tuolumne deer herd due to difficultly of obtaining liver samples necessary for copper status diagnostics. Livestock operations within California use supplementation of micronutrients to improve weight gain and reproduction. Within Tuolumne County, supplementation with selenium and copper is occurring in domestic livestock.

Deer on the west slope of the Sierras appear to be predisposed to hair loss. During sampling efforts in the spring of 2009, three deer exhibiting hair loss were collected that did not have any lice. Each deer was deficient in copper and selenium (when compared with livestock levels). Copper deficiency resulting in hair loss (alopecia) has been reported in moose (Frank 1998). Based on louse abundance, hair loss scores, and mineral levels identified in deer with HLS, the relationship to hair loss may be closely tied to micronutrient levels (preliminary DFG data).

Study Objectives

This proposal is a three-year phased approach to monitor the impacts of exotic lice and examine potential methods to minimize the spread and impact of exotic lice on deer populations. Each year has specific objectives to test. Surveillance of deer in hand will occur throughout the Central Region opportunistically during deer captures and through examination of road-killed deer. Deer composition counts will continue throughout the region and will include hair loss scoring and record behavioral changes associated with louse presence.

Year 1, 2012-2013, Survival

The first year of this effort will repeat the 2011-2012 study effort to monitor YOY survival through the winter. The 2011-2012 winter was mild with most deer using habitats in the transitional and lower summer range into February. A high acorn mast crop and lack of winter green-up also occurred with most traditional winter range areas not being used through early February. It is unknown if the winter conditions and lack of winter deer concentrations have had an effect on survival. Therefore, a repeat of the 2011-2012 study is proposed for the first year of this study.

Objectives for 2012-2013 are to repeat the treatment/control of YOY deer on the Jawbone Ridge.

Questions

1.) Are lice impacting YOY survival?
2.) Do treatment deer survive at a level consistent with adult survival?

Year 1, 2012-2013, Habitat Use and Micronutrient Availability

Deer use of the winter range is not evenly distributed. It appears that habitat use is based on a specific preference of habitat values. These habitat values for deer are not known. The US Forest Service has plans for habitat manipulations that could impact deer use, micronutrient availability, and predation risk. The goal of this evaluation is to define the habitats used, assess the survival probability of habitats used, and determine the micronutrient availability of the habitats based on common treatments. Currently, the treatments used are shredding, hand thinning and pile burning, under burning, shredding/ burning, and plantations. In addition, prior wildfire burns will be examined to assess the impacts of uncontrolled fires.

The objectives are to GPS collar 20 adult female deer in the major habitats represented. Compare microhabitats used versus habitats available. Habitat assessments will be completed on treatment methods previously completed on habitats by sampling in December and April/May, with samples of forage micronutrients (if year 2 assessment shows impacts of micronutrients) in treated and control habitats based on year since treatment.

Questions

1.) What specific microhabitats are used by deer?
2.) What are the preferred microhabitats used by deer on winter range?

3.) What habitat treatments are preferred by deer?
4.) What are the deer forage micronutrient values in habitat treatments?

Proposed actions for Years 2 (Micronutrients) and 3 (Predator-Prey Relationships) will be evaluated at a state-wide Deer Hair-Loss Syndrome workshop (planned for mid-August, 2012) in conjunction with other efforts regarding this issue being conducted in other areas of the State. These phases of the proposal may be implemented as written, implemented with changes to the proposed work plan, or not implemented at all based on the outcome of the evaluation at the workshop.l

Year 2, 2013-2014, Proposed Adaptive Management - Micronutrients

Objectives of the 2013-2014 year are to examine if mineral salt blocks can be used to supplement deer and if the supplements will supply adequate minerals to reduce the impacts of exotic lice and hair loss. This investigastive approach may be modified or redirected based upon analysis and results derived from this or statewide hair loss project.

As mineral enhancement may also result in a delayed response to hair loss due to the hair coat already being grown, the examination will also include examination of the deer in the second spring (when deer are yearlings) to examine the impacts on 2nd year deer.

Questions

1.) Is hair loss correlated with mineral deficiencies?
2.) Does mineral enhancement through mineral salt blocks reduce the louse load and/or extent of hair loss?

Year 3, 2014-2015, Proposed Pilot Investigation into Predator-Prey Relationships

The addition of a lion component to the proposal could increase the understanding of the impacts of DHS on deer survival relative to predator-prey relationships. Dependent on available funding and consensus at the DHLS workshop, the addition of a lion component may occur. If lions are targeting deer with low vigilance and an increased percentage of time foraging/grooming, then the kill rate per cohort could possibly be detected. Capture and GPS collar five lions would occur to complete kill site analysis. Using weekly satellite downloads, kill sites would be examined to determine the age cohort of deer killed by lions. The age cohort of lion kills through the winter would be used to determine if the age cohort of deer killed changes through the winter with a correlation to the louse cycle.

Questions

1.) Does lion predation on deer follow the lice cycle and degree of lice load by age class and cohort?
2.) How closely does lion habitat use correspond to deer habitat use?
3.) Do lions migrate or does the home range extend into deer transitional range?
4.) How many lion collars would be needed to assess the lion habitat preference on the Jawbone winter range?

Methods

Study Area

This study will include surveillance throughout the Central Region and a focused study effort on the Jawbone Ridge of the Tuolumne Deer Herd. Regional surveillance will be used to monitor for the presence

or spread of exotic lice into other deer populations. Jawbone Ridge will be the focus area for specific examination and is a major wintering area for a portion of the Tuolumne Deer Herd (Maddox, 1980). Jawbone Ridge winter range is approximately 37 square miles and is located on the west slope of the Sierras in Tuolumne County. The Jawbone Ridge study area is in the Stanislaus National Forest, and includes some private lands. Leopold et al. (1951) identified a major division in deer use along the Jawbone Ridge area and defined them as the Clavey Unit and Cherry Unit. A full description of the Jawbone winter range is available in Leopold et al 1951.

Study Design- Region Wide and Standardized Procedures

Regional surveillance will be completed during other ongoing deer activities and examination of road-killed deer. Targeted examinations will be completed during the peak of the louse cycle in areas where exotic louse presence is suspected based on hair loss or behavioral traits.

Hair loss scoring will occur during all composition counts in the Central Region, and for deer targeted for capture and during capture processing. The Central Region hair loss scoring technique (DFG unpublished report) will be used as a standard scoring technique. Each deer will get a score of 0-5 based on the amount of hair loss and the number of body regions affected. A louse scoring process will be completed on all captured deer (Appendix 1).

Deer will be captured by free-range darting using Pneu-Dart compression rifle and Pneu-Dart disposable darts or by clover traps. Chemical immobilization of free-range darting will use Telazol® (2-3 mg/kg) and xylazine (2-3 mg/kg) per deer. Dosage will be based on the size of the average deer targeted during the capture period. Deer captured in clover traps will be immobilized with xylazine (2.2-4.4 mg/kg) to facilitate louse exams. Reversal with Tolazoline (4.4 mg/kg) will occur no sooner than 45 minutes after initial Telazol®/xylazine injection. Reversal of clover-trapped deer with Tolazoline (4.4 mg/kg) will occur at the end of the processing.

Standard processing for all deer captured will include the following: whole blood, blood serum, thin blood smear, body hair, tail hair, external parasites, fecal pellets, measurements, weight, body condition index, louse abundance, and hair loss score. Each deer will be administered injections of penicillin, vital E, and Mu-Se®. Photographs will be taken of each captured deer and will be used as a cross reference. All deer will be marked with a metal and a plastic ear tag. YOU deer will have a VHF ear tag transmitter applied. Adult deer will have a G.P.S. collar or VHF collar applied depending on the year of the study.

When deer migrate onto Yosemite National Park and the Immigrant Wilderness summer range areas, the locations and a check for mortalities will be completed by fixed wing aircraft in July and the end of September to allow time to recover collars prior to winter snow.

Ectoparasite samples will be examined regionally for species collected, then be sent to the National Veterinary Services Laboratories in Ames, Iowa for species confirmation. Whole blood samples will initially be frozen after capture. Tiger top blood tubes will be spun and serum collected. Whole blood and serum will be submitted to the Wildlife Investigations Laboratory in batch shipments. Blood samples will then be submitted to the California Animal Health and Food Safety Laboratory (CAHFS) for selenium and micronutrient screen. Hair samples will be stored in a cool dry location for possible future analysis. If the hair samples are processed, then the samples will be submitted to the CAHFS for micronutrient analysis. Fecal samples will be examined in the region. Fecal samples will be collected, placed in a whirl-pak® bag, and placed on ice. Within 72 hours, one to three grams of feces will be thoroughly mixed with fecasol flotation solution in a 10-ml vial. The tube will be filled to capacity and covered with a glass cover slip. The

cover slip will be removed after 15 minutes by lifting straight up, and will be placed on a glass slide. The slide will be examined under a microscope (40X-100X magnification) for eggs and oocysts.

A field necropsy will be completed when the whole carcass can not be rapidly shipped to the CAHFS. All major organs will be sampled and preserved in formalin. Fresh samples of liver, spleen, kidney, and brain will be frozen.

Study Design- Jawbone Ridge Focus Area Year 1, 2012-2013, Survival

The first year of the Jawbone Ridge effort will examine if the presence of exotic lice changes the survival of YOY deer through the first winter to the age of recruitment. Up to 50 YOY will be captured as soon as possible after arrival onto the winter range. Half of the captured deer will be treated with an antiparasitic treatment to control louse presence and re-infestation. Antiparasitic treatment will consist of Cydectin® pour on (0.1 cc/kg) and PYthon® insecticide cattle ear tag. Control YOY deer will not receive any treatment. Each YOY deer will have a VHF transmitting ear tag and standard processing will be completed. It will be attempted to evenly capture deer on the Cherry and Clavey subunits of the winter range. The transmitters will be monitored weekly from capture to March 1st . From March 1st through migration off the winter range, the deer will be monitored at least twice weekly. Monitoring will include locations, survival, and cause specific mortality. If predation mortality occurs, the cause of mortality will be determined and a camera trap will be set on the carcass to confirm the predator, duration of use, and scavenging. If a mortality occurs from a source other than predation, a field necropsy will be completed or the carcass will be submitted to the CAHFS for necropsy.

Study Design- Jawbone Ridge Focus Area with Mountain Lion Component

Additional information on the predator-prey relationship would enhance the objectives of assessing the YOY mortality through the period of behavioral changes associated with louse infestion. Additional funding or support would be required to fund this option. If approval of the lion option is granted, then an assessment of and application of funding from non-Big Game funds would direct if this option would be completed. During the 2011-2012 year, funding for assistance to capture and complete mortality assessments was offered to DFG.

Lions will be captured using cage traps and pursuit dogs. All captures will be conducted under the direction of qualified and experienced DFG personnel. Immobilization drugs will only be used by personnel certified by the DFG Wildlife Investigations Laboratory (WIL) and under the direction of a DFG wildlife veterinarian. In the event of mortalities during the project, additional lions will be captured to maintain a total of five collared animals. Lions will be chemically immobilized using a Pneu-Dart compression rifle and Pneu-Dart disposable darts, or by pole syringe. Lions will be immobilized with Telazol® (tiletamine and zolazepam) at a maximum dosage of 8mg/kg (3.6mg/lb). Actual dosage will likely be 4.4mg/kg (2.0mg/lb). If supplemental drugs are needed during processing, Ketamine will be used. Diazepam will be available and used in case of seizures. Dart wounds will be treated topically with cloxacillin benzathin to prevent infection.

Handling and monitoring will be conducted in a manner that will prevent injury to the lion and attending personnel. Injury to darted lions from falling from the retreat tree will be prevented by allowing partially drugged animals opportunity to safely climb down to the ground. The potential for injury resulting from a fall may also be reduced by securing lions with ropes before they become anesthetized and by providing blankets or other cushion below the tree. Eye covers and ophthalmic ointment will be used to protect the eyes during handling. Leg hobbles will be applied to chemically immobilized lions to prevent injury to

themselves and personnel. Vital signs (temperature, respiration, heart rate, capillary refill time) will be monitored every 10 minutes throughout animal handling procedure. Cool water and blankets will be available for use during captures to keep body temperatures within desired ranges. Processing of the immobilized lions will consist of sample collection, body measurements, and the attachment of ear tags and radio-collars. Samples collected will include; blood, hair, and external parasites. Blood will be collected (50cc) from the cephalic or saphenous vein of each lion and placed in red-topped and lavender-topped vials. Red-topped vials will be centrifuged and the serum harvested. Blood samples will be kept in a cool location until they can be transported to the appropriate lab for analysis. A sample of external parasites will be collected and placed in ethanol. Body measurements collected will include; weight, chest girth, total length, and neck circumference. A body condition index will also be assigned to each animal. Age will be estimated using patterns of tooth wear and staining and gum line recession. Individually identifiable ear tags will be applied to the center of each ear using an appropriate ear tag applicator. Released animals will be monitored until they have recovered from effects of the immobilization drugs. Collars used on lions may be equipped with an automatic release mechanism. Thus collared lions will be recaptured at the end of the study or at the end of the expected collar battery life. Depending upon the project timeline, collars will either receive fresh batteries and replaced on the animal until the end of the project or will be removed and the animal released.

Using a satellite service, the lion locations will be determined prior to weekly deer monitoring. All potential kill sites on Jawbone Ridge will be investigated, based on cluster analysis of greater than or equal to three location data points within 200 meters over a 24 hour period to determine the locations of possible kill sites (Anderson and Lindzey 2003). Searches will begin in the center of the cluster and cover the area within the cluster. When deer kills are located, the age of the deer will be determined by collection of deer jaws and using tooth wear and replacement, and incisors will be submitted for cementum annuli analysis for confirmation. Femur will be collected for health assessment of deer. When fresh deer kills are located, a camera trap will be set to determine the length of time and amount of use, single or multiple lions, and scavenging by other species. All deer that have hair coats present will be examined for hair loss and louse infestation. The age of deer killed will be compared through the winter to determine if a change occurs in the spring corresponding to increased louse abundance and hair loss on deer. Each lion sex and age class will be compared to determine if lion preference is based on lion characteristics or deer age. Additional information on lion abundance based on camera traps and collared lion presence will enhance the information available from collared deer. Lions that move outside the study area will likely not have kill site examinations due to access issues in some portions of the winter range.

Study Design- Jawbone Ridge Focus Area Year 2, 2013-2014 Micronutrients

Up to 50 YOY will be captured as soon as possible after arrival onto the winter range. Each deer will have a large plastic ear tag with a unique number/color/ear recorded. Each deer captured will be fitted with a VHF ear tag transmitter and standard processing will be completed. VHF ear tag transmitters will be used to monitor survival and use area. Mineral blocks with added copper and selenium will be placed in traditional salt use sites. Each mineral block will have a camera trap placed so that individual deer using the mineral block will be monitored. Memory cards will be replaced weekly. The number of times and duration of use for each marked YOY deer will be recorded for each mineral block site. In mid-April, recapture of as many tagged YOY deer will occur and standard processing will be completed. If adequate sample size can not be obtained through recapture, then collection of five tagged deer using mineral blocks and five tagged deer not using mineral blocks would occur with complete necropsy for each deer. A comparison from capture to recapture/collection for selenium, mineral block use, weight, hair loss, and louse presence would be used to determine if mineral enhancement has an effect on hair loss and micronutrient levels.

Study Design- Jawbone Ridge Focus Area Year 1, 2012-2013, Habitat Use and Micronutrient Availability

At least twenty adult does will be captured and fitted with G.P.S collars as soon as possible after deer arrive on the winter range and standard processing will be completed. Capture locations will be distributed throughout the winter range and evenly divided between the Clavey and Cherry subunits. Weekly monitoring of locations and survival will occur. If store on board collars are used, the collar will be programmed to drop no later then the end of the 2015 winter to facilitate data processing. Iridium satellite collars will be used when possible to obtain weekly locations. Data on previously G.P.S. collared does from 2009-2013 will be used to supplement habitat use. G.P.S. data will be used to assess habitat use, habitat availability vs use, and survival based on habitat type used. The does will be visually located at least once per month to determine if a fawn is present to determine the fitness of the doe for fawn rearing.

Habitat assessments will be completed in and adjacent to habitat treatments, including shredding, shredding followed by underburn, hand thin and burn piles, underburn, and uncontrolled wildfire. Assessments will include line transect and point counts and will be marked for repeated sampling. Habitat assessments will be completed in December and April. Representative samples of deer forage within treatments and adjacent untreated will be analyzed for micronutrients. Treatments examined will include first year after treatment, 1-5 years after treatment, and 6-10 years after treatment.

DFG has been working with the US Forest Service to complete a habitat enhancement project on the Alder Creek section of the Clavey subunit. If the Forest Service completes the proposal and implementation is started, then pre and post-treatment habitat and micronutrient sampling will be conducted as part of this wildlife habitat improvement project.

Data Analysis

Survival will be calculated using Program Mark.

The graduate students will prepare a study proposal that will outline the statistical tests required for each phase. The DFG Statistical Unit will be contacted to determine or approve the appropriate statistical tests to compare treated and control young of the year survival, cohort of lion predation, hair loss and micronutrients, and habitat micronutrient treatment and control, and other statistical tests that will be used in the analysis of the data.

When GPS deer collars are retrieved, information on migration routes, summer use areas, and winter use areas will be defined to show the potential overlap in range areas with adjacent deer herds. The range use areas will be compared to other deer herds where summer range use areas are available. VHF data locations from winter range monitoring and July flights will be used to augment use areas from GPS locations. G.P.S. data will be used to determine habitat preferences vs availability.

Comparison of hair loss score prior to initial capture and from relocation and scoring of ear tagged fawns in April will be used to assess the development of clinical signs from known louse status at initial capture period. The factors found on captured deer that indicate preclinical and clinical signs will be summarized. Timing of louse infection and onset of visual clues to assess the potential of infected deer in other herds will be examined. Baseline data on the health assessment will be provided and used in the statewide assessment program for a louse infected herd.

Products (and estimated dates of completion)

As each year has specific objectives, the results of each phase will be reported separately. An attempt will be made to have graduate students work on each phase of this proposal. The products of each phase would be either a M.S. Thesis if graduate students are used, or a DFG report if completed entirely by DFG staff. Progress reports will be submitted to the Regional Office and to Sacramento Deer Program twice yearly. A final report will be completed within 18 months of the completion of each phase. Publications in scientific, peer-reviewed journals are expected as part of this effort.

A summary report of regional surveillance and findings will be completed to summarize the effort and findings as they relate to the regional deer management and implications to deer management in the region and statewide.

Collaborators

The Department Central Region Wildlife Program will be the lead in the entire project. Greg Gerstenberg will be the project leader, with field assistance from other unit biologists, graduate students, and cooperating agencies and non-profit as needed to complete the objectives of the project.

The Department will seek to complete a cooperative venture with graduate students through each phase of this proposal. The specific methods and questions may be added, or adjusted to fit within the needs of the graduate projects, but will fulfill the goals set forth in this proposal by examining the impacts and seeking to provide corrective measures to reduce the spread and impact of exotic lice on deer populations. Humboldt State University has expressed interest in providing graduate students to work on the exotic louse studies and this is currently being examined.

The US Forest Service Jawbone Ranger Station will be used as the primary housing for all field activities. The US Forest Service also provides additional staff assistance in composition counts, during captures and monitoring. The findings of these efforts will be used by the Forest Service in the implementation of habitat management prescriptions.

The USDA Wildlife Services has provided assistance from Wildlife Specialists in capture operations and mortality assessment. Wildlife Specialists have been available to assist with deer captures. Funding assistance would be required to bring in a Wildlife Specialist with pursuit dogs if the lion component is approved and this funding would be sought through county wildlife committees and local sportsman's groups. In 2011-2012, Tuolumne County provided $28,323 in staff time for a USDA Wildlife Specialist to work on the louse studies.

The Mule Deer Foundation, the California Deer Association, and the Tuolumne County Sportsmen's have provided assistance with composition counts and during capture operations. The Mule Deer Foundation and California Deer Association have expressed interest in assisting with additional support to the louse studies on Jawbone Ridge. Funding will be applied for once the study is approved to provide additional data collection if this is deemed necessary to complete the objectives of the study.

The California Deer Association originally purchased the G.P.S. collars for the Stanislaus deer herd fawn pilot study and these collars were re-used in the 2009-2012 louse studies.

The Mule Deer Foundation has provided G.P.S. collar refurbishment during 2009 and has expressed interest in providing additional mineral blocks to be used in the study.

The Tuolumne County Fish and Game Advisory Committee provided 6 man months of the USDA Wildlife Services time during the 2011-2012 study ($28,323), and provided propane for the Jawbone Ranger Station and mineral blocks for use on the deer winter range ($700/year).

Dr. Leslie Woods and Dr. Birgit Puschner from the CAHFS have provided technical assistance for sample collection and will provide assistance in the review of necropsy and biological sample results.

Program Planning

Prior to the start of the project, planning will be completed with prospective graduate students and professors to ensure that the goals of the project are fulfilled. Each year, a planning meeting will be completed with the Sacramento Deer Program to ensure that prior year objectives are met, and that the next phase of the project are completed in a manner that will address management issues.

Personnel Requirements and Commitments from DFG

The completion of this project will require commitments of staff time from the Senior Environmental Scientist for study preparation, captures, and report preparation, approximately 50% staff time from the Sonora Environmental Scientist for captures and monitoring, and additional assistance from the other regional Environmental Scientists for captures and monitoring. Scientific aid assistance will be required for monitoring, data collection, data entry, and data analysis. Assistance from Sacramento Big Game program staff would be needed during portions of the capture and data analysis.

Funding Sources

DFG Dedicated Big Game Management Account
Tuolumne County Fish and Game Advisory Committee
U.S. Forest Service
USDA Wildlife Services

Potential funding includes the following:
Mule Deer Foundation
Stanislaus County Fish and Wildlife Committee
Tuolumne County Sportsmen's
California Deer Association
Fresno County Sportsmen's

Issues to be Resolved

Secure M.S. Graduate students to assist with each phase of the project. This is not required to complete the study, but would enhance the ability to complete each phase in a timely manner. Humboldt State University has expressed interests and further discussions will be completed.

If the lion component is approved, then funding for use of a USDA Wildlife Services Wildlife Specialist (Steve Galantine) will be sought from the Stanislaus County Fish and Wildlife Committee or another outside funding source.

A special use permit will need to be renewed for aerial flights over Yosemite National Park.

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Central Region Deer Hair-Loss Syndrome Studies Budget

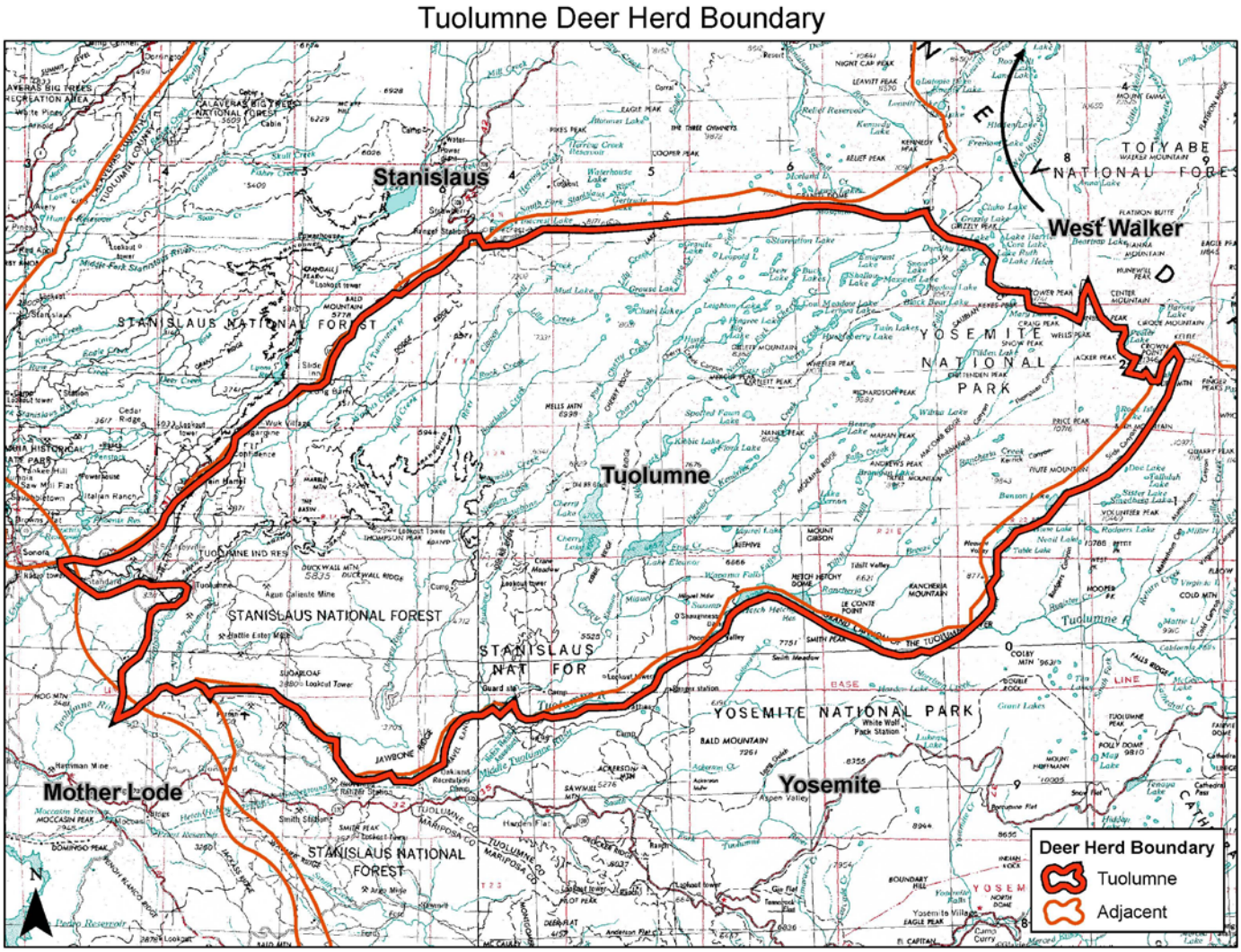
Funding from Big Game Program - **$75,000/year**

	Year 1	Year 2	Year 3
Equipment			
Lion Collars $5,000 each x 5 =	$25,000*		
Deer GPS Collars		$25,000	$25,000
Deer VHF ear tag transmitters	$10,000	$10,000	
Capture supplies	$ 5,000	$ 5,000	$ 5,000
Per Diem	$ 5,800	$ 5,800	$ 5,800
Flights	$ 4,200	$ 4,200	$ 4,200
Habitat Assessment Samples			$10,000
Personnel			
Seasonal	$25,000	$25,000	$25,000
Subtotal	*$75,000*	*$75,000*	*$75,000*
Other Contributions			
DFG Permanent- PR in kind or Big Game account	$40,000	$40,000	$40,000
Housing provided by USFS	$ 6,000	$ 6,000	$ 6,000
Tuolumne County	$ 700	$ 700	$ 700
Existing Regional Deer allotment			
Per diem	$ 8,000	$ 8,000	$ 8,000
Fuel	$15,000	$15,000	$15,000
Subtotal	*$64,300*	*$64,300*	*$64,300*
Grand Total	**$139,300**	**$139,300**	**$139,300**

* if the mountain lion option is not approved, then these funds will be used for G.P.S deer collars.

To operate within the budget presented the existing allotments allocated to the Central Region for deer must be maintained. The existing Central Region allotments will be used for per diem, fuel, and additional scientific aid time needed to complete this project.

Figure 1. Map of the Tuolumne Deer Herd.



Appendix 1

Louse Scoring Technique

The louse score is a method to obtain an index of the number and distribution of lice on a deer. When monitoring deer populations for louse presence in deer herds where lice are not known to occur, an exact count is not needed and this technique can be used as a guide for examinations and recording results.

Tools required: comb, hand lens, tweezers, louse sample vials, data sheet.

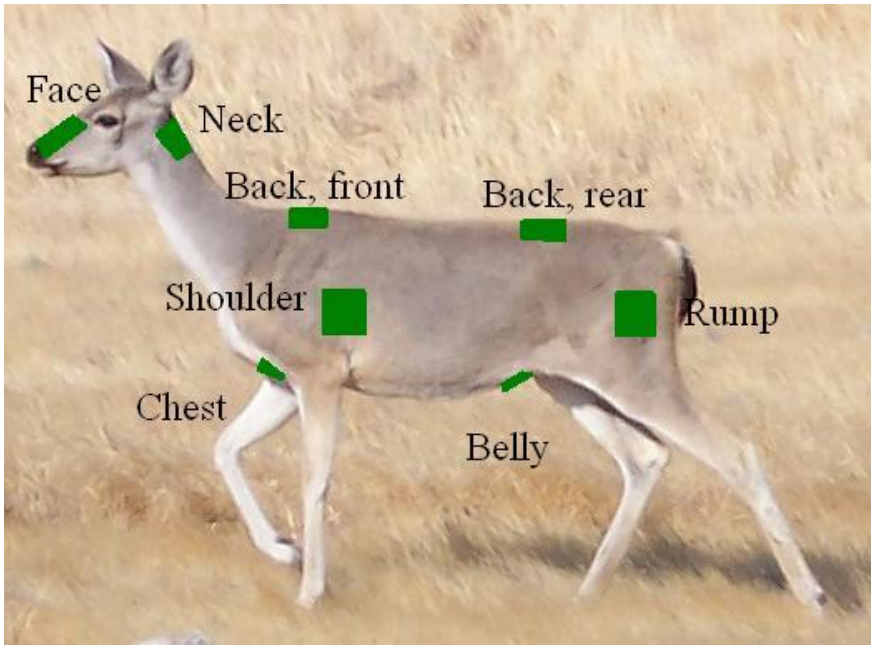
Methodology

1) A complete count is made in two 10 x 10 cm sample areas within each of the 5 body regions used in the hair loss technique as follows.

a) Head and neck
    1. Face from edge of hair on muzzle toward eyes (may go over eyes on small deer)
    2. Top of neck just behind ears.
b) Back
    1. Front is centered along the spine over the top of the front legs
    2. Rear back is centered along the spine across the back and forward of the rear leg muscle mass.
c) Belly and Chest
    1. Chest is centered between the front legs
    2. Belly is centered with the center of the point at the umbilical.
d) Shoulder
    1. Left mid side, centered fore and back at the connection of the front leg and the side
    2. Right mid side, centered fore and back at the connection of the front leg and the side
e) Rump
    1. Left rump at center of rump
    2. Right rump at center of rump

2) A comb is used to "mark" the sample area. The hair is parted and as the comb is moved against the grain through the hair, the numbers of lice present are counted. All other parasites are counted.

3) If no lice are found, then examine the entire body for presence of lice. Use the comb and move against the grain of the hair to examine for lice.



Louse Examination Data Sheet

Date: _____
Deer Herd: _____
Range: _____
Location: _____
Collector: _____
Sample Number: _____

Deer Study Name: _____
Capture Number: _____

G.P.S. Location (UTM NAD 83)
Northing _____
Easting _____

Lice Present? Yes / No
Collection of lice? Yes / No

If no lice were found on the sample areas, were lice found on any other area of the animal? (Describe)
_____
_____

Body Region	Biting Lice	Sucking Lice	Keds	Ticks	Other Parasites- list
Face					
Neck					
Back, front					
Back, rear					
Chest					
Belly					
Left shoulder					
Left rump					
Right shoulder					
Right rump					
Total					

Other information:
_____
_____
_____

Pre-clinical signs:

Y / N Hair scruffy
Y / N Wet appearance
Y / N Hair dull

Clinical Signs:

Y / N Hair loss- list % of each body region affected
_____ Head and Neck
_____ Back
_____ Shoulder and Side
_____ Rump
_____ Belly

Y / N Diarrhea