2014 - JCR Evaluation Form

SPECIES: Mule Deer

HERD: MD101 - TARGHEE

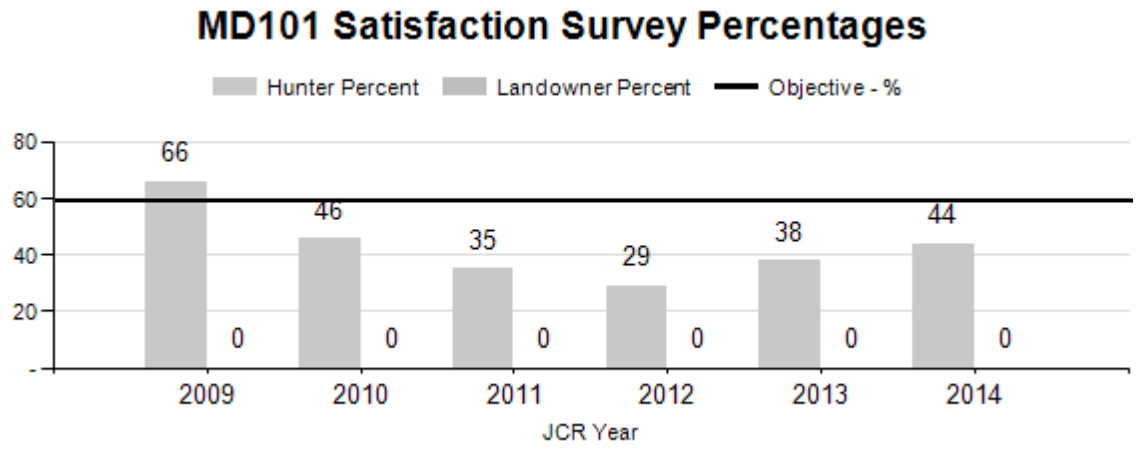
HUNT AREAS: 149

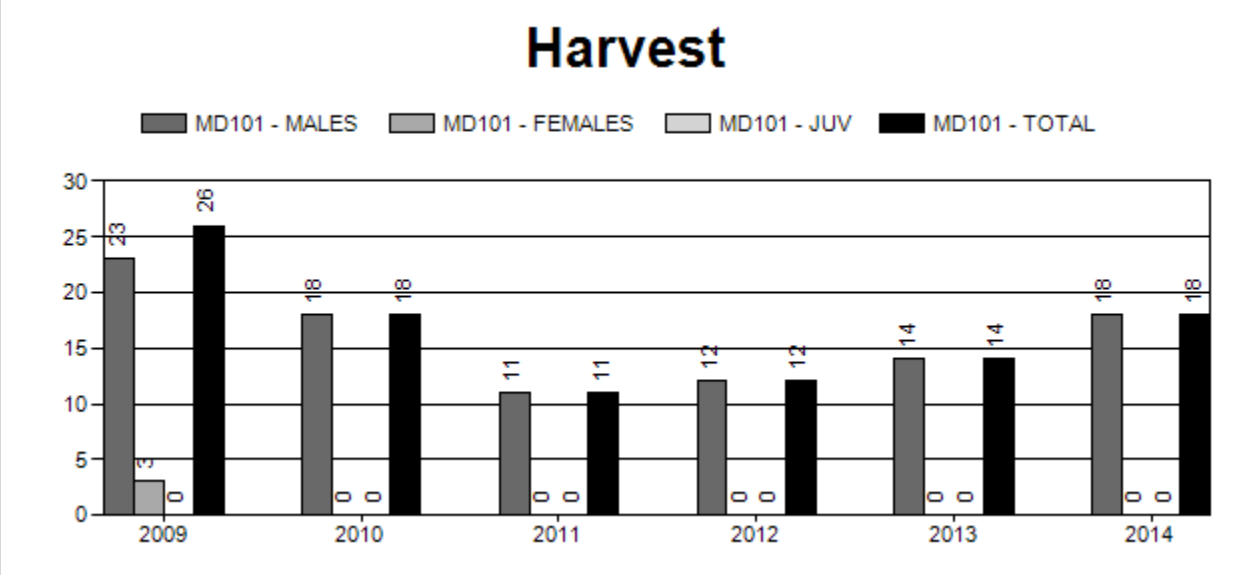
PERIOD: 6/1/2014 - 5/31/2015

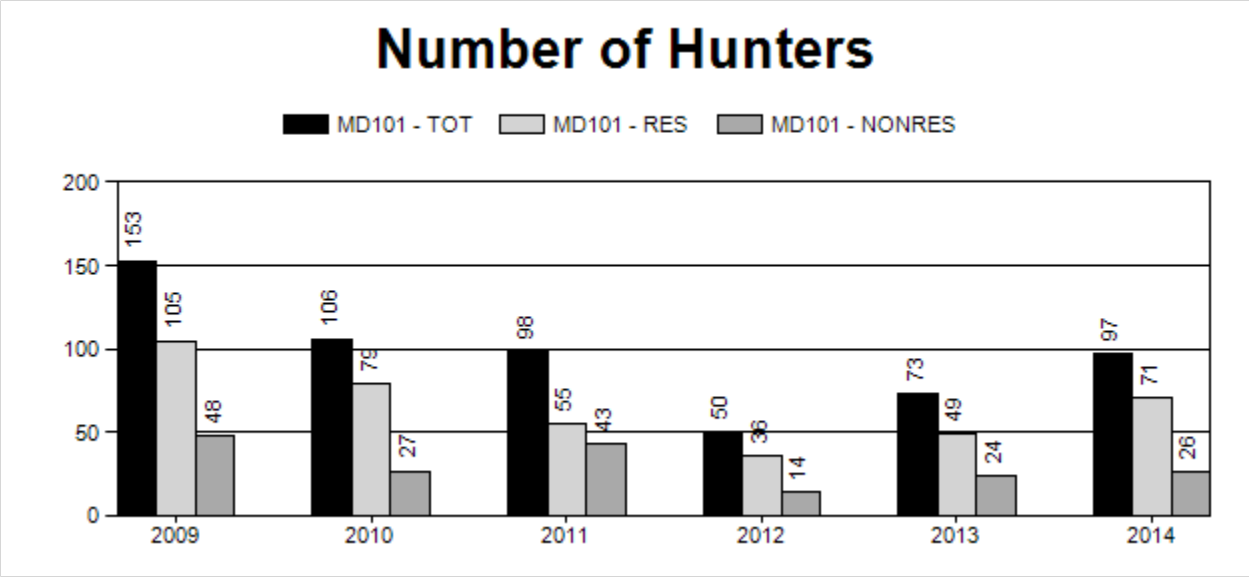
PREPARED BY: ALYSON COURTEMANCH

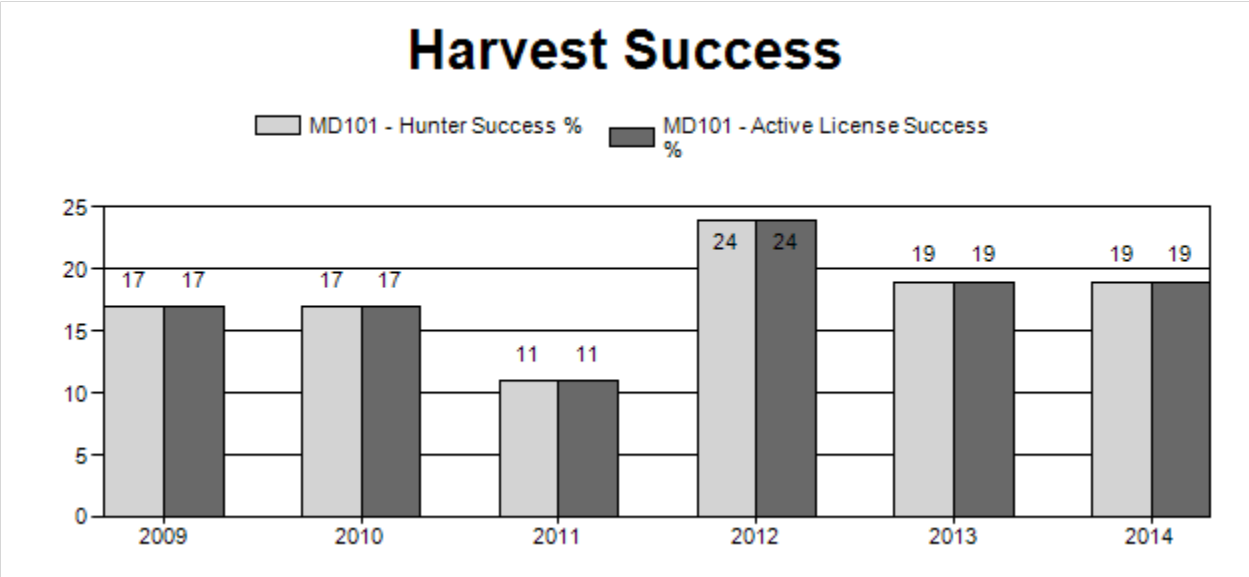
	2009 - 2013 Average	2014	2015 Proposed
Hunter Satisfaction Percent	47%	44%	60%
Landowner Satisfaction Percent	N/A	N/A	N/A
Harvest:	16	18	25
Hunters:	96	97	100
Hunter Success:	17%	19%	25 %
Active Licenses:	96	97	100
Active License Success:	17%	19%	25 %
Recreation Days:	577	434	430
Days Per Animal:	36.1	24.1	17.2
Males per 100 Females:			
Juveniles per 100 Females			

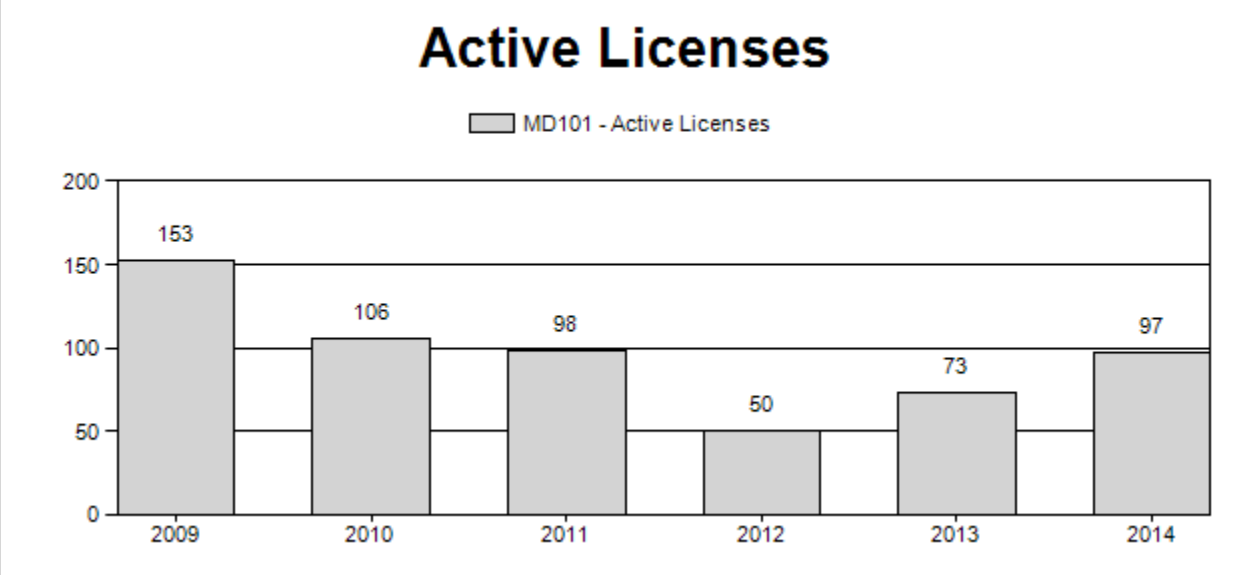
Satisfaction Based Objective	60%
Management Strategy:	Recreational
Percent population is above (+) or (-) objective:	N/A
Number of years population has been + or - objective in recent trend:	5

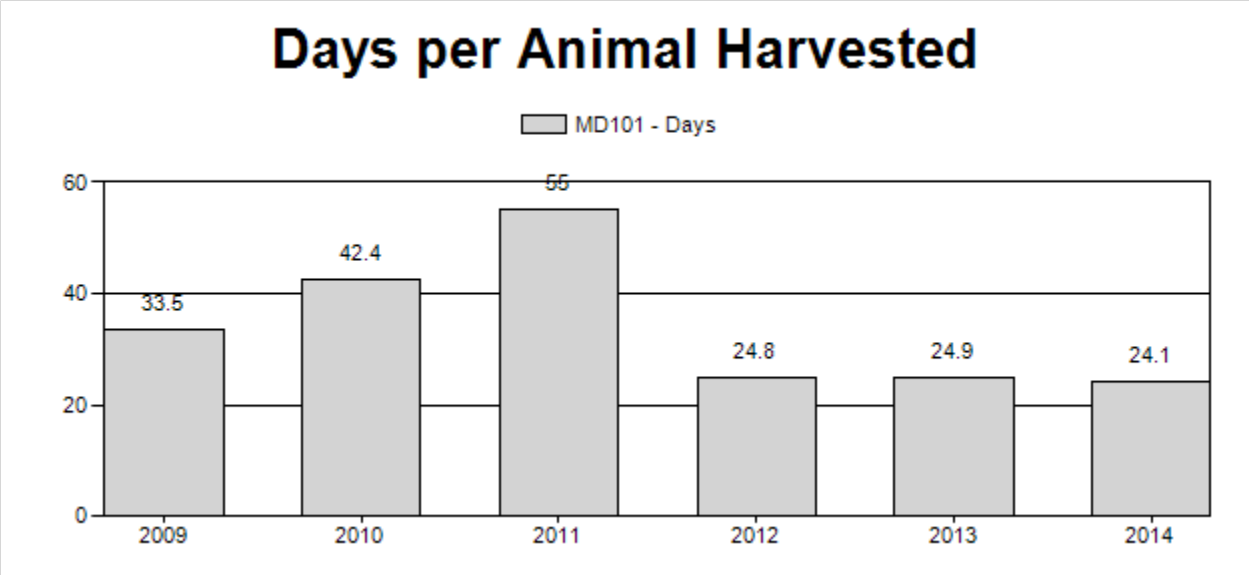


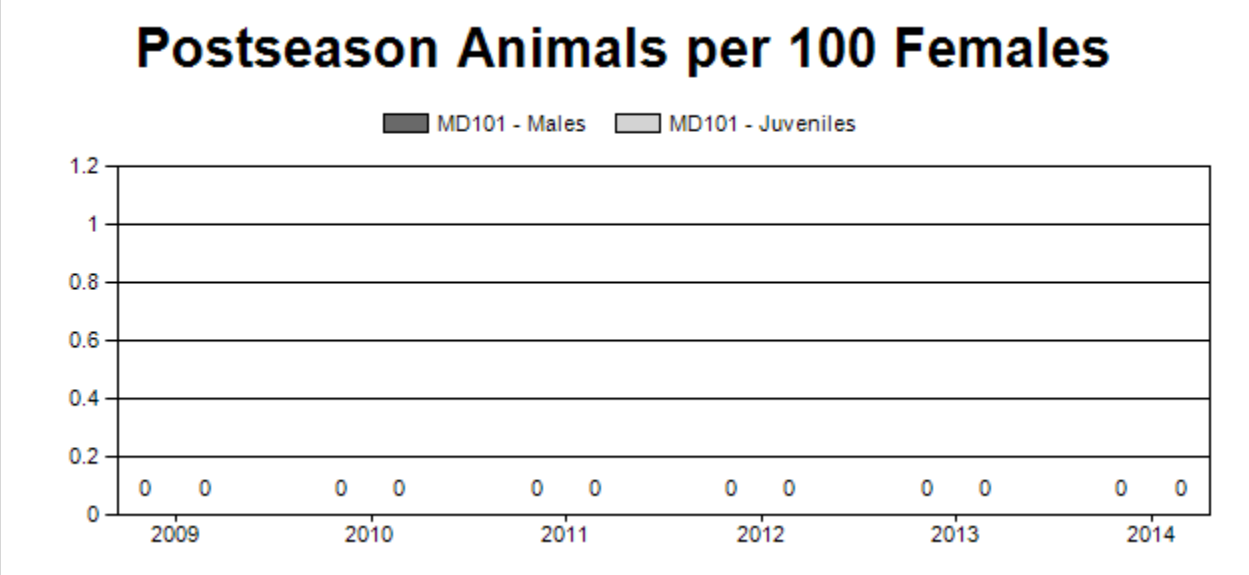

Harvest
MD101 - MALES
MD101 - FEMALES
MD101 - JUV
MD101 - TOTAL
30
25
20
15
10
5
0
23
3
0
26
18
0
0
18
11
0
0
11
12
0
0
12
14
0
0
14
18
0
0
18
2009
2010
2011
2012
2013
2014


Number of Hunters
MD101 - TOT
MD101 - RES
MD101 - NONRES
200
150
100
50
0
153
105
48
106
79
27
98
55
43
50
36
14
73
49
24
97
71
26
2009
2010
2011
2012
2013
2014


Harvest Success
MD101 - Hunter Success %
MD101 - Active License Success %
25
20
15
10
5
0
17
17
17
17
11
11
24
24
19
19
19
19
2009
2010
2011
2012
2013
2014


Active Licenses
MD101 - Active Licenses
200
150
100
50
0
153
106
98
50
73
97
2009
2010
2011
2012
2013
2014


Days per Animal Harvested
MD101 - Days
60
40
20
0
33.5
42.4
55
24.8
24.9
24.1
2009
2010
2011
2012
2013
2014


Postseason Animals per 100 Females
MD101 - Males
MD101 - Juveniles
1.2
1
0.8
0.6
0.4
0.2
0
0 0
0 0
0 0
0 0
0 0
0 0
2009
2010
2011
2012
2013
2014

2015 HUNTING SEASONS
TARGHEE MULE DEER HERD (MD101)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
149		Sep. 15	Oct. 7		General	Antlered mule deer or any white-tailed deer
149	8	Sep. 15	Nov. 30	50	Limited quota	Doe or fawn white-tailed deer

Special Archery Seasons

Hunt Area	Season Dates	
	Opens	Closes
149	Sep. 1	Sep. 14

Summary of Changes for 2015

Area	Type	Quota	Change from 2014
149	8	50	Addition of Type 8 license valid for doe or fawn white-tailed deer

Management Evaluation

Management Strategy: Recreational
Hunter Satisfaction Objectives:
Primary Objective: Achieve a 3-year average of ≥ 60% of hunters indicating they are "satisfied" or "very satisfied" on the harvest survey.
Secondary Objective: Achieve a 3-year average of ≥ 15% harvest success.

The Wyoming Game and Fish Department (WGFD) proposed changing the objective for the Targhee Mule Deer Herd from a postseason population objective to a hunter satisfaction objective in 2014. The objective change was needed because the herd is rarely surveyed due to budget priorities elsewhere and spreadsheet models do not appear to adequately simulate observed population trends. In addition, the interstate nature of the herd poses additional challenges to population surveys and management. A hunter satisfaction objective was adopted in 2014 after public review, and included a primary and secondary objective (listed above). The region did not adopt a landowner satisfaction objective because the majority of the herd unit is located on public lands.

In 2014, 44% of hunters indicated they were “satisfied” or “very satisfied” with hunting in the Targhee Mule Deer Herd (Figure 1). The average satisfaction for the past 3 years is 37%. Therefore, the herd is currently below its primary objective of ≥ 60% hunter satisfaction.

In 2014, 19% of hunters were successful in the Targhee Mule Deer Herd (Figure 2). The 3-year average of hunter success is 21%. Therefore, the herd is meeting the secondary objective of an average of ≥ 15% harvest success over 3 years.

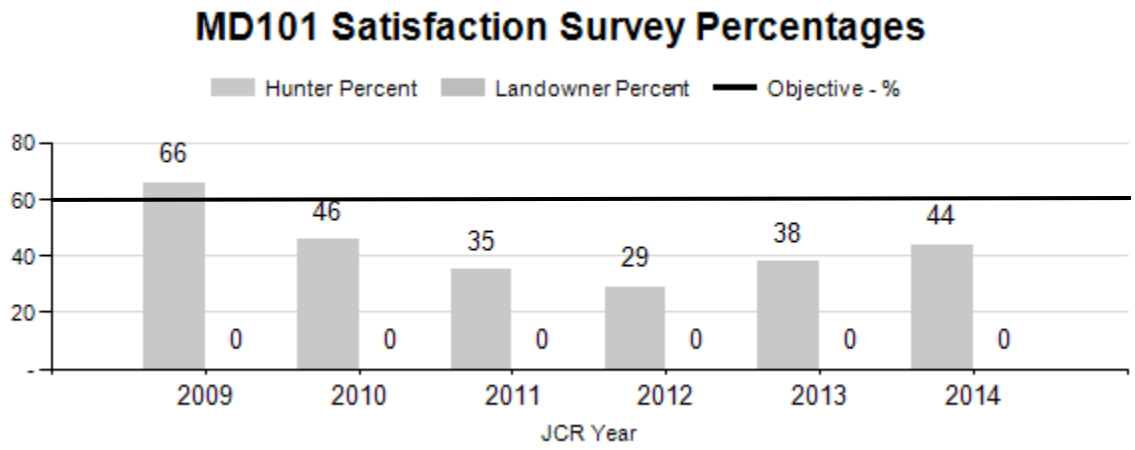


Figure 1. Percent of hunters indicating they are “satisfied” or “very satisfied” with hunting in the Targhee Mule Deer Herd on WGFD’s annual harvest survey. Black line indicates the objective of 60%.

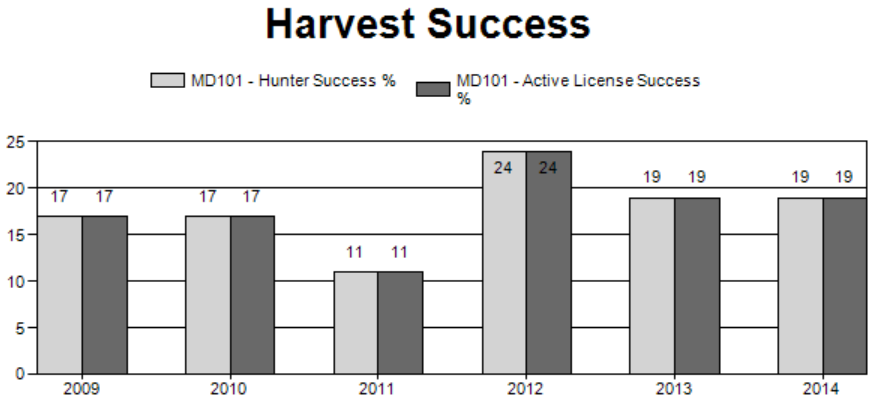


Figure 2. Harvest success rates in the Targhee Mule Deer Herd for 2009-2014.

Herd Unit Issues

Post-season classification surveys are not flown in this herd due to budget constraints. However, mule deer were opportunistically recorded during an aerial survey of the Targhee bighorn sheep herd in March 2015. Fifteen mule deer were observed. Many of the historical winter ranges for the Targhee Herd have been converted to agriculture and residential development in Idaho. Winter ranges that remain are primarily low elevation mountain shrub and aspen communities in

Wyoming and riparian areas in Idaho along the Teton River. Many of the mountain shrub and aspen communities along the state line are old and decadent and are being encroached by conifers. More restrictive hunting seasons have been implemented to allow this population to increase and increase hunter satisfaction. In addition, several private landowners have expressed interest in expanded white-tailed deer hunting opportunities due to increasing numbers.

Weather

Summer and fall 2014 produced consistent moisture, leading to good forage production. Mule deer migrated relatively late in the fall due to warm temperatures and late snowfall. The Snake River Basin received above-average snowfall in December and early January, but weather turned warm and dry by February. Many low elevation slopes were snow-free by mid-February, but snow remained deep and heavy with a hard crust on north-facing slopes and higher elevations. At the time of the mid-winter survey, winter precipitation was reported at 91% of normal. Please refer to the following web sites for specific weather station data.
http://www.wrds.uwyo.edu/wrds/nrcs/snowprec/snowprec.html and
http://www.ncdc.noaa.gov/oa/climate/research/prelim/drought/pdiimage.html

Habitat

There are several historical vegetation transects in mule deer winter ranges that have not been monitored in the past 5 years. Several habitat improvement projects are being planned in this herd unit, including the Hill Creek Prescribed Burn, which is scheduled for completion in 2015. In addition, a habitat treatment in Teton Canyon is currently in the planning stages to improve mountain shrub and aspen communities for mule deer. The WGFD is assisting Caribou-Targhee National Forest (CTNF) with vegetation monitoring in aspen stands pre and post-treatment. Please refer to the 2014 Annual Report Strategic Habitat Plan Accomplishments for Jackson Region habitat improvement project summaries (https://wgfd.wyo.gov/web2011/wildlife-1000708.aspx).

Field Data

No field data were collected in the Targhee Herd Unit during the 2014 biological year.

Harvest Data

Based on harvest statistics, the density of mule deer in the Targhee Herd continues to be a concern. Although the secondary objective of an average of ≥ 15% harvest success over 3 years is being met, most hunters are not satisfied with their hunting experience. The average days to harvest was 24 in 2014. Ninety-seven hunters participated in the hunt and 18 deer were harvested. The number of hunters peaked in 1983 when 575 hunters participated in this hunt.

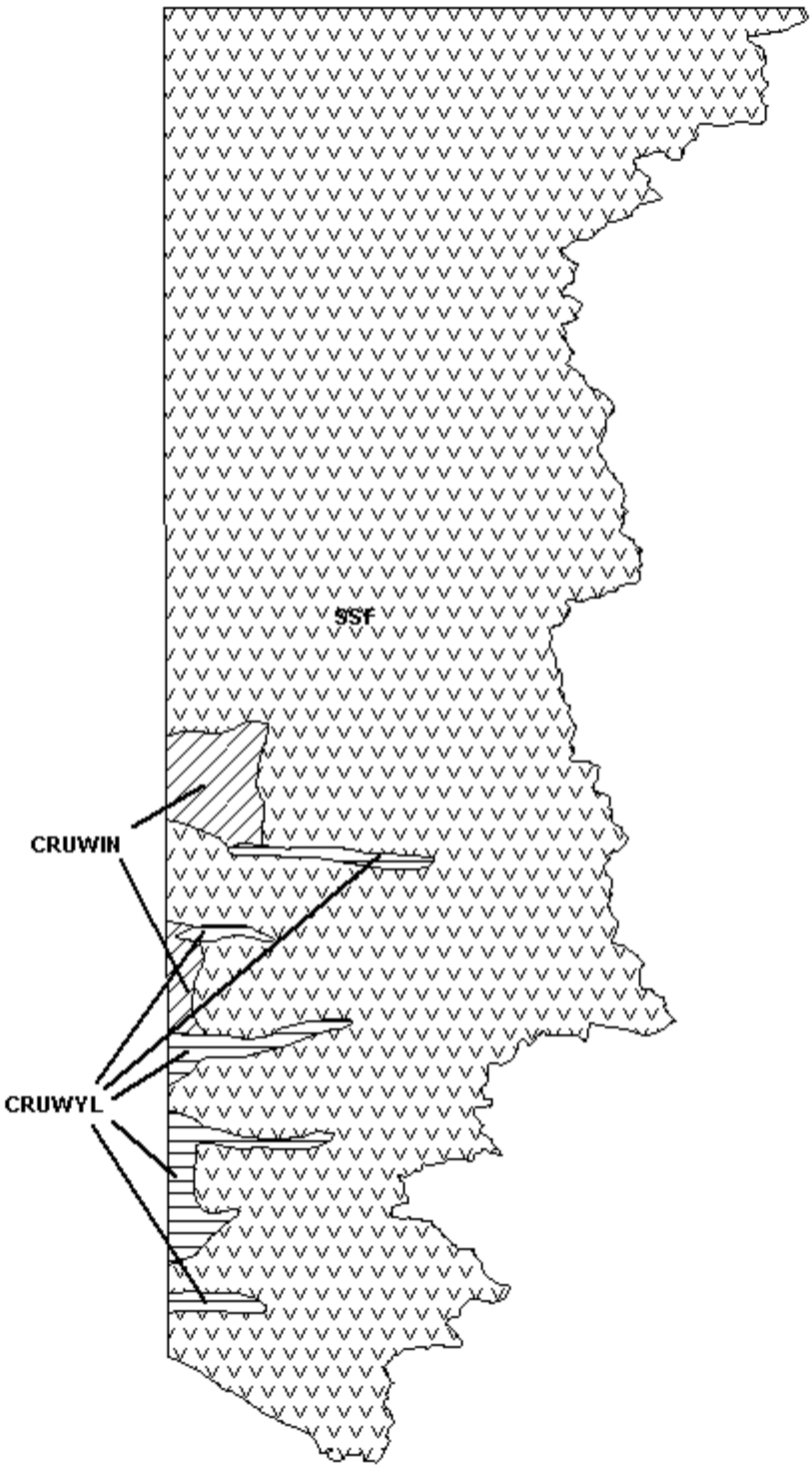
Population

This population likely declined following liberal hunting seasons in Idaho. Data are limited for this population and spreadsheet models do not simulate observed trends. Mule deer winter and transitional ranges in Wyoming are dominated by older age class shrubs and conifer-encroached aspen stands. Many mountain shrub communities are decadent, with plants reaching over 10 feet in height, well above a mule deer's browse zone.

Management Summary

Due to the "interstate" nature of this mule deer population, managing this herd is difficult. Observations of deer along the state line indicate this population remains at a low density even though hunting seasons are conservative. There are no changes planned for the 2015 mule deer hunting season. Antlered deer seasons will close on October 7 to coincide with hunt season closures in adjacent hunt areas east of Jackson. Hunting seasons in Area 149 have minimal impact on this herd and it is likely that more harvest occurs in Idaho than Wyoming. The WGFD continues to work closely with CTNF to develop habitat improvement projects for mule deer and other big game species. In addition, WGFD plans to work more closely with IDFG beginning in 2015 on management issues related to mule deer.

Several private landowners have expressed interest in expanded white-tailed deer hunting opportunities in Hunt Area 149. Therefore, a new Type 8 license will be offered beginning in 2015 for doe or fawn white-tailed deer. Fifty licenses will be available and the season will be open from September 15 – November 30. White-tailed deer licenses will help maintain low densities to prevent competition with mule deer, reduce damage to private lands, and create additional deer hunting options in this area.



Mule Deer (MD101) - Targhee
HA 149
Revised - 7/87

2014 - JCR Evaluation Form

SPECIES: Mule Deer | PERIOD: 6/1/2014 - 5/31/2015

HERD: MD131 - WYOMING RANGE

HUNT AREAS: 134-135, 143-145 | PREPARED BY: GARY FRALICK

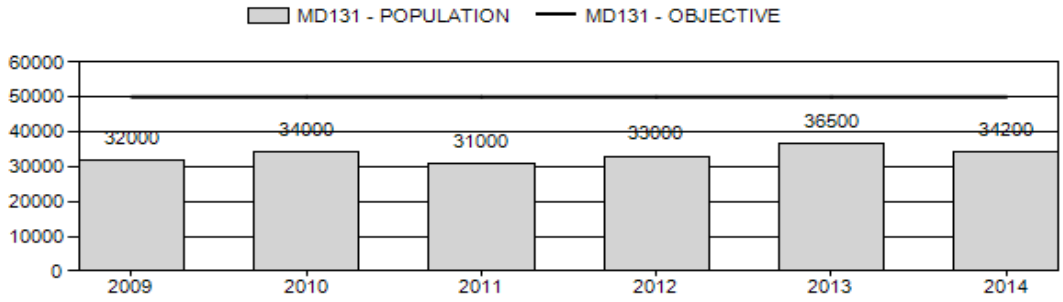
	2009 - 2013 Average	2014	2015 Proposed
Population:	33,300	34,200	34,000
Harvest:	2,244	2,761	2,565
Hunters:	5,463	5,917	5,790
Hunter Success:	41%	47%	44 %
Active Licenses:	5,463	5,917	5,790
Active License Success:	41%	47%	44 %
Recreation Days:	29,878	32,762	31,890
Days Per Animal:	13.3	11.9	12.4
Males per 100 Females	37	41	
Juveniles per 100 Females	65	77	

Population Objective (± 20%) :	50000 (40000 - 60000)
Management Strategy:	Special
Percent population is above (+) or below (-) objective:	-31.6%
Number of years population has been + or - objective in recent trend:	22
Model Date:	2/23/2015

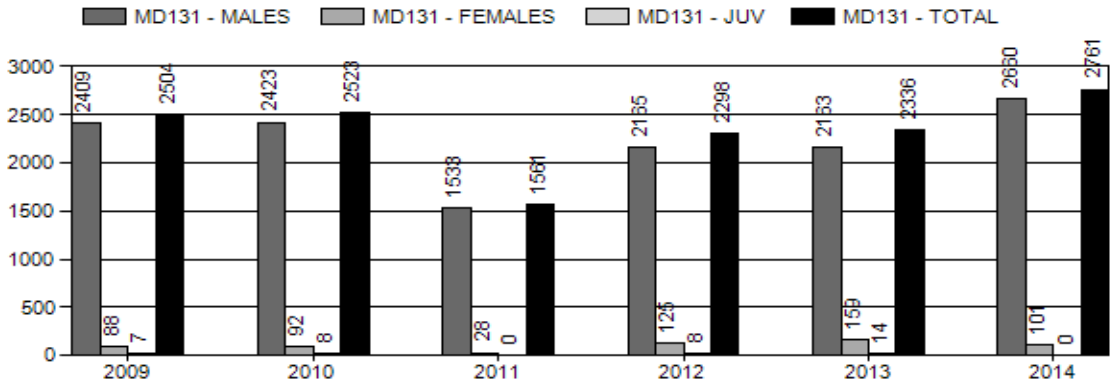
Proposed harvest rates (percent of pre-season estimate for each sex/age group):

	JCR Year	Proposed
Females ≥ 1 year old:	7%	7%
Males ≥ 1 year old:	35%	31%
Juveniles (< 1 year old):	0%	0%
Total:	8%	7%
Proposed change in post-season population:	6%	1%

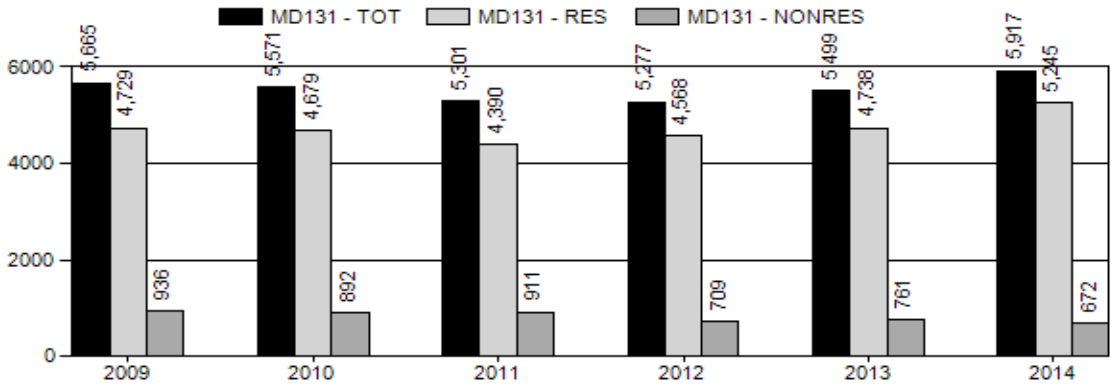
Population Size - Postseason



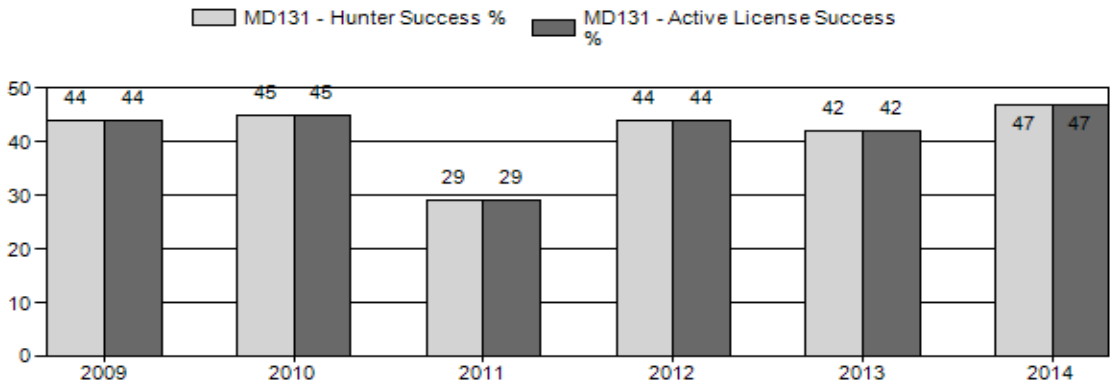
Harvest



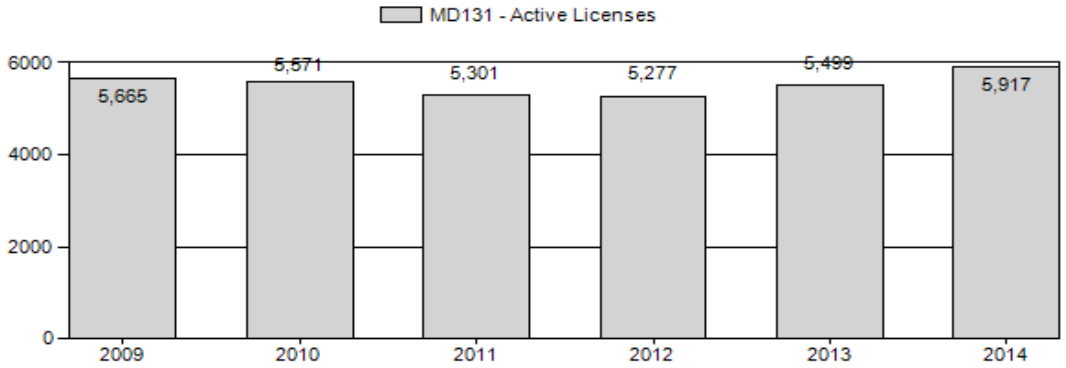
Number of Hunters



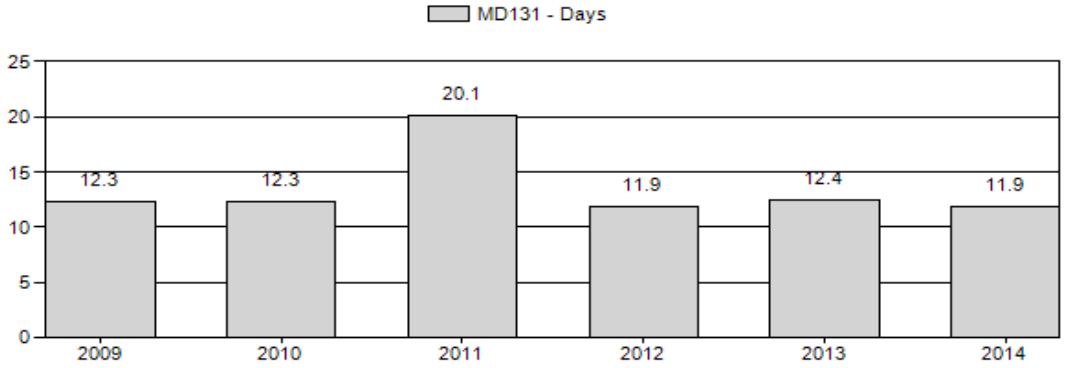
Harvest Success



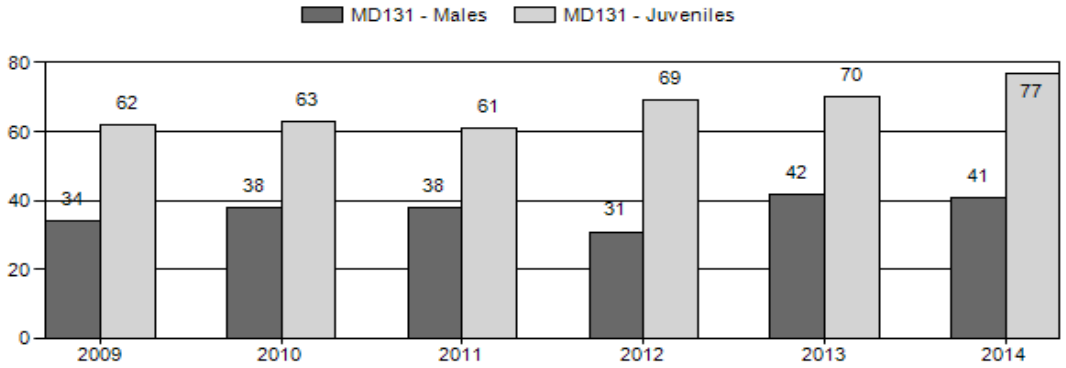
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2009 - 2014 Postseason Classification Summary

for Mule Deer Herd MD131 - WYOMING RANGE

		MALES							FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Post Pop	Ylg	2+ Cls 1	2+ Cls 2	2+ Cls 3	2+ UnCls	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Ylng	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2009	32,000	466	0	0	0	760	1,226	17%	3,617	51%	2249	32%	7092	1240	13	21	34	± 1	62	± 2	46
2010	34,000	494	0	0	0	688	1,182	19%	3,124	50%	1960	31%	6266	1265	16	22	38	± 1	63	± 2	46
2011	31,000	340	0	0	0	998	1,338	19%	3,563	50%	2173	31%	7074	1224	10	28	38	± 1	61	± 2	44
2012	33,000	251	0	0	0	439	690	15%	2,256	50%	1556	35%	4502	1325	11	19	31	± 2	69	± 3	53
2013	36,500	544	0	0	0	704	1,248	20%	2,946	47%	2065	33%	6259	1376	18	24	42	± 2	70	± 2	49
2014	34,200	582	627	428	274	0	1,313	19%	3,239	46%	2478	35%	7030	1232	18	23	41	± 2	77	± 2	54

2015 HUNTING SEASONS
WYOMING RANGE MULE DEER HERD (MD131)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
134		Oct. 1	Oct. 14		General	Antlered mule deer three (3) points or more on either antler or any white-tailed deer
135		Oct. 1	Oct. 14		General	Antlered mule deer or any white-tailed deer
143		Sep. 15	Oct. 7		General	Antlered mule deer or any white-tailed deer
144		Sep. 15	Oct. 7		General	Antlered mule deer or any white-tailed deer
145		Sep.15	Oct. 7		General	Antlered mule deer or any white-tailed deer
145	3	Nov. 1	Nov. 30	60	Limited quota	Any white-tailed deer
145	3	Dec. 1	Jan. 31			Unused Area 145 Type 3 licenses valid for doe or fawn white-tailed deer
134, 135		Sep. 1	Sep. 30			Archery only – REFER TO SECTION 3
143, 144, 145		Sep. 1	Sep. 14			Archery only - REFER TO SECTION 3

SUMMARY OF PROPOSED CHANGES BY LICENSE NUMBER

Area	**License Type**	**Change from 2014**
145	3	Eliminate Type 8 licenses and add Type 3 licenses
Herd Unit Total		No Net Change

<u>Management Evaluation</u>
Current Postseason Population Management Objective: 50,000
Management Strategy: Special
2014 Postseason Population Estimate: ~34,200
2015 Proposed Postseason Population Estimate: ~34,000

The population objective for Wyoming Range mule deer herd is 50,000 deer. The management strategy is special and the objective and management strategy were last revised in 1994. The current population estimate is approximately 34,000 deer. The population objective will be reviewed in 2016.

Herd Unit Issues

The population objective for Wyoming Range mule deer herd is 50,000 deer. The management strategy is special management. The objective and management strategy were last revised in 1994. The current population estimate is approximately 34,000 deer.

Management strategies since 1993 have emphasized hunting antlered deer in an effort to promote population growth. Antlered deer hunts occur in mid -September and early October throughout the herd unit. Hunt seasons close in the northern hunt areas prior to the onset of the annual fall migration in order to minimize vulnerability of bucks that migrate from subalpine summer ranges to sagebrush winter ranges in the Upper Green River Basin. Sustained population growth has been difficult because of the frequency of high overwinter mortality every 3 years on crucial winter ranges, and low vigor and productivity of important winter range browse.

The Wyoming Range Mule Deer Project was launched in March 2013. The overall goal of this research project is to address important research and management needs indentified by the Wyoming Mule Deer Initiative and Wyoming Range Mule Deer Initiative. An important aspect of this research is to investigate the nutritional relationships between mule deer population dynamics, energy development and disturbance, habitat conditions, and climate to provide a mechanistic approach to monitoring and management of mule deer (Appendix A). A planned approach is to integrate data on nutritional condition, forage production and utilization, and population performance to understand factors regulating Wyoming Range mule deer and the ability of the current habitat to support mule deer. In addition, there is an opportunity to address secondary objectives including nutritional contributions of winter and summer ranges, factors affecting reproduction, identification of habitats of nutritional and reproductive importance to mule deer, timing and delineation of important migration routes, and direct assessment of the effects of energy development on nutrition and survival of mule deer (Monteith et al. 2012).

In March 2015 Phase II of the Wyoming Range Mule Deer Project will be implemented. Phase II will focus on measuring survival and cause-specific mortality of mule deer fawns to quantify the relative roles of habitat, nutrition, and predation on recruitment of young (Monteith et al. 2014; Appendix B). Specific objectives of this project will quantify the effects of predation on survival

of young mule deer, which will 1) identify key regions where predation is a main limiting factor and thus, would benefit from targeted predator control, 2) characterize what key habitat features may lead to reduced risk of predation, and 3) understand the role that predators have played in reducing population performance of Wyoming Range mule deer (Monteith et al. 2014). A consortium of partners and cooperators have contributed essential funding for this project.

Weather

Weather conditions during the 2014 were ideal for forage production beginning in early spring and continuing through fall. By late summer the moisture regime had changed frequent precipitation scenario that persisted into the fall hunting season. Drought conditions in the early portion of the summer abated by late fall as persistent snow storms began to deposit snowpack in the Wyoming and Salt Mountain Ranges. By mid winter snow conditions on winter ranges had changed significantly. Little to no snow had accumulated on core winter ranges. These conditions persisted throughout the remainder of the winter. By late winter 2015 snowpack in western Wyoming watersheds were estimated to be at or slightly above normal. For additional weather and precipation data please visit the following websites:
http://www.ncdc.noaa.gov/temp-and-precip/time-series and
http://www.ncdc.noaa.gov/oa/climate/research/prelim/drought/pdiimage.html.

Habitat

Winter range browse plants have been measured each spring and fall to assess production and utilization since the late 1990s. Growing conditions improved in 2014 on winter ranges because of moisture regimes in early spring and throughout the growing seasons. Improved growing conditions were due to spring and summer rains which have a different effect on shrubs than winter snowpack due to rates of infiltration. Leader production on Wyoming big sagebrush and black sagebrush were the species most notably improved compared to the 2013 leader growth. However, average leader growth was still less than a half inch for Wyoming big sagebrush sites and less than two inches for mountain shrubs. For additional site specific information, please refer to the 2014 Annual Report Strategic Habitat Plan Accomplishments, for the Pinedale Region habitat improvement project summaries
(http://wgfd.wyo.gov/web2011/wildlife-1000708.aspx).

Field Data

The Wyoming Range deer herd has been unable to sustain population growth for more than 3 consecutive years since the early 1990s. Normal to high over-winter mortality has suppressed this population's ability to sustain growth because of poor survival and recruitment of fawns.

Since the initiation of the Wyoming Range Mule Deer Project, radio-collared adult does have provided an index on two important metrics: adult survival and fetal rates. Adult survival has exceeded 70% over the last three years; during the same period fetal rates have averaged from 1.6 fetuses/doe. An on-going effort to monitor population dynamics with posthunt herd composition surveys provides an assessment of buck recruitment and fawn production and survival. Buck:doe ratios have met or exceeded the special management objective of 30-45

bucks:100 does in the posthunt population over the last 7 years. Moderate to high overwinter survival has ensured recruitment of 1.5+ year old bucks.

The primary issue affecting the population dynamic of the northern segment of the herd, is the general decline in productivity and survival of fawns on the LaBarge/Big Piney winter ranges (Area 143) as seen in fawn:doe ratios from 1996- present. During the 5-year period from 1996-2000, an average of 82 fawns:100 does were observed on this winter range. During a subsequent 5-years period (2010-2014), the average fawn:100 does ratio was 64:100. Body condition of pregnant does that arrive on winter ranges and depart in the spring is the primary determinant to fawn production and survival.

Despite lower fawn survival and recruitment, buck ratios have met management goals of 30-45 bucks in the posthunt population. Since 2010 buck:does ratios have exceeded 40:100 in four of The last two years buck ratios herd unit wide have exceeded 40:100. On the LaBarge winter ranges buck:doe ratios averged 42 bucks:100 since 2010. The highest buck ratio achieved in at least 20 years was in 2013 when 46 bucks:100 does were observed on the LaBarge winter ranges.

On the southern winter ranges, low fawn recruitment is of concern, and is believed to be related to habitat conditions, nutritional condition of doe deer, effects of winter severity, and predation. Poor browse production related to persistent drought, and an increase in decadent and over-mature forage plants on crucial winter ranges are factors that dictate over-winter deer survival even in mild and open winters. Additional factors are the declining trend in vigor, and increase in dead and decadence, of aspen communities in parturition and summer ranges. The condition of aspen communities is believed to be significant contributors to declining neonatal fawn survival and recruitment.

Over the last 22 years, posthunt herd composition surveys have been followed by post-winter change-in-ratio (CIR) surveys. These surveys provide a metric of over-winter survival of the juvenile cohort by comparing December to April changes in proportions of fawns.

Harvest

Hunting seasons since 1993 have been designed to allow 7-14 days of hunting in the southern areas (Areas 134,135) and 16-23 days of hunting in the northern areas (Areas 143-145). Antlered only hunting, and the near absence of antlerless harvest has failed to produce the sustained population increase since the late 1990s. Nonresident licenses were reduced to 600 licenses for Region G beginning in 2012. Observed buck:doe ratios totaled 42 bucks :100 does in 2013, which is the highest observed buck:doe ratio since 1991. A conservative management approach of closing hunting seasons prior to annual fall migration in the northern hunt areas has ensured that trophy class bucks continue to be recruited into the posthunt population.

Hunter success was estimated at 47% in 2014 with a total harvest of 2760 deer. Harvest success has exceeded 40% the last two years and reflects relatively high over-winter survival of all age and sex cohorts of the population, especially the 2+-years old male cohort. A total of 101 does were taken in 2014; antlerless harvest tallied 4% of the total herd unit harvest. Nonresident

hunters comprised 11% of the herd unit's total hunters, and accounted for 14% of the total harvest. Since the reduction in nonresident G licenses in 2012, the percentage of antlered deer harvested by resident hunters and checked in the field by Department personnel has increased.

Population

The population trend has increased over the last 5 years, although only minimally. The "Time Sensitive Juvenile – Constant Adult Mortality Rate" (TSJ,CA) spreadsheet model was used to derive the post season population estimate. The TSJ,CA model showed the best overall fit compared to the suite of available models (Fit=1, Relative AICc=116). This model tracks observed buck:100 doe ratios extremely well.

Management Summary

The population remains below the objective. The 2015 hunting season is designed to promote population growth and retain bucks in the posthunt population by closing hunt seasons prior to the onset of the fall migration. Nonresident Region G licenses will remain at 600 licenses. The 2015 season in Hunt Areas 134 and 135 will allow 14 days of general season antlered deer hunting, with the added restriction that antlered deer with three points or more on either antler may be taken in Areas 134. Both areas will allow the take of any white-tailed deer.

Hunt Areas 143-145 will close on October 7 in 2015, and offer hunters the opportunity to harvest antlered mule deer or any white-tailed deer. The 2015 closing date is similar to the 2014 closing date. The October portion of the hunting season in the northern areas will close prior to the onset of the fall migration which typically begins in late September; it is during the fall migration that bucks are most vulnerable when snow accumulations at higher elevations force deer to into areas more accessible to hunters. Season closure prior to this migration will ensure that overharvest of bucks does not occur.

In Area 145, a limited quota any white-tailed deer hunt will allow hunters to take any white-tailed deer during the November portion of the hunting season, and doe or fawn white-tailed deer in an area where chronic damages to stored crops on private property have been occurring.

The 2015 hunting seasons are projected to harvest approximately 2600 deer. The population should be maintained at approximately 34,000 deer following the 2015 hunting seasons.

INPUT	
Species:	Mule Deer
Biologist:	Gary Fralick
Herd Unit & No.:	Wyoming Range
Model date:	02/23/15

☐ Clear form

MODELS SUMMARY		Fit	Relative AICc	Check best model to create report	Notes
CJ,CA	Constant Juvenile & Adult Survival	214	223	☐ CJ,CA Model	
SCJ,SCA	Semi-Constant Juvenile & Semi-Constant Adult Survival	129	149	☐ SCJ,SCA M	
TSJ,CA	Time-Specific Juvenile & Constant Adult Survival	1	116	☑ TSJ,CA Model	

Population Estimates from Top Model

Year	Posthunt Population Est.		Trend Count	Predicted Prehunt Population				Predicted Posthunt Population				Objective
	Field Est	Field SE		Juveniles	Total Males	Females	Total	Juveniles	Total Males	Females	Total	
1993				30468	19543	63111	113123	30422	18489	62483	111394	
1994				31489	16959	51581	100029	31489	15582	51581	98652	
1995				32857	19350	47679	99885	32857	17675	47679	98211	
1996				30995	16113	39725	86833	30995	14565	39725	85285	
1997				22892	12469	32269	67630	22892	11158	32269	66319	
1998				23098	13971	30585	67654	23098	11762	30585	65445	
1999				22857	14476	29288	66621	22857	11617	29288	63762	
2000				22737	13991	27897	64626	22698	10595	27584	60877	
2001				16659	12611	25980	55250	16616	9624	25705	51945	
2002				13659	9241	21896	44797	13622	6831	21441	41894	
2003				13982	8621	20118	42722	13914	6207	19806	39927	
2004				12491	7127	17829	37446	12432	5058	17389	34878	
2005				11917	7277	16981	36175	11917	5478	16951	34347	
2006				11274	7411	16439	35124	11274	5350	16439	33064	
2007				12769	9453	18179	40402	12769	6955	18179	37904	
2008				9996	8027	16860	34884	9984	6036	16790	32810	
2009				10425	8389	16851	35665	10418	5739	16754	32911	
2010				11257	9360	18029	38646	11248	6695	17928	35871	
2011				10250	7998	16838	35086	10250	6312	16807	33369	
2012				10452	7017	15276	32745	10443	4631	15141	30215	
2013				11173	7822	16093	35087	11158	5442	15918	32518	
2014				12520	8232	16476	37228	12520	5306	16365	34191	
2015				11121	8610	17313	37043	11121	5915	17186	34222	
2016												
2017												
2018												
2019												
2020												
2021												
2022												
2023												
2024												
2025												

Survival and Initial Population Estimates

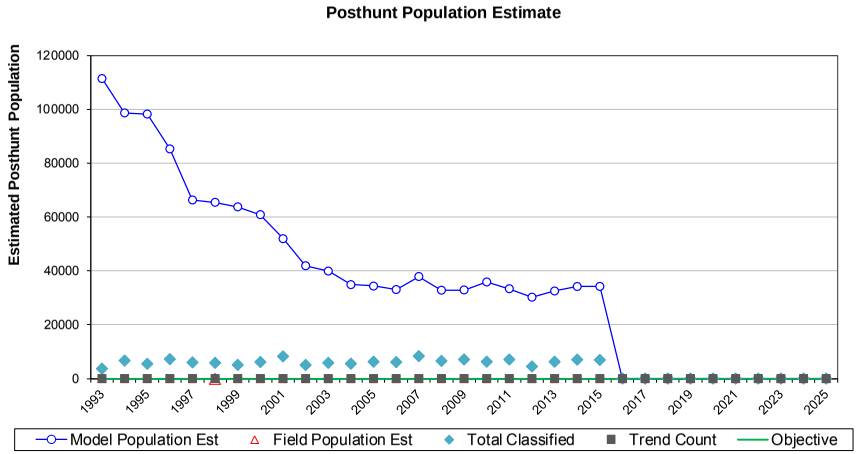
Year	Winter Juvenile Survival Rates			Annual Adult Survival Rates		
	Model Est	Field Est	SE	Model Est	Field Est	SE
1993	0.16			0.79		
1994	0.45			0.79		
1995	0.13			0.79		
1996	0.07			0.79		
1997	0.45			0.79		
1998	0.45			0.79		
1999	0.42			0.79		
2000	0.38			0.79		
2001	0.20			0.79		
2002	0.48			0.79		
2003	0.32			0.79		
2004	0.53			0.79		
2005	0.52			0.79		
2006	0.93			0.79		
2007	0.40			0.79		
2008	0.73			0.79		
2009	0.93			0.79		
2010	0.49			0.79		
2011	0.40			0.79		
2012	0.80			0.79		
2013	0.71			0.79		
2014	0.71			0.79		
2015	0.71			0.79		
2016						
2017						
2018						
2019						
2020						
2021						
2022						
2023						
2024						
2025						

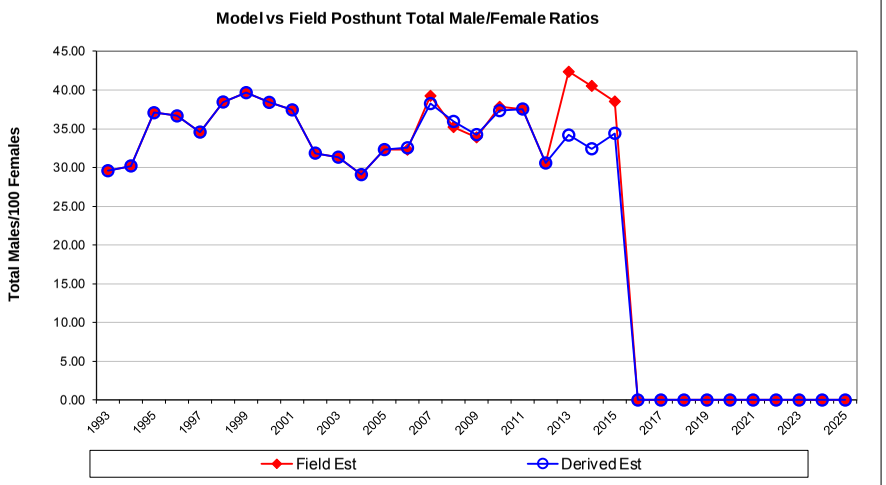
Parameters:	Optim cells
Adult Survival =	0.787
Initial Total Male Pop/10,000 =	1.849
Initial Female Pop/10,000 =	6.248

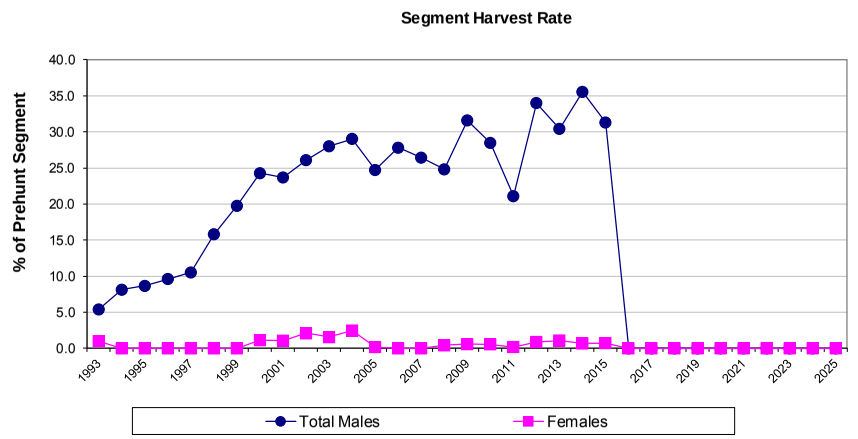
MODEL ASSUMPTIONS	
Sex Ratio (% Males) =	50%
Wounding Loss (total males) =	10%
Wounding Loss (females) =	10%
Wounding Loss (juveniles) =	10%

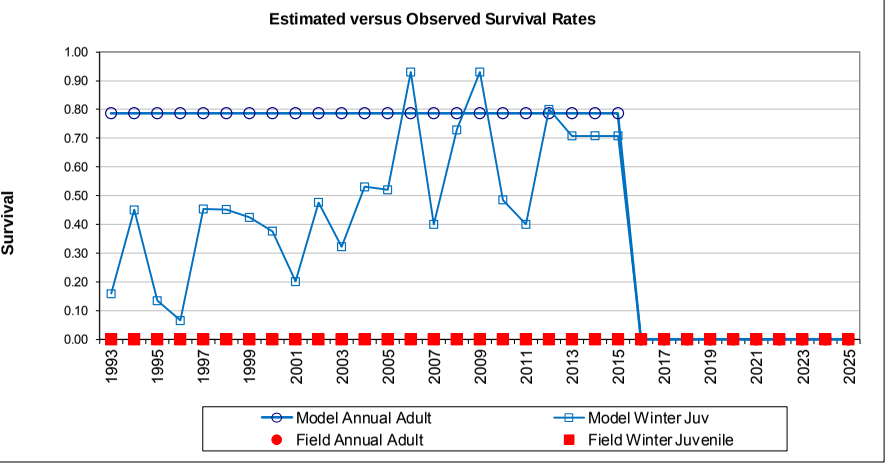
	Classification Counts						Harvest						
Year	Juvenile/Female Ratio			Total Male/Female Ratio								Segment Harvest Rate (% of Prehunt Segment)	
	Derived Est	Field Est	Field SE	Derived Est	Field Est w/o bull adj	Field SE	Juv	Yrl males	2+ Males	Females	Total Harvest	Total Males	Females
1993		48.69	1.88	29.59	29.59	1.37	42	0	958	571	1571	5.4	1.0
1994		61.05	1.68	30.21	30.21	1.06	0	0	1252	0	1252	8.1	0.0
1995		68.91	2.09	37.07	37.07	1.38	0	0	1522	0	1522	8.7	0.0
1996		78.03	2.03	36.66	36.66	1.22	0	0	1408	0	1408	9.6	0.0
1997		70.94	2.04	34.58	34.58	1.26	0	0	1192	0	1192	10.5	0.0
1998		75.52	2.21	38.46	38.46	1.40	0	0	2008	0	2008	15.8	0.0
1999		78.04	2.44	39.66	39.66	1.54	0	0	2599	0	2599	19.7	0.0
2000		82.29	2.32	38.41	38.41	1.38	36	0	3087	285	3408	24.3	1.1
2001		64.64	1.61	37.44	37.44	1.12	39	0	2715	250	3004	23.7	1.1
2002		63.53	2.01	31.86	31.86	1.28	34	0	2191	414	2639	26.1	2.1
2003		70.25	2.03	31.34	31.34	1.19	62	0	2195	284	2541	28.0	1.6
2004		71.50	2.11	29.09	29.09	1.17	53	0	1881	400	2334	29.0	2.5
2005		70.30	1.97	32.32	32.32	1.18	0	0	1635	27	1662	24.7	0.2
2006		68.58	1.95	32.55	32.30	1.18	0	0	1873	0	1873	27.8	0.0
2007		70.24	1.73	38.26	39.25	1.17	0	0	2271	0	2271	26.4	0.0
2008		59.47	1.68	35.95	35.22	1.19	11	0	1810	64	1885	24.8	0.4
2009		62.18	1.67	34.25	33.90	1.12	7	0	2409	88	2504	31.6	0.6
2010		62.74	1.81	37.34	37.84	1.29	8	0	2423	92	2523	28.5	0.6
2011		60.99	1.66	37.55	37.55	1.20	0	0	1533	28	1561	21.1	0.2
2012		68.97	2.27	30.59	30.59	1.33	8	0	2169	123	2300	34.0	0.9
2013		70.10	2.01	34.19	42.36	1.43	14	0	2163	159	2336	30.4	1.1
2014		76.51	2.04	32.42	40.54	1.33	0	0	2660	101	2761	35.5	0.7
2015		64.71	1.77	34.42	38.53	1.25	0	0	2450	115	2565	31.3	0.7
2016													
2017													
2018													
2019													
2020													
2021													
2022													
2023													
2024													
2025													

FIGURES









Comments:

END

The Wyoming Cooperative Fish and Wildlife Research Unit and the Wyoming Game and Fish Department, along with numerous research partners initiated the Wyoming Range Mule Deer Project in March 2013. The overarching goal of our work is to investigate the nutritional relationships among habitat conditions, climate, behavior, and population dynamics of mule deer in the Wyoming Range of western Wyoming. This update will report on the recently completed spring and summer fieldwork, which aimed to quantify habitat quality and diet composition of mule deer during migration and while on summer range. It is hypothesized that phenology, or the life stage of plants, plays an important role in driving migration and habitat use on summer range, and these behavioral strategies are reflected in nutritional condition. This season, we collected a suite of data to investigate these relationships.

What is Phenology Tracking?

Plant phenology is the timing of various life stages of plants and is driven by environmental and climatic influences that vary seasonally.

Changes in plant phenology through time

06/15/14

06/24/14

07/17/14

07/26/14

Deer are a lot like goldilocks, they prefer to eat plants at a very specific life stage (not too old and not too young). This way, they can access the most digestible and nutrient rich food, which should ultimately result in enhanced nutritional condition.

Too Young

Not enough biomass

Just Right

Easy to digest

High in nutrients

Too Old

Build up of defense compounds

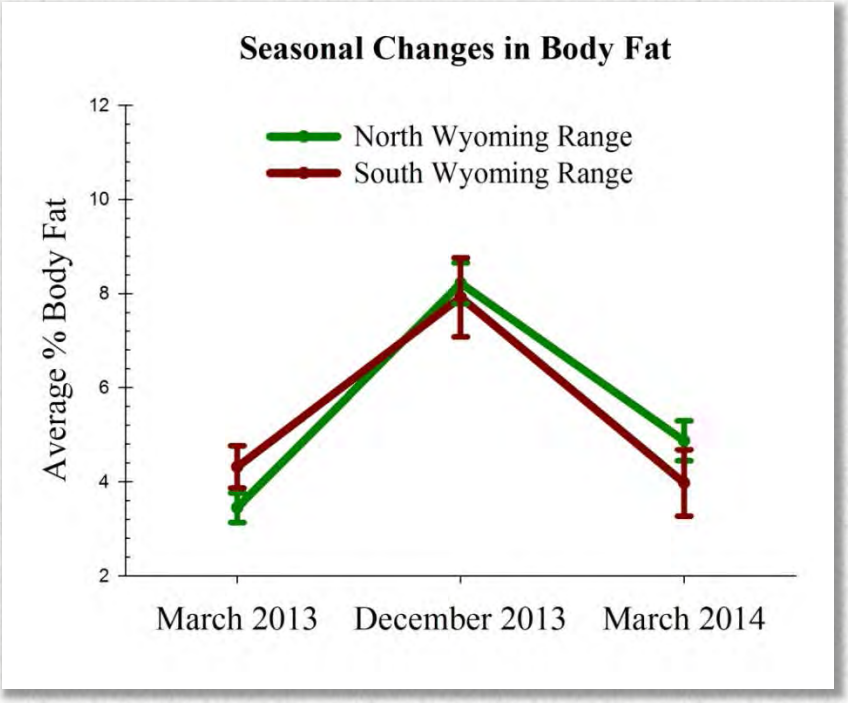
Hard to digest

For mule deer, phenology of newly emerging forage can play a major role in various aspects of migration (e.g. timing of migration or selection of stopover sites). As mule deer migrate, they can exhibit the phenomenon known as **phenology tracking** by following the green-up of the most nutritious forage along an elevational and latitudinal gradients. Phenology tracking also can occur through habitat use on summer ranges. Deer that select for landscapes that are topographically diverse (i.e. elevation, slope, aspect) may prolong access to nutritious green-up across different topographical gradients. The benefits of phenology tracking should be reflected in nutritional condition on both the individual and population levels

What data are we collecting?

Nutritional Condition

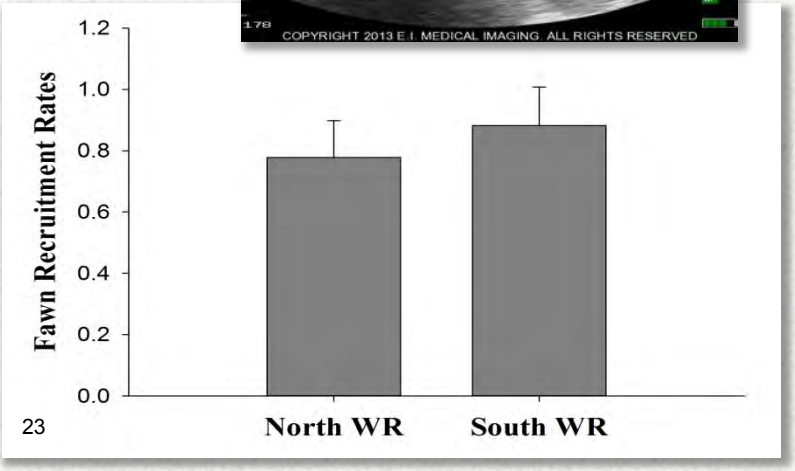
Since spring 2013, we have been monitoring seasonal changes in nutritional condition of mule deer by recapturing GPS collared individuals each March and December. Nutritional condition is determined by combining a body condition score with rump fat measured using ultrasonography. Currently, we have data on changes in nutritional condition from individual animals over 2 seasons (summer of 2013 and winter of 2014) and will continue monitoring through spring 2015.



With these data, we can link changes in nutritional condition of individual animals with the forage quality and habitat conditions they experience during migration and throughout the summer.

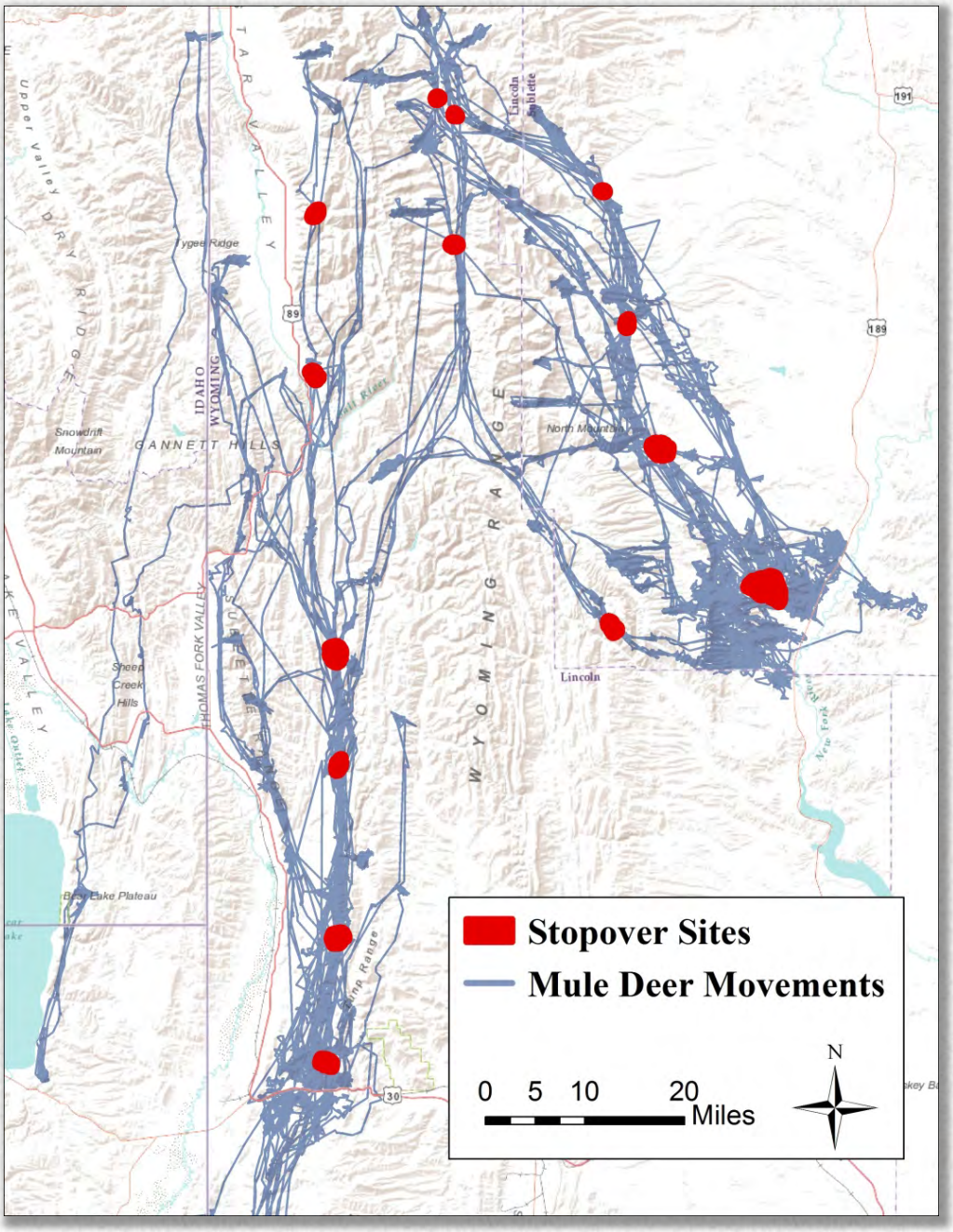
Reproduction

We also assess reproductive status of each individual deer by measuring pregnancy in spring and fawn recruitment in autumn. With this information, we can better evaluate how different strategies in migration and summer habitat conditions influence nutritional condition and recruitment of young.



Migration

Throughout the spring of 2014, we collected a suite of data from stopover sites used by mule deer fitted with GPS collars throughout the Wyoming Range. Stopover sites are areas along a migration route that are characterized by prolonged use. It is suspected that these sites are selected for because of enhanced quality of available forage (i.e. the phenology is "just right") allowing for refueling as animals migrate from winter to summer ranges. Data collected from these stopover sites will be used to identify migratory strategies and quantify the benefits of transitional habitat during migration.



Each of the 14 stopovers were visited every 1-2 weeks; we collected the following data during each visit:

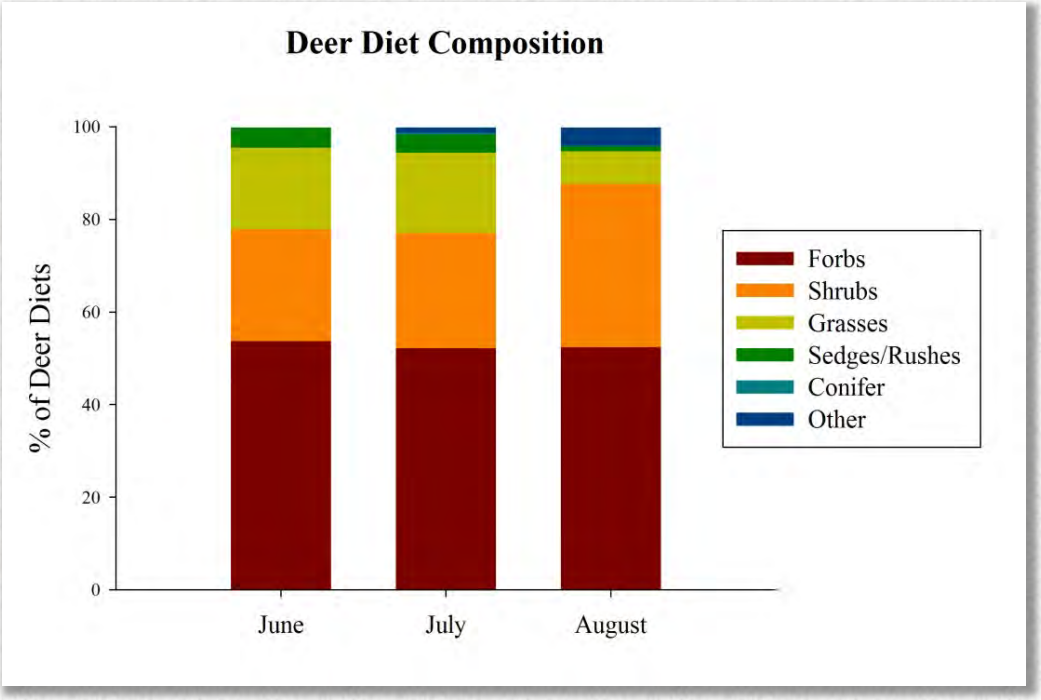
1. Vegetation measurements – used to assess composition and availability of target plants through time.

2. Fecal samples –used to assess the diet composition of mule deer as they migrate.

3. Plant clippings of 12 target plants – used to evaluate temporal changes in digestibility and available protein.

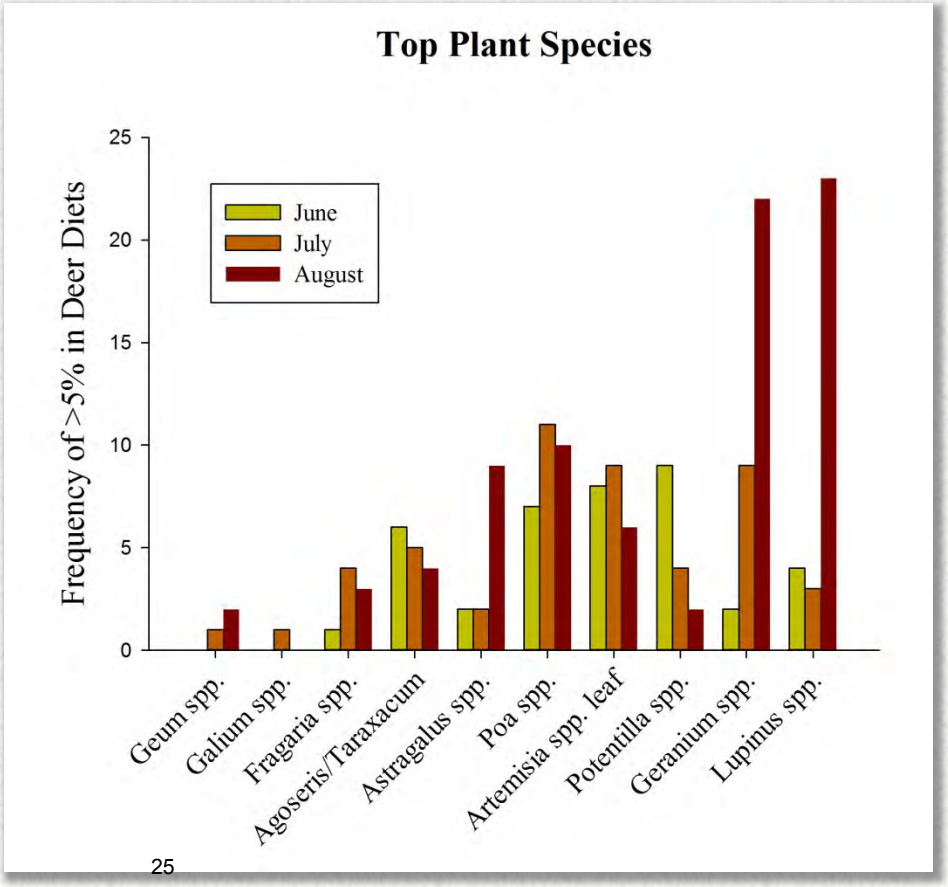
Summer Range

To evaluate composition and quality of mule deer diets on summer ranges, we collected fecal samples from summer home ranges of 35 GPS collared mule deer in summer 2013. Summer home ranges were visited 3 times throughout the summer to capture variation in diet choice as they relate to plant phenology and habitat composition across the landscape.



In summer 2014, we revisited summer home ranges and collected plant samples that will be analyzed for nutritional content (i.e. crude protein and digestibility). Plant samples collected in 2014 were based on diet results from fecal samples collected in 2013 and were focused on plant species that frequently appeared in deer diets.

To evaluate the relationship between plant phenology and topographical variation on summer ranges, we collected bi-weekly data on composition and availability of targeted plant species on summer home ranges of our study animals.

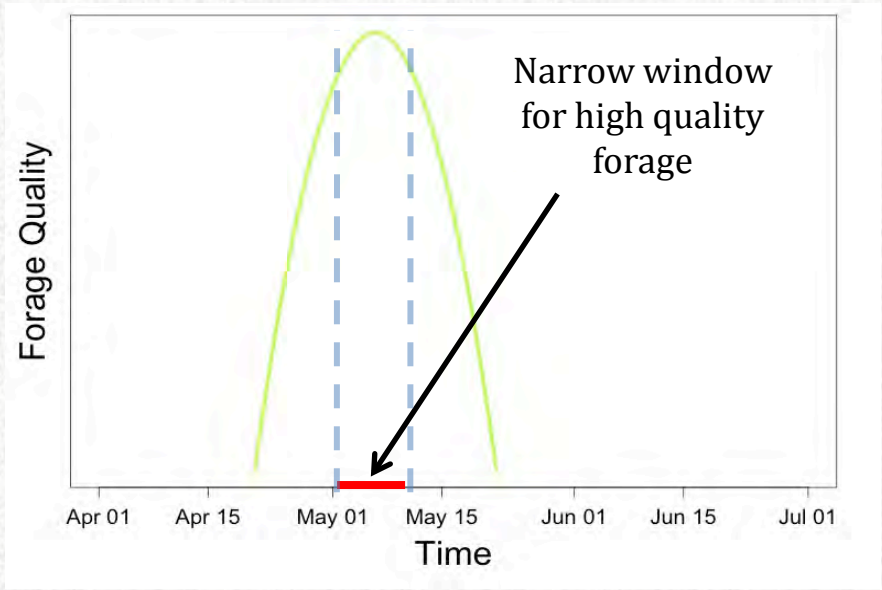


Why phenology tracking could be important?

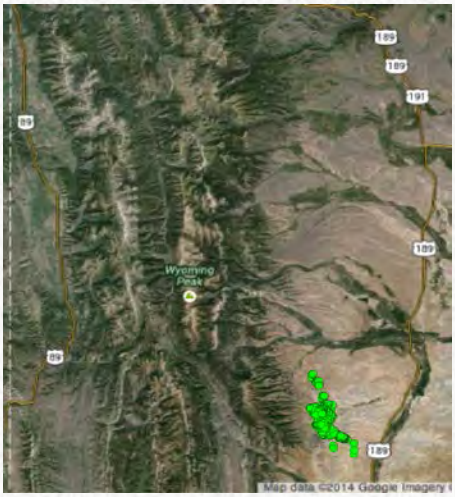
Linking Forage Quality and Behavioral Strategies to Nutritional Condition

During Migration

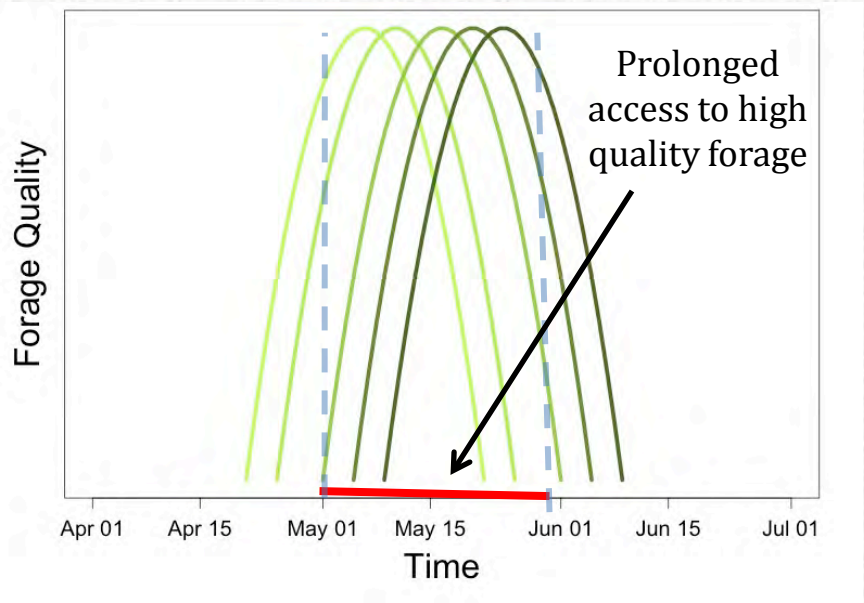
We will quantify the nutritional benefits of phenology tracking during migration by linking individual nutritional condition with migratory strategies and on-the-ground measurements of forage abundance and quality. Further, we will evaluate how other environmental conditions such as climate can influence nutritional benefits of migration.



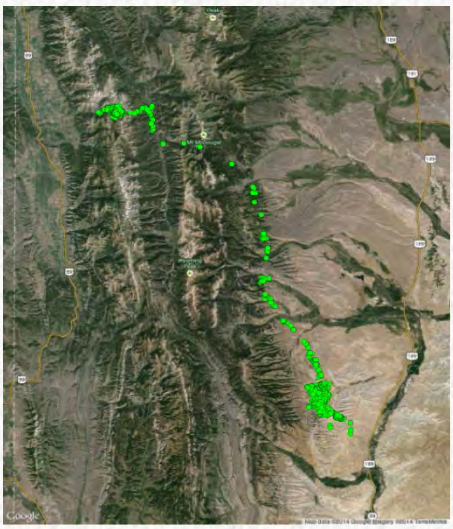
Non-migratory deer



Deer that stay in one place all year, have only a very narrow window of time when plants are at the preferred, nutritious life-stage which may be reflected in individual nutritional condition.



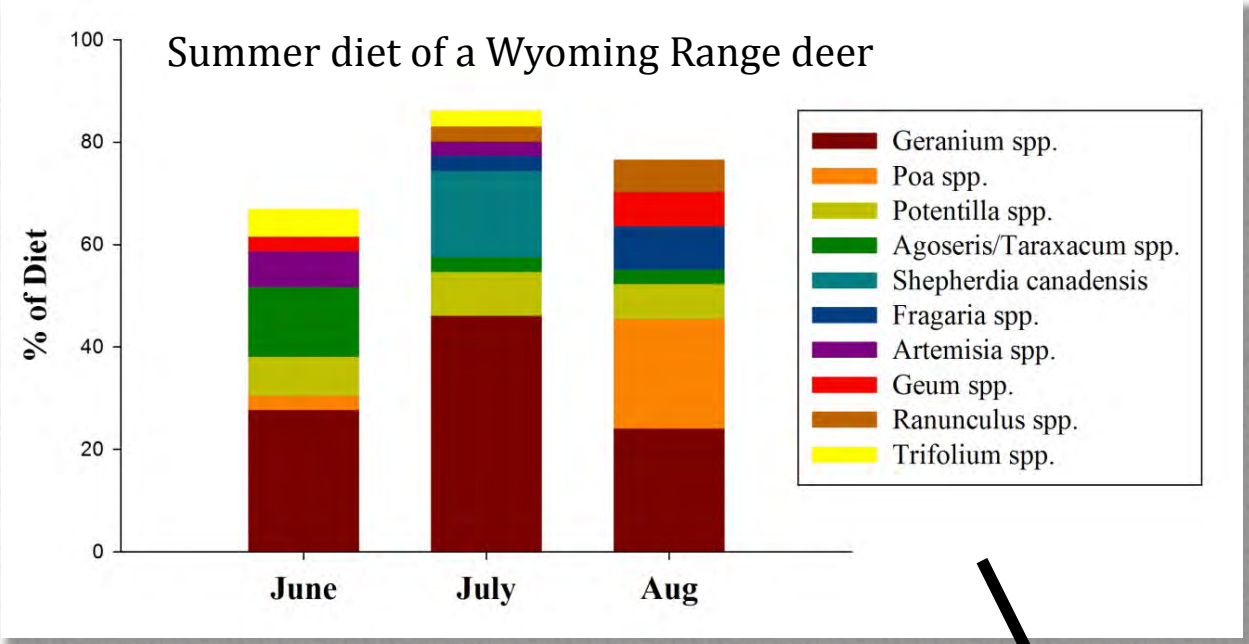
Migratory deer



By moving along an elevation and/or latitudinal gradient, migratory deer may lengthen the amount of time that preferred plants are accessible because patterns of plant phenology are delayed at higher elevations or different topographical gradients. Moving to these areas may allow animals to be present more locations when forage quality is at its greatest, thereby reaping the benefits of phenology tracking during migration. Imagine each green line above representing the phenology at a different location on the landscape that an animal moves through during migration.

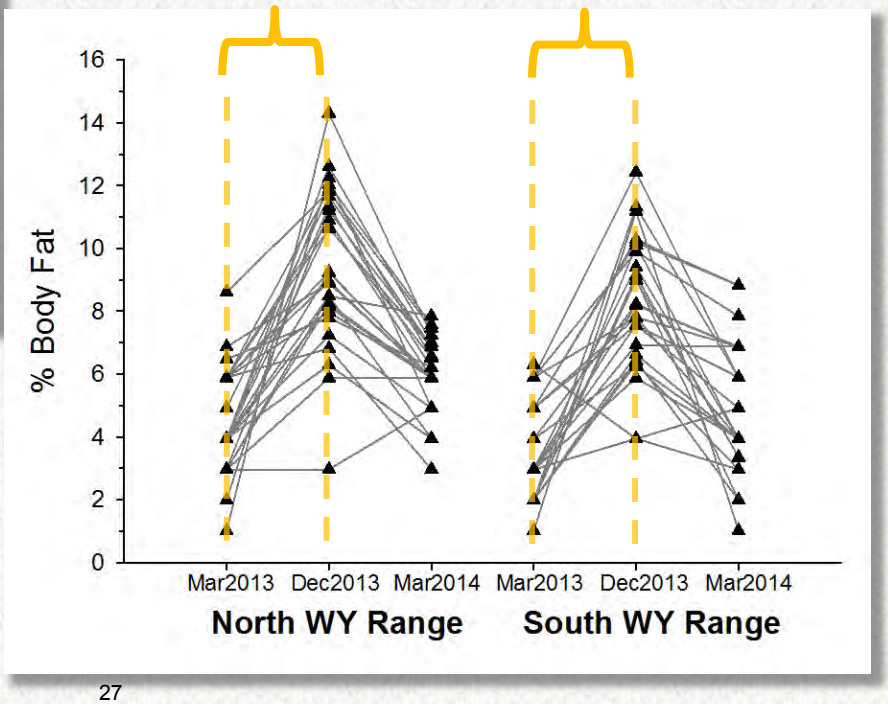
On Summer Range

Phenology tracking across diverse topographical characteristics on summer range can act as a means to prolong access to forage when it is the most nutritious. This strategy can be critical for deer that rear offspring into the fall in that it provides the necessary fuel the metabolic demands of maternal care (i.e. lactation). We will evaluate how habitat use and forage quality promote an individual's ability to meet and exceed metabolic demands over the summer months by linking changes in fat reserves of individuals over the summer to data collected on habitat use, forage availability, diet composition, and diet quality on summer ranges.



We will determine nutritional quality of plants found within deer diets and will link those data to changes in fat reserves.

Change in summer fat



Ultimately, connecting conditions of summer range with deer behavior and diet will yield key information to the components of summer range habitat that are most productive for growing mule deer in western Wyoming.

The Wyoming Range Deer Project and its components would not be possible without the financial and logistical contributions of our research partners. Funds have been provided by the Wyoming Game and Fish Department, Muley Fanatic Foundation, Wyoming Wildlife and Natural Resource Trust, National Science Foundation, United States Geological Survey, Berry Graduate Fellowship, Boone and Crockett Club, Bureau of Land Management, Knobloch Family Foundation, Wyoming Governor's Big Game License Coalition, Animal Damage Management Board, Ridgeline Energy Atlantic Power, Bowhunters of Wyoming, and the Wyoming Outfitters and Guides Association. Additional thanks go to all who were able to assist with captures and fieldwork.

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APPENDIX B

EFFECTS OF PREDATION ON SURVIVAL OF NEONATAL MULE DEER IN THE WYOMING RANGE

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University of Wyoming, Laramie, WY

Gary Fralick, Biologist
Wyoming Game and Fish Department
Thayne, WY

Jill Randall, Habitat Biologist
Wyoming Game and Fish Department
Pinedale, WY

Mule deer (*Odocoileus hemionus*) are an iconic species of mountains and plains of the western US, are highly sought after by hunters and wildlife enthusiasts, and are an important source of revenue for state wildlife agencies. Despite being renowned status across the West, mule deer populations today persist at populations sizes that pale in comparison to their great abundance during the mid-20th century (deVos et al. 2003). Factors responsible for population declines in recent decades remain contentious (deVos et al. 2003); however, recent comprehensive research has identified habitat quality, winter severity, and drought conditions as important factors that are currently limiting mule deer in the West (Bishop et al. 2009, Hurley et al. 2011, Monteith et al. 2014), while others have also identified the contributing and interactive role of predation (Monteith et al. 2014). Recolonizing and growing populations of large carnivores, especially gray wolves (*Canis lupus*), grizzly bears (*Ursus arctos*), and black bears (*Ursus americanus*), highlight the importance of quantifying the ecological effects of their presence. Furthermore, concerns over effects of predators on prey populations, efforts at intensive predator control, potential for lost opportunities for hunters to harvest ungulates, and human safety all have fueled the controversy behind the effects of predators and emphasize the need to directly assess their influence on ungulates.

Demography of adult female mule deer is typified by relatively high and invariable survival, pregnancy, and fetal rates (Unsworth et al. 1999, Andelt et al. 2004). Consequently, survival of young is the demographic that typically underpins population trajectory from year-to-year (Raithel et al. 2007). In systems where ungulates co-occur with large predators, such as in the Wyoming Range, predation is commonly the leading cause of mortality among young ungulates; but simply identifying cause of death is of little value without understanding the underlying basis of those mortalities (Bleich and Taylor 1998, Ballard et al. 2001, Bowyer et al. 2005, Monteith et al. 2014). Therefore, it is critical to characterize the relative contributions of nutrition (i.e., habitat) and predation to survival and mortality of young to understand their effects on population dynamics. For example, young born to mothers in poor nutritional condition may have a low probability of surviving because their mother lacks the ability to properly provision their young and thus, mortality is directly tied to nutrition (Bartmann et al. 1992, Pierce et al. 2012). Conversely, predation can operate independently of nutrition and have significant impacts on survival and recruitment of young, making mortality additive and directly tied to intensity of predation (Gasaway et al. 1992, Monteith et al. 2014). Separating the

underlying consequences of mortality and how each component contributes to population dynamics is difficult, but is possible when nutrition and cause-specific mortality are investigated in tandem (Pierce et al. 2012, Bowyer et al. 2013, Monteith et al. 2014). For example, Monteith et al. (2014) demonstrated that for a migratory deer population in the Sierra Nevada of California, bears had a significant additive effect on survival of young mule deer on the west side of the Sierra crest, while nutrition was the primary factor affecting survival of young mule deer on the more xeric east side.

In March 2013, the Wyoming Range Mule Deer Project commenced, with the overall goal to address important research and management needs indentified by the Mule Deer Working Group in the Wyoming Mule Deer Initiative and the herd-specific Wyoming Range Mule Deer Initiative. Broadly, this project is investigating the nutritional relationships between mule deer population dynamics, energy development and disturbance, habitat conditions, and climate to provide a mechanistic approach to monitoring and management of mule deer. This project is the top research priority for the Wyoming Game and Fish Department and has received considerable support from numerous partners (Table 1); because of that support, this 630K project is within 61K of being fully funded. Also, given the intensity of the monitoring that is taking place to meet project objectives, we have a unique opportunity to more fully address complex questions, such as quantifying the effects of predation on fawn survival—a study objective that is often cost-prohibitive to do properly. Indeed, adding a fawn survival component to the Wyoming Range Mule Deer Project was discussed at length during the Projects inception, but was deemed too costly to pursue at the time. A study examining survival and cause-specific mortality of a Wyoming ungulate is unprecedented and would be a valuable addition to the Wyoming Range Mule Deer Project. Moreover, the relative roles of habitat and predation on dynamics of mule deer populations were key topics discussed during the public input process of the Wyoming Mule Deer Initiative, and knowing their relative contributions will aid in formulating strategies to enhance population growth.

In response to requests by the WWNRT Board at the meeting on 15 August in Marbleton, WY, we are proposing to add an Addendum to the core of the Wyoming Range Mule Deer Project to address directly, the contributions of predation to fawn survival and deer population dynamics. To do so, we will capture, collar, and subsequently monitor survival and determine cause-specific mortality of neonatal mule deer. Because the Wyoming Range Mule Deer Project is underway, we will take advantage of the adult deer (n = 70) that are already fitted with GPS radiocollars, and the helicopter captures that will be occurring during March of 2015 to refit those females with new GPS collars. Therefore, accomplishing the additional objective focused on quantifying the effects of nutrition and predation on young mule deer will be much more feasible and revealing given the previous 2 years worth of research already conducted on the ecology of mule deer in this region.

PROJECT OBJECTIVES:

1) Determine survival and cause-specific mortality of neonatal mule deer.
2) Assess factors that contribute to probability of survival of neonatal mule deer, including but not limited to: birth mass, sex, birth date, litter size, habitat conditions, maternal nutritional condition, and maternal age,
3) Evaluate factors that contribute to the cause of mortality (e.g., black bear, coyote, malnutrition, accident), including but not limited to: birth mass, sex, birth date, litter size, habitat conditions, maternal nutritional condition, and maternal age,

4) Quantify the effects of nutrition and predation on survival and recruitment of young to identify which is most limiting to Wyoming Range mule deer.
5) Identify locations of birth sites and characterize the associated habitats.

STUDY AREA

The location for this project encompasses the seasonal ranges occupied by mule deer in the Wyoming Range herd, which includes much of the area west of the Green River to the Idaho border. Winter range includes the Big Piney/La Barge wintering area and the Kemmerer/Evanston winter complex. Summer range includes those areas of higher elevation occupied by migratory mule deer during summer, particularly the Wyoming and Salt River mountain ranges (Figure 1).

METHODS

As part of the core of the Wyoming Range Mule Deer Project, we will recapture 70 female mule deer using helicopter netgunning on winter range during March of 2015; 35 females are located on the Big Piney/La Barge winter complex, while 35 are located on the Kemmerer/Evanston winter ranges (Figure 3). New unmarked females will be captured to replace those lost to mortality from each respective winter range. Each radiocollared female will be recaptured twice each year to provide detailed information on the condition of animals arriving on winter range and subsequently, condition of females prior to departing winter for summer ranges. To allow processing and collection of information critical to understanding the role of climate, habitat, and predation on mule deer, captured females will be transported via helicopter to a central processing area. We will use ultrasonography and manual palpation to measure nutritional condition (% body fat) of captured females, which will allow us to link seasonal fat levels to adult female survival, and survival and cause of mortality of young.

In March we will determine pregnancy and litter size (i.e., number of fetuses) using ultrasonography. All pregnant females (pregnancy rates were 98.6% in March 2013) will be fit with vaginal implant transmitters (VITs), which are small VHF radiotransmitters that are inserted into the vaginal canal with silicone wings that expand to retain the VIT in the animal until birth (Bishop et al. 2007). VITs are programmed with a temperature-sensitive switch that increases in pulse rate from 40 pulses to 80 pulses per minute when the temperature decreases below 32° C, which is representative of the VIT being expelled by the deer during the birth of young. Vaginal implant transmitters have no effect on reproduction or survival of the adult female, and are a practical technique for locating birth sites and facilitating capture of neonatal deer (Johnstone-Yellin et al. 2006, Bishop et al. 2007). Given the high pregnancy rates observed in March 2013, we antipicate needing potentially 70 VITs. We will be recovering all VITs immediately after birth and thus, we intend to refurbish and reuse those VITs during year 2 to reduce costs associated with this component of the project. We do however, expect to have to purchase some because of possible transmitter failure and chewing by rodents.

During the following spring and the beginning of the parturition season, adult females and VITs will be monitored via new technology that Advanced Telemetry Systems is currently engineering for us. This new technology will take advantage of the Iridium satellite system and Iridium GPS collars to uplink data that correspond to the status of the VIT and fawn collars directly. Therefore, all monitoring will be conducted remotely via email, as opposed to the daily telemetry flights that are required in the absence of this technology (an annual cost of >75K). Upon evidence of an expelled VIT (rapid pulse rate), we will use field crews and ground-based

telemetry to locate the VIT and the radiocollared female as quickly as possible. The location of the VIT, and location and behavior of the female will be used to identify search areas for the newborns. We will capture newborn mule deer by hand and place them in a cloth bag containing sagebrush to minimize scent transfer. We will record sex of each fawn, weight using a hand-help spring scale, GPS location, fit with an expandable radiocollar with a 4-hr mortality delay, and process all fawns as quickly as possible to minimize potential for abandonment or attraction of predators. During March 2013, average litter size was 1.8 fawns/female, which would yield an expected number of 126 fawns being born to our radiocollared females. Although performance of VITs have improved in recent years, it is unlikely that we will capture fawns from every radiocollared female. Therefore, we plan to purchase 100 expandable radiocollars for fawns, with the expectation that it will not be possible to capture all fawns and some females will likely succumb to mortality prior to the birthing season. In addition, we will recover all collars associated with mortalities and will re-deploy those collars on new fawns during the 2014 summer to avoid having to purchase new fawn collars each year. We do expect however, to have to purchase some new collars because predators sometimes mangle collars to the point where they are unusable.

Following capture of fawns, we will monitor radiocollared fawns again using the Iridium satellite system and Iridium GPS collars for continuous remote monitoring. When mortalities are detected, we will use ground telemetry to locate carcasses as quickly as possible (<8 hrs). We will examine carcasses to estimate date of death based on decomposition and condition of the animal. We will evaluate and record the location and arrangement of the carcass, presence and position of tooth marks, ante- and post-mortem bleeding or bruising, fractures, and remaining organs when present. We will identify other physical evidence of predation including tracks and feces (Elbroch 2003), and collect hair for confirmation of the predator responsible (Moore et al. 1997). When the cause of death cannot be ascertained, the carcass will be taken from the field to the laboratory to be necropsied; field necropsies will be performed when distance or a precarious location hinders transport of the carcass from the field.

Following data collection, we will evaluate factors that affected probability of survival of young mule deer, and identify the factors that contributed to cause of mortality. Not only will this project identify the primary proximal causes of mortality, but importantly, will disentangle the relative roles of predation and nutrition in regulating population growth of this deer herd. Indeed, studies have demonstrated positive effects of predator control where resources were not limited (Gasaway et al. 1983, White et al. 2010), compared with others where resource limitation regulated population growth and predator removal had little effect (Ballard et al. 2001, Hurley et al. 2011). This project will identify if and where predator control would be most effective (predation was limiting), while distinguishing if and where habitat improvement efforts would be most effective (nutrition was limiting) in enhancing population growth.

BENEFITS

Results from this project will be made available to cooperators through multiple articles published in the peer-reviewed literature, and a final report. In addition, other information including maps, data sets, and progress reports will be provided at the cooperators request. Results of this study will address explicitly, the effects of predation on survival of young mule deer, and thus, will quantify the relative roles of predation and nutrition on population dynamics of the Wyoming Range deer herd. By linking habitat, nutrition, and predation together, we will be able to elucidate the relative contributions of each to population growth and provide

considerations for population, habitat, and predator management that are liable to enhance growth of this and other mule deer herds in the Wyoming. Much like the Wyoming Range Mule Deer Project, the results of the Fawn Survival Addendum will be presented in public forums in conjunction with the public input process, and by way of other venues to inform the public and stakeholders of issues facing Wyoming Range mule deer as well as strategies likely to be most beneficial to the mule deer population.

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Table 1. Projected budget for the Fawn Survival and Cause-Specific Mortality Study, an addendum to the Wyoming Range Mule Deer Project.

Description	FY2015	FY2016	FY2017	FY2018	FY2019
Radiocollars/Transmitters					
VHF expandable fawn collars (n=100 in Yr1, n=50 in Yr2; $250per	25,000	12,500	0	0	0
Vaginal implant transmitters (VITs; n=70 in Yr1, n=20 in Yr2; $250per	17,500	5,000	0	0	0
70 GPS Iridium Uplink Collars ($2500per)	175,000	0	0	0	0
Satellite Uplink Fees ($225/collar/year)	5,750	15,750	10,000	0	0
Adult Female Captures					
March helicopter capture (Mar 2016 & 2017)	0	42,000	42,000	0	0
December helicopter capture (Dec 2015 & 2016)	0	42,000	42,000	0	0
Personnel, Travel, Supplies					
PhD Student	29,000	29,000	29,000	29,000	29,000
2 Summer Field technicians (fawn capture/monitoring)	7,000	25,000	18,000	0	0
Travel expenses	5,000	15,000	10,000	4,000	4,000
Field equipment (telemetry gear, gps units, water filters, etc.)	7,000	1,500	0	0	0
Page charges for publications	0	0	0	2,000	2,000
Accounting and spatial analyst support	13,563	16,898	13,590	2,970	2,970
Total:	**$284,813**	**$204,648**	**$164,590**	**$37,970**	**$37,970**

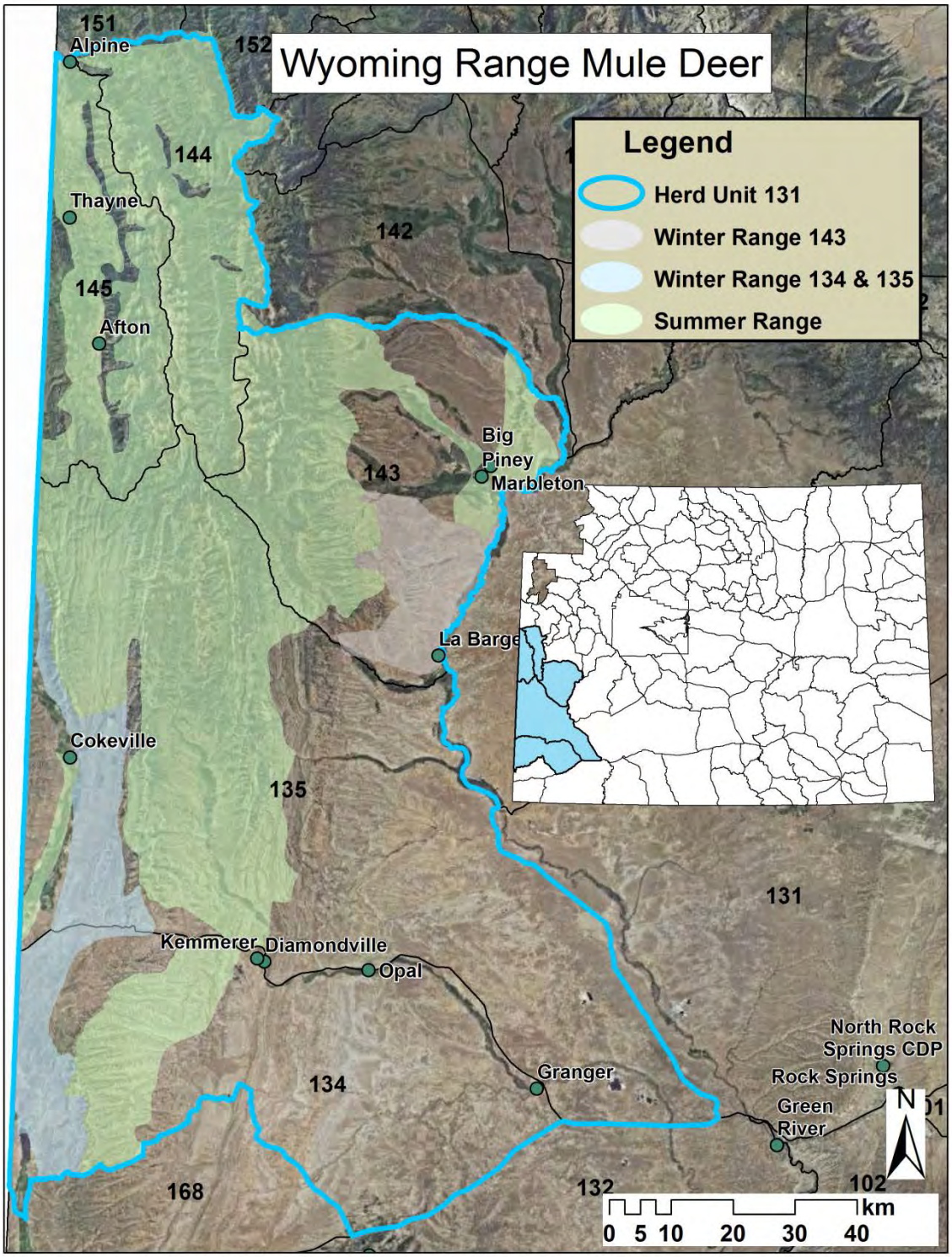

Figure 1. Wyoming Range herd unit boundary, hunt areas, summer range, and primary winter range habitat.

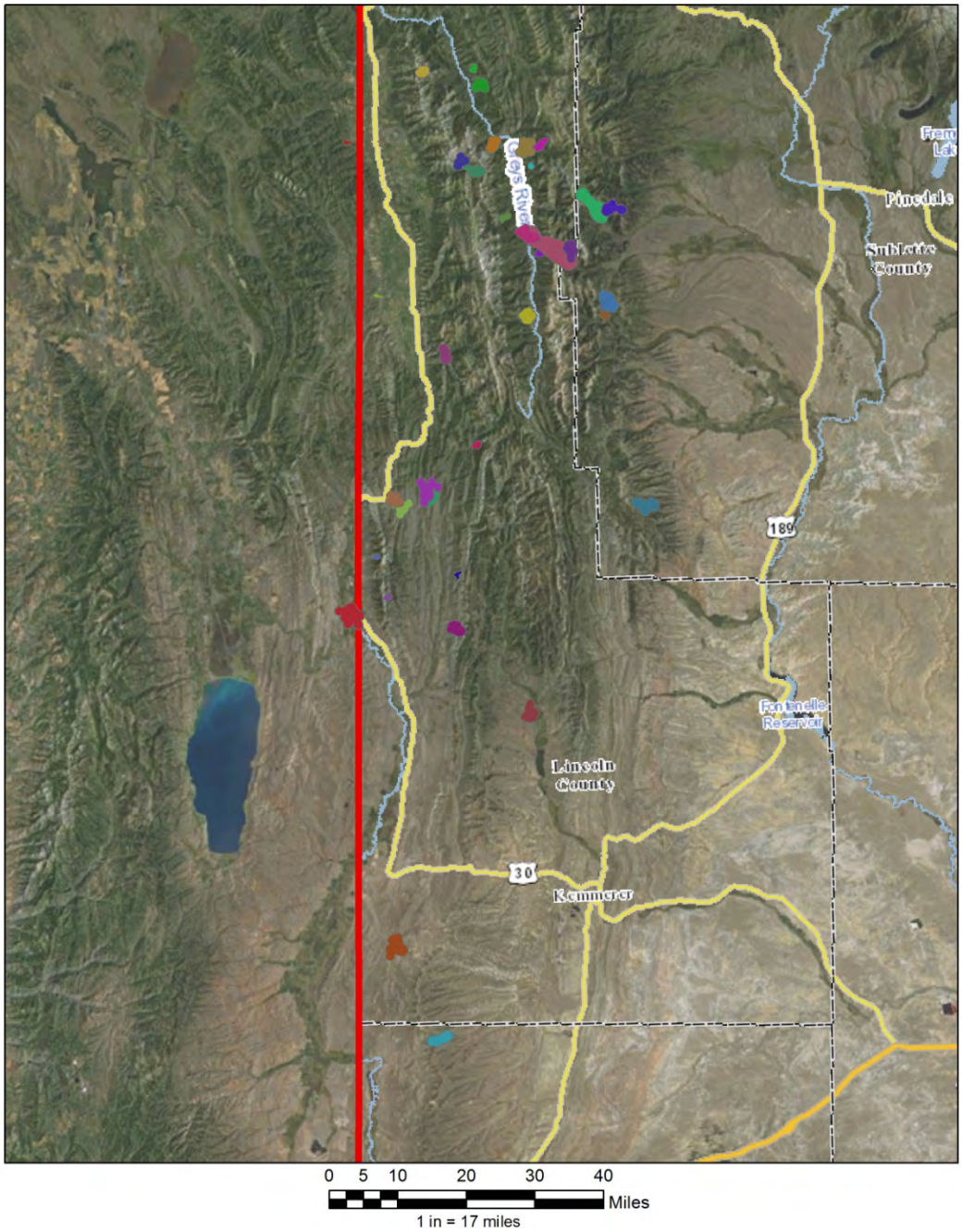

Figure 2. Minimum convex polygons of summer ranges occupied by adult female mule deer that were captured during March 2013 and fitted with GPS radiocollars with capabilities of remote download via satellite.

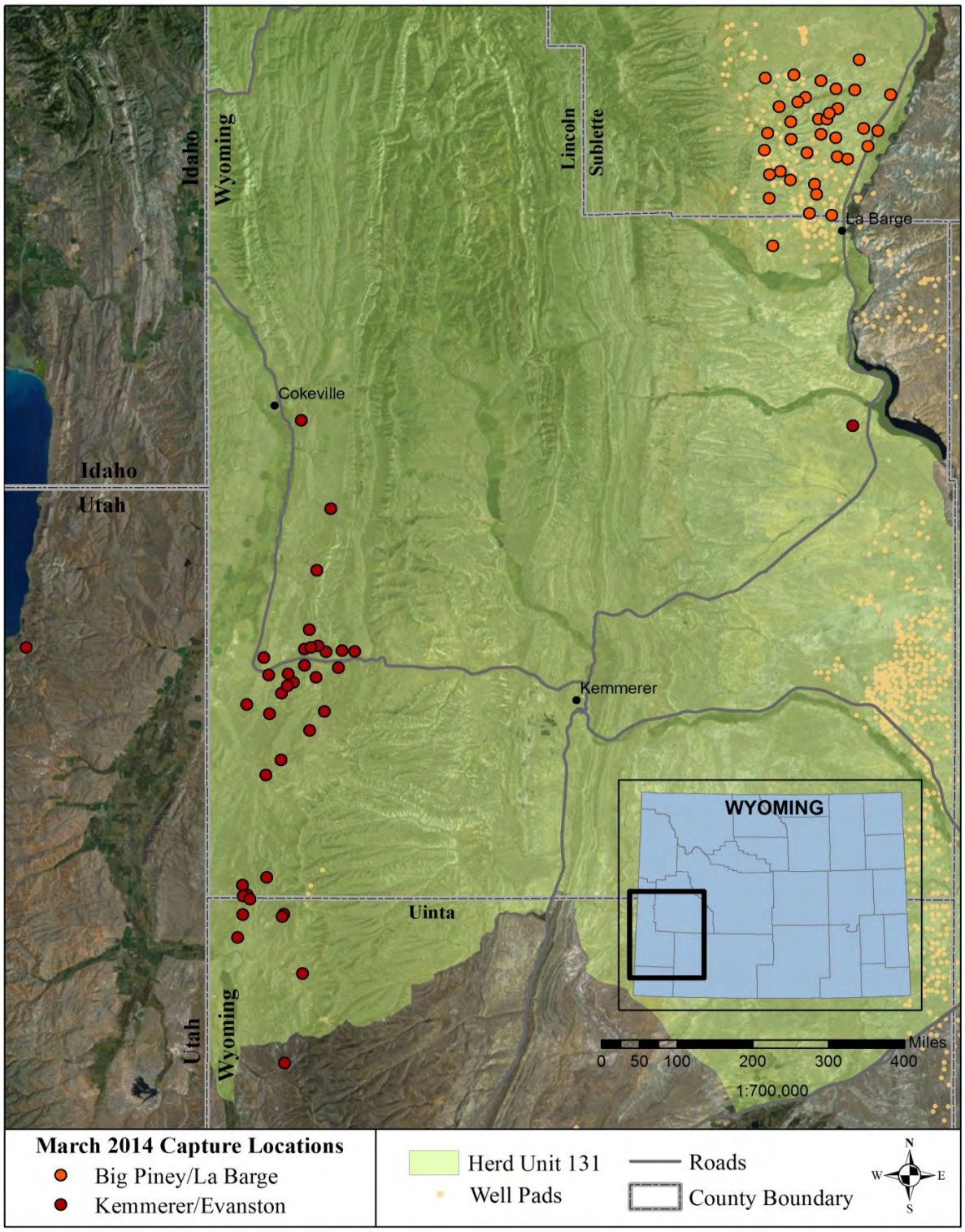

Figure 3. Capture locations of female mule deer recaptured during March 2014 as part of the Wyoming Range Deer Project.

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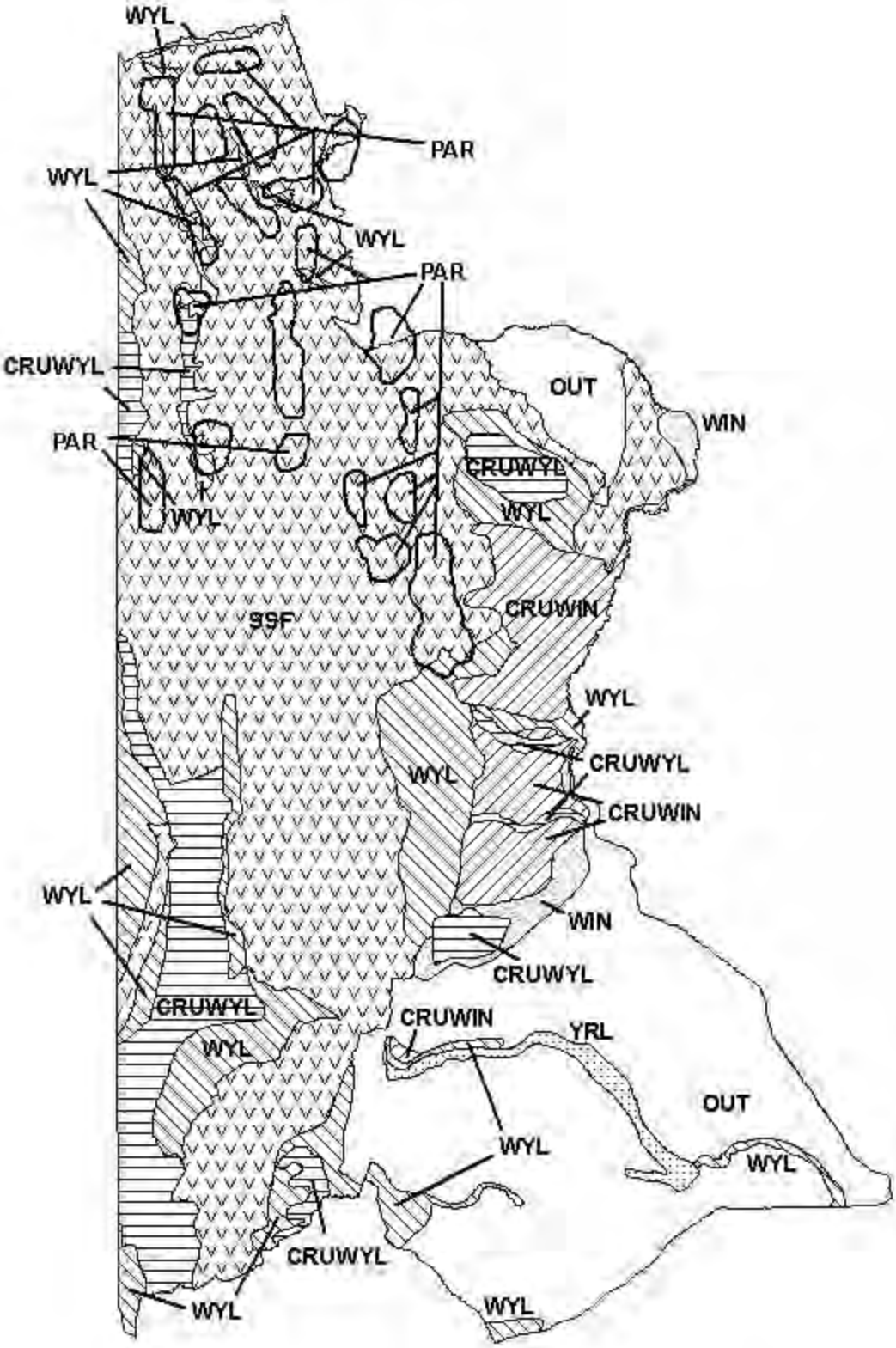

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