BRUCELLOSIS MANAGEMENT (EL104) - 2013

BRUCELLOSIS/POPULATION SURVEILLANCE & EARTAG RETURNS

McNeel Feedground

In 2014, two elk were captured via chemical immobilization on McNeel feedground in mid-February primarily to remove a radio-collar deployed in 2013 that had not dropped. Both elk were bled for brucellosis testing, but one sample froze and was not testable (Table 1).

Dell Creek Feedground

For the seventeenth consecutive winter, elk were captured via corral trap (rebuilt summer 2012) at Dell Creek feedground for ongoing brucellosis surveillance and associated research regarding strain 19 vaccination efficacy. Sixty-three elk (43 newly tagged) were captured and processed during one trap day in February. All elk were ear-tagged, and yearling and adult females were bled and received visibility collars.

In 2014, brucellosis seroprevalence of yearling and older females as determined by the four standard (card, SPT, Riv, CF) and cELISA tests was 0% (0/1) and 39% (14/36) at McNeel and Dell Creek (Table 1). The sample size from McNeel is too small for adequate statistical confidence (i.e., ≥ 85%), however, samples pooled among years give average seroprevalence of 58%. Seroprevalence at Dell Creek feedground averages 35%. Dell Creek feedground remains the control (i.e., non-vaccinated) site for the *Brucella* strain 19 elk vaccination program. Average seroprevalence of all animals captured in EL104 from 1997 through 2011, is 36% (n = 239/666).

Table 1. Total seropositive, seronegative, and percent seroprevalent elk based on 4 standard tests and cELISA from Dell Creek and McNeel feedgrounds, 1998-2014.

			Count		% Seroprevalence
Feedground	**Year**	**Positive**	**Negative**	**Total**	
Dell Creek	1998	9	25	34	26
	1999	18	18	36	50
	2000	10	12	22	45
	2001	9	26	35	26
	2002	12	22	34	35
	2003	11	19	30	37
	2004	3	33	36	8
	2005	6	28	34	18
	2006	5	25	30	17
	2007	6	31	37	16
	2008	10	33	43	23
	2009	12	32	44	27
	2010	13	24	37	35
	2011	20	26	46	44
	2012	14	10	24	58
	2013	44	24	68	65
	2014	14	22	36	39
	Sum	216	410	626	Mean = 35
McNeel	1997	0	2	2	0
	1998	9	2	11	82
	2011	5	2	7	71
	2012	7	6	13	54
	2013	2	4	6	33
	2014	0	1	1	0
	Sum	23	17	40	Mean = 58
E104	**Sum**	**239**	**427**	**666**	**Mean = 36**

A total of 1,356 individual elk were captured and tagged on feedgrounds between in EL104 between 1997 and 2013. Among these, information of 195 harvested elk were returned to the WGFD. A breakdown of eartag return locations by elk herd unit is in Table 2. Nearly 70% of all elk tagged in the Hoback herd were harvested in the Hoback herd unit, and a considerable number of returns were reported from the Fall Creek and Upper Green River elk herd units.

Table 2. Proportion of elk eartag returns of elk captured and tagged on Dell Creek and McNeel feedgrounds in the Hoback elk herd from 1997-2013.

Hoback elk eartag return summary; 1997-2013			
Location of harvest	Number of returns	Percent of total tag returns	Percent of all tagged elk
Hoback herd	135	69.2%	10.0%
Fall Cr. herd	21	10.8%	1.5%
Upper Green R.	17	8.7%	1.3%
Jackson herd	7	3.6%	0.5%
Unreported herd	7	3.6%	0.5%
Piney herd	5	2.6%	0.4%
Wiggins Fk. Herd	3	1.5%	0.2%
Total	195	100%	1356

STRAIN 19 BALLISTIC VACCINATION

McNeel Feedground

Vaccination was conducted during several days in April 2014 during above average temperatures, receding snow, and diminishing dependency of elk on alfalfa hay. Approximately 95 of 189 juveniles classified (50%) were vaccinated. Since 1992, at least 2,905 of a possible 3,136 juveniles (92%), 706 adult females, and several undocumented yearlings have been vaccinated.

Dell Creek Feedground

No strain 19 vaccination has occurred at this feedground. This site hosts the control population for comparison of seroprevalence and reproductive failure data with other vaccinated feedground elk. Active surveillance and analysis of associated data is ongoing.

RESEARCH – STRAIN 19 VACCINATION EFFECTS ON SEROPREVALENCE & ABORTIONS

The index of exposure to *Brucella* that is seroprevalence and the influence of strain 19 (s19) vaccination on elk seroprevalence levels in field conditions is not well understood, has been hotly debated, and thus is under current investigation. In captive studies, vaccination with s19 has shown to modestly reduce proportions of captive elk that aborted (25% - 60%) following challenge with *Brucella abortus* field strain 2308. However, no field study has assessed efficacy of the s19 program based on abortions. WGFD initiated the s19 ballistic vaccination program in 1985 at Grey's River feedground, and by 1997, all state-maintained feedgrounds (excluding Dell Creek) were incorporated. The NER initiated vaccination for three years in the late 1980's but discontinued the program until 2003 following completion of associated EIS. During s19 program initiation, juvenile and female elk were vaccinated from one to four years, then only juveniles thereafter. Among feedgrounds, targeted coverage of females averaged 66.5% per year and ranged from 21.5% on the NER to 101% at Scab Creek. Among feedgrounds, annual coverage of juveniles has averaged 98.8% per year.

Assessment of the s19 program has focused primarily on ocular comparison of serology data from Grey's River (vaccinated) and Dell Creek (non-vaccinated) elk, as well as determination of trend in Grey's River serology following inception of the s19 program. Given the length of time that the s19 program has occurred among the feedground metacomplex, however, provides a much larger dataset for more appropriate comparisons and investigations of seroprevalence trend. To determine the proportion of seropositive elk aborting and birthing among vaccinated and non-vaccinated feedgrounds, BFH personnel have also utilized vaginal implant transmitters

(VITs) from 2006-2013. For seroprevalence data, BFH personnel split data between yearling and adult females, pooled seroprevalence data within feedgrounds, then among or within years (depending on type of analysis) to provide significant sample sizes (bound on the error of estimation of +/-15%), incorporated an arcsine-square root transformation to normalize seroprevalence data, set alpha at 0.05, and utilized parametric t-tests for comparisons. For VIT abortion and birth data, BFH personnel compared data among feedgrounds with no s19 vaccination, less than 100% coverage of juveniles, greater than or equal to100% coverage (Table 3) of juveniles by use of a chi-square test of association.

Table 3. Total abortions and viable births among seropositive elk from feedground populations with varying levels of vaccination coverage, 2006-2013.

	Average Annual s19 Coverage of Juvenile Elk			
Outcome	0%	<100%	≥100%	> 0%
Abortion	8	15	0	15
Viable Birth	27	57	15	72

Paired data for yearlings ($t_{15, 16}$ = -0.15, P = 0.44) and adults ($t_{15, 16}$ = -0.44, P = 0.33) from 1998-2013 show no difference between mean seroprevalence of vaccinated Grey's River and unvaccinated Dell Creek populations. Among all feedgrounds from 1971-2013 for yearlings, seroprevalence prior to (mean = 16%, n = 14) and following (mean = 14%, n = 17) inception of s19 suggests that seroprevalence has not been lowered by s19 ($t_{14, 29}$ = -0.25, P = 0.40). Among all feedgrounds from 1971-2013 for adults, seroprevalence prior to (mean = 29%, n = 14) and following (mean = 33%, n = 18) inception of s19 suggests that seroprevalence has been not lowered but rather raised by s19 ($t_{15, 31}$ = -1.30, P = 0.04; Figure 1). Chi-square analysis shows no association of fewer abortions among categories (0%, <100%, ≥ 100%) of s19 vaccination coverage ($\chi^2_{2, 122}$ = 4.04, P = 0.13).

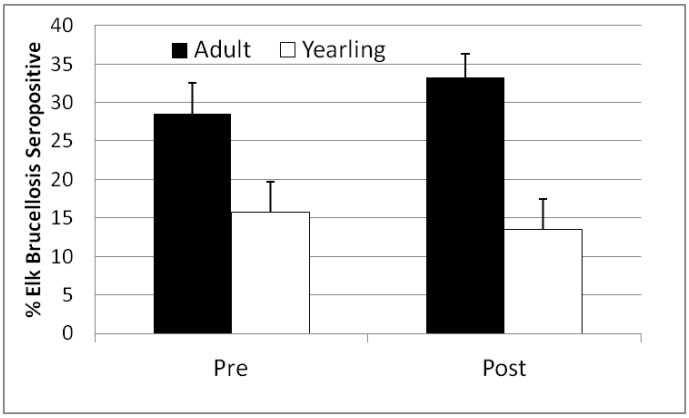

Figure 1. Mean (+SE) seroprevalence of brucellosis in adult and yearling feedground elk pre- and post-vaccination.

Based on these analyses, the s19 program has not affected seroprevalence or abortion rate at the population level. Despite the use of s19 or levels of coverage, numerous abortions continue to occur on feedgrounds allowing the disease to perpetuate in elk. Although one-time booster doses of s19 have shown no positive effect in elk immune response, an orally delivered s19 vaccine has shown positive effects. Furthermore, the addition of adjuvants to s19 is currently being explored. Other alternatives to s19 to minimize elk exposure to and/or contact with abortions include 1) Target Feedground strategies including Low-Density Feeding and Early End-Date, 2) Habitat treatments adjacent to feedgrounds, and/or 3) immunocontraception). Test and slaughter has been tested as a pilot project, and although effective at reducing seroprevalence, it is extremely cost-prohibitive when compared to habitat treatments, early end-date, and especially LD Feeding. Final analyses and a manuscript on the history and efficacy of the s19 program are currently being produced.

RESEARCH – ELK PARTURITION

In conjunction with several collaborative research projects including elk parturition ecology and accuracy of currently delineated elk parturition areas, BFH personnel continued a multi-year project on several feedgrounds including Dell Creek and McNeel in EL104. In 2013, 12 VITs were deployed and recovered from elk captured on Dell Creek (n = 8) and McNeel (n = 4) feedgrounds; all VITs were associated with viable births and birth site habitats ranged from low-elevation aspen/willow to high-elevation rock and sparse conifer (Fig. 2A). From 2008 to 2013, 78 VITs were deployed in elk captured on Dell Creek (n = 56) and McNeel (n = 22) feedgrounds. A total of 59 parturition sites and 10 abortions have been documented; 6 elk were not pregnant upon blood tests, 2 elk died prior to expelling their VITs, and one VIT was never heard after deployment (unknown). Birthsites occurred within both EL104 and EL103 unit boundaries, and only one occurred within currently delineated WGFD elk parturition areas in the Hoback herd unit (Figure 2B). In 2014, two VITs were deployed at Dell Creek out of 17 elk tested for pregnancy, and no VITs were deployed at McNeel.

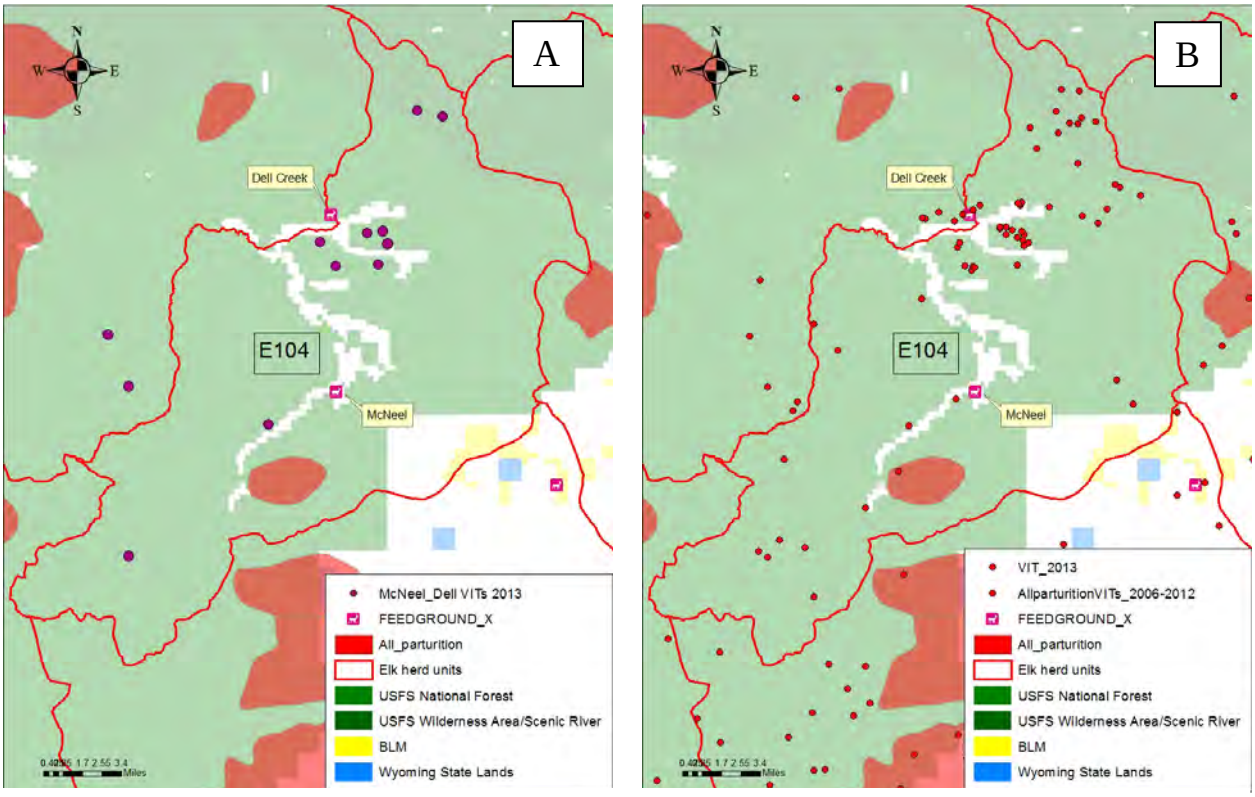

Figure 2. VIT locations from Dell Creek and McNeel Feedgrounds (2013, A; 2008-2013, B) and overlap with WGFD elk parturition areas.

Starting in 2011, BFH personnel began deploying GPS radio-collars on elk in EL104 to assess overlap with the proposed PXP natural gas exploration project and to gain additional information on elk distribution and possible overlap with adjacent herd units. Leases from the proposed PXP herd unit were retired following purchase or "buy-out" in 2013. From 2012 to 2013, 16 GPS collars were deployed on elk from McNeel Feedground; one elk died on the feedground, and data were inadequate and censured from the study. Each collar obtained a location every 30-minutes for approximately one year. Locations from the remaining 15 elk show that the majority stayed within EL104, yet five elk spent a substantial portion of time in Cliff Creek (EL103), and one elk relocated to Dog Creek Feedground (Figure 3). In 2014, 4 GPS collars were deployed at Dell Creek. One elk died the day following capture and this collar was redeployed at Scab Creek Feedground (EL108).

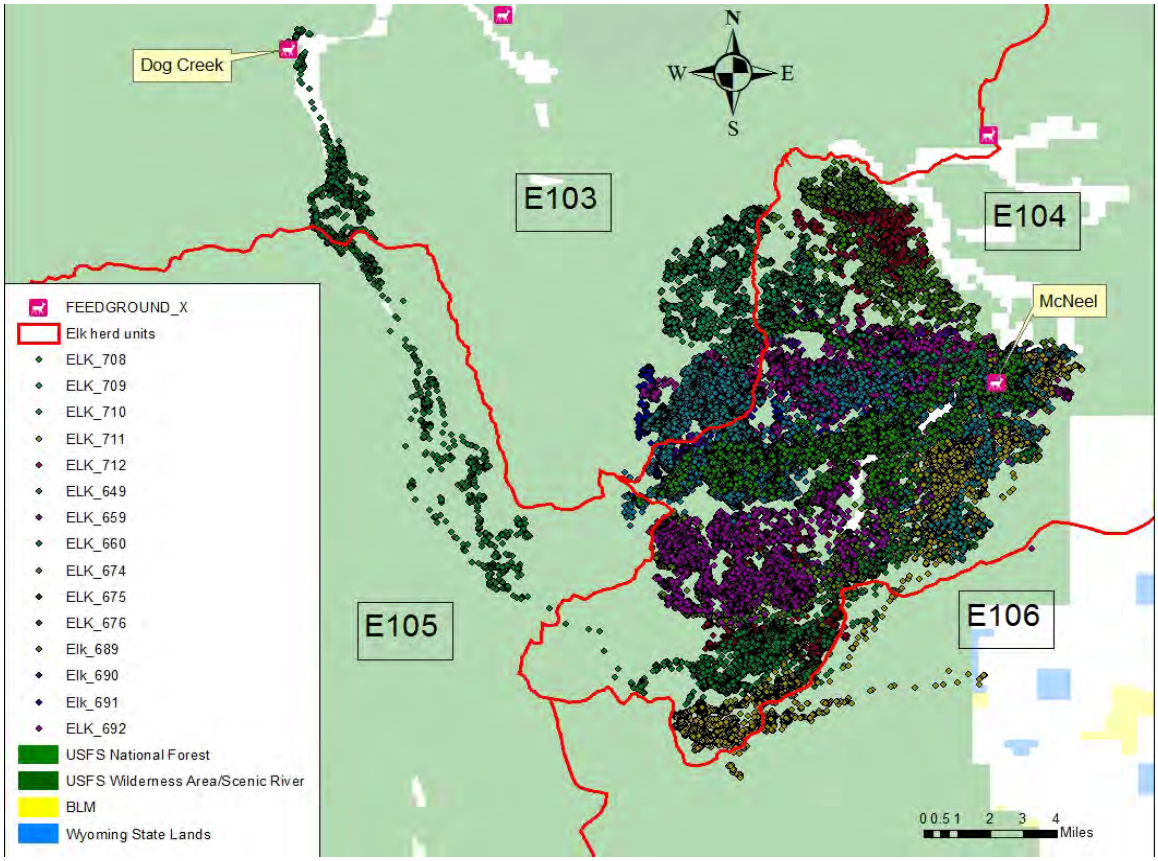

Figure 3. GPS collar locations of 15 elk from McNeel feedground, 2012-2014.

BRUCELLOSIS MANAGEMENT (EL106) – 2013

BRUCELLOSIS/POPULATION SURVEILLANCE & EAR TAG RETURNS

During February and March of 2014, 13adult female elk were captured on Franz (3), Jewett (2), Bench Corral (5) and Finnegan (3) feedgrounds by use of chemical immobilization. All elk had ear tags and visibility collars applied and blood samples taken. Captures were a collaboration among the WGFD, University of Wyoming, University of Montana, and USGS in conjunction with several research projects including brucellosis monitoring (ongoing since 1971); elk parturition ecology, analysis of WGFD parturition areas, and interspecific brucellosis transmission risk (ongoing since 2006); efficacy of the strain 19 vaccination program (ongoing since 2008); and assessment of the capture drug BAM on elk.

In 2014, brucellosis seroprevalence of females was 67%, 50%, 0%, and 0% at Franz, Jewett, Bench Corral, and Finnegan (Table 1). The sample sizes from all feedgrounds sampled in 2014 was too small for adequate statistical confidence (≥ 85%), therefore no inferences should be made to this population based on 2014 estimates. Average seroprevalence of all animals captured in EL106 from 1982 through 2014, incorporating cELISA corrections for strain19 vaccination titers, is 26.0% (n = 131/503).

Table 1. Number of yearling and adult female elk testing positive and negative for antibodies of brucellosis, total tested, and % brucellosis seroprevalence of elk sampled from feedgrounds in E106, 1982-2014.

Feedground	Year	Positive	Negative	Total	Prevalence (%)
Finnegan	1982	0	14	14	0
	1983	0	14	14	0
	1984	1	2	3	33
	1989	0	13	13	0
	2001	6	27	33	18
	2009	6	26	32	18
	2010	0	1	1	0
	2014	0	3	3	0
	Sum	**13**	**100**	**113**	**12**
Franz	1983	14	12	26	54
	1984	3	12	15	20
	1985	3	15	18	17
	2003	19	32	51	37
	2005	12	23	35	34
	2009	2	2	4	50
	2010	5	2	7	71
	2011	4	0	4	100
	2012	1	0	1	100
	2014	2	1	3	67
	Sum	**65**	**99**	**164**	**40**

North Piney	1990	6	15	21	29
	1991	2	19	21	10
	Sum	**8**	**34**	**42**	**19**
Bench Corral	2006	4	26	30	13
	2007	3	11	14	21
	2008	0	4	4	0
	2014	0	5	5	
	Sum	**7**	**46**	**51**	**14**
Jewett	2010	0	5	5	0
	2011	8	27	35	23
	2012	8	25	33	24
	2013	23	35	58	40
	2014	1	1	2	50
	Sum	**40**	**93**	**133**	**30**
El106	**Sum**	**131**	**372**	**503**	**26**

A total of 904 individual elk were captured and tagged on Jewett (400), Franz (282), Finnegan (169) and Bench Corral (53) feedgrounds between 2001 and 2013. Among these, information of 148 harvested elk were returned to the WGFD. A breakdown of eartag return locations by elk herd unit is in Table 2. Most elk tagged in the Piney herd were harvested in the Piney herd, and nearly 19% were harvested in the Hoback herd, comprised mostly of elk tagged at Franz feedground.

Table 2. Proportion of elk eartag returns of elk captured and tagged on feedgrounds in the Piney elk herd from 2001-2013.

Piney elk eartag return summary; 2001-2013			
Location of harvest	Number of returns	Percent of total tag returns	Percent of all tagged elk
Piney herd	108	73.0%	12.4%
Hoback herd	28	18.9%	3.2%
Afton herd	3	2.0%	0.3%
Upper GR herd	3	2.0%	0.3%
Unreported herd	3	2.0%	0.3%
West GR herd	1	0.7%	0.1%
Fall Cr. herd	1	0.7%	0.1%
Pinedale herd	1	0.7%	0.1%
Total	148	100%	869

STRAIN 19 BALLISTIC VACCINATION

Bench Corral Feedground

The strain 19 vaccination program was implemented at this feedground in 1997. Since 1997, the proportion of juveniles vaccinated relative to those classified annually averages 68%; this is second lowest among all vaccinated feedgrounds but is similar to the NER (64%), Gros Ventre (82%), and Soda Lake (83%) where winter conditions tend to be mild and elk are subsequently less dependent on supplemental forage and tolerant of human disturbance. Because elk on this feedground are extremely skittish, most elk that are vaccinated are not marked, and during multiple operations, some animals may be vaccinated twice. In 2014, only 18/156 (12%) of juveniles were vaccinated during one day in early March following several days of the feeder conditioning elk to the gun. The total number of vaccine doses administered to all elk (juvenile and older) at this feedground since 1997 is 2,520.

Finnegan Feedground

Since 1996, the proportion of juveniles vaccinated annually has averaged 106% suggesting that some yearling females have received boosters or elk have immigrated to the feedground between classification and vaccination. In 2014, 40/65 (62%) juveniles were vaccinated over several days in March and April. Since 1996, at least 1,283 juveniles, 172 adult females and likely numerous yearlings have been vaccinated.

Franz Feedground

Vaccination was completed at this feedground for the 18th consecutive year. Since 1997, the average proportion of juveniles vaccinated annually has been 94%. In 2014, 59 of 47 juveniles (126%) were vaccinated during several days from February through March. At least 1,806 juveniles, 545 adult females, and likely numerous yearlings have been vaccinated on this feedground since program initiation.

Jewett Feedground

Strain 19 vaccination was completed for the 17th consecutive winter at this feedground, and since 1997, average annual coverage of juveniles has been 109%. From February through early April, 200 of 173 (116%) juveniles were vaccinated. Since 1997, at least 3377 juveniles, 547 adult females, and likely numerous yearling females have been vaccinated.

North Piney Staging Area

Since 1996, elk have migrated from this site to Bench Corral feedground from mid-late January, which is prior to the initiation of vaccination activities on Bench Corral or other feedgrounds. Therefore, elk are vaccinated on this feedground but are vaccinated at Bench Corral. In 2014, about 50 elk staged at North Piney and moved to Bench Corral in late December.

RESEARCH –ELK PARTURITION

To document elk abortions and brucellosis transmission event, to facilitate understanding of elk parturition ecology, and in preparation of updating WGFD elk parturition areas, BFH personnel continued research in El106 by deploying vaginal implant transmitters (VITs) in elk attending Jewett (n=2) and Franz (n=2) feedgrounds in 2013. All VITs were recovered; one was from an abortion on the edge of Franz Feedground, and three were associated with live births (Figure 1). Live births occurred in aspen and aspen/sage edge (Jewett) as well as decadent conifer/aspen (Franz). From 2006 through 2013, elk birth sites in EL106 have ranged from willow/riparian areas on private lands to treeline on USFS lands, but have occurred primarily in aspen/conifer habitats on USFS lands (including the Maki prescribed, and Horse Creek and Mule wildfire burn areas). Three of four live births in 2013 were within current WGFD elk parturition areas (Figure 1), and based on all VITs associated with live births in El106 elk from 2006 through 2013, 28% (n =18/65) have occurred within current WGFD elk parturition areas. VIT data from 2006-2013 coupled with GPS collar data from 2008-2013 will be used as elk parturition areas are updated. In 2014, elk from Franz (3), Jewett (1), Bench Corral (4), and Finnegan (3) were fitted with VITs; three of these animals were seropositive and none have aborted as of early June.

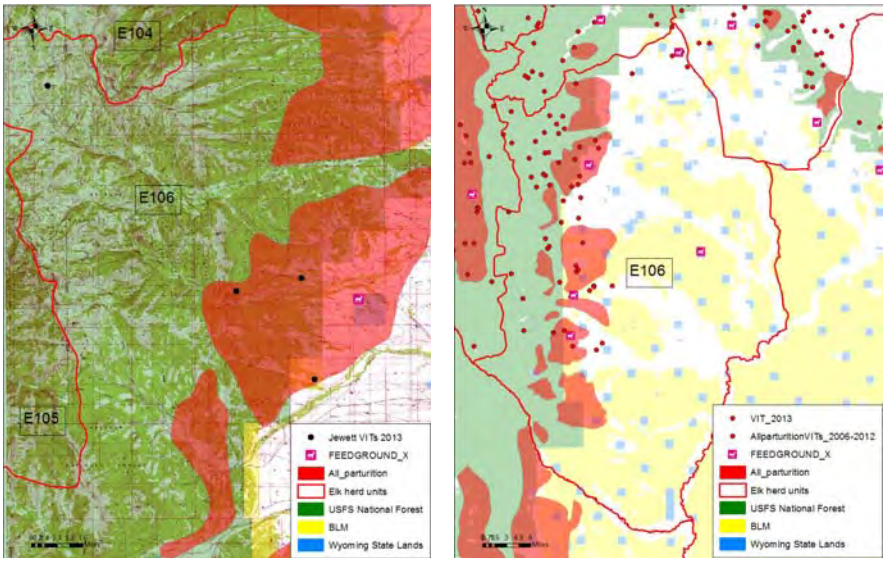

Figure 1. Jewett birth locations and overlap with current elk parturition areas (left),and all E106 birth locations and overlap with current elk parturition areas (right).

RESEARCH/MANAGEMENT – TARGET FEEDGROUND PROJECT

In summer 2007, BFH personnel initiated a project to reduce brucellosis transmission/seroprevalence using novel techniques on feedgrounds with low potential for commingling/damage (Bench Corral, Forest Park, Green River Lakes, Soda Lake, and Fall Creek). Goals of the project were to reduce contacts of elk with aborted fetuses by 1) instituting altered feeding patterns (Low-Density vs. traditional feedline) from early February through end of feeding, 2) attempting to actively (management decision) rather than passively (elk decision)

end feeding, and 3) promoting late-season free-ranging by switching from alfalfa to grass hay (reduced palatability, preference).

In 2012, Low-Density (LD) feeding was incorporated in EL106 on Bench Corral, Jewett, and Franz feedgrounds, occurring from 1 February through end of feeding. At Bench Corral, LD feeding was again enhanced by use of a large tractor and bale-feeder, allowing for precise distribution of hay in multiple rows across the feedground with minimal physical effort on part of the feeder. Feeders at Jewett and Franz initially had good success implementing LD feeding then had to recover following a series of storms in February. However, feeders at Franz and particularly Jewett were able to slowly expand the feeding area and incorporate multiple lines (i.e, 4-8 Franz, 8-16 Jewett) thereafter. Through consistent communication with the Big Piney warden, feedground, and BFH personnel, a favorable long-term forecast, and new feedground compensation plan that uses the long-term end date as a tentative season end-date, feeding at Bench Corral was ended 21 March 2012. This is three days over the average end-date (2000-2013). No attempts were made to use grass hay at the end of the feeding season to encourage elk to free-range from any EL106 feedgrounds. It was reported that around 50 elk briefly attended and departed the North Piney Staging Area in early January, and no damage situations were reported from this migration to Bench Corral.

RESEARCH – USING ELK GPS COLLAR, SWE, HARVEST, AND POPULATION DATA to EDUCATE PUBLIC HUNTERS & INCREASE HARVEST

To help better understand elk movement and distribution during hunting season, increase harvest, and balance the Piney elk herd, BFH personnel used existing elk GPS collar data (n = 38), local snow water equivalent (SWE, n = 4 sites), hunter success, and elk population data to generate maps, figures, and statistics for public presentations in Big Piney and Pinedale. This initiative came from the request and approval of the JN/PE wildlife coordinator, PE supervisor, and administration. Results show that in the last 10 years 1) the Piney herd has been stable but over objective, 2) number of type 6 (cow/calf) tags as well as days to hunt later in the season have increased, 3) SWE is highly correlated with cow/calf harvest, especially in November ($R^2 = 0.67$, Figure 2), 4) elk avoid high-traffic areas (i.e., S. Beaver, N. Horse Roads, Hoback Ranches), and 5) elk shift use from USFS lands in October/November to feedgrounds in December/January (Figure 3). Meetings in Big Piney and Pinedale were attended by 13 and 15 members of the public, respectively. Feedback from the meetings was positive, including several individuals who used the information to hunt and harvest elk.

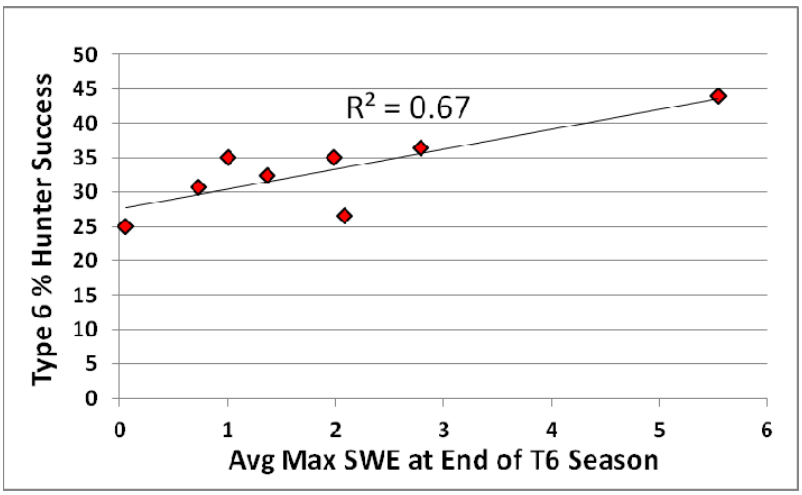

Figure 2. Correlation between Type 6 (cow/calf) tag hunter success and snow water equivalent (SWE) at the end of the Type 6 season.

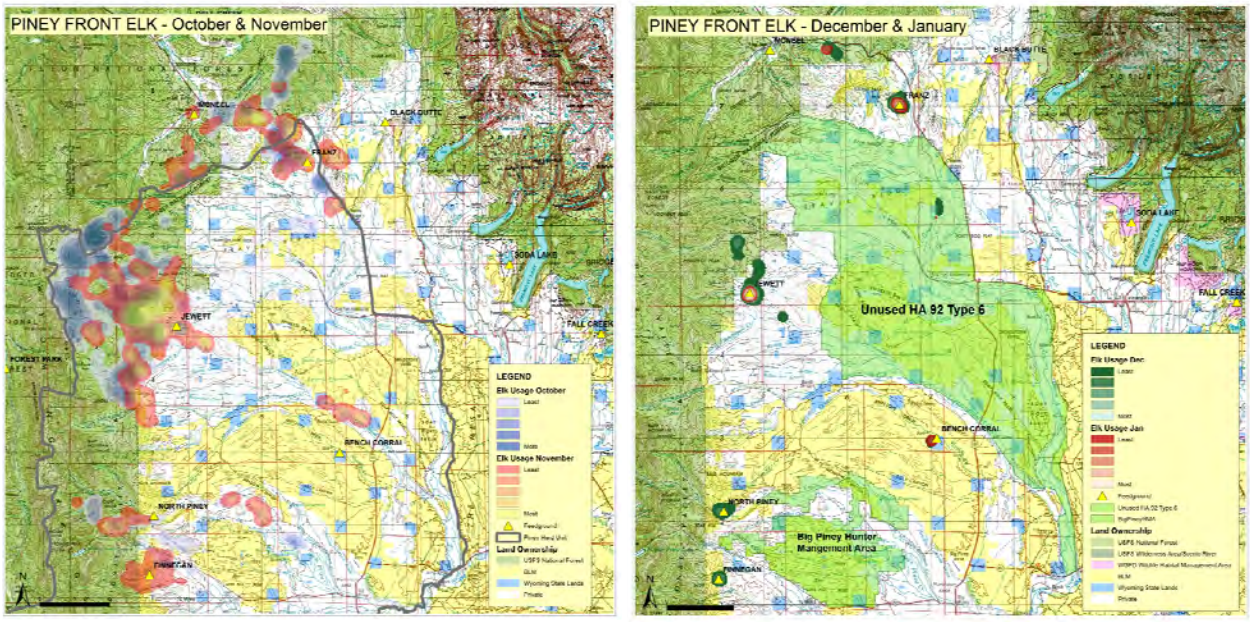

Figure 3. Kernel density estimator maps based on GPS locations of elk during October & November (left) and December & January plus late-season hunt areas (right) in EL106. Isolated locations away from feedgrounds in December & January result from mortalities or collars dropped off of feedgrounds.

BRUCELLOSIS MANAGEMENT (EL106) – 2013

BRUCELLOSIS/POPULATION SURVEILLANCE & EAR TAG RETURNS

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	1984	1	2	3	33
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	2001	6	27	33	18
	2009	6	26	32	18
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Franz	1983	14	12	26	54
	1984	3	12	15	20
	1985	3	15	18	17
	2003	19	32	51	37
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	2007	3	11	14	21
	2008	0	4	4	0
	2014	0	5	5	
	Sum	**7**	**46**	**51**	**14**
Jewett	2010	0	5	5	0
	2011	8	27	35	23
	2012	8	25	33	24
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STRAIN 19 BALLISTIC VACCINATION

Bench Corral Feedground

The strain 19 vaccination program was implemented at this feedground in 1997. Since 1997, the proportion of juveniles vaccinated relative to those classified annually averages 68%; this is second lowest among all vaccinated feedgrounds but is similar to the NER (64%), Gros Ventre (82%), and Soda Lake (83%) where winter conditions tend to be mild and elk are subsequently less dependent on supplemental forage and tolerant of human disturbance. Because elk on this feedground are extremely skittish, most elk that are vaccinated are not marked, and during multiple operations, some animals may be vaccinated twice. In 2014, only 18/156 (12%) of juveniles were vaccinated during one day in early March following several days of the feeder conditioning elk to the gun. The total number of vaccine doses administered to all elk (juvenile and older) at this feedground since 1997 is 2,520.

Finnegan Feedground

Since 1996, the proportion of juveniles vaccinated annually has averaged 106% suggesting that some yearling females have received boosters or elk have immigrated to the feedground between classification and vaccination. In 2014, 40/65 (62%) juveniles were vaccinated over several days in March and April. Since 1996, at least 1,283 juveniles, 172 adult females and likely numerous yearlings have been vaccinated.

Franz Feedground

Vaccination was completed at this feedground for the 18th consecutive year. Since 1997, the average proportion of juveniles vaccinated annually has been 94%. In 2014, 59 of 47 juveniles (126%) were vaccinated during several days from February through March. At least 1,806 juveniles, 545 adult females, and likely numerous yearlings have been vaccinated on this feedground since program initiation.

Jewett Feedground

Strain 19 vaccination was completed for the 17th consecutive winter at this feedground, and since 1997, average annual coverage of juveniles has been 109%. From February through early April, 200 of 173 (116%) juveniles were vaccinated. Since 1997, at least 3377 juveniles, 547 adult females, and likely numerous yearling females have been vaccinated.

North Piney Staging Area

Since 1996, elk have migrated from this site to Bench Corral feedground from mid-late January, which is prior to the initiation of vaccination activities on Bench Corral or other feedgrounds. Therefore, elk are vaccinated on this feedground but are vaccinated at Bench Corral. In 2014, about 50 elk staged at North Piney and moved to Bench Corral in late December.

RESEARCH –ELK PARTURITION

To document elk abortions and brucellosis transmission event, to facilitate understanding of elk parturition ecology, and in preparation of updating WGFD elk parturition areas, BFH personnel continued research in El106 by deploying vaginal implant transmitters (VITs) in elk attending Jewett (n=2) and Franz (n=2) feedgrounds in 2013. All VITs were recovered; one was from an abortion on the edge of Franz Feedground, and three were associated with live births (Figure 1). Live births occurred in aspen and aspen/sage edge (Jewett) as well as decadent conifer/aspen (Franz). From 2006 through 2013, elk birth sites in EL106 have ranged from willow/riparian areas on private lands to treeline on USFS lands, but have occurred primarily in aspen/conifer habitats on USFS lands (including the Maki prescribed, and Horse Creek and Mule wildfire burn areas). Three of four live births in 2013 were within current WGFD elk parturition areas (Figure 1), and based on all VITs associated with live births in El106 elk from 2006 through 2013, 28% (n =18/65) have occurred within current WGFD elk parturition areas. VIT data from 2006-2013 coupled with GPS collar data from 2008-2013 will be used as elk parturition areas are updated. In 2014, elk from Franz (3), Jewett (1), Bench Corral (4), and Finnegan (3) were fitted with VITs; three of these animals were seropositive and none have aborted as of early June.

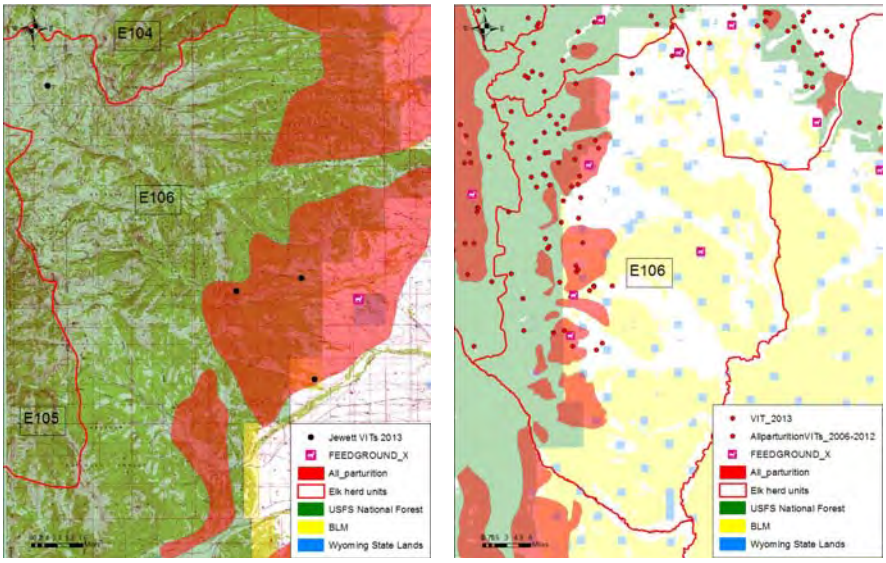

Figure 1. Jewett birth locations and overlap with current elk parturition areas (left),and all E106 birth locations and overlap with current elk parturition areas (right).

RESEARCH/MANAGEMENT – TARGET FEEDGROUND PROJECT

In summer 2007, BFH personnel initiated a project to reduce brucellosis transmission/seroprevalence using novel techniques on feedgrounds with low potential for commingling/damage (Bench Corral, Forest Park, Green River Lakes, Soda Lake, and Fall Creek). Goals of the project were to reduce contacts of elk with aborted fetuses by 1) instituting altered feeding patterns (Low-Density vs. traditional feedline) from early February through end of feeding, 2) attempting to actively (management decision) rather than passively (elk decision)

end feeding, and 3) promoting late-season free-ranging by switching from alfalfa to grass hay (reduced palatability, preference).

In 2012, Low-Density (LD) feeding was incorporated in EL106 on Bench Corral, Jewett, and Franz feedgrounds, occurring from 1 February through end of feeding. At Bench Corral, LD feeding was again enhanced by use of a large tractor and bale-feeder, allowing for precise distribution of hay in multiple rows across the feedground with minimal physical effort on part of the feeder. Feeders at Jewett and Franz initially had good success implementing LD feeding then had to recover following a series of storms in February. However, feeders at Franz and particularly Jewett were able to slowly expand the feeding area and incorporate multiple lines (i.e, 4-8 Franz, 8-16 Jewett) thereafter. Through consistent communication with the Big Piney warden, feedground, and BFH personnel, a favorable long-term forecast, and new feedground compensation plan that uses the long-term end date as a tentative season end-date, feeding at Bench Corral was ended 21 March 2012. This is three days over the average end-date (2000-2013). No attempts were made to use grass hay at the end of the feeding season to encourage elk to free-range from any EL106 feedgrounds. It was reported that around 50 elk briefly attended and departed the North Piney Staging Area in early January, and no damage situations were reported from this migration to Bench Corral.

RESEARCH – USING ELK GPS COLLAR, SWE, HARVEST, AND POPULATION DATA to EDUCATE PUBLIC HUNTERS & INCREASE HARVEST

To help better understand elk movement and distribution during hunting season, increase harvest, and balance the Piney elk herd, BFH personnel used existing elk GPS collar data (n = 38), local snow water equivalent (SWE, n = 4 sites), hunter success, and elk population data to generate maps, figures, and statistics for public presentations in Big Piney and Pinedale. This initiative came from the request and approval of the JN/PE wildlife coordinator, PE supervisor, and administration. Results show that in the last 10 years 1) the Piney herd has been stable but over objective, 2) number of type 6 (cow/calf) tags as well as days to hunt later in the season have increased, 3) SWE is highly correlated with cow/calf harvest, especially in November ($R^2 = 0.67$, Figure 2), 4) elk avoid high-traffic areas (i.e., S. Beaver, N. Horse Roads, Hoback Ranches), and 5) elk shift use from USFS lands in October/November to feedgrounds in December/January (Figure 3). Meetings in Big Piney and Pinedale were attended by 13 and 15 members of the public, respectively. Feedback from the meetings was positive, including several individuals who used the information to hunt and harvest elk.

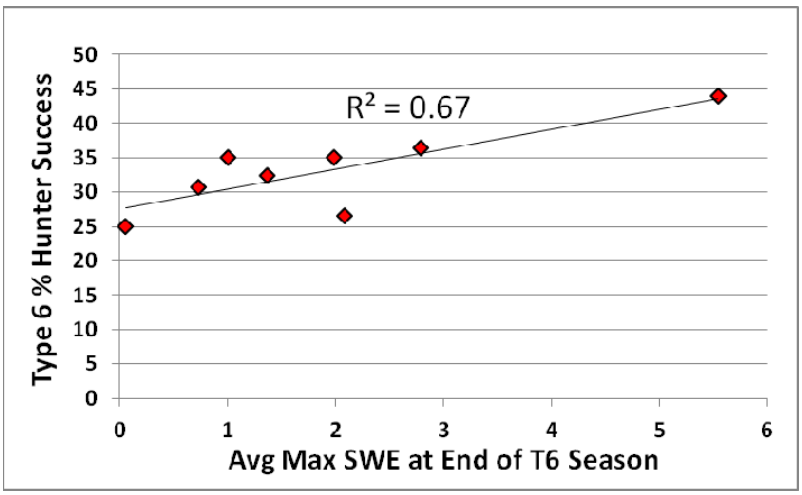

Figure 2. Correlation between Type 6 (cow/calf) tag hunter success and snow water equivalent (SWE) at the end of the Type 6 season.

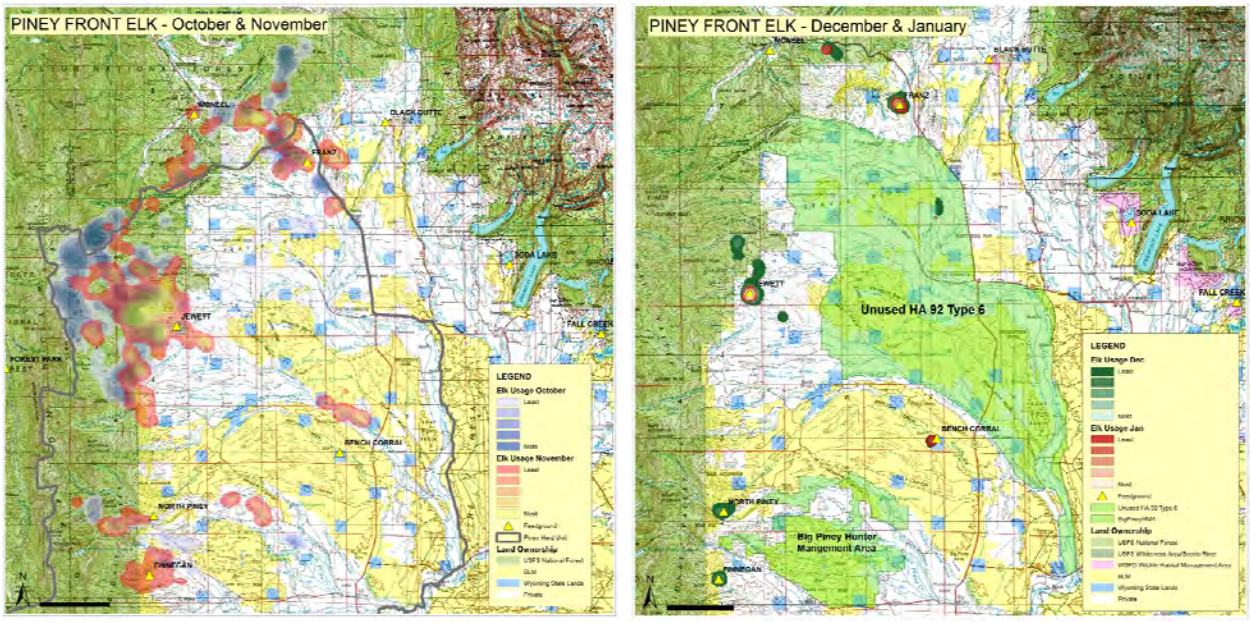

Figure 3. Kernel density estimator maps based on GPS locations of elk during October & November (left) and December & January plus late-season hunt areas (right) in EL106. Isolated locations away from feedgrounds in December & January result from mortalities or collars dropped off of feedgrounds.

BRUCELLOSIS MANAGEMENT (EL107) – 2013

SURVEILLANCE/RESEARCH

Ear tags are permanently affixed to all elk captured and released during brucellosis surveillance and research efforts. Ear tags are recovered when the animal is harvested or a carcass is discovered. This effort aids in our knowledge of elk distribution and facilitates understanding of how brucellosis and other diseases could be spread among herd units. Since 1990, 377 individual elk have been ear tagged in the Upper Green River elk herd unit. About 24% (89) of those tags have been returned, with 85% known to have come from within the herd unit boundary, and 12% known to have come from within 5 different units. The largest amount of interchange appears to be with the Jackson herd unit (Table 1).

Soda Lake Feedground

Five adult female elk were captured via chemical immobilization (1.0ml Carfentanil and 0.5ml Xylazine) on this feedground on January 31, 2014 to either remove GPS collars that failed to drop off automatically as programmed or to outfit with a new GPS collar and Vaginal Implant Transmitter (VIT), and to test for exposure to brucellosis. One elk tested seropositive for brucellosis, but the sample is too small for a significant brucellosis seroprevalence estimate of the feedground population (Table 2). Three GPS collars that were deployed during the previous winter were removed. Two were from Black Butte feed ground and one from the Gros Ventre range's Patrol Cabin feedground. The Patrol Cabin female was of particular interest due to her inter-herd movement and was again outfitted with a new GPS collar, but not with a VIT as the elk was not pregnant at time of recapture. Two other pregnant adult females were captured and outfitted with both a GPS collar and VIT. The GPS collars record a location every 30 minutes for two years and the VITs will be expelled upon either abortion or parturition during late winter/spring of 2014. These efforts are part of region-wide ongoing project to evaluate elk distribution/movement with respect to brucellosis transmission to identify high risk areas. Locations from all GPS collars and VITs (abortion and calving locations) recovered to date for elk captured from this and other feedgrounds within the Upper Green River elk herd unit are illustrated in Figure 1.

Black Butte Feedground

Three females (2 adult, 1 yearling) were captured via chemical immobilization (1.0ml Carfentanil and 0.5ml Xylazine) at this feedground on February 4, 2014. All three were outfitted with GPS collars that record a location every 30 minutes for one year. The two adult females were determined to be pregnant via use of a portable ultrasound and both outfitted with Vaginal Implant Transmitter (VITs) that will be expelled upon either abortion or parturition during late winter/spring of 2014. Locations from all GPS collars and VITs recovered to date for elk captured from this and other feedgrounds within the Upper Green River elk herd unit are illustrated in Figure 1. Although several aborted fetuses have been recovered from this feedground over the years, no abortions have been

documented at Black Butte using VITs. All of the elk tested seronegative for brucellosis in 2014, but the sample of 3 is far too few for a statistically significant brucellosis seroprevalence estimate of the population attending Black Butte feedground (Table 2).

Green River Lakes Feedground

Four adult females were captured via chemical immobilization (1.0ml Carfentanil and 0.5ml Xylazine) on this feedground on February, 25, 2014 and outfitted with GPS collars. All four were determined to be pregnant via portable ultrasound and were also fitted with Vaginal Implant Transmitters (VITs). Locations from all recovered GPS collars and VITs to date for elk captured from this and other feedgrounds within the Upper Green River elk herd unit are illustrated in Figure 1. One of the four elk tested seropositive for brucellosis, but the sample of 5 is too small for a statistically significant brucellosis seroprevalence estimate of the population attending Green River Lakes feedground (Table 2).

One GPS collar that was deployed on the Jewett feedground in 2013 was recovered from the Green River Lakes feedground in early 2014. The GPS data with location fixes taken once every 30 minutes for about a year are displayed in Figure 2. This elk, which had just turned 2 years old in spring 2013, made a dispersal movement from HA92 in the Piney elk herd unit on the morning of June 30th and arrived in HA95 of the Upper Green River herd unit the morning of July 3rd. She was visually observed spending winter 2013-2014 on the Green River Lakes feedground.

Table1. Distribution of ear tag returns during 2004 to 2013 that were permanently affixed to captured elk in the Pinedale elk herd unit.

UPPER GREEN RIVER ELK HERD UNIT (1993-2013)

HERD UNIT OF TAG RETURN	# OF TAG RETURNS	% OF TAG RETURNS	% OF ALL TAGGED ELK
UPPER GREEN RIVER	76	85.39%	20.16%
JACKSON	4	4.49%	1.06%
HOBACK	3	3.37%	0.80%
WIGGINS FORK	2	2.25%	0.53%
PINEY	1	1.12%	0.27%
SOUTH WIND RIVER	1	1.12%	0.27%
unknown	2	2.25%	0.53%
Total	n=89	100%	n=377

Table 2. Yearling, adult, and total female seroprevalence of elk on feedgrounds in the Upper Green River elk herd unit based on 4 standard tests and cELISA, 1990-2014.

UPPER GREEN RIVER ELK HERD UNIT

Feedground	Year	Yearling			Adult			All Females		
		+	*n*	%	+	*n*	%	+	*n*	%
Black Butte	1989*	0	9	0%	4	15	27%	4	24	17%
	2000	1	9	11%	6	25	24%	7	34	21%
	2012*	0	1	0%	0	4	0%	0	5	0%
	2013*	0	0	0%	1	5	20%	1	5	20%
	2014*	0	1	0%	0	2	0%	0	3	0%
	SUM	1	20	5%	11	49	22%	12	68	18%
Green River Lakes	1991*	0	2	0%	3	12	25%	3	14	21%
	1993*	0	1	0%	3	8	38%	3	9	33%
	2003	1	7	14%	5	19	26%	6	26	23%
	2009*	0	0	0%	0	4	0%	0	4	0%
	2011*	0	0	0%	0	5	0%	0	5	0%
	2014*	0	0	0%	1	4	25%	1	4	25%
	SUM	1	10	10%	12	52	23%	12	58	21%
Soda Lake	1988	0	3	0%	12	56	21%	12	59	20%
	1989*	0	4	0%	0	14	0%	0	18	0%
	2006	0	2	0%	5	32	16%	5	34	15%
	2007*	0	0	0%	9	29	31%	9	29	31%
	2008*	0	0	0%	3	5	60%	3	5	60%
	2009*	0	0	0%	12	33	36%	12	33	36%
	2011*	0	0	0%	6	22	27%	6	22	27%
	2014*	0	0	0%	1	5	20%	1	5	20%
	SUM	0	9	0%	48	196	24%	48	205	23%
	TOTAL	**2**	**39**	**5%**	**71**	**297**	**24%**	**72**	**331**	**22%**

* inadequate *n* for the estimated prevalence to be +/- 15% of the true prevalence

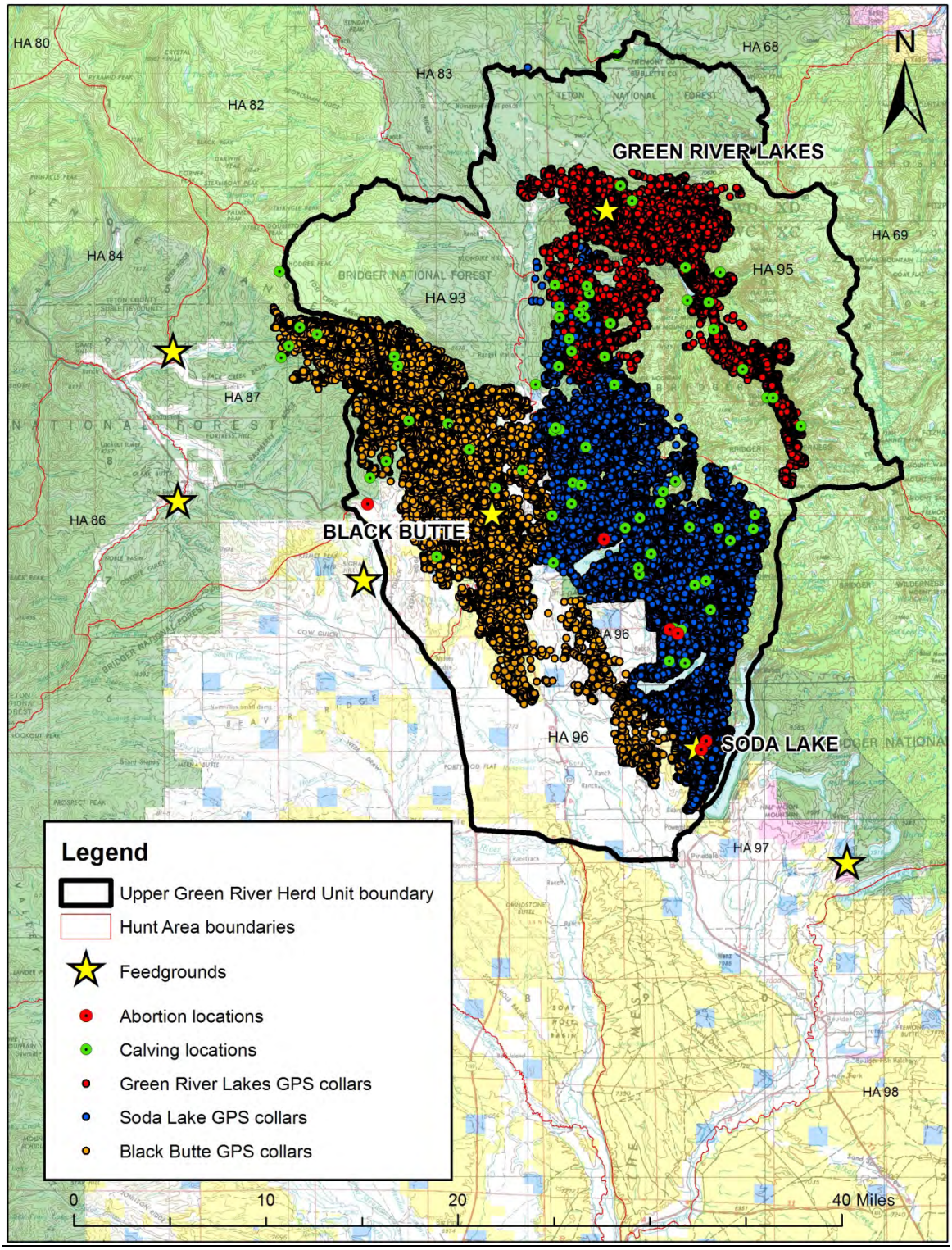

Figure 1. Calving locations based on VIT recovery (bright green circles) and GPS collar locations from all elk captured during winter on Green River Lakes (red), Black Butte (orange), and Soda Lake (blue) feedgrounds, 2008-2013.

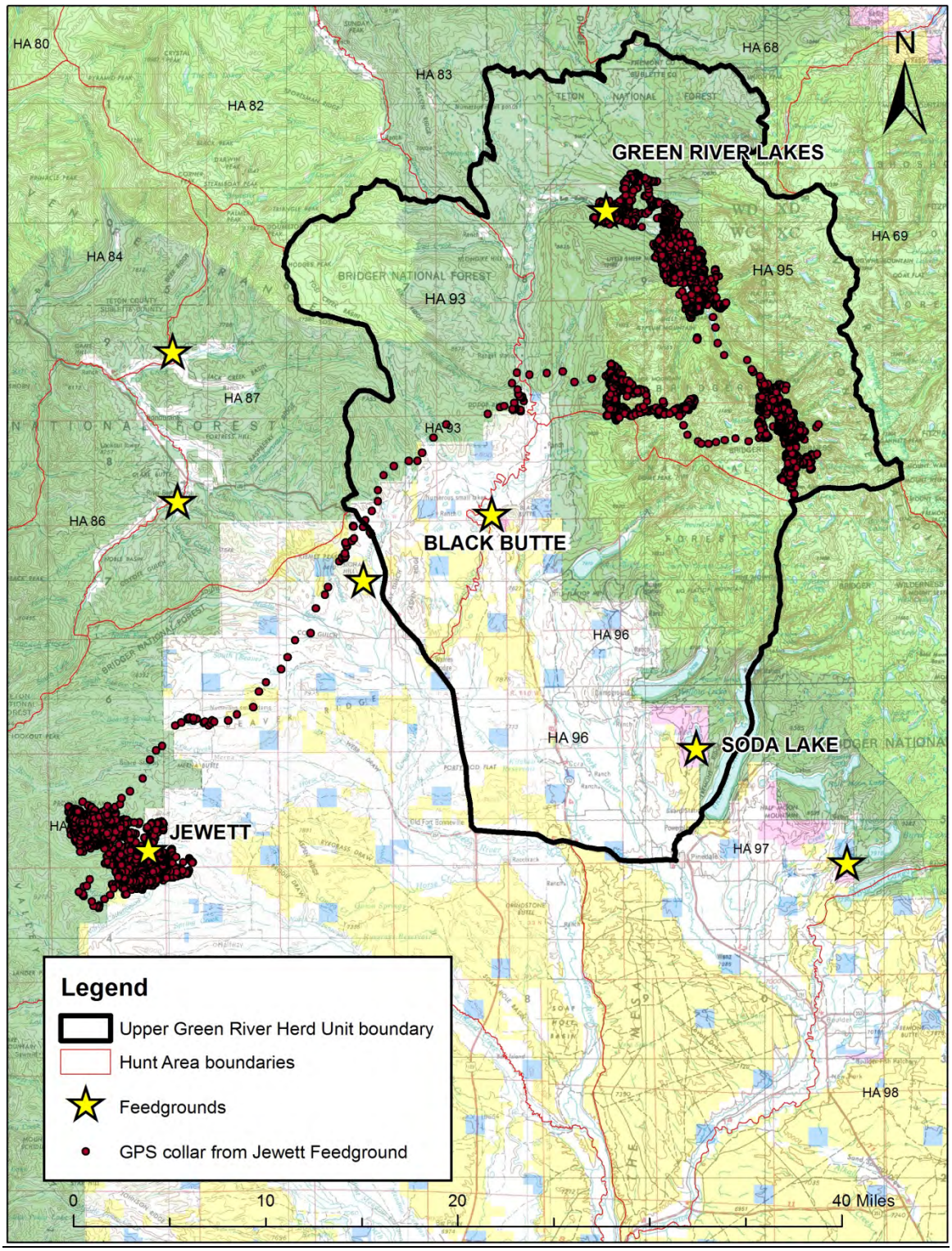

Figure 2. GPS locations for one elk from Jewett feedground that relocated to the Upper Green River herd unit during June 30th to July 3rd of 2013 with location fixes every 30 minutes (red circles).

STRAIN 19 VACCINATION

Soda Lake Feedground

Strain 19 was first administered at this feedground in 1992. There were 270 vaccinated of the 295 juveniles classified on this feedground (92% coverage) over a 15-day period in February. Since 1992, there have been 2,444 juveniles and 821 adult females vaccinated

Black Butte Feedground

Vaccination was completed for the twenty-third consecutive year at this feedground. A total 154 of the 74 classified juveniles (>100% coverage) were vaccinated over a 6-day period in February and March. Since 1989, a total of 4,414 juveniles and 909 adult females have been inoculated.

Green River Lakes Feedground

There were 140 of 155 classified at this feedground this year (>100% coverage). The total vaccine doses administered since the program's initiation at this feeground twenty-eight years ago is 2,555 for juveniles and 1,006 for adult females.

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BRUCELLOSIS MANAGEMENT (EL108) – 2013

SURVEILLANCE

Muddy Creek Feedground

The five-year elk Test and Slaughter (T&S) pilot project (2006-2010) was effective at reducing brucellosis seroprevalence among elk at all three feedgrounds in the Pinedale elk herd, most noticeably at the Muddy Creek feedground where seroprevalence fell from 37% to 5% during the years of the project. However, post T&S monitoring efforts in early 2012 indicate that exposure to *Brucella* at Muddy Creek had increased during the 2011 brucellosis transmission season (Feb-June); the first year that slaughter was not conducted. Subsequent trapping efforts have indicated that seroprevalence is continuing to climb. On February 16th, 2014, a total of 142 elk were captured, including 71 different test-eligible (yearling and adult) females, which were bled and tested to reveal 17% (12/71) had been exposed to *Brucella abortus* (Table 1).

Brucellosis testing results subsequent to T&S indicate that the efficacy of the project at reducing brucellosis seroprevalence is ephemeral. T&S did not prevent brucellosis transmission events among elk during the 5 years of the project, as several females seroconverted upon recapture during the project. Prevalence of brucellosis in elk attending feedgrounds where T&S was employed will likely increase to pre-project level.

Scab Creek Feedground

A successful trapping effort was conducted at this feedground on February 22nd. The primary purpose was to continue to evaluate the long-term effect of the pilot T&S project, which occurred on this feedground during two years of the 5-year project (2009, 2010). A total of 140 elk were captured, including 86 test-eligible (yearling and adult) females. A total of 53% (46/86) of elk tested seropositive for the disease (Table 1), which greatly exceeds the 2008 pre-T&S level of 21%.

Fall Creek Feedground

Surveillance at this feedground is conducted on an every other year rotation with the Scab Creek feedground and was not trapped during winter 2013-14. Results from previous year's brucellosis surveillance are included in Table 1. Upon last check in 2013, seroprevalence had risen to 12%, slightly above pre-T&S levels.

Table 1. Yearling, adult, and total female seroprevalence of elk on feedgrounds in the Pinedale elk herd unit based on 4 standard tests and cELISA, 1990-2014.

PINEDALE ELK HERD UNIT

Feedground	Year	Yearling			Adult			All Females		
		+	*n*	%	+	*n*	%	+	*n*	%
Fall Creek	1994*	1	2	50%	5	12	42%	6	14	43%
	1995*	2	4	50%	9	22	41%	11	26	42%
	2008	2	31	6%	19	160	12%	21	191	11%
	2009	0	13	0%	11	145	8%	11	158	7%
	2011	0	16	0%	3	53	6%	3	69	4%
	2013	0	0	0%	4	34	12%	4	34	12%
	SUM	5	66	8%	51	426	12%	56	492	11%
Muddy Creek	1990*	0	2	0%	4	14	29%	4	16	25%
	1991*	0	5	0%	1	5	20%	1	10	10%
	1996	10	17	59%	19	35	54%	29	52	56%
	1997	3	7	43%	16	31	52%	19	38	50%
	2004*	1	3	33%	3	12	25%	4	15	27%
	2005	0	5	0%	8	25	32%	8	30	27%
	2006	2	10	20%	56	147	38%	58	157	37%
	2007	2	25	8%	11	54	20%	13	79	16%
	2008	1	24	4%	19	134	14%	20	158	13%
	2009	0	13	0%	8	101	8%	8	114	7%
	2010	0	26	0%	7	115	6%	7	141	5%
	2011	0	12	0%	4	60	7%	4	72	6%
	2012	2	19	11%	7	51	14%	9	70	13%
	2013	2	11	18%	7	44	16%	9	55	16%
	2014	1	14	7%	11	57	19%	12	71	17%
	SUM	24	193	12%	181	885	20%	205	1078	19%
Scab Creek	2006*	0	0	0%	3	15	20%	3	15	20%
	2007	0	0	0%	8	38	21%	8	38	21%
	2008*	0	0	0%	1	3	33%	1	3	33%
	2009	3	20	0%	28	129	22%	31	149	21%
	2010	2	21	0%	25	120	21%	27	141	19%
	2012	2	8	0%	19	57	33%	21	65	32%
	2014	1	15		45	71	63%	46	86	53%
	SUM	8	64	0%	129	433	30%	137	497	28%
	TOTAL	**37**	**323**	**11%**	**361**	**1744**	**21%**	**398**	**2067**	**19%**

* inadequate *n* for the estimated prevalence to be +/- 15% of the true prevalence

RESEARCH

Fall, Scab, and Muddy Creek Feedgrounds

Ear tags are permanently affixed to all elk captured and released during brucellosis surveillance and research efforts. Ear tags are recovered when the animal is harvested or a carcass is discovered. This effort aids in our knowledge of elk distribution and facilitates our understanding of how brucellosis and other diseases could be spread among herd units. Since 1994, 2,670 individual elk have been ear tagged in the Pinedale elk herd unit. About 15% (395) of those tags have been returned, with 89% known to have come from within the herd unit boundary and 7% known to have come from within 5 different herd units. The largest amount of interchange appears to be with the South Wind River herd unit (Table 2).

During elk captures in 2014, five adult pregnant female elk at Muddy Creek were chemically immobilized and fitted with Vaginal Implant Transmitters (VITs) and VHF radio collars, and 7 adult pregnant female elk at Scab Creek feedground were fitted with VITs and GPS collars, which record a location every 30 minutes for one year. The VITs will be expelled upon either abortion or parturition during late winter/spring 2014, and the GPS collars are programmed to drop off in January 2015 when they will be recovered and the data retrieved. No captures were conducted at Fall Creek in 2014. When combined, these data will build upon ongoing research that began in 2006 with the primary goal of identifying high risk areas for brucellosis transmission. Locations from all recovered GPS collars and VITs to date for elk captured within the Pinedale elk herd unit are illustrated in Figure 1.

Table 2. Distribution of ear tag returns during 2004 to 2013 that were permanently affixed to captured elk in the Pinedale elk herd unit.

PINEDALE ELK HERD UNIT (1994-2013)

HERD UNIT OF TAG RETURN	# OF TAG RETURNS	% OF TAG RETURNS	% OF ALL TAGGED ELK
PINEDALE	352	89.11%	13.18%
SOUTH WIND RIVER	19	4.81%	0.71%
WIGGINS FORK	5	1.27%	0.19%
UPPER GREEN RIVER	3	0.76%	0.11%
GREEN MOUNTAIN	2	0.51%	0.07%
PINEY	1	0.25%	0.04%
unknown	13	3.29%	0.49%
Total	n=395	100%	n=2670

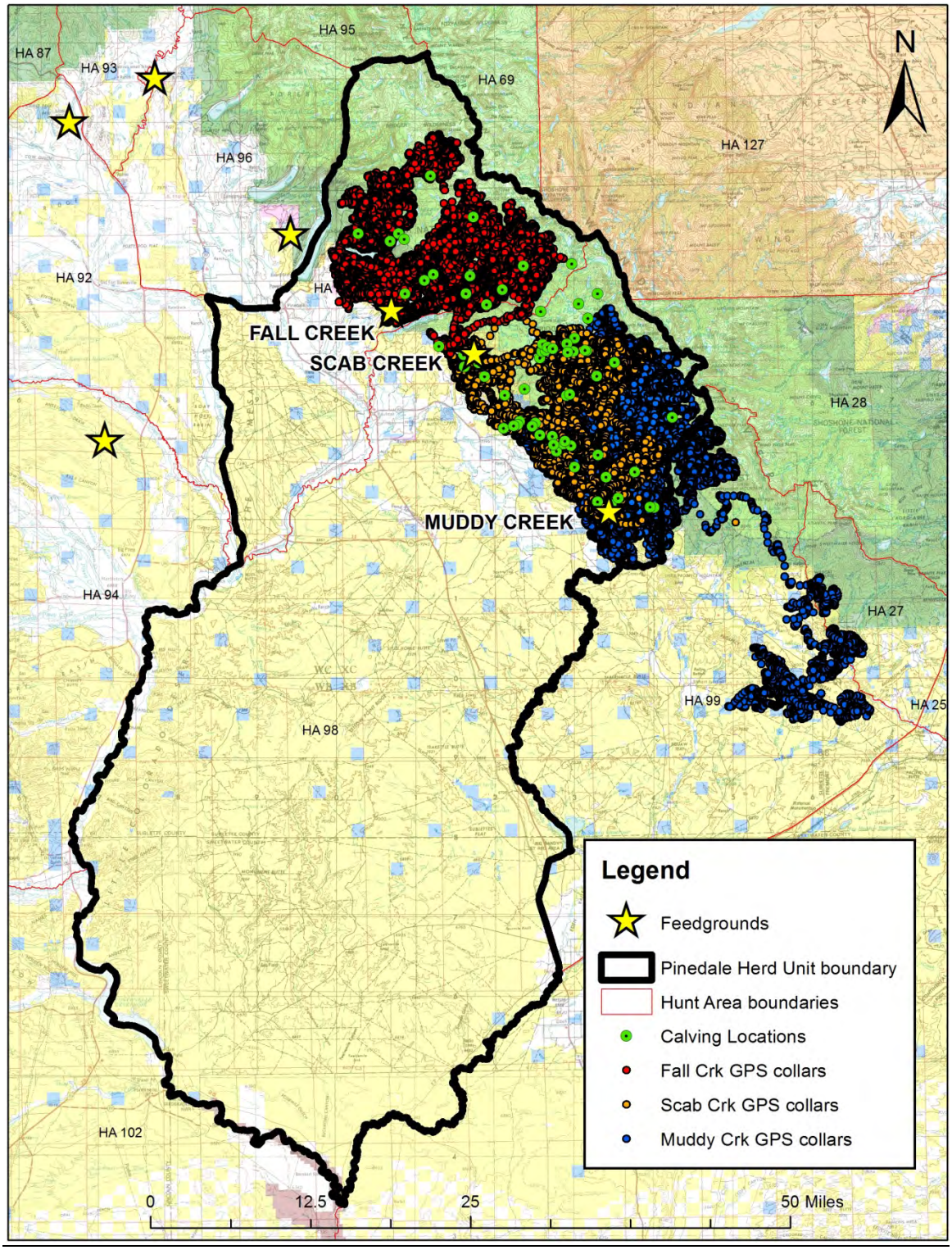

Figure 1. Calving locations based on VIT recovery (bright green circles) and GPS collar locations from all elk captured during winter on Fall Creek (red), Scab Creek (orange), and Muddy Creek (blue) feedgrounds, 2008-2013 (n=31 GPS collars).

STRAIN 19 VACCINATION

Fall, Scab, and Muddy Creek Feedgrounds

Due to the initiation of the pilot T&S project in the Pinedale elk herd unit feedgrounds in 2006, elk have not been vaccinated in effort to reduce the potential for 'false positives', or vaccine reactions, in subsequent T&S trapping or surveillance efforts.