Central Region Exotic Deer Louse Studies
Jawbone Ridge Focal Area

Progress Report
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Jawbone Ridge Focal Area
2011-2013 Project Phase 2
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INTRODUCTION

Exotic louse infestations on North American deer were sporadically reported prior to 1995 (Brunetti and Cribbs 1971, Westrom et al. 1976). During 1995, hair loss in black-tailed deer (*Odocoileus hemionus columbianus*) was noticed in west-central Washington, and by 1998, had spread to Oregon (Bildfell et al. 2004). A severe infestation with exotic lice, later identified as an indeterminate species of *Damalinia* (Cervicola), was consistently demonstrated in deer with hair loss (Bildfell et al. 2004).

Black-tailed deer infestation by *Damalinia sp.* (Cervicola) in Oregon results in preclinical signs that manifest in December and January. Fawn losses also occur during this period followed by increasing clinical signs peaking in April with additional fawn losses (D. Cottam, per com). Preclinical signs include a “wet” appearance and darkened hair producing a shadow effect. Clinical signs include missing patches of fur, bare skin, and raw skin. Excessive grooming behavior is often evident when preclinical signs first appear. Bender and Hall (2004) used fall and spring composition counts to show that within hair-loss syndrome areas decreased over-winter survival was not supported. It was suspected that reduced recruitment prior to fall counts may have occurred, as five of eight 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 infesting these central Washington deer was identified as the exotic chewing louse *Bovicola tibialis*. Washington estimated a 40-50% decline in the deer population within the affected herds in central Washington (Washington Department of Fish and Wildlife 2009). 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 greater survival in non-hair loss syndrome fawns.

During the spring of 2009, *B. tibialis* was confirmed on mule deer in seven western states. Two fawns collected on the Jawbone Ridge during April 2009 in Tuolumne County, California were heavily infested with lice (thousands per fawn). Observation of deer on the Jawbone Ridge portion of the Tuolumne deer herd in April 2009 revealed that many of the deer had hair loss and were frequently grooming. Additional sampling revealed that *B. tibialis* was on deer in portions of Tuolumne and Merced counties. A three year pilot study was started in the fall of 2009 to examine the impacts of this louse and determine the distribution of the deer population that was effected.

Very little is known on the range and use areas of deer that winter on Jawbone Ridge. Prior to the start of the fall 2009 Jawbone Ridge investigation, use of radio transmitters

had not occurred for Jawbone wintering deer. However, use of telemetry on the Stanislaus deer herd showed that deer movement outside the defined 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 and the potential for lice to spread into other west slope and east slope herds is unknown but deserves investigation.

Deer from the Tuolumne and Yosemite deer herds 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 standards. 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 DFW data).

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. Using livestock standards, the “adequate” values of blood selenium is 0.08-0.5 ppm. Studies of deer to determine the levels of clinical and sub-clinical selenium deficiencies have not been completed. Oliver, et al 1990 suggested using a value of 0.10 ppm for population means since this level will include individuals below the 0.08 ppm levels. We have elected to use 0.08 ppm as the individual deer level for deficiency and 0.10 ppm as the level for age and sex cohorts and between year comparisons for deficiency.

Selenium is an essential micronutrient and an integral part of the glutathione peroxidase system which is an antioxidant, enzyme-based, defense system (Flueck, et al 2012). Flueck (1994) found that selenium enhancement of study deer in a selenium deficient deer population increased pre-weaning fawn survival from 0.32 fawns/female to 0.83 fawns/ female in northern California. Changes in environmental selenium availability can be effected by soil acidification, soil contamination with heavy metals, a 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 the 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 due to mineral deficiencies in locally available feed.

Phase 1 of the exotic louse examinations were to determine if exotic louse presence was temporary or reoccurring, describe the louse cycle through the winter, describe the areas on a deer infested, identify the deer population and potential for spread to other populations, and to obtain some background information on the infected deer population. As part of phase 1, high mortality on the young of the year was suspected because 44% and 28% were predated between capture and prior to migration off the winter range. Some of these predation events were shortly after capture and late spring was the time period of highest mortality.

Phase 2 is reported here and is an investigation examining the effects of exotic lice on deer survival. The primary goal of this project was to determine whether exotic lice impact YOY survival and, if so, the timing and location of mortality in relation to hair loss. The timing of infestation through the winter, rate of infection, and when hair loss can be observed were used to define the infestation process. Preliminary results from mortality, health assessment, and biological samples were used to determine the potential effects on the deer population.

Secondary goals of this project included determining methods to lessen the impact of exotic lice on louse-infested deer populations and reducing the spread of exotic lice to non-infested deer populations. Many louse infested deer have exhibited clinical signs of hair loss and the severity of these signs peaks most often during late winter through spring (DFW unpublished data). Initial studies regarding louse presence and abundance through the winter, and the infestation abundance through the winter has been completed and previously reported in prior progress reports. Migration routes and summer use areas have also been monitored to determine where louse spread is likely to occur. The results of the migration results will be reported in the final report.

METHODS

Study Area

Jawbone Ridge, a major wintering area for a portion of the Tuolumne deer herd, was the focus of this project. Jawbone Ridge winter range is approximately 37 square miles and is located on the west slope of the Sierras in Tuolumne County (Maddox, 1980). The study area is located in the Stanislaus National Forest, and includes some private lands and lies just west of Yosemite National Park. Leopold et al. (1951) identified a major division in deer use along the Jawbone Ridge area and defined them as the Clavey subunit and Cherry subunit. A full description of the Jawbone winter range is available in Leopold et al. (1951).

Study Design- Region Wide and Standardized Procedures

Composition counts were conducted on the primary deer herds along the west slope of the Sierra Nevada range within the Central Region. Composition counts were completed in the fall (November-December) and spring (March-April). During the fall,

the composition of bucks, does, and fawns was recorded. During the spring, the composition of adults and fawns was recorded along with a record of any deer where a hair loss score was completed. Hair loss scoring occurred 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 (DFW unpublished report) was used as a standard scoring technique. Each deer was assigned a score of 0-5 based on the amount of hair loss and the number of body regions affected.

Age Classifications

All deer less than 1 year of age are classified as fawns for the composition counts and young of the year (YOY) for all other parts of this study. Classification of YOY was used since the deer can attain near adult body stature by time they are reaching 1 year old. The classification of yearling was assigned to all deer between 1 year and 2 years old. Identification of deer captured as yearlings is considered 100% since tooth wear and replacement is an acceptable criteria for this age class. An attempt was made to assign an age to all deer over 2 years. The precision of the aging can be inexact, so for analysis the use of "adult" was assigned to all deer over 2 years.

Deer were captured either by free-range darting using Pneu-Dart compression rifle and Pneu-Dart disposable darts or in Clover traps. Chemical immobilization involving free-range darting was accomplished using Telazol® (2-3 mg/kg) and xylazine (2-3 mg/kg). Dosage was based on the estimated weight of deer targeted during the capture period. Deer captured in Clover traps were immobilized with xylazine (2.2-4.4 mg/kg) to facilitate louse exams. Reversal of darted deer with Tolazoline (4.4 mg/kg) occurred no sooner than 45 minutes after initial Telazol®/xylazine injection. Reversal of Clover-trapped deer with Tolazoline (4.4 mg/kg) occurred at the end of the processing.

Standard processing for all deer captured included the collection of whole blood, separation of blood serum, and preparation of a thin whole blood smear. Body hair, tail hair, external parasites, and fecal pellets samples were also collected. Body measurements, body weight, louse abundance, and the hair loss score were recorded. A body condition index was used to assign a score to three areas of the body; the withers, ribs, and hips. Each deer was administered injections of penicillin (3 cc YOY, 4 cc adult), Vital E (2 cc YOY, 3 cc adult), and Mu-Se® (1 cc for all deer) to reduce risks of infection and capture myopathy. Photographs were taken of each captured deer and used as a cross reference. All deer were marked with a metal and a plastic ear tag (Temple Tag herdsman medium)(Y-Tex PYthon® insecticide ear tag). YOY had a very high frequency (VHF) ear tag transmitter applied. A GPS collar (Advanced Telemetry Systems Model 2110) or VHF collar (Telonics Mod-500) were attached to adult deer.

Whole blood samples were initially frozen after capture. Tiger top blood tubes were spun and serum collected. Whole blood and plasma were submitted to the Wildlife Investigations Laboratory (WIL) in batch shipments. Blood samples were then submitted to the California Animal Health and Food Safety Laboratory (CAHFS) for selenium and micronutrient screen. Hair samples were stored in a cool dry location for possible future analysis. If the hair samples are processed at some point in the future,

the samples will be submitted to the CAHFS for micronutrient analysis. Ectoparasite samples were submitted to the WIL and sent to the National Veterinary Services Laboratories in Ames, Iowa for species identification. Fecal samples were collected, placed in a whirl-pak® bag, and placed on ice until they could be frozen. When processed, 1-3 grams of feces was thoroughly mixed with fecasol flotation solution in a 10-ml vial. The tube was filled to capacity and covered with a glass cover slip. The cover slip was removed after 15 minutes by lifting straight up and placed on a glass slide. The slide was examined under a microscope (40X-100X magnification) for eggs and oocysts.

Study Design- Treatment and Monitoring

YOY were captured as soon as possible after arrival onto the winter range. Half of the captured YOY deer were treated with an antiparasitic treatment to control louse presence and re-infestation. Antiparasitic treatment consisted of a Cydectin® pour-on (0.1 cc/kg) and placement of a PYthon® insecticide cattle ear tag. The Cydectin treatment is effective at controlling both biting and sucking lice, with an effective duration of 4-8 weeks. The antiparasitic ear tags are labeled to treat biting lice and "aid" in the control of sucking lice. Untreated (control) YOY deer did not receive any antiparasitic treatment. Each YOY deer was marked with a VHF transmitting ear tag and standard processing was completed. We attempted to capture equal numbers of deer on the Cherry and Clavey subunits of the winter range. The transmitters were monitored weekly from the date of capture to March 1st and then monitored twice weekly after March 1st until the deer migrated off the winter range. Monitoring included locations, survival, and cause-specific mortality. If predation mortality occurred, the cause of mortality was determined and a camera trap was set on the carcass to confirm the predator, duration of use, and occurrence of scavenging.

Data Analysis

Unpaired t-tests assuming unequal variance were used to compare weight, girth, body length, body weight, parasite abundance, and micronutrients between categories. Paired t-tests were used to compare YOY at initial capture and recapture for the same parameters listed above. The association of louse presence and YOY with hair loss was compared using chi-squared tests. The three body condition scores assigned to three body regions of each YOY were averaged into a single condition score allowing us to classify each individual as being in poor condition, moderate condition, or good condition. Chi-squared tests were then used to compare the frequencies at which YOY fell into each body condition classification for different groups. All analyses were performed using Microsoft Excel using an alpha of 0.05.

PRELIMINARY RESULTS

YOY

Summary: 2011-2012

Between 11/8/2011 and 3/1/2012, forty-seven YOY were captured, marked, and released. All YOY captured were used for baseline information of YOY. The baseline condition of the treatment and control used for the survival analysis was then compared. Of these YOY 46 survived more than 14 days after capture and were included in the survival analysis. In total there were a total of 24 controls and 23 treatments, and 23 control and 23 treatment were used in the survival analysis. Twenty-seven YOY were female and 19 were male. The Cherry subunit contained 11 control YOY and 10 treatment YOY, and the Clavey subunit contained 13 controls and 13 treatment YOY. The mean weight of marked YOY was 62 pounds with weights ranging from 36 to 78 pounds. Body condition scores average was 2.11 and ranged from 1 to 4.

At capture, lice were found on 20 controls and 19 treatment YOY (85% total); only chewing lice were found on 34%, only sucking lice were found on 28.6%, and both types were found on 23.4%. Numbers of chewing lice varied greatly between YOY ranging from a single louse to 1600. On average, 63 chewing lice were tallied per deer. Three individual YOY had over 1500 sucking lice, and 5905 adult sucking lice were tallied from one of the marked YOY; the YOY with 5905 sucking lice was censored from the survival analysis due to mortality occurring within 14 days of capture.

Where both chewing and sucking lice were found on a single deer, one type generally dominated in numbers. Chewing lice numbers were greater in 55% of YOY with both types of lice and sucking lice numbers were greater in 36% of these YOY. Of YOY with lice present, 53.2% had *B. tibialis*, 26% had *L. africanus*, and 26% had *Solenopotes. ferrisi*. Specimens of both the native and exotic sucking lice were documented on only one YOY. Keds were found on all but one YOY. Ticks were found on 74% of YOY, 19% of YOY had chiggers and 6% had fleas.

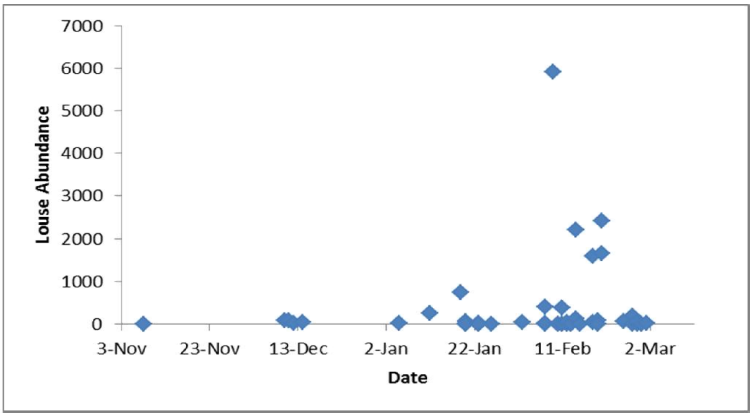

Figure 1. Number of lice found onYOY at initial capture (2011-2012). N = 47.

Twelve YOY were scruffy at capture, three had a wet appearance, and six had dull hair (Appendix 2). Eight YOY (17%) had hair loss at initial capture but only four were assigned pre-capture hair loss scores. No lice were found on two of the YOY with hair loss but lice were found on the other six. YOY with hair loss scores of two or less had only chewing lice while YOY with scores >3 had either both types or large numbers of sucking lice. However, only a few sucking lice were found on one YOY and no lice were found on another YOY with hair loss scores of five.

None of the four YOY with hair loss scores of 5 were considered deficient in selenium. Some of the highest levels of selenium among the YOY were the deer with hair loss. Two YOY with hair loss were deficient in selenium. At initial capture 18 YOY (38.3%) had blood selenium values below 0.10 ppm (Figure 2). The mean blood selenium value for marked YOY was 0.124 ppm with no significant difference in selenium between the control (0.13 +/- 0.013) and treatment (0.12 +/- 0.011) groups.

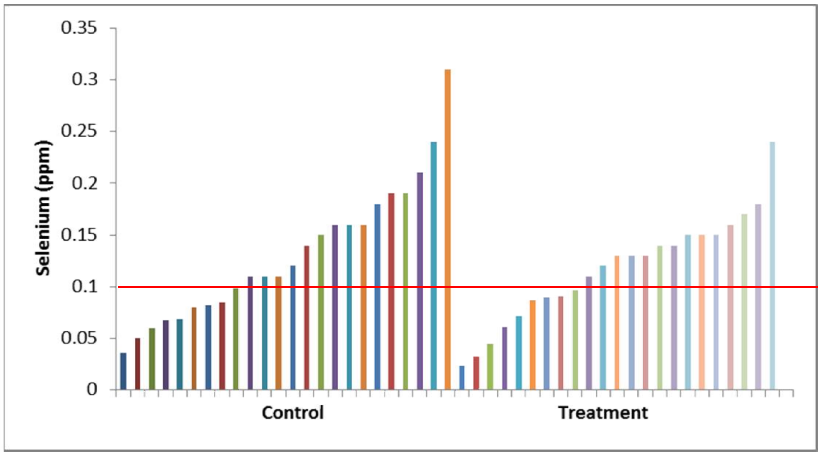

Figure 2. Whole blood selenium levels (ppm) of marked YOY at initial capture (Winter 2011-2012), divided by control and treatment. All bars that fall below the red line indicate a YOY deficient in selenium. N = 47.

Two YOY from the treatment group and one from the control group died prior to migration off the winter range (6.5% of the study population died). All were predated by mountain lion, two in the Clavey and one in the Cherry Subunit. The three mortalities included in analysis had few to moderate numbers of lice at initial capture and mean body condition of these animals was ≥2. None of YOY that resulted in mortality had hair loss at capture. Exotic chewing lice, *B. tibialis* were recovered from all three of the mortalities when first captured.

Summary: YOY 2012-2013

Between 12/7/2012 and 2/9/2013, fifty YOY were captured, marked, and released. Of these, 48 survived more than 14 days after capture and were included in the survival/mortality analysis. Twenty-six YOY were female and 22 male. The Cherry Subunit consisted of 9 control YOY and 10 treatment YOY, and the Clavey Subunit included 15 control YOY and 14 treatment YOY resulting in an even split of 24 control and 24 treatment YOY. The mean body weight of marked YOY was 54 pounds (+/- SE),

and weights ranged from 35 to 70 pounds. Body condition scores averaged 1.66 and ranged from 0.5 to 3.5.

Lice were found on 28 (58.3%) of the YOY at initial capture; 21 had chewing lice, three had sucking lice and four had both. YOY with lice at initial capture was 54.2% of the treatment and 62.5% control. Numbers of chewing lice varied greatly between YOY at initial capture ranging from a single louse to over a thousand. The mean number of chewing lice per deer was 127. Sucking lice were less abundant with a mean number of 19 per deer, though one individual had over a hundred, and one of the marked YOY censored from the study due to early mortality had 5702 adult sucking lice (5905 total lice). When both louse types were present on a single animal, abundance of each was below 80 individuals and chewing lice were always found in greater numbers. Keds and ticks were also found on all but two of the YOY and 25% of YOY had chiggers. Three YOY showed dull and scruffy hair at initial capture, and two showed evidence of hair loss, though not enough to assign a score. Noticeable hair loss did not manifest in YOY until March of 2013 (Table 1).

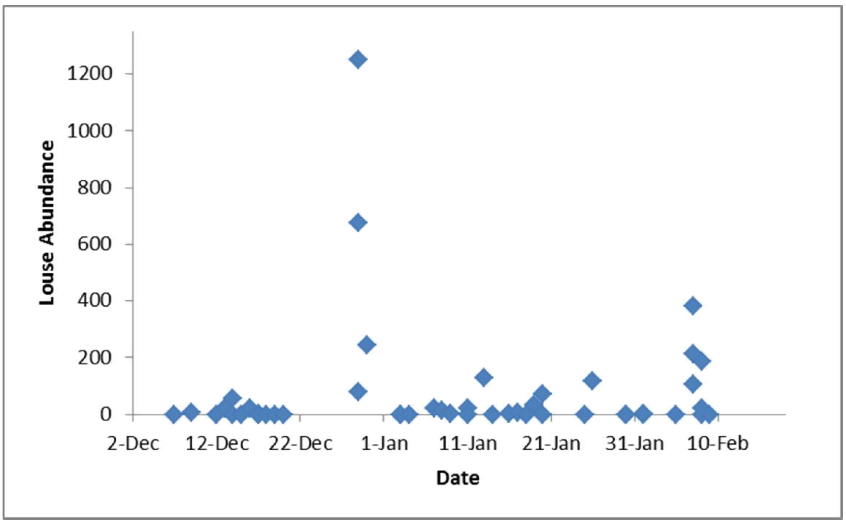

Figure 3. Number of both chewing and sucking lice found on YOY at initial capture (2012-2013). N = 48

Table 1. Encounter history and hair loss scores of known 2012/2013 YOY affected by Hair Loss Syndrome.

Freq.	Group	Dec	Jan	Feb	Mar	Apr	May
159.860	Treatment Cherry		0-Capture		0-Resight	3-Recap	2 - Resight
159.839	Treatment Cherry		0-Capture		0-Resight	2-Recap	
159.809	Treatment Cherry		0-Capture	0-Resight	0-Resight	1-Recap	
159.380	Control Clavey		0-Capture			4-Resight	4-Resight
159.899	Control Clavey	0-Capture	0-Resight	0-Resight	2-Mort		

At initial capture, 32 (64.0%) YOY had whole blood selenium levels below 0.10 ppm. The mean level of selenium was 0.11 ppm though a single YOY had an unusually high reported value of 1.00 ppm. Eliminating this outlier from the calculation lowered the mean value to 0.09 ppm. There was no significant difference in blood selenium levels between the control and treatment groups when first captured. All four YOY mortalities were deficient in selenium at capture.

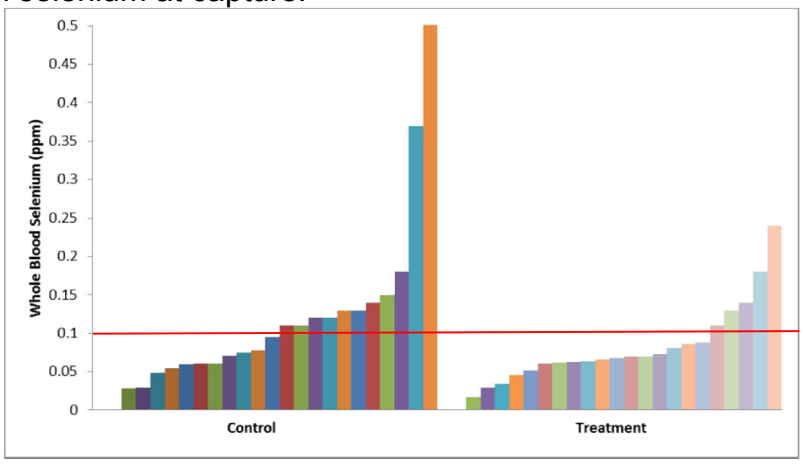

Figure 4. Whole blood selenium levels (ppm) of marked YOY at initial capture (Winter 2012-2013), separated by control and treatment. All bars that fall below the red line indicate a YOY deficient in selenium. The last bar in the control group is an outlier with selenium reported at 1.00ppm. N = 48. Note that the bar represents the cutoff value of 0.1 ppm.

Between 12/17/2012 and 5/30/2013 four (8.3%) of the marked YOY died. Three of the four mortalities were controls. Two mortalities were confirmed as mountain lion predation. The cause of the other two mortalities is unknown, with both carcasses completely consumed by either the predator or scavengers; two carcasses were determined to have been scavenged by black bears and one by a gray fox. The partially consumed carcass of one YOY killed by a mountain lion showed widespread hair loss on both hind legs.

YOY Recapture: 2012-2013

Seven YOY were recaptured between 4/9/13 and 4/18/13 to test the effectiveness of the treatment. The goal was to recapture additional YOY, but the migration from the winter range occurred 2-4 weeks earlier than during the prior three years resulting in fewer than expected deer available for capture in April. There was no significant difference between the mean weight of the control group and the mean weight of the treatment group at initial capture. At recapture, however, there was a significant difference in the mean body weight of the treatment (27 kg) and control (23.7 kg) groups (t = -2.89, df = 6, P = 0.027). There was no significant difference in the number of chewing lice found on treatment YOY vs. control YOY nor a significant difference in the number of sucking lice between the two groups at initial capture (Table 2).

Table 2. Comparison of number and type of lice found on eight California mule deer YOY at initial capture (before), and recapture (after) during the 2012-2013 capture season at the Jawbone Ridge study area.

Chewing Lice				**Sucking Lice**			
Control		**Treatment**		**Control**		**Treatment**	
1st Capture	*Recapture*	*1st Capture*	*Recapture*	*1st Capture*	*Recapture*	*1st Capture*	*Recapture*
71	271	7	0	2	0	0	159
0	0	0	0	0	5	0	0
243	871	0	0	0	0	0	0
		0	0			0	0
		0	0			0	0

All three recaptured control YOY had lice. Two of three with chewing lice at initial capture showed dramatic increases in louse abundance, while the un-infested control YOY at initial capture became infested with sucking lice. Four out of five of the recaptured treatment YOY did not have any lice at initial capture or at recapture. No chewing lice were recovered at recapture from the single YOY from which chewing lice were collected at initial capture; however, sucking lice were recovered from this animal at recapture (Table 2). At recapture, there was no significant difference in the number of chewing lice in the control group vs. the treatment group. There was also no significant difference in the number of sucking lice between control YOY and treatment YOY at recapture. No significant difference was found in the number of lice on controls at initial capture vs. recapture. The same is true when comparing treatment YOY at capture and recapture.

Hair loss of the YOY recaptured was not apparent at initial capture. Six of eight recaptured YOY did show some hair loss. Hair loss was seen in 66% of recaptured

controls and 80% of treated. In general, treatment YOY had more body regions affected and greater areas of hair loss than did the untreated YOY.

Half of the recaptured YOY (n= 7) had selenium levels below 0.10 ppm at both initial capture and recapture (Figure 5). Between initial capture and recapture, selenium decreased in 37.5% and increased in 50% though these changes may not be significant based on test error. There was no significant difference in selenium between control or treatment groups at initial capture or at recapture.

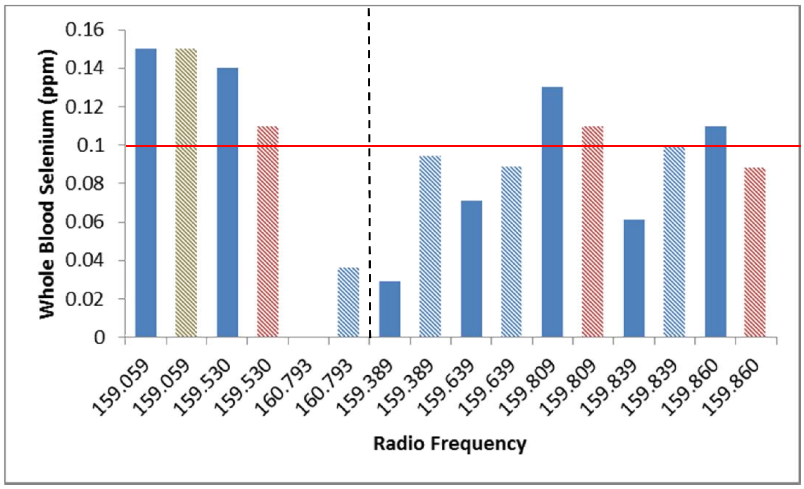

Figure 5. Comparison of whole blood selenium values for seven YOY at initial capture (dark blue bar) and at recapture. Grey bars indicate no change in Se value over time, red bars indicate a decrease, and blue and increase. Control YOY are left of the dashed line and treatment are on the right. Bars below the red line indicate Se deficiency.

YOY Comparison: 2011-2012 and 2012-2013

YOY marked in the winter of 2011/2012 had significantly higher weights than those marked in 2012/2013 (t = 4.77, df = 90, P = 6.9E-06; Figure 6). Body measurements of 2011/2013 YOY were significantly longer (t = 4.04, df = 89, P = 0.0001) and had significantly larger girth (t = 4.71, df = 93, P = 8.5E-06). YOY from 2011/2012 had significantly higher body condition scores than 2012/2013 YOY (X^2 = 7.07, df = 2, P = 0.029). There was a higher frequency of louse infestation in 2011/2012 (X^2 = 8.37, df = 1, P = 0.004). There was no significant difference in the numbers of sucking lice found on YOY from either winter. However, significantly more sucking lice were found on YOY in the winter of 2011/2012 than were found in 2012/2013 (t = 2.01, df = 46, P = 0.05). The mean number of keds, ticks, and other parasites found on YOY were not significantly different between winters. Of the YOY sampled in 2011/2012, 38.3% had a whole blood selenium level below 0.10 ppm while 66.7% of 2012/2013 YOY had whole blood selenium levels below 0.10 ppm.

Adults and Yearlings

Summary: Adults and Yearlings 2011-2012
Ten does and three female yearlings were captured between 11/7/2011 and 4/3/2012. Nine of the does were fitted with either radio or GPS collars. Adult deer were found to be between the ages of three and six years old. The mean weight of the does was 53.4 kg and yearlings weighed an average of 45.9 kg. Most body condition scores were moderate to high averaging >3 for each body region.

Lice were found on five of the adults (50%) and none of the yearlings. *Bovicola tibialis* was found on one doe and *L. africanus* found on one other with the remaining three deer having the native sucking louse. All of the adults and yearlings had blood selenium levels above the threshold for deficiency. The mean level of selenium detected was 0.16 ppm and 0.23 ppm in adults and yearlings, respectively. Five of the marked adults were killed by predation in 2011/2012.

Summary: Adults and Yearlings 2012-2013
Thirteen adult females, one adult male, and three female yearlings were captured between 12/20/12 and 4/10/13. The 13 adult does were fitted with either radio or GPS collars. The mean weight of the adult deer was 47.7 kg while yearlings weighed an average of 35.2 kg. Body condition scores averaged $\leq$2 for all three body regions examined. One marked doe was killed by a mountain lion after capture. One unmarked doe was killed by a lion in a clover trap.

Chewing lice were found on 38.5% of the captured adults with the range from 4 to 188 (x= 52). One yearling had chewing lice, another had no lice, and the third was not examined. Sucking lice were not found on adults or yearlings during 2012-2013. None of these deer showed any signs of hair loss.

The mean level of selenium was 0.10 ppm and 0.15 ppm in yearlings and adults, respectively.

Comparison: 2011-2012 Adults/Yearlings and 2012-2013 Adults/Yearlings
There was no significant difference in weight, body length, or girth between adults captured in the winter of 2011/2012 and the winter of 2012/2013 . Yearlings captured in the winter of 2011/2012 were significantly longer than those captured in 2012/2013 (t = 5.47, df = 2, P = 0.03). While yearlings in 2011/2012 were on average heavier and had larger than 2012/2013, the weight and girth of two groups were not significantly different. The numbers of chewing lice found on adults did not differ significantly between the two winters. Sucking lice were only found on adult deer in the winter of 2011/2012. There were more keds found on adult deer in the winter of 2012/2013 than found the previous winter (t = -2.07, df = 18, P = 0.05). There was no difference in the number of ticks or other ectoparasites from deer during the two winters. Hair loss was seen in captured adults in 2011/2012 but not 2012/2013. Whole blood selenium values of 2011/2012 adults were significantly greater than those found in deer captured the following winter, though both means were above 0.10 ppm (t = 2.59, df = 22, P = 0.02).

In the winter of 2011/2012 no adults were deficient in selenium. However, in 2012/2013, 71% of adults had selenium levels below 0.10ppm during the 2012-2013 season.

Table 3. Hair loss by Cherry vs. Clavey on spring composition count week.

	Hair Loss Score								
	0	**1**	**2**	**3**	**4**	**5**	**Preclinical**	**Sample Size**	**Percent**
April 2010									
Adult	347	8	5	3	0	0		363	4.4
Fawn	54	1	4	1	5	0		65	16.9
April 2011									
Adult	288	2	3	1	0	0		294	2.0
Fawn	36	6	0	1	4	1		48	33.3
April 2012									
Adult	249	0	6	4	6	3	1	269	10.8
Fawn	58	1	1	2	2	0		64	10.3
April 2013									
Adult	197	6	5	5	3	1		217	9.2
Fawn	36	8	10	1	5	0		61	39.3
All Years Combined									
Adult	1081	16	19	13	9	4	1	1143	5.3
Fawn	184	16	15	5	16	1	0	238	22.3

Summary

Two mild winters occurred with very low mortality. Insufficient mortality occurred to assess if louse presence impacts survival. During mild winters with low mortality, louse presence does not increase the susceptibility to mortality.

During the Phase 1 investigation, high mortality was suspected, especially in late spring where 65% of the overwinter mortality occurred after April 1st. During this investigation, there was no mortality after April 1st. The winter weather during the Phase 1 investigation was average and above average precipitation and snowfall with normal to a delayed migration off the winter range. Phase 2 had dry winters with early migration off the winter range. It is also unknown if there was a change in the predator population between years. The frequency of lion tracks seen was not recorded yet was thought to be less frequent in the phase 2 investigation. The effect of louse presence on overwinter survival during a normal to above normal precipitation winter should be examined to determine if there is an impact on overwinter survival.

A high mast crop associated with oaks, and possibly other factors can result in an increase in the blood selenium levels. The increased selenium level does not result in a

decrease in hair loss during April. Body condition also increased in the year with a high mast crop.

A catastrophic wildfire occurred in August 2013. The entire winter range was impacted, along with all the adjacent winter range areas. In total over 255,000 acres burned. The study plans and objectives for 2013-2015need to change due to the impacts of the fire. Attached to this progress report is the proposed changes to the study.

Collaborators

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

The US Forest Service Jawbone Ranger Station was used as the primary housing for all field activities. The US Forest Service also provided 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 provided assistance from Wildlife Specialists in capture operations and mortality assessment. Wildlife Specialists have been available to assist with deer captures.

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 California Deer Association originally purchased the GPS?. collars for the Stanislaus deer herd YOY pilot study and these collars were re-used in the 2009-2012 louse studies.

The Tuolumne County Fish and Game Advisory Committee provided six 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 provided assistance in the review of necropsy and biological sample results.

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