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Mule Deer **Page Number**

Elk

Moose

Bighorn Sheep

Mountain Goat

Bison

2018 - JCR Evaluation Form

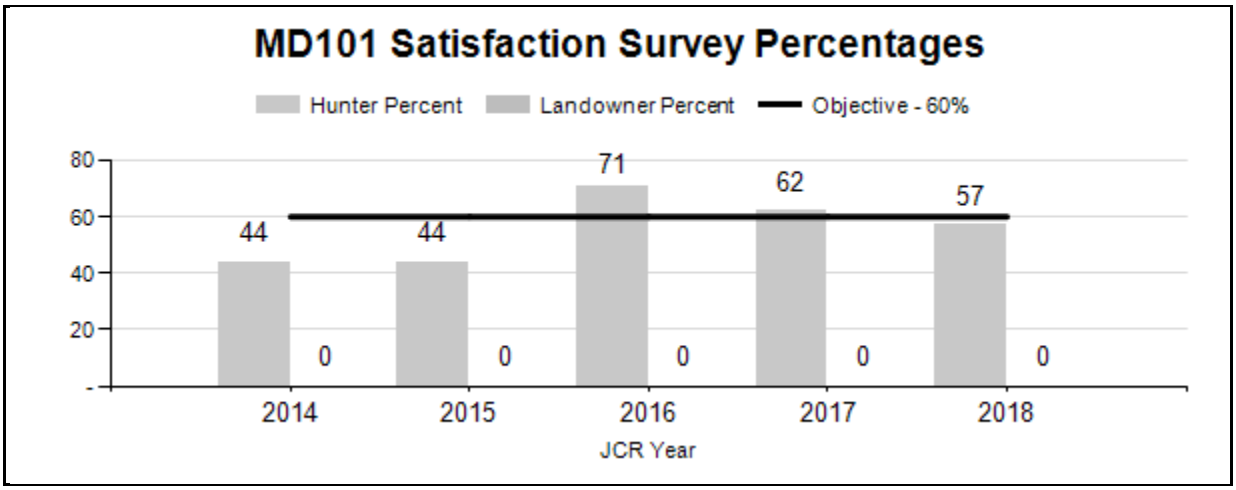
SPECIES: Mule Deer
PERIOD: 6/1/2018 - 5/31/2019

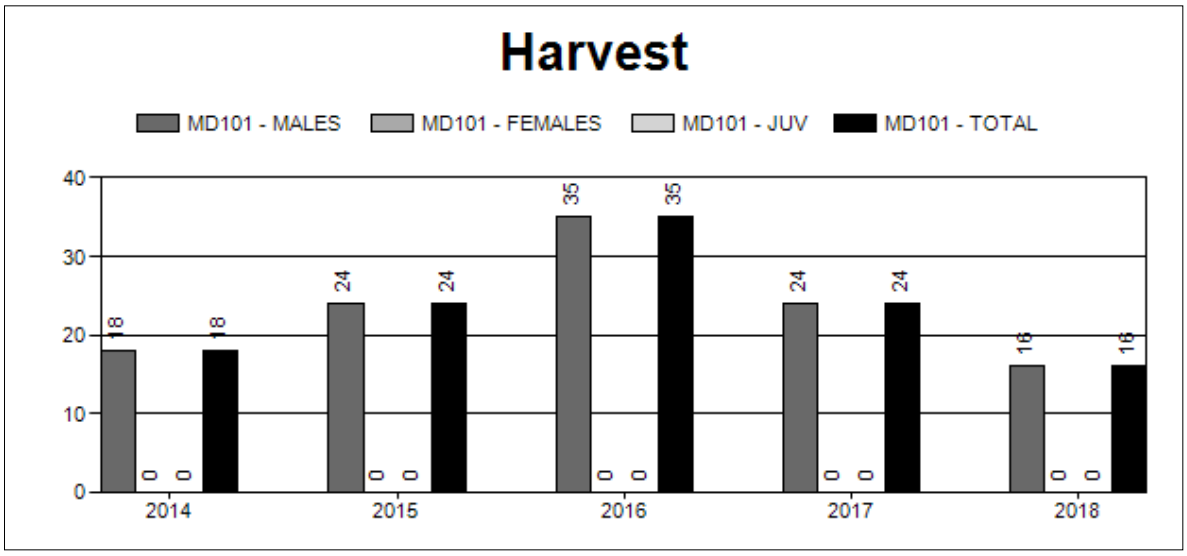
HERD: MD101 - TARGHEE

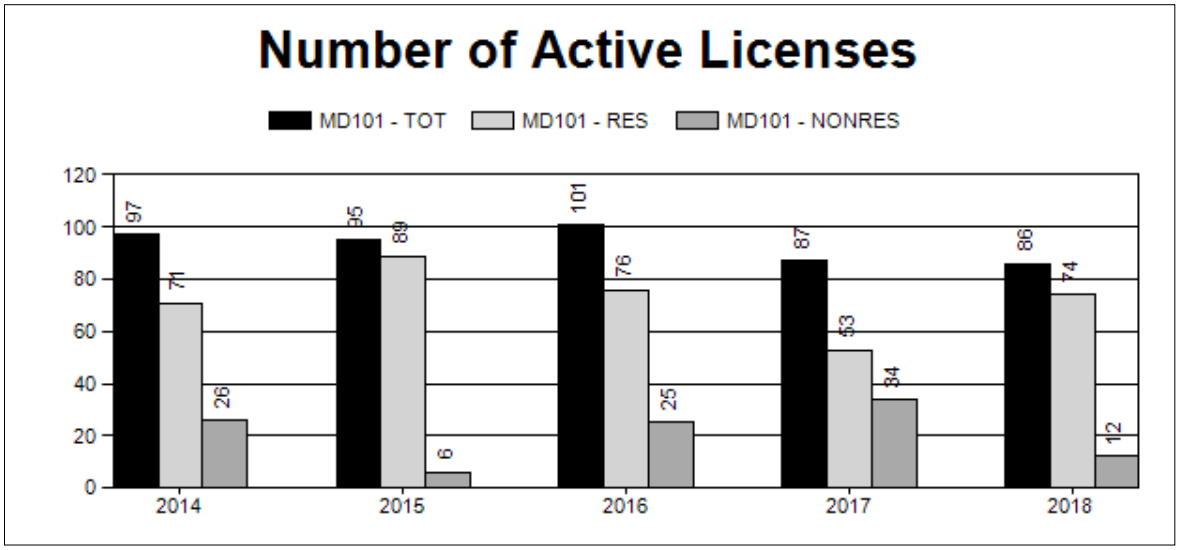
HUNT AREAS: 149
PREPARED BY: ALYSON COURTEMANCH

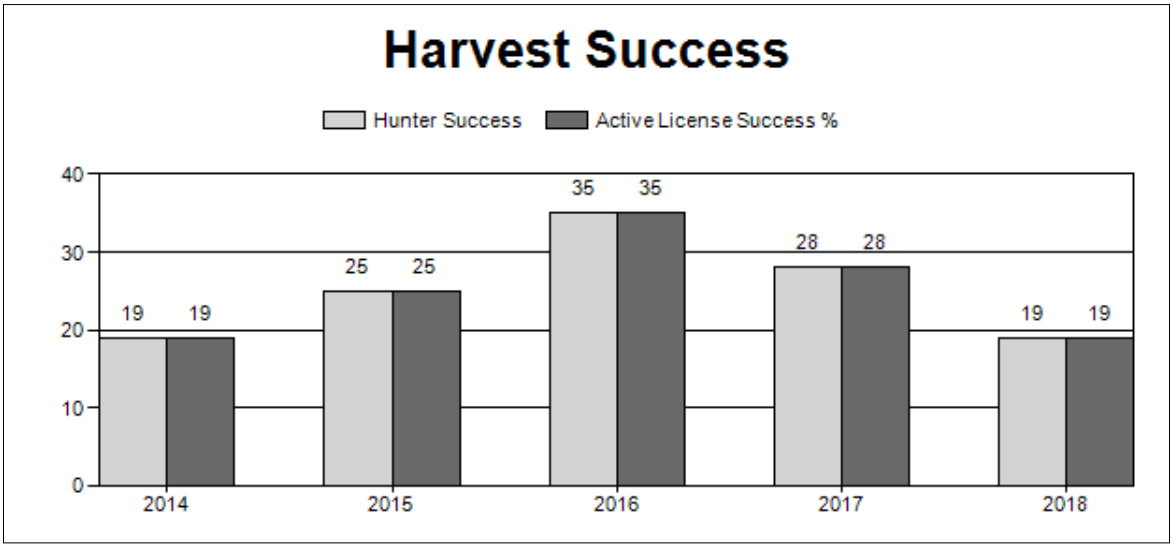
	2013 - 2017 Average	2018	2019 Proposed
Hunter Satisfaction Percent	53%	57%	60%
Landowner Satisfaction Percent	0%	0%	0%
Harvest:	23	16	25
Hunters:	91	86	90
Hunter Success:	25%	19%	28 %
Active Licenses:	91	86	90
Active License Success:	25%	19%	28 %
Recreation Days:	435	509	250
Days Per Animal:	18.9	31.8	10
Males per 100 Females:	0	0	
Juveniles per 100 Females	0	0	

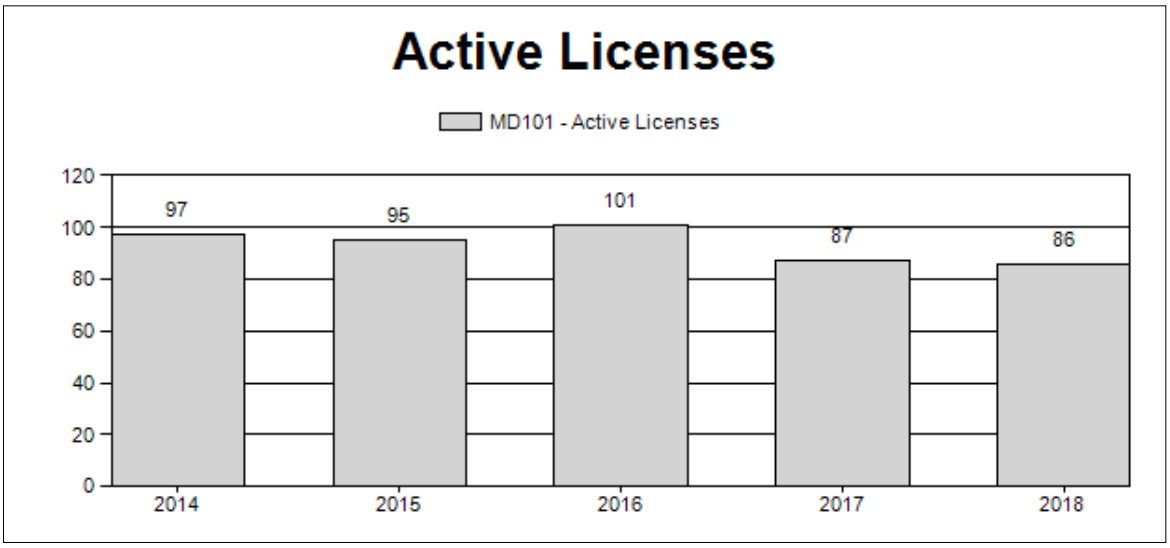
Satisfaction Based Objective	60%
Management Strategy:	Recreational
Percent population is above (+) or (-) objective:	N/A%
Number of years population has been + or - objective in recent trend:	1

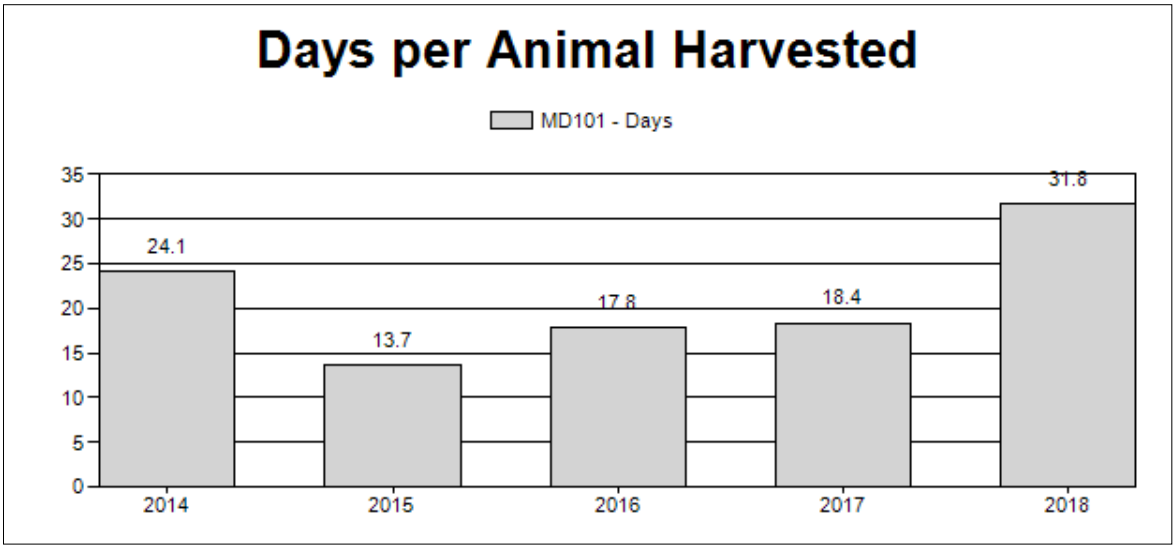


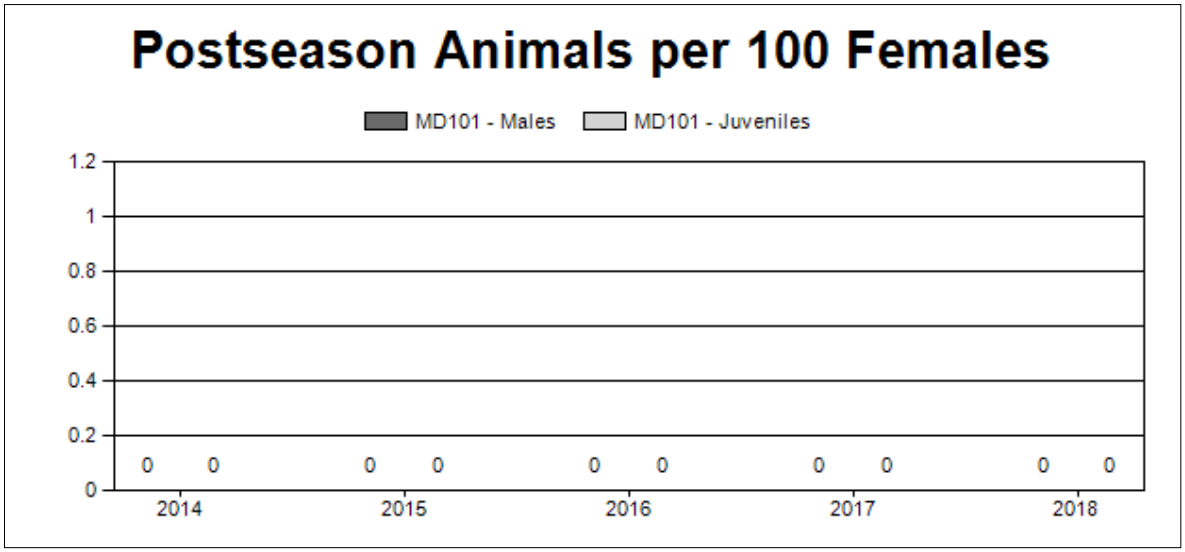

Harvest
MD101 - MALES
MD101 - FEMALES
MD101 - JUV
MD101 - TOTAL
40
30
20
10
0
18
0
0
18
24
0
0
24
35
0
0
35
24
0
0
24
16
0
0
16
2014
2015
2016
2017
2018


Number of Active Licenses
MD101 - TOT
MD101 - RES
MD101 - NONRES
120
100
80
60
40
20
0
97
71
26
95
89
6
101
76
25
87
53
34
86
74
12
2014
2015
2016
2017
2018


Harvest Success
Hunter Success
Active License Success %
40
30
20
10
0
19
19
25
25
35
35
28
28
19
19
2014
2015
2016
2017
2018


Active Licenses
MD101 - Active Licenses
120
100
80
60
40
20
0
97
95
101
87
86
2014
2015
2016
2017
2018


Days per Animal Harvested
MD101 - Days
35
30
25
20
15
10
5
0
24.1
13.7
17.8
18.4
31.8
2014
2015
2016
2017
2018


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
2014
2015
2016
2017
2018

2019 HUNTING SEASONS
TARGHEE MULE DEER HERD (MD101)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
149		Sep. 15	Oct. 6		General	Antlered mule deer three (3) points or more on either antler or any white-tailed deer
	3	Sep. 15	Nov. 30	15	Limited quota	Any white-tailed deer
	8	Sep. 15	Nov. 30	50	Limited quota	Doe or fawn white-tailed deer
149	Archery	Sep. 1	Sep. 14			Refer to Section 2 of this Chapter

Management Evaluation

Management Strategy: Recreational

Population Objective Type: Hunter Satisfaction
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.
Evaluation: meeting primary and secondary objectives

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 since the majority of the herd winters in Idaho. 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 2018, 57% of hunters indicated they were "satisfied" or "very satisfied" with hunting in the Targhee Mule Deer Herd. The average satisfaction for the past 3 years is 63%. Therefore, the herd is meeting its primary objective of ≥ 60% hunter satisfaction.

In 2018, 19% of hunters were successful in the Targhee Mule Deer Herd. The 3-year average of hunter success is 27%. Therefore, the herd is meeting the secondary objective of an average of ≥ 15% harvest success over 3 years.

Herd Unit Issues

The current objective and management strategy for this herd will be maintained based on internal discussions and conversations with our constituents. Population status was evaluated and it was determined a change is not warranted at this time. These objectives will be reviewed again in 2024; however, if a situation arises that requires immediate change, proposals will be developed and submitted as needed.

Post-season classification surveys are not flown in this herd due to budget constraints. 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 success. Beginning in 2015, a Type 8 doe/fawn white-tailed deer license was added to the hunt area due to several private landowners expressing interest in controlling white-tailed deer numbers. In 2017, a Type 3 any white-tailed deer license was also added.

Weather

Spring and summer 2018 produced average moisture. Fall and early winter weather was very mild with warm temperatures and little snowfall at high elevations. This may have increased days to harvest for hunters. However, several large snowstorms occurred in February that resulted in the rapid accumulation of a deep snowpack. 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 no permanent vegetation transects in mule deer winter ranges for the Targhee Herd. Several habitat improvement projects are being planned in this herd unit, including the Hill Creek Prescribed Burn, which is scheduled for completion in 2019. In addition, a habitat treatment in Teton Canyon is currently in the planning stages to improve mountain shrub and aspen communities for deer and other big game with potential for implementation beginning in 2019. The WGFD is assisting Caribou-Targhee National Forest (CTNF) with vegetation monitoring in aspen stands pre and post-treatment. Please refer to the 2018 Annual Report Strategic Habitat Plan Accomplishments for Jackson Region habitat improvement project summaries (https://wgfd.wyo.gov/Habitat/Habitat-Plans/Strategic-Habitat-Plan-Annual-Reports).

Field Data

No field data were collected in the Targhee Herd Unit during the 2018 biological year.

Harvest Data

Based on harvest statistics, the density of mule deer in the Targhee Herd continues to be a concern. However, there has been a promising trend in the last 3 years of increased hunter success

and satisfaction in this herd unit. The average days to harvest was 31.8 in 2018, indicating that it is difficult for hunters to find deer. Eighty-six hunters hunted in this herd unit for mule deer and 16 mule deer were harvested. Thirty-eight hunters hunted white-tailed deer and 19 deer were harvested.

Population

This population likely declined following liberal hunting seasons in Idaho. Data are limited for this population. 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. Antlered mule deer seasons will close on October 6 to coincide with hunt season closures adjacent to Jackson.

Several private landowners have expressed interest in expanded white-tailed deer hunting opportunities in Hunt Area 149. Therefore, a new Type 8 license was offered beginning in 2015 for doe or fawn white-tailed deer with 50 licenses. Fifteen Type 3 licenses valid for any white-tailed deer were offered beginning in 2017. This is in response to a growing white-tailed deer population near private lands in the herd unit and requests by the public for additional license types. Since the majority of white-tailed deer occur on private land, access is likely a limiting factor for white-tailed deer harvest. 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.

2018 - JCR Evaluation Form

SPECIES: Mule Deer | PERIOD: 6/1/2018 - 5/31/2019

HERD: MD131 - WYOMING RANGE

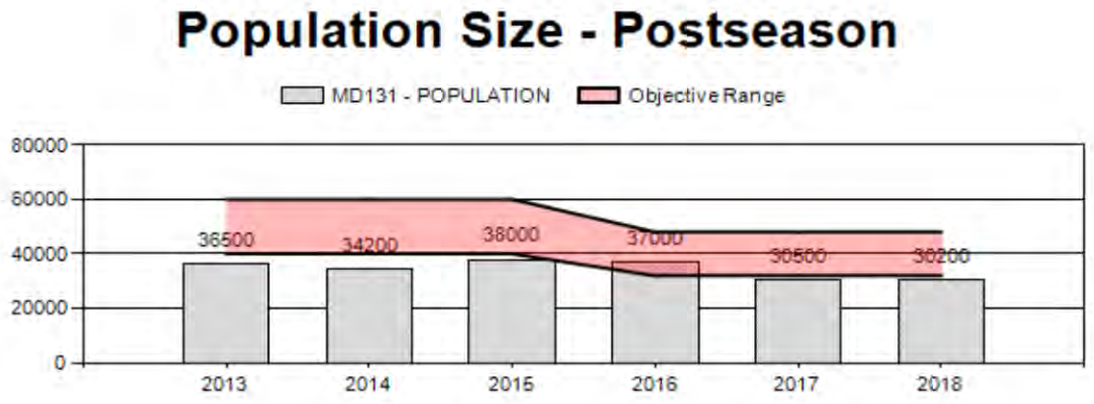
HUNT AREAS: 134-135, 143-145 | PREPARED BY: GARY FRALICK

	2013 - 2017 Average	2018	2019 Proposed
Population:	35,240	30,200	30,720
Harvest:	2,620	1,799	2,332
Hunters:	5,904	4,840	5,100
Hunter Success:	44%	37%	46 %
Active Licenses:	5,904	4,840	5,100
Active License Success:	44%	37%	46 %
Recreation Days:	32,077	26,464	28,000
Days Per Animal:	12.2	14.7	12.0
Males per 100 Females	37	30	
Juveniles per 100 Females	63	60	

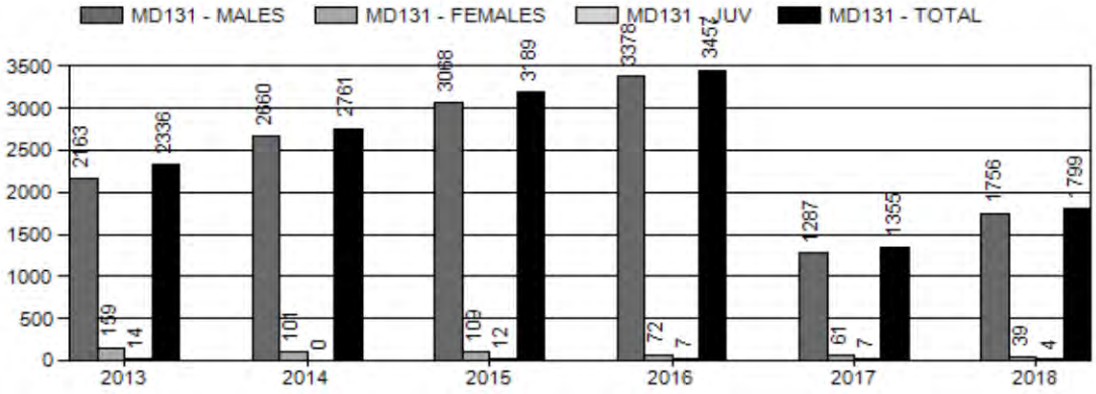
Population Objective (± 20%) :	40000 (32000 - 48000)
Management Strategy:	Special
Percent population is above (+) or below (-) objective:	-24.5%
Number of years population has been + or - objective in recent trend:	26
Model Date:	02/21/2019

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

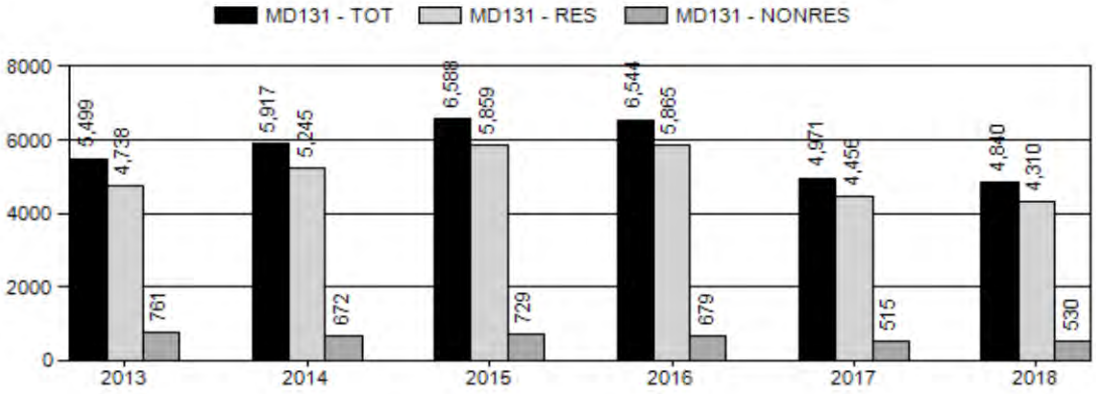
	JCR Year	Proposed
Females ≥ 1 year old:	2%	4%
Males ≥ 1 year old:	28%	33%
Total:	6%	8%
Proposed change in post-season population:	-1%	+2%



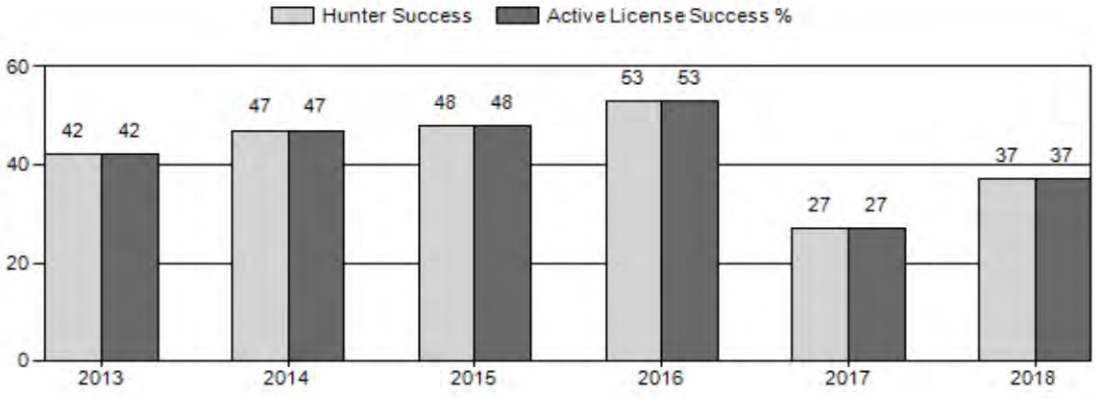
Harvest



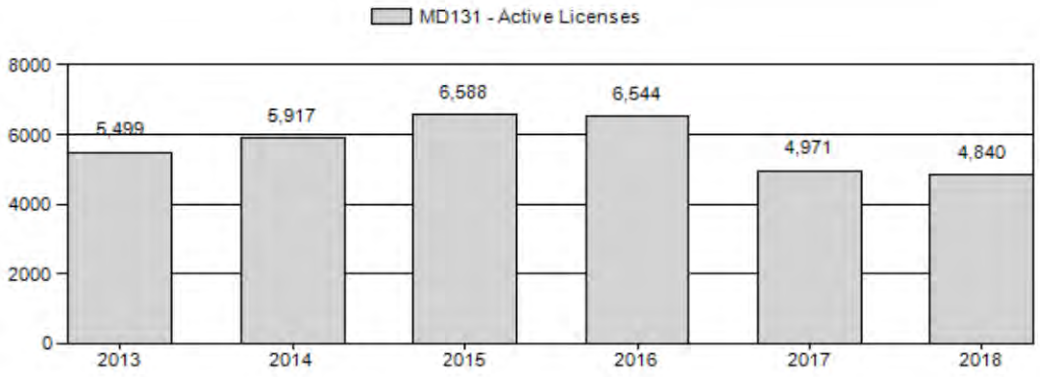
Number of Active Licenses



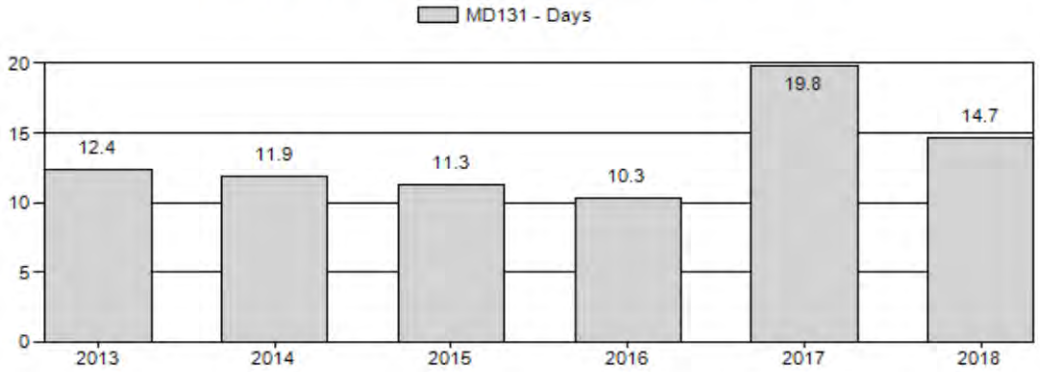
Harvest Success



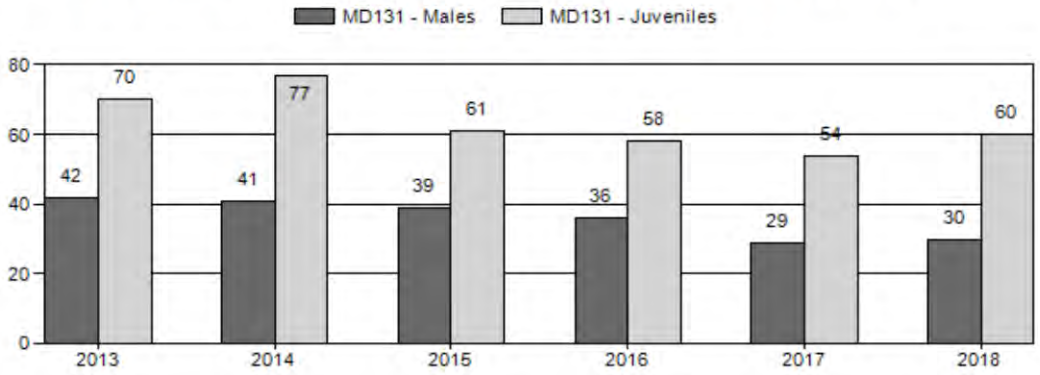
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2013 - 2018 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	Yling	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2013	36,500	544	0	0	0	704	1,248	20%	2,946	47%	2,065	33%	6,259	0	18	24	42	± 2	70	± 2	49
2014	34,200	582	627	428	274	0	1,313	19%	3,239	46%	2,478	35%	7,030	0	18	23	41	± 2	77	± 2	54
2015	38,000	672	408	308	158	0	1,546	20%	3,930	50%	2,381	30%	7,857	0	17	22	39	± 1	61	± 2	43
2016	37,000	533	420	303	107	0	1,363	18%	3,810	52%	2,220	30%	7,393	0	14	22	36	± 1	58	± 2	43
2017	30,500	172	428	281	74	0	955	16%	3,324	55%	1,791	30%	6,070	0	5	24	29	± 1	54	± 2	42
2018	30,200	509	287	313	149	0	1,258	16%	4,252	53%	2,533	31%	8,043	0	12	18	30	± 1	60	± 2	46

2019 HUNTING SEASONS
WYOMING RANGE MULE DEER HERD (MD131)

Hunt Area	Type	Season Dates Opens	Closes	Quota	License	Limitations
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 three (3) points or more on either antler or any white-tailed deer
143		Sep. 15	Oct. 6		General	Antlered mule deer three (3) points or more on either antler or any white-tailed deer
144		Sep. 15	Oct. 6		General	Antlered mule deer three (3) points or more on either antler or any white-tailed deer
145		Sep.15	Oct. 6		General	Antlered mule deer three (3) points or more on either antler or any white-tailed deer
145	3	Nov. 1	Nov. 15	50	Limited quota	Any white-tailed deer
145	3	Nov. 16	Jan. 31			Antlerless 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

REGION G NON-RESIDENT QUOTA - 400 LICENSES

SUMMARY OF PROPOSED CHANGES BY LICENSE NUMBER

Area	License Type	Change from 2018
134	General	Closing date from Oct. 10 to Oct. 14
135	General	Closing date from Oct. 10 to Oct. 14
143, 144, 145	General	No Changes
Region G Licenses	NR Region G	No Changes
Herd Unit Total		No Changes

Management Evaluation
Current Postseason Population Management Objective: 40,000
Management Strategy: Special
2018 Postseason Population Estimate: 30,200
2019 Proposed Postseason Population Estimate: 30,700

The management objective was reviewed in 2015. The current population objective for Wyoming Range mule deer herd is 40,000 deer. The management strategy is special.

In February 2018 the first animal abundance survey was conducted in this herd unit. A total of 25,317 deer were counted on Wyoming Range winter ranges (North winter ranges - 10,074 deer, 40% of sample; South winter ranges - 15,243 deer, 60% of sample). The spreadsheet model was updated with current year's classification and harvest data, annual survival estimates for adult does and fawns, and the 2018 sightability estimate. Based on these parameters and observed data from the sightability survey, the 2018 posthunt population estimate is 30,200 deer. The projected 2019 posthunt population is approximately 30,700 deer.

Herd Unit Issues

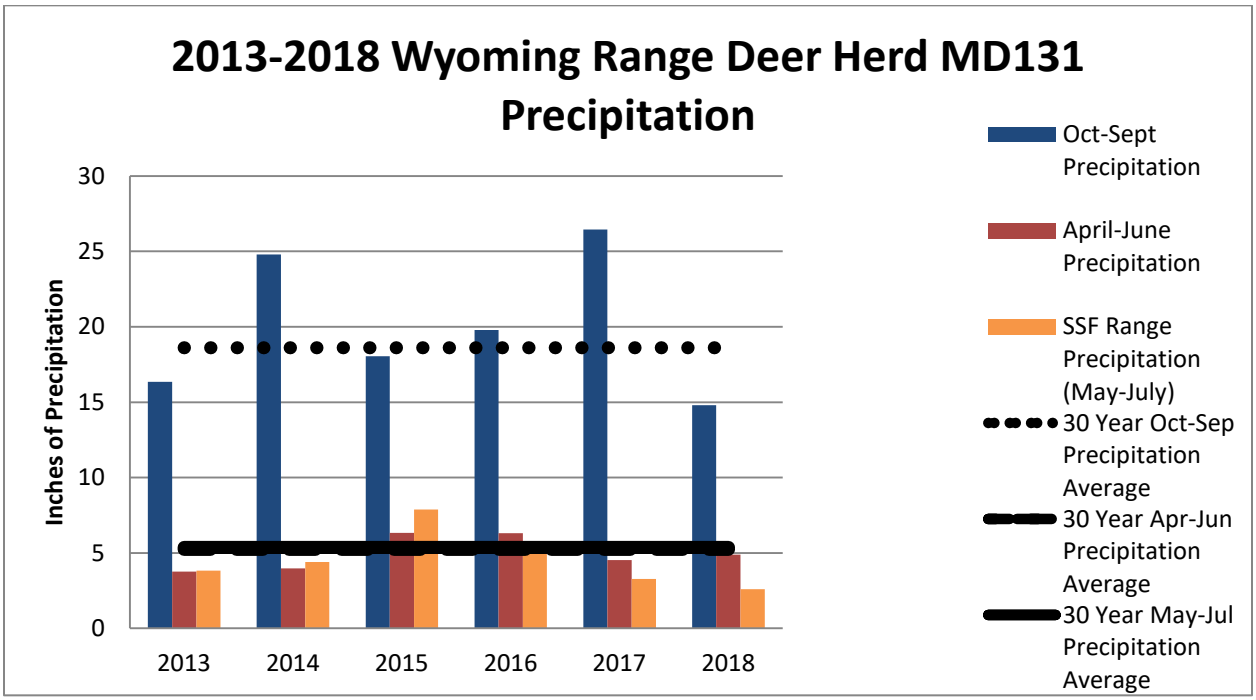
Management strategies since 1993 emphasized hunting antlered deer in an effort to promote population growth. Antlered deer hunts occur in mid-September and early October throughout the herd unit. Hunt seasons close in the northern hunt areas prior to the onset of the annual fall migration in order to 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 to extreme overwinter mortality every 3 years on crucial winter ranges, low vigor and productivity of important winter range browse, and reduced fawn survival and recruitment.

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 (Appendix A).

Weather



Precipitation

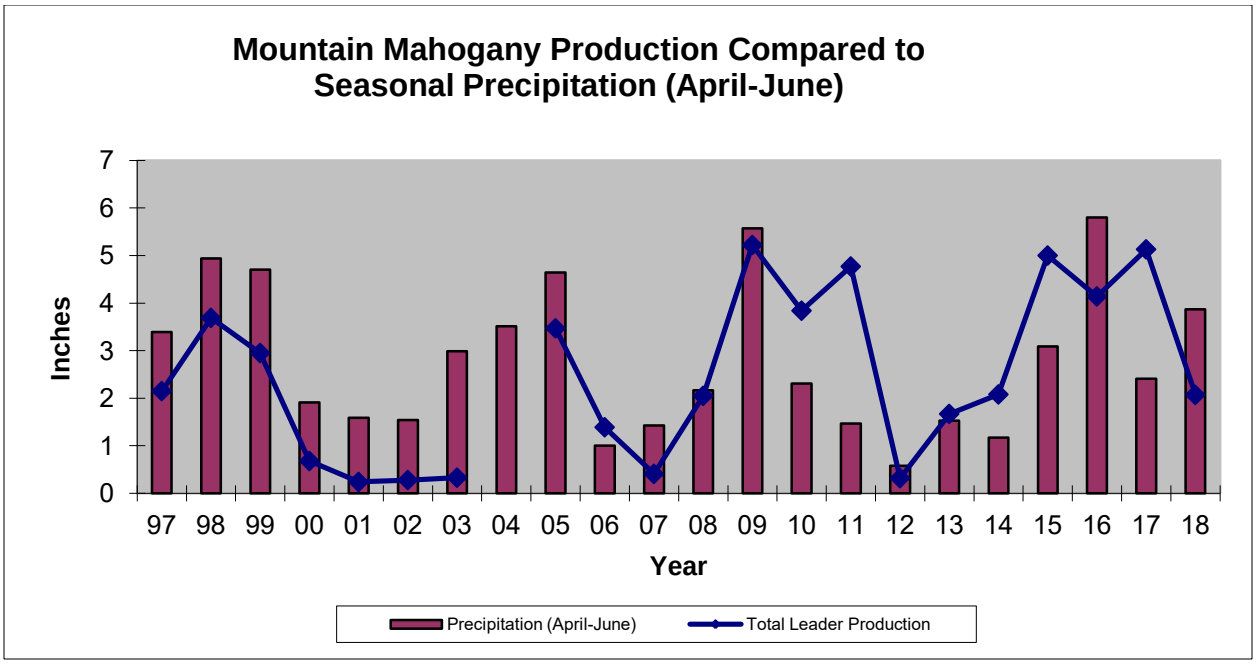
Overall precipitation from October 2017 through September 2018 was well below average when evaluated across the entire herd unit, over the water year (October through September of the following year). The general characteristics included a very mild and dry winter followed by average spring precipitation. Although growing season (April through June) precipitation was near average due to several significant precipitation events, summer (May-July) precipitation was significantly below average and resulted in less than ideal growing conditions on summer range.

Winter Severity
The 2018-2019 winter started mild but turned severe in February and were increasingly tough for wildlife with regard to snow accumulation and cold temperatures on winter ranges. This was especially true for the southern winter ranges, where adult and fawn survival was considerably lower than that of deer on Big Piney-LaBarge winter ranges.

Habitat
In 2018, annual leader production on important forage shrubs was significantly less than the last three years. This reduction is due not only to less overall precipitation, but also relatively higher than average temperature during the growing season, which affected the availability of soil moisture which is an important resource for plants to put into growth. As of late February, lower stature sagebrush are only available in areas with favorable topography but taller shrubs such as true mountain mahogany and serviceberry are largely still available. Snow crusting has been noteworthy which limits mobility and requires deer to expend more energy moving between patches of habitat.

Significant Events
Habitat treatments were conducted at several locations in 2018 throughout the herd unit. The Wyoming Range Mule Deer Habitat Project accomplishments for 2018 include: 1,014 acres of sagebrush mowing, 355 acres of sagebrush aerator thinning, 263 acres of aspen mechanical preparation (slashing and cut-pile), 806 acres of prescribed burning aspen, 17,083 acres of cheatgrass herbicide application, and three livestock riders were hired to manage livestock distribution post-treatment. Generally, vegetation has responded very well to disturbance with increased aspen density in the prescribed burn, improved leader length on sagebrush plants, increased production of herbaceous species, reduction of cheatgrass, and establishment of seeded species in treatments. Additionally in 2018, 2.4 miles of fence was converted to wildlife friendly design in the LaBarge Creek drainage on private land. More detailed information can be obtained by reading the Pinedale Region report in the 2018 Strategic Habitat Plan (SHP) Annual Report.

Habitat Monitoring
Leader production in 2018 for True Mountain Mahogany decreased from an average of 5.13 inches in 2017 to 2.07 inches in 2018 across the four transects that were monitored. Other shrub species within habitat treatments are also being monitored and are discussed in more detail in the 2018 Strategic Habitat Plan Report.



Rapid Habitat Assessments

In 2016, Department personnel initiated the Rapid Habitat Assessment methodology to survey important mule deer habitats. This method strives to capture large-scale habitat quality metrics to better understand how the habitat is providing for the current population of mule deer. The overall end result of this effort will be to provide a standardized habitat component to discussions about how mule deer objectives should or should not be adjusted based on the general concept of carrying capacity. In 2018, 759 acres of Aspen RHAs and 8,031 acres of Rangeland RHAs were completed in the Wyoming Range Mule Deer herd by personnel in the Pinedale and Green River Regions.

Field Data

The Wyoming Range deer herd has been unable to sustain population growth for more than 4 consecutive years since the early 1990s. Normal to high over-winter mortality, in addition to other factors identified by research associated with the Wyoming Range Mule Deer Project continues to suppress this population's ability to sustain growth for more than four consecutive years 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 of two important metrics: adult survival and fetal rates. Phase II – the fawn survival component of the project was implemented in 2015 to provide an assessment of annual fawn survival. The Phase II segment of the project focused 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 (Appendix A). Specific objectives of this project quantified the effects of predation and other mortality factors on survival of young mule deer, and provided a relative assessment of the effect of juvenile mortality on the annual population dynamic.

During 2015 an important, but previously unknown, mortality factor was discovered in this deer herd. The disease, Adenovirus Hemorrhagic Disease (AHD) was determined to be responsible for killing radio-collared newborn fawns and un-collared fawns as old as 5 months old throughout the herd unit. Although the impact to the annual population dynamic is unknown at this time, it is suspected that AHD, in addition to predation and malnutrition, and fawn mortality at parturition played important roles in the mortality of a substantial percentage of fawns born in 2015 - 2017.

In December 2018 Phase III of the Wyoming Range Mule Deer project has begun to disentangle many of the factors that may regulate mule deer herds in Wyoming, but there is still a critical gap in understanding the ecology of this herd. Despite the fact that males are often the segment of the population most valued by the public, there exists little information on how their ecology differs from females, and thus, how males may behave or respond differently from females to regulating or limiting factors (Appendix B). In an effort to better understand the ecology of male deer in the Wyoming Range, males were captured on LaBarge and Kemmerer/Evanston winter ranges in December 2018 and January 2019.

The overarching goal of this work is to improve our understanding of the ecology of male mule deer, with a specific eye towards characterizing seasonal behavior, migration, survival and vulnerability to harvest, and growth and recruitment. Given the long-term and ongoing research associated with the Wyoming Range Mule Deer Project, we have a unique opportunity to gain much value-added through minimal additional investment to fill a current gap in understanding. To achieve this goal, we propose to fit male mule deer of varying age with GPS collars and monitor them over time to:

1) Evaluate migratory behaviors and migratory routes of adult males, and identify how they differ from adult females.
2) Evaluate how male deer select habitat relative to females, during summer and winters.
3) Assess how males occupy the landscape and ultimately stock the ranges in which hunters cherish as hunting destinations.
4) Evaluate the vulnerability of male mule deer to harvest as a function of both age, behavior, and size.
5) Examine temporal and spacial characteristics of male deer during hunting seasons and at time of harvest.
6) Should time and resources allow, with the recent decline in population abundance following the 2016-17' winter and the corresponding rise in nutritional condition of females, we aim to evaluate how characteristics of the population (i.e., population density, nutritional condition of females, etc) during the year of birth affects growth and ultimately, the size obtained by males at maturity.

Adult survival exceeded 85% during the period from 2013 – 2015. During the same three year period, fetal rates averaged 1.6 fetuses/doe. An on-going effort to monitor population dynamics with posthunt herd composition surveys provided an assessment of buck recruitment and fawn production and survival. From 2015 – 2017 total fawn mortality was estimated at 54%, 100%, and 59% of the radio-collared fawns marked in June died during this three period, respectively.

The 2016-2017 winter resulted in the highest recorded mortality of mule deer in at least 33 years. Annual survival of radio-collared does and fawns was the lowest recorded since inception of the Wyoming Range mule deer project in 2013. Collared fawn mortality was observed at 100%; while 37% of radio-collared does succumbed to the winter (Appendix C). The over-winter population declined by as much as 35%-45%, with varying degrees of mortality observed over the many distinct winter range complexes found on the North (Big Piney-LaBarge, Ryegrass, Star Valley) and South Winter Ranges (Kemmerer, Evanston, Cokeville).

During the 2017-2018 winter, core winter ranges received substantially less accumulated snowfall and fewer extended subzero temperature periods that persisted throughout the winter. The diminished effects of this winter on population performance promoted the conditions for initial population recovery following the record level of mule deer losses observed in 2017. Consequently, adult and fawn survival was estimated at 100% and 93%, respectively (Kevin Monteith, pers. comm.) of radio-collared deer associated with the Wyoming Range mule deer research.

The current winter resulted in substantially different impacts on segments of the population because precipitation and temperature regimes varied across the major winter ranges in the herd unit Appendix D). The winter of 2018-19 was characterized by high over winter survival on the Big Piney-LaBarge winter ranges for all age and sex age classes of mule deer. By the end of March, survival was estimated at 86%, and 70% for radio-collared does and fawns, respectively (Tayler LaScharr, pers. comm.). Conversely, mule deer that spent the winter on the South Winter Ranges (Kemmerer, Cokeville, and Evanston) experienced normal to relatively high winter losses depending on age/sex class. An index of over winter survival was estimated by the fate of radio-collared mule deer. By the end of March, 70% and 40% of radio-collared does and fawns, respectively were alive.

Buck:doe ratios have met or exceeded the special management objective of 30-45 bucks:100 does in the posthunt population since 1990 in all years except 2004, 2017, and 2018 (Appendix E). During these three years the observed buck:doe ratio was 29 bucks:100 does. During the most recent 5-period (2013 – 2017) high overwinter survival in all years except 2017 has contributed to recruitment of 1.5+ year old bucks. Despite lower fawn survival and recruitment, buck ratios have met management goals. Since 2012 buck:does ratios have exceeded 39:100 in three of the last seven years.

Harvest

Hunting seasons since 1993 have been designed to allow 8 - 14 days of hunting recreation in the southern areas (Areas 134,135) and 16-23 days of hunting in the northern areas (Areas 143-145) of the herd unit. Antlered only hunting, and the near absence of antlerless harvest has failed to produce the sustained (≥4 consecutive years) population increase since the late 1990s. Nonresident licenses were reduced from 800 licenses to 600 licenses in Region G beginning in 2012, and were further reduced in 2017 to 400 licenses. A conservative management approach of closing hunting seasons prior to the annual fall migration in the northern hunt areas has promoted the recruitment of trophy class bucks into the posthunt population.

Overall hunter success declined from 53% in 2016 to 27% in 2017. Hunters tallied 34% success in 2018. A total of 1799 deer were harvested in 2018, which reflects the initial recovery of the population from the 1355 deer taken in 2017, but less than the 3457 deer taken in 2016 prior to the severe winter losses in winter 2017. Additional harvest statistics, such as days/harvest and recreation days, provide additional metrics that reflect the downturn in the annual population dynamic from 2016 – 2017. This population correction is directly associated with high over-winter mortality in 2017. Consequently, hunters expended more days (N=20 days) to harvest a deer in 2017 than in 2016 (N=10 days). In 2018, hunter effort declined to 14 days/harvest in response to higher over winter survival during the 2018.

Doe harvest typically accounts for less than 5% of the total annual harvest. In 2014 – 2016, 1.5+ year old does accounted for 4%, 3%, and 2% of the total herd unit harvest, respectively. In 2017, 61 does were harvested which accounted for only 1% of the herd unit's total harvest. A total of 39 does were taken in 2018, which comprises 2% of the total harvest. Nonresident hunters contributed 18% of the total deer harvest in 2018. In nonresident Region G, nonresidents accounted for 16% of the total harvest in Areas 135, 143-145. Resident Hunters accounted for 87%, 96%, 76%, and 79%, of the total harvest in Areas 135, 143-145, respectively.

Hunt Area 135 accounted for 28% of all Region G nonresident hunters in 2018, while the three northern hunt areas of the herd unit, Areas 143-145, accounted for 72% of all Region G nonresident hunters. Interestingly, Hunt Areas 144 and 145 accounted for 68% of Region G Hunters while only 16 nonresident hunters, or 3% of nonresident hunters.

Population

The model was updated with the sightability estimate and standard error information. 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=100). In addition, observed data and model derived output such as adult and fawn survival, postseason buck ratios, and the sightability estimate derived in February 2018 aligns within the identified constraints that are based on model Fit and Relative AICc parameters.

Management Summary

The population remains below the ± 20% management threshold of the population objective. The 2019 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 and influx of elk hunters in preparation for the October 15 hunting season opener. The hunting seasons are proposed to remain conservative because of the extremely high winter mortality noted during the previous winter, postseason buck:doe ratios that were below the management minimum of 30 buck:100 does, a population below the ±20% management threshold, and a public sentiment that requests a conservative management approach. Additionally, Nonresident Region G licenses are proposed to remain at 400 licenses.

The hunt season in Hunt Area 134 will increase the number of days from 10 days to 14 days of general season antlered deer only hunting, with a continuation of the added restriction that antlered deer with three points or more on either antler may be taken. In Hunt Area 135, the

season will be lengthened from October 10 to October 14, with the added restriction that antlered deer may be taken with three points or more on either antler which has been in place since the 2017 season. The increase in length of the seasons in Areas 134 and 135 is an attempt to return hunting season structure to historical closing dates. Both areas typically offered closing dates between October 8 and October 14, which also encompassed at least one weekend of hunting opportunity. The 2017 hunt season was the first year in at least 20 years in which Area 135 did not offer at least one weekend of hunting opportunity. Perhaps more importantly, the proposal to provide a few more days of hunting recreation in 2019 will not adversely impact buck ratios, the annual population dynamic or overall survival of the adult female, or reproductive, segment of the population. Perhaps just as important in the deer management program in southwest Wyoming is the proposed increase in hunting recreation in Area 135 which will likely mitigate the displacement of hunters into other surrounding areas (i.e. Area 134). An extended season may also disperse hunters over a longer period of time, and thereby reduce hunter congestion in 2019 in southwestern Wyoming hunt areas. Moreover, a significant number of publics throughout southern Lincoln County and Uinta County request that deer seasons are proposed to provide at least one weekend of hunting opportunity.

Similar to the last two years, Hunt Areas 143-145 will close on October 6 in 2019, and offer hunters the opportunity to harvest antlered mule deer with three points or more on either antler. This Antlered Point Restriction is a continuation from the 2017 hunting season, and consideration will be given to returning to antlered deer only hunting in 2020. The October 6 closing date is the same closing date in 2018, and is a management strategy that provides the public with a consistent 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 that are more accessible to hunters. Season closure prior to this migration will ensure that overharvest of bucks does not occur. Shorter season dates in these areas is in response to public concerns regarding deer numbers following the severe winter. A shorter season in the northern three areas is an assurance that bucks are not taken during the fall migration when they can be more vulnerable to late season harvest. This management strategy is supported by the hunting public.

In Area 145, a limited quota any white-tailed deer hunt will continue to allow hunters to take any white-tailed deer during a portion of the November hunting season. The number of Type 3 licenses will be maintained at 50 licenses, and the segment of the any white-tailed deer hunt will continue to be November 1 - November 15 for the 2018 hunt. Doe and fawn white-tailed deer may be taken from November 16 – December 31. Public concerns have focused on a general lack of access to suitable hunting locations and fewer white-tailed deer being observed in those areas. Also, there has been a decrease in reported chronic damages to stored crops on private property by landowners in recent years thereby resulting in the proposed reduction in hunting opportunity for the Type 3 license.

The 2019 hunting seasons are projected to harvest approximately 2330 deer. The population is projected to remain essentially unchanged from 2018 levels because, in part, to the above normal winter mortality observed on the southern Wyoming Range winter ranges. The posthunt 2019 population is projected at 30,700 deer.

APPENDIX A

Nutritional carrying capacity and factors limiting population growth of mule deer in the Wyoming Range

Wyoming Cooperative Fish and Wildlife Research Unit
Wyoming Game and Fish Department
University of Wyoming
2013

PROJECT TITLE
Nutritional carrying capacity and factors limiting population growth of mule deer in the Wyoming Range

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DURATION: 1 July 2012 – 30 June 2016

INTRODUCTION

Concerns over population performance and factors limiting population growth have heightened in recent decades in response to near ubiquitous declines in the abundance of mule deer (*Odocoileus hemionus*) throughout much of the West. Factors responsible for such declines remain largely speculative and controversial (deVos et al. 2003); however, recent comprehensive research has identified habitat quality and winter severity as important factors that are currently limiting mule deer in the Intermountain West (Bishop et al. 2009, Hurley et al. 2011). In response to concerns of mule deer populations in Wyoming, in 2007, the Wyoming Game and Fish Commission adopted the *Wyoming Mule Deer Initiative* (MDI) with the intent to develop individual management plans or strategies for key herd units based on overarching goals and objectives. Separately, the Mule Deer Working Group (2007) recognized that the *"Success and implementation of these plans will depend upon our ability to identify limiting factors to mule deer populations and their habitats"*.

Of particular concern is the Wyoming Range mule deer herd in western-central Wyoming- one of the largest mule deer herds in the state and a premier destination for mule deer hunting in the country. The Wyoming Range mule deer population (MD131) has undergone dynamic changes in recent decades from a population high of >50,000 in the late 1980s, to a sustained population of ~30,000 during the last decade. Prior to the acceptance of the MDI, the Wyoming Range mule deer herd was a top priority for the development of a management plan according to the MDI. The first of the herd-specific management plans, the *Wyoming Range Mule Deer Initiative* (WRMDI), was finalized in 2011 following a collaborative public input process. The proposed research we describe here stems directly from research and management issues identified by the Mule Deer Working Group in the WRMDI, and we have proposed to conduct this research on Wyoming Range mule deer because of its priority status and controversy behind its population dynamics.

The marked decline of this deer population following the 1992-93 winter, and the near absence of any substantial recovery, has engaged the WGFD in controversy regarding management and herd unit objectives. Despite conservative harvest focused on the antlered portion of the population with limited to no harvest of females, the population has failed to recover to the herd unit objective of 50,000 animals. Given current population trends, severity of winters, and deteriorating range conditions, it has become apparent that

the habitat is not capable of supporting the current herd unit objective. Nevertheless, identifying the current capacity of the habitat to support mule deer in the Wyoming Range has been a persistent management challenge. Habitat conditions on both winter and summer range occupied by Wyoming Range mule deer have been deteriorating as a result of both drought and land-use practices. Declines in snowpack and rising spring temperatures have been pronounced in recent decades across much of the Rocky Mountains (Westerling et al. 2006, Pederson et al. 2011); both of which have a negative effect on forage quality and abundance, thereby influencing carrying capacity.

PRIMARY OBJECTIVE

The overall goal of this research project is to address important research and management needs indentified by the MDI and WRMDI. **Overall, we seek 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.** Our approach is to mesh 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, we have the 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.

BENEFITS

The impetus behind this project follows from questions underlying the population dynamics of the Wyoming Range mule deer herd, and was formulated to meet multiple objectives outlined by the Mule Deer Working Group in the *Wyoming Mule Deer Initiative*, and the herd-unit specific *Wyoming Range Mule Deer Initiative* (WRMDI). Our proposed study will meet objectives under 5 of the 6 management issues identified in the WRMDI which was finalized in 2011, including but not limited to:

• Estimate the nutritional capacity of existing habitat available to mule deer in the Wyoming Range to evaluate whether revision of the current population objective of 50,000 wintering mule deer is warranted.

• Characterize existing habitat conditions with respect to population density by implementing a nutritionally based approach to estimating carrying capacity that could be applied to other herd units in Wyoming.

• Link habitat use with vital rates and nutritional processes will help identify vegetation communities and habitat treatments most beneficial for mule deer to enhance mule deer populations as wells as identifying effective mitigation strategies.

• Assess the nutritional capacity for survival and reproduction will help characterize the potential effects of predation on mule deer, as well as the benefits of predator control efforts already in place.

• Evaluate patterns of mule deer migration will delineate important mule deer migration corridors, and provide predictive models for timing of seasonal migration to identify critical migration periods.

• Evaluate the physiological effects of oil and gas development will help to quantify the direct and indirect effects of habitat loss and disturbance on mule deer in the Wyoming Range, as well as identifying habitat manipulations that are likely to be most effective in mitigating the effects of energy development.

• Results of this research project 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 management strategies likely to be most beneficial to the mule deer population.

APPENDIX B

ECOLOGY OF MALE MULE DEER IN THE WYOMING RANGE: MOVEMENT, GROWTH, AND SURVIVAL

PRINCIPAL INVESTIGATORS

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BACKGROUND

Mule deer are an iconic species of the West, and highly valued by hunters and wildlife enthusiasts. The Wyoming Range mule deer herd is one of the most cherished populations of mule deer in Wyoming, and there is substantial interest among both the public and researchers in understanding the factors that regulate this population. This herd holds substantial cultural and economic importance, in part because of the opportunities it provides for hunters from both Wyoming and throughout the West to harvest male deer, and for some, to harvest large males. Despite the importance of male mule deer in the Wyoming Range to both the public and economy, we still lack fundamental understandings of much of the ecology of males (i.e., migratory behaviors, vulnerability to harvest, dispersal from natal home ranges), and thus, many questions arise as to how season dates should be established, how male deer respond to harvest pressure, and whether males are being recruited into older age segments. Or for example, even more basic questions associated with how population processes are stocking high-elevation basins with male deer remains largely unknown.

In 2013, the Wyoming Range Mule Deer project was initiated to address goals and objectives outlined by the Wyoming Game and Fish Commission and the public in the Wyoming Mule Deer Initiative (MDI). The goal of the Wyoming Range Mule Deer project has been to elucidate the relative roles of nutrition, habitat, anthropogenic disturbance, changing climates, predation, and disease on regulating populations of mule deer in the Wyoming Range. In March 2013, 70 adult females were captured and collared and each subsequent winter and spring, those individuals have been recaptured. The longitudinal design of this study has revealed important patterns in nutritional condition of females coming out of and going into winter ranges (see Spring Update), has disentangled the direct and indirect effects that energy development can have on winter ranges

(Dwinnell et al. *in revision*), and has provided insight into how climate change may influence use of important migratory routes (Aikens et al. 2017; *in prep*). To better understand the most sensitive demographic of the population, a neonatal survival component was added to the project in the summer of 2015, with the goal of monitoring and evaluating survival and cause-specific mortality of newborns in the population. Beginning in 2015, and each subsequent summer, newborns belonging to radiocollared females have been captured and monitored throughout the summer and following winter, with each year revealing fluctuating contributions to mortality of young including disease, predation, and malnutrition. Thus far, the work that has been conducted on this population has been restricted to females and neonates, in large part because females are the reproductive drivers and most important component in regulating populations.

The Wyoming Range Mule Deer project has begun to disentangle many of the factors that may regulate mule deer herds in Wyoming, but there is still a critical gap in understanding the ecology of this herd. Despite the fact that males are often the segment of the population most valued by the public, there exists little information on how their ecology differs from females, and thus, how males may behave or respond differently from females to regulating or limiting factors. Indeed, harvest of females has been restricted almost completely in the Wyoming Range since 1993 and thus, almost all harvest-related opportunity in the population is provided by the male segment. The Wyoming Range herd is universally considered by many to be one of the premier herds for hunting large mule deer in North America. Accordingly, most conversations associated with management of the Wyoming Range herd, and many others for that matter, is focused around harvest of males. Outside of antler morphology characteristics (Table 1 and 2) and age specific data (Table 3) that is collected in the field by managers subsequent to harvest, little information is available that contributes to the management of the male cohort (Fralick 2001). In fact, other than posthunt male:female ratios, there are no other long-term, consistently obtained or reliable data sets that describe the annual population dynamic, or effects of management action on the 1+-year old male cohort (Fralick 2007). Consequently, we generally lack empirical information to help inform discussions as to management of males. This discussion occurs at a time when segments of the hunting public are asking for a dichotomous, and inherently conflicting, set of management actions be implemented that dramatically restricts hunting of males, as well as providing increased opportunity to harvest trophy class males during the migratory period (i.e., longer hunting seasons) or when males arrive on winter ranges.

Existing evidence and theory indicates that male ungulates differ markedly in their behavior, nutritional dynamics, and growth (Barboza and Bowyer 2000, Monteith et al. 2009, Monteith et al. 2018), and as a consequence, can exhibit demographics divergent to that of females (Stevenson and Bancroft 1995, Ditchkoff et al. 2001). In fact, it has been recommended that male ungulates be considered as essentially a different species compared with females, because of their striking differences in life history (Kie and Bowyer 1999). Although they represent a flexible resource within populations because harvest of males plays little role in affecting population dynamics for polygynous ungulates (Mysterud et al. 2002, Freeman et al. 2014), increasing interest in maintaining male:female ratios at specified levels and maintaining a specific age structure has become common criteria in management plans. Moreover, heightened discussions on harvest

pressure and the topic of limited quota harvest regimes exemplify the need for additional insight into the ecology of male deer.

PRIMARY OBJECTIVE

The overarching goal of this work is to improve our understanding of the ecology of male mule deer, with a specific eye towards characterizing seasonal behavior, migration, survival and vulnerability to harvest, and growth and recruitment. Given the long-term and ongoing research associated with the Wyoming Range Mule Deer Project, we have a unique opportunity to gain much value-added through minimal additional investment to fill a current gap in understanding. To achieve this goal, we propose to fit male mule deer of varying age with GPS collars and monitor them over time to:

1) Evaluate migratory behaviors and migratory routes of adult males, and identify how they differ from adult females.
2) Evaluate how male deer select habitat relative to females, during summer and winters.
3) Assess how males occupy the landscape and ultimately stock the ranges in which hunters cherish as hunting destinations.
4) Evaluate the vulnerability of male mule deer to harvest as a function of both age, behavior, and size.
5) Examine temporal and spatial characteristics of movement by male deer during hunting seasons and at time of harvest.
6) Should time and resources allow, with the recent decline in population abundance following the 2016-17' winter and the corresponding rise in nutritional condition of females, we aim to evaluate how characteristics of the population (i.e., population density, nutritional condition of females, etc) during the year of birth affects growth and ultimately, the size obtained by males at maturity.

METHODS

To achieve our objectives, we propose to capture male deer via either ground darting and chemical immobilization or helicopter netgunning on winter range. Our goal is to fit a minimum of 30 adult (>1 yr old) male deer and any surviving juvenile deer that we captured as neonates on summer range with expandable GPS collars. Recapturing of surviving juveniles will be key to evaluating dispersal from natal ranges and ultimately, what shapes distribution of adult males on summer ranges. For males of unknown age, we will remove an incisiform canine from each newly captured deer to determine age via cementum annuli. Finally, for each captured male, we will measure body mass, morphological structure or size, and measure antler size using the Boone and Crockett scoring system. In subsequent years, we will evaluate antler size of surviving males via photography and cartographic software designed for measuring antler size (Buckscore ©). Using GPS data from collared male mule deer, we will:

1. Identify migratory behaviors, and important migratory routes for male mule deer and compare those behaviors and routes to that of females.
2. Identify changes in movement behavior between hunting and non-hunting seasons as a function of both age and size.

3. Identify summer ranges of males collared as neonates, and compare to the summer ranges of females within their family (i.e., mothers and sisters).

BENEFITS

Despite the inherent social and economic value of the male deer in the Wyoming Range and other ranges across the West, we have yet to develop a comprehensive understanding of the ecology and life history of male deer. For legitimate reasons, most work to date has focused on the segment of the populations that are responsible for producing and rearing young. And although we have learned much, the point between a surviving male offspring to an independent, adult male on the landscape has and remains a missing link. Nevertheless, it is those males that are providing valuable wildlife viewing and hunting opportunity that is at the core of our outdoor heritage in Wyoming. In achieving the objectives associated with this proposed research, we will help fill this missing link and provide valuable information as to the ecology of male deer that will be a key point of information for future discussions on management and harvest. Moreover, we propose to do our work in one of the premier destinations for mule deer hunters in Wyoming and throughout the West, and in a place that offers the greatest amount of recreational opportunity in pursuit of mule deer in the state of Wyoming. To say the Wyoming Range mule deer herd is a treasure of the state of Wyoming would not be overstated. Male deer are truly a different beast, both figuratively and literally, and thus, perhaps it's time we truly do better to understand how they are and what that should mean for us in an ever-changing world.

PROJECTED BUDGET

Personnel capacity and support will be provided by the ongoing work associated with the Wyoming Range Mule Deer Project and thus, needs for this work are associated only with collars and capture of males, travel for fieldwork, and minor supplies and support for outreach efforts.

Description	FY2019	FY2020	FY2021
Radiocollars			
Live Satellite GPS radiocollars $800per	36,000	12,000	0
Satellite uplink fees at $250/collar/yr	11,250	15,000	15,000
Animal capture			
Mid-winter helicopter capture @600/per	9,000	9,000	0
Chemical immobilization	3,000	0	0
Mortality replacement	0	3,600	3,600
Personnel, Travel, Supplies			
Travel (fieldwork, collaboration, conference, etc.)	8,500	4,500	4,500
Lab analyses (tooth sectioning)	500	250	250
Field equipment (darts, cameras, optics)	6,000	1,500	1,500
Publications and outreach	0	0	3,000
Accounting and technical support	5,713	4,292	3,392
Projected annual cost for project:	$79,963	$50,142	$31,242
		Project Total:	**$161,347**

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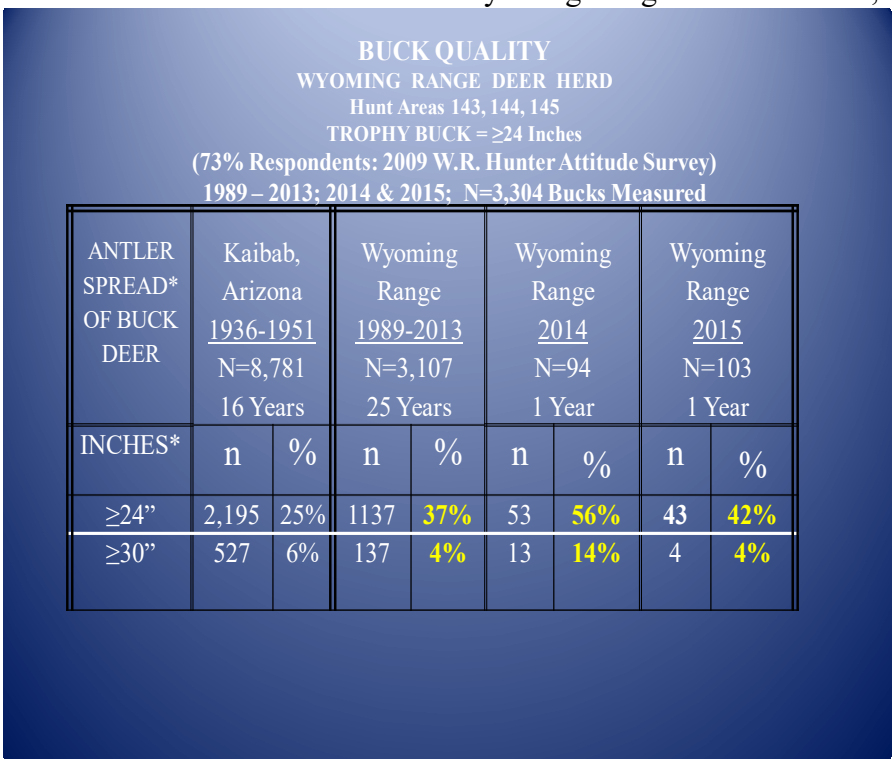
Table 1. A summary of antler point characteristics of male deer harvested in the Wyoming Range mule deer herd, 1989 - 2015, (N=3,304).

BUCK QUALITY
WYOMING RANGE DEER HERD
HUNT AREAS 143, 144, 145
TROPHY BUCK = ≥4-POINTS
(75% Respondents: 2009 W.R. Hunter Attitude Survey)
1989 – 2013; 2014 & 2015; N=3,304 Bucks Measured

4-POINTS OR BETTER PER ANTLER	Wyoming Range 1989-2013 N=3,107 25 Years		Wyoming Range 2014 N=94 1 Year		Wyoming Range 2015 N=103 1 Year	
	n	%	n	%	n	%
4-Points	2,429	78%	91	97%	96	93%

Table 2. A summary of antler morphology characteristics based on widest outside measurement of male mule deer harvested in the Wyoming Range mule deer herd, 1989 – 2015 (N=3,304).



BUCK QUALITY
WYOMING RANGE DEER HERD
Hunt Areas 143, 144, 145
TROPHY BUCK = ≥24 Inches
(73% Respondents: 2009 W.R. Hunter Attitude Survey)
1989 – 2013; 2014 & 2015; N=3,304 Bucks Measured

ANTLER SPREAD* OF BUCK DEER	Kaibab, Arizona 1936-1951 N=8,781 16 Years		Wyoming Range 1989-2013 N=3,107 25 Years		Wyoming Range 2014 N=94 1 Year		Wyoming Range 2015 N=103 1 Year	
INCHES*	n	%	n	%	n	%	n	%
≥24”	2,195	25%	1137	37%	53	56%	43	42%
≥30”	527	6%	137	4%	13	14%	4	4%

Table 3. A summary of age at harvest based on cementum annuli estimation of hunter-harvested mule deer bucks, Wyoming Range mule deer herd, 1988-2001 (N=3,153).

AGE CLASSES OF HARVESTED MULE DEER BUCKS										
Year	1	2	3	4	5	6	7	8	9	10
1988	109	63	57	40	9	18	7	2	2	0
1989	57	37	42	19	6	0	3	1	4	0
1990	117	21	56	44	14	6	1	0	0	0
1991	189	84	94	57	22	9	3	1	2	1
1992	64	57	93	37	28	13	4	1	0	0
1993	5	7	12	11	4	1	2	0	0	0
1994	33	4	12	20	11	7	1	0	1	0
1995	67	15	24	19	12	8	2	2	0	0
1996	43	35	38	12	13	20	8	2	1	0
1997	19	17	32	17	8	5	4	2	0	0
1998	40	18	44	36	15	10	7	7	4	0
1999	101	39	46	49	34	15	1	3	5	0
2000	104	53	74	36	43	29	12	2	3	1
2001	79	46	60	27	24	16	15	2	3	0
Totals	1027	496	684	424	243	157	70	25	25	2

Wyoming Range Mule Deer Project

Winter 2017-18 Update

UNIVERSITY OF WYOMING

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WYOMING RANGE MULE DEER PROJECT

Project Background

In recent decades, mule deer abundance throughout the West has struggled to reach historic numbers, and Wyoming is no exception to the nearly ubiquitous trend of population declines. In response to concerns of mule deer populations in Wyoming, in 2007, the Wyoming Game and Fish Commission adopted the *Wyoming Mule Deer Initiative* (MDI) with the intent to develop individual management plans for key populations. Of particular concern was the Wyoming Range mule deer population in western Wyoming—one of the largest mule deer herds in the state and a premier destination for mule deer hunting in the country. The Wyoming Range mule deer population has undergone dynamic changes in recent decades from a population high of >50,000 in the late 1980s, to a sustained population of ~30,000 during much of the last decade (Fig. 1). Consequently, the Wyoming Range mule deer population was identified as a top priority for the development of a management plan according to the MDI. The first of the population-specific management plans, the *Wyoming Range Mule Deer Initiative* (WRMDI), was finalized in 2011 following a collaborative public input process. To direct development of an effective management plan, it was recognized by the Mule Deer Working Group (2007) that the *"Success and implementation of these plans will depend upon our ability to identify limiting factors to mule deer populations and their habitats"*. Accordingly, the Wyoming Range Mule Deer Project was initiated 2013 to address the need for research in identifying the factors that regulate the Wyoming Range mule deer population.

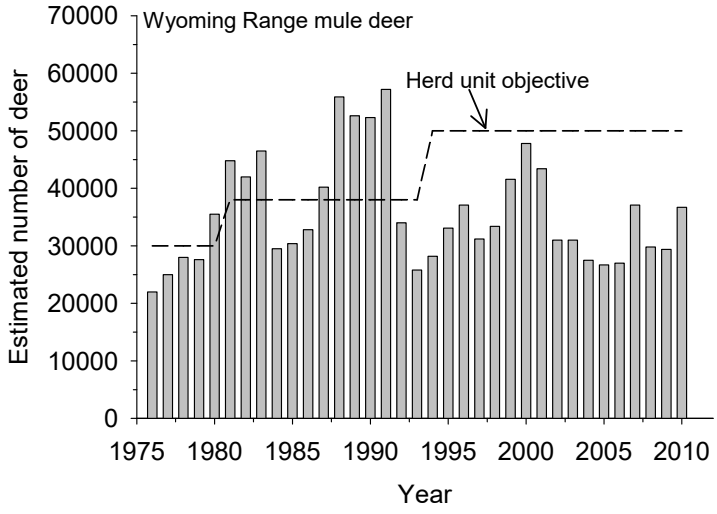


Figure 1. Estimated population size of the Wyoming Range mule deer herd relative to herd unit objective, 1976-2010.

The overarching goal of the Wyoming Range Mule Deer Project is to investigate the nutritional relationships among habitat conditions, climate, and behavior to understand how these factors interact to regulate population performance. We initiated the project in March 2013 with the capture of 70 adult, female mule deer on two discrete winter ranges for migratory, Wyoming Range mule deer (Fig. 2). In summer 2015, we initiated Phase II of the Wyoming Range Mule

Deer Project that focuses on survival and cause-specific mortality of neonate mule deer. Since the initiation of the project, we have tracked and monitored the survival, behaviors, reproduction, and habitat conditions of 202 adult female and 195 juvenile mule deer of the Wyoming Range. This update highlights some of our many discoveries on mule deer ecology since the initiation of the project.

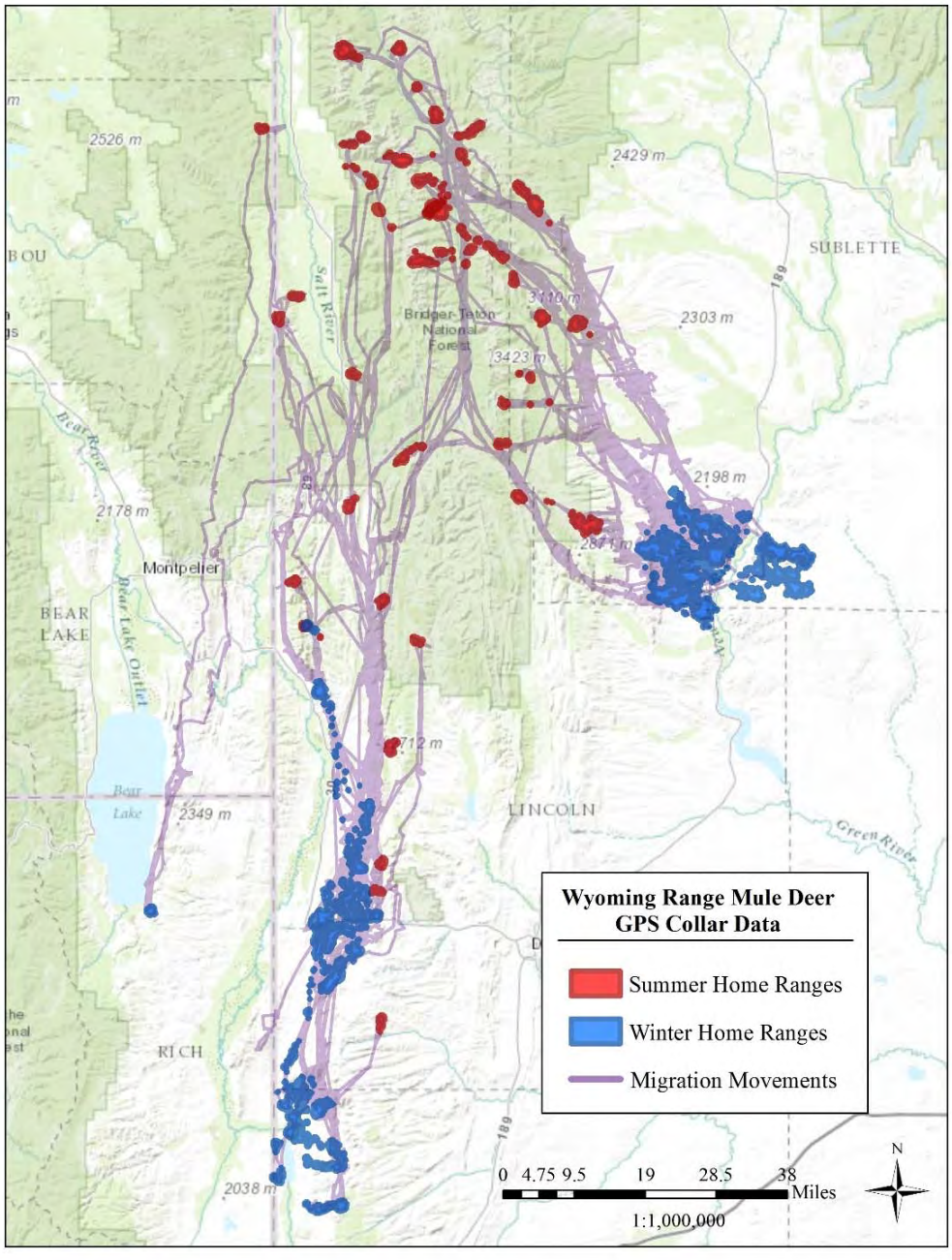


Figure 2. Winter and summer home ranges (based on 95% Kernel Utilization Distribution of GPS collar data) as well as migration movements of Wyoming Range mule deer.

A Nutritional Ecology Framework: Linking the Individual to the Population

Using a nutritional ecology framework, we aim to evaluate how conditions of all seasonal ranges mule deer encounter throughout the year—ranges used during summer, winter, and migration—affect individual animals. Using this unique approach, we can develop a comprehensive understanding of how the connections individual mule deer have with their environments influences population dynamics.

Mule Deer Capture

Since March 2013, we have captured and recaptured 202 adult, female mule deer. Upon each capture, in addition to fitting each animal with a GPS collar, we collect a suite of data on individual animals including age, nutritional condition, morphometry, and pregnancy. Animals are recaptured each spring (in March) and autumn (in December) to monitor longitudinal changes in nutritional condition and reproduction. In doing this, we can link various life-history characteristics with behaviors and habitat conditions of individual animals.

Nutritional Condition

At each capture event, we use ultrasonography to measure fat reserves (i.e., % body fat). By recapturing collared mule deer and measuring body fat each autumn and spring, we are able to track changes in nutritional condition between summer and winter seasons.

Although most animals lost fat in the winter and gained fat in the summer, the rate at which fat reserves increased or decreased varied widely among individual animals (Fig. 3). A suite of factors can influence fat dynamics between winter and summer seasons, but availability of food on seasonal ranges and number of fawns a female raises have the greatest effect on fat dynamics.

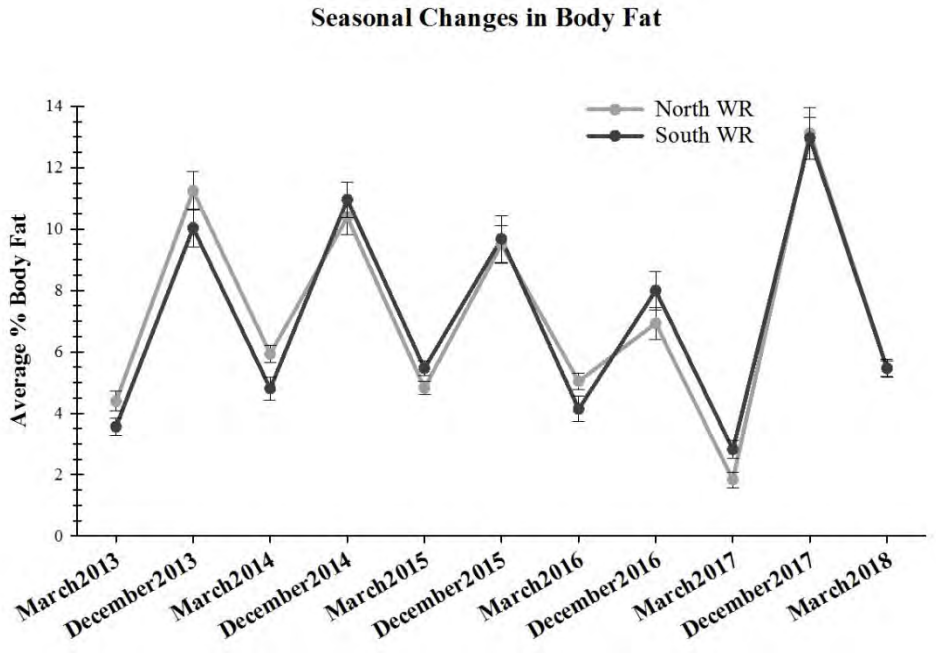


Figure 3. Average % body fat of adult, female mule deer on North (near Big Piney, WY) and South (near Cokeville and Evanston, WY) winter ranges for Wyoming Range mule deer.

Reproduction

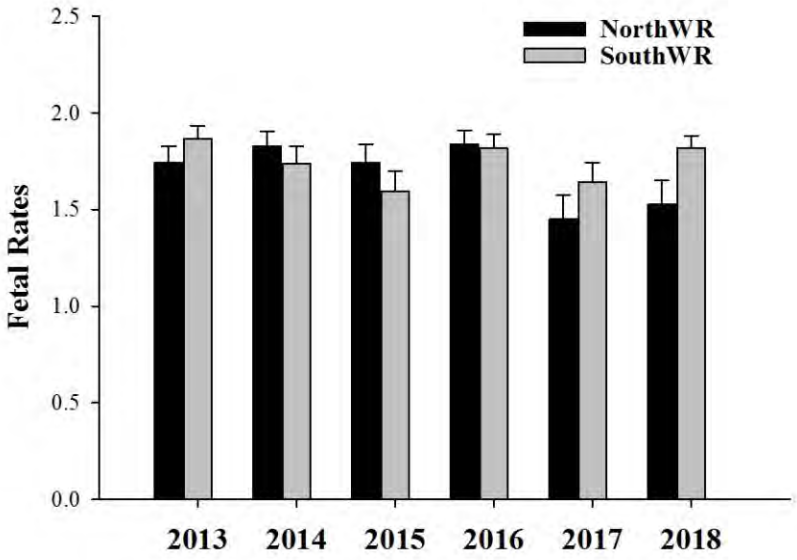


Figure 4. Fetal rates (average number of fetuses per pregnant animal) on North (near Big Piney, WY) and South (near Cokeville and Evanston, WY) winter ranges for Wyoming Range mule deer in 2013-2018.

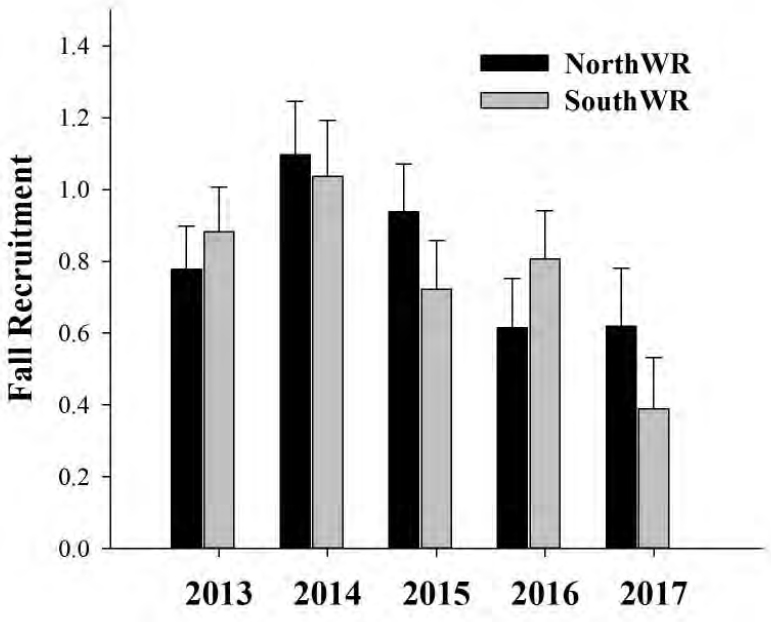


Figure 5. Recruitment rates on North (near Big Piney, WY) and South (near Cokeville and Evanston, WY) winter ranges for Wyoming Range mule deer in 2013-2017.

Reproductive success of individual animals greatly influences population dynamics; therefore, we closely monitor pregnancy and recruitment of young for each of our study animals. We use ultrasonography to monitor pregnancy rates of our study animals during spring capture events. Each autumn, as animals arrive to winter range, we evaluate fall recruitment using on-the-ground observations of the number of fawns at heel of our collared adults.

Pregnancy rates among mule deer of the Wyoming Range were typically high and ranged between 90-99%. Furthermore, most animals were pregnant with twins each year resulting in relatively high fetal rates (average number of fetuses per pregnant animal was 1.71 ± 0.03 across years; Fig. 4). Although fetal rates tended to be high, recruitment of young tended to be low. Since 2013, approximately half of the potential fawns born in early summer survived to autumn, and fall recruitment averaged 0.83 ± 0.05 fawns per collared female for Wyoming Range mule deer 2013-2016 but dropped to 0.51 ± 0.11 in 2017, following severe winter conditions of 2016/2017 (Fig. 5).

Disentangling the Relative Role of Predation, Habitat, Climate, and Disease on Fawn Survival

Fawn Capture

In March 2015, we initiated Phase II of the Wyoming Range Mule Deer Project by recapturing collared deer and deploying a vaginal implant transmitter (VIT) in pregnant females. VITs were used to indicate where and when birth occurred. Once birth events were identified, we captured and collared fawns born to our collared females as well as fawns that were found opportunistically throughout the Wyoming Range. Since 2015, we have successfully tracked 194 fawns and have been continually monitoring their survival.

	2015	2016	2017
Number of Fawns Tracked	58	70	67
Median Birthdate	June 10	June 13	June 17
Summer Mortality	45%	56%	52%
Winter Mortality	10%	44%	7%
Total Mortality	55%	100%	NA

Cause-Specific Mortality of Fawns

To evaluate cause-specific mortality of fawns, we tracked daily survival of all fawns captured 2015 – 2017. When a mortality was detected, we immediately investigated the event to ensure an accurate assessment of the cause of mortality. There was a breadth of various causes for fawn mortality including predation, disease, malnutrition, drowning, hypothermia, vehicle-collision, and just being caught in vegetation. The proportion of fawns that died because of the aforementioned causes varied from year to year (Fig. 7).

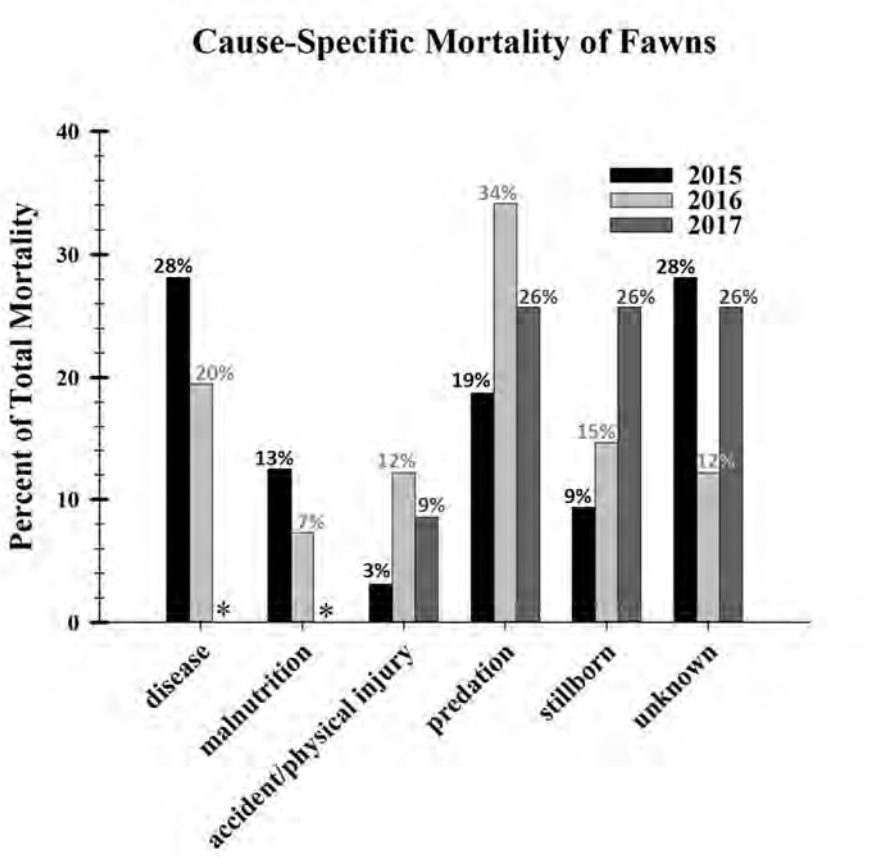


Figure 7. The relative occurrences of various causes of mortality for mule deer fawns of the Wyoming Range in 2015-2017. Asterisks indicate lab results from 2017 that are still pending.

In 2015, disease was the leading cause of death and accounted for 28% of all mortalities. The most prevalent disease adenovirus hemorrhagic disease (AHD). AHD is a viral disease that can cause internal hemorrhaging and pulmonary edema. Although AHD was detected in mule deer populations before, it was not previously known to be a major mortality factor in Wyoming. Nevertheless, the discovery of AHD in the Wyoming Range mule deer population has been motivation for further research into the epidemiology of AHD. We are still awaiting necropsy results from the Wyoming State Vet Lab from samples collected from fawn mortalities in 2017; therefore, the relative influence of various causes of mortality—specifically, disease and malnutrition—on fawn mortality is still pending. Regardless, 26% of mortalities in 2017 were because fawns were stillborn. Currently, this ties with predation as the leading cause of death for fawns in 2017.

Habitat and Maternal Conditions

The condition of a female and the habitat conditions she experiences in the summer may be very important in predicting and understanding fawn survival—especially in understanding the influence of malnutrition and disease on fawn survival. Therefore, we are coupling data on summer habitat conditions with information on maternal condition (i.e., nutritional condition) to evaluate how it influences fawn survival.

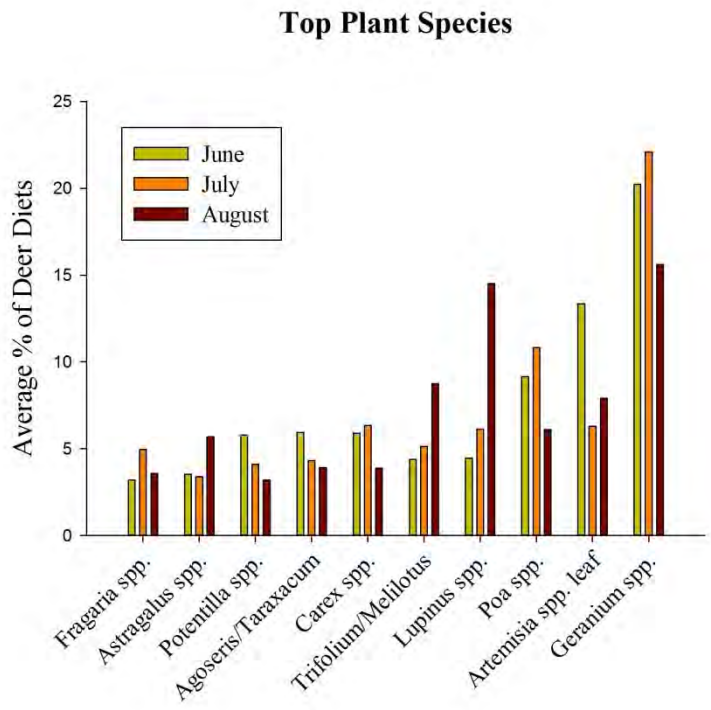


Figure 8. The top ten plant genera within diets (according to the average % of diets comprised of each plant genera) of Wyoming Range mule deer. Diet composition was evaluated in June, July, and August of 2013 and 2014.

Since 2013, we have evaluated the quality and availability of plants within the diets of Wyoming Range mule deer during summer. To assess mule deer diets, we collected fecal samples from summer home ranges of collared deer and used microhistology to identify plant species within their diets (Fig. 8) in summer 2013 and 2014. Based on frequency of plants within mule deer diets, we then collected plant clippings that we analyzed for quality (e.g., crude protein and digestibility). We are now coupling data on diet quality with forage availability by quantifying the abundance of key forage species at known locations of collared mule deer throughout the summer.

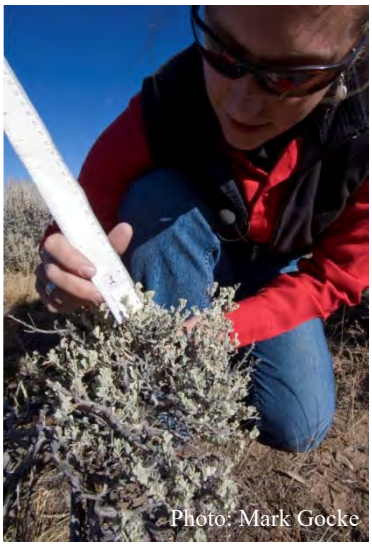


Photo: Mark Gocke

Effects of Winter Severity on Survival and Reproduction

Adult Winter Survival

Winter of 2016/2017 proved to be a tough on mule deer. Conditions on winter ranges for Wyoming Range mule deer were severe with snowpack levels exceeding 200% and numerous days of sub-zero weather. These harsh winter conditions strongly affected winter survival and only 63% of our collared adults survived from November until summer 2017 (compared with >90% in years past). Older animals and animals that entered winter in poor condition were more susceptible to succumbing to winter exposure (Fig. 9).

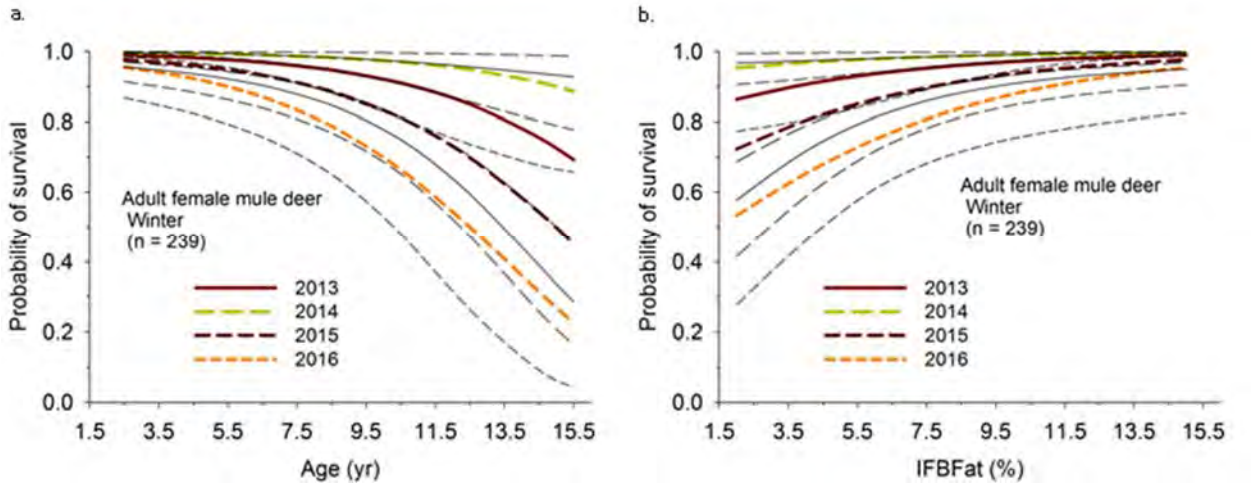


Figure 9. The effects of age (a) and December body fat (IFBFat %; b) on the probability of survival overwinter. Probability of survival decreased as animals aged and as the % body fat (IFBFat %) in December decreased.

Fawn Winter Survival

Winter conditions tend to have the greatest effect on survival of fawns, and this winter was no exception. We observed 100% mortality of the fawns we collared in summer 2016 (44% died overwinter). Mortality rates of that caliber can have substantial repercussions on population dynamics because the majority of an entire cohort of deer is gone. Although these numbers are staggering, winter die-offs, as the one observed this winter, do occasionally occur and populations do eventually rebound. We have now found ourselves with a unique opportunity to evaluate how mule deer populations rebound from harsh winters.

Nutritional Condition

Nutritional condition in March 2017, measured as % body fat, was the lowest we have observed in our research (2.3% in 2017 compared with 4.0–5.3% in 2013–2016; Fig. 10). Although it is rare to see animals in this poor of condition, it was surely a product of deep snow restricting access to forage and heightened energy expenditures associated with locomotion in deep snow and thermoregulation in plummeting temperatures.

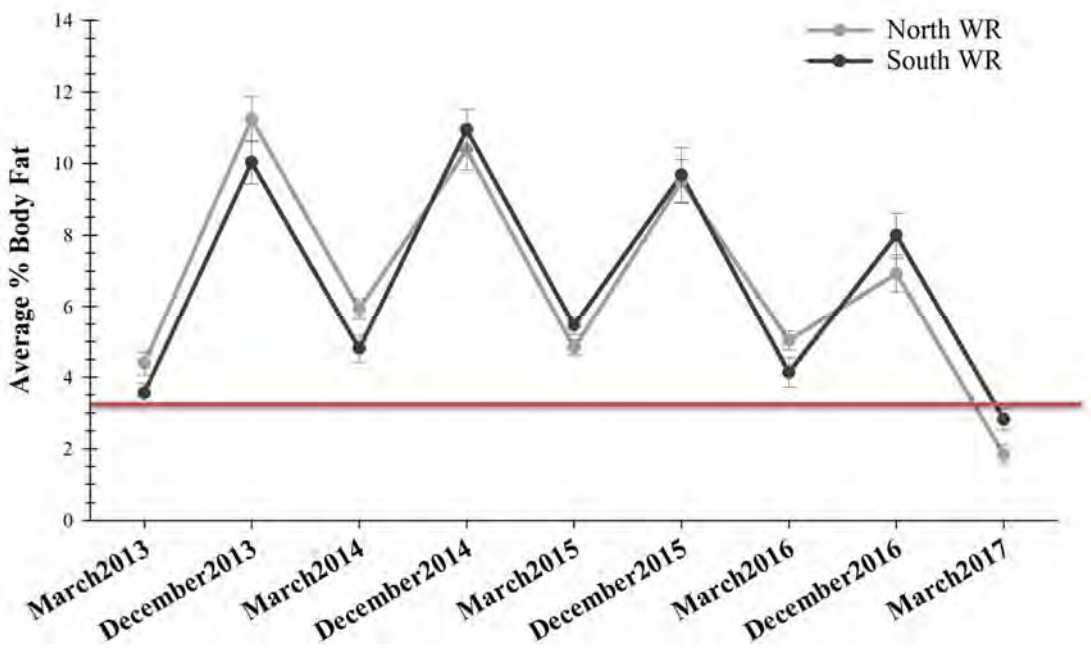


Figure 10. Average % body fat of adult, female mule deer on North (near Big Piney,WY) and South (near Cokeville and Evanston, WY) winter ranges for Wyoming Range mule deer in March 2013 – March 2017. Following the sever winter conditions of 2017, animals were in the worst nutritional condition recorded since the beginning of our research in 2013.

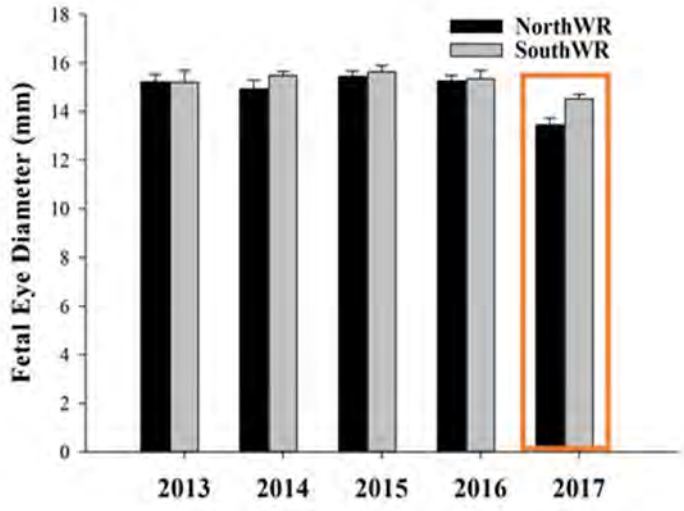


Figure 11. Average fetal eye diameter measured in March of each year. Fetal eye diameter was significantly smaller in March 2017 compared with any other year.

Pregnancy

Despite extremely poor nutritional condition of animals in March 2017, fetal rates among winter ranges were comparable to the preceding 4 years (Fig. 4) and pregnancy rates remained high. Interestingly, average eye diameter of fetuses was lower in March 2017 (14.0 ± 0.18) than in previous years (15.3 ± 0.11; Fig. 11). Fetal eye diameter is a measure of fetal development and is often used to estimate the timing of birth.

Carryover Effects

Newborn fawns caught in 2017 were significantly lighter than newborn fawns caught in previous years (Fig. 12). This was of little surprise because of the overall poor nutritional condition of pregnant females and the smaller eye diameter of fetuses measured in March 2017. With this information, we are now in a position to better evaluate the influence of birth weight and maternal condition on summer survival of fawns.

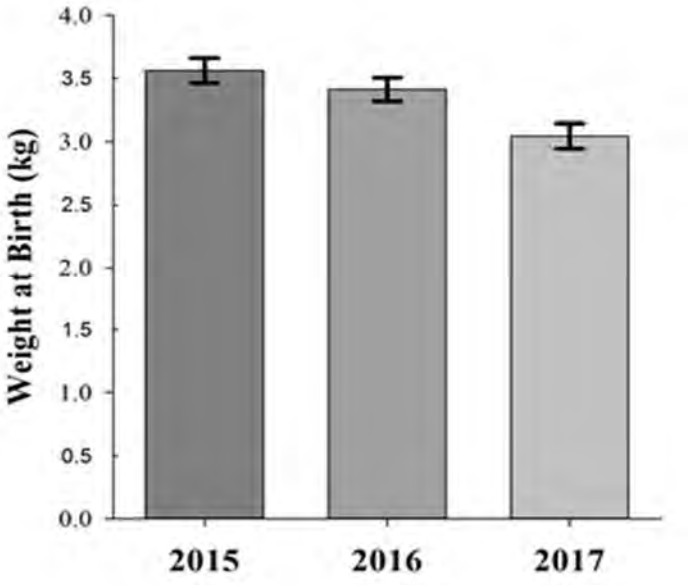


Figure 12. Average weight of fawns captured <48hours from birth. Fawns were significantly lighter in 2017 compared with the previous two years.

Population Benefits of Reduced Deer Density

Following the severe winter of 2016/2017, the Wyoming Range mule deer population had found itself in an interesting place. The high adult morality and depressed reproduction in the summer following undoubtedly resulted in decreased abundance of deer in the Wyoming Range. The silver lining to the decrease in the population is that population growth is often higher when abundance is low (Fig. 13). This is because deer populations are relieved from competition with other deer.

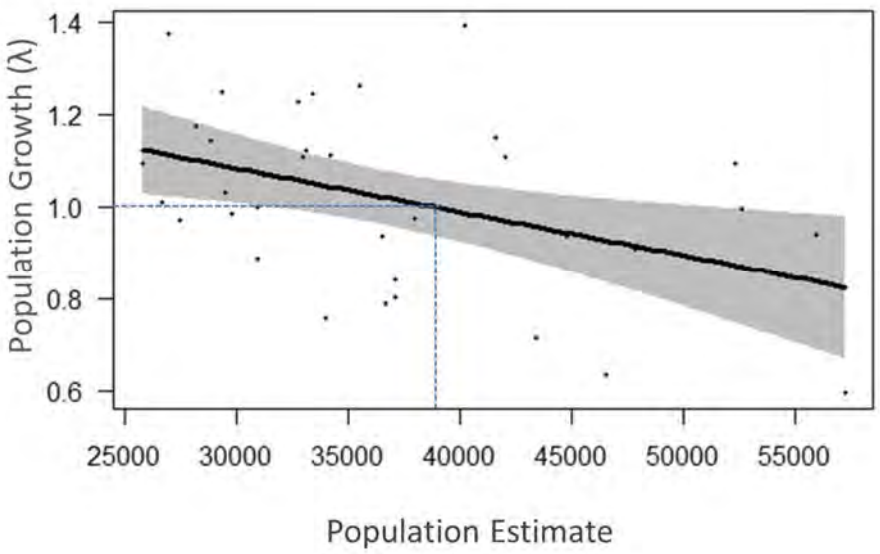


Figure 13. The relationship between population growth (λ) and estimated population abundance of Wyoming Range mule deer. As population abundance decreases, the growth rate (λ) of that population increases.

As deer density decreases, per capita food increases. Consequently, populations at low abundance, relative to the carrying capacity (*K*) of their landscape, tend to be in overall better nutritional condition because each individual has access to more food (Fig. 14). Conversely, deer populations that are at or near carrying capacity tend to be in overall worse nutritional condition because deer are competing with other deer for food. Some of these trends were reflected in our longitudinal data of trends in fat dynamics since 2013, and deer were in the greatest nutritional condition we had observed in March 2017 (Fig. 15).

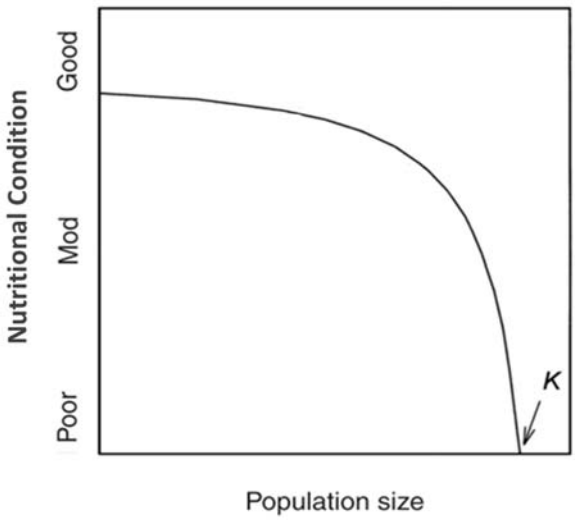


Figure 14. The relationship between population size and nutritional condition of ungulate populations. As population size increases and approaches carrying capacity (*K*), the overall nutritional condition of that population decreases (Kie et al. 2003).

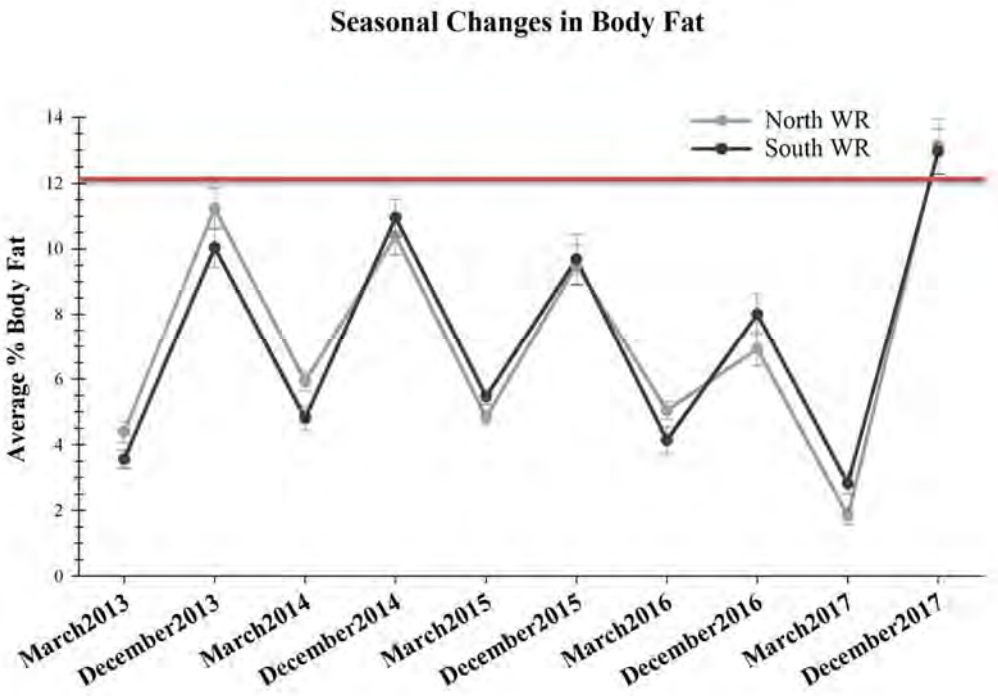


Figure 15. Average % body fat of adult, female Wyoming Range mule deer in March 2013 – March 2017. Following the population decline after the severe winter conditions of 2016/2017, animals were in the best nutritional condition recorded since our research began in March 2013. Essentially, the Wyoming Range mule deer population went from the worst nutritional condition to the best nutritional condition over a summer.


Photo: Gary Fralick

The nutritional condition of mom (i.e., maternal condition) can have life-long effects on her offspring. Previous research by Dr. Monteith (Monteith et al. 2009, *Journal of Mammalogy*) has shown that antler size of male deer is influenced more by maternal condition than genetics. Dr. Monteith, along with colleagues, observed that male fawns born to mothers in good maternal condition grew to be larger deer that exceeded the size of their fathers. Considering these research findings, Wyoming Range mule deer that can exploit their high nutritional condition (relative to previous years) observed in December 2017 may be better poised in allocating stored fat to fetal development and provisioning of young that are born in spring/early summer 2018. The summer of 2018 will be telling for the propensity for population growth and potential for large male deer in years to come.

A Positive Outlook for the Future

Overall survival throughout winter 2017/2018 was high (100% of collared adults and 93% of collared fawns survived), and in March 2018, we recaptured all surviving adult deer and their female offspring. Average % body fat in March 2018 was slightly higher than the overall average over the 6 years of our research (average of 5.46 ± 0.20% in March 2018 compared with overall study average of 4.46 ± 0.10% in March 2013-2018; Figure 3). Also, as would be expected for this population of mule deer, pregnancy rates and fetal rates were comparable to previous observations—94% of animals were pregnant and most were pregnant with twins (fetal rate was 1.68 ± 0.07, which is similar to the average throughout the study; figure 4).

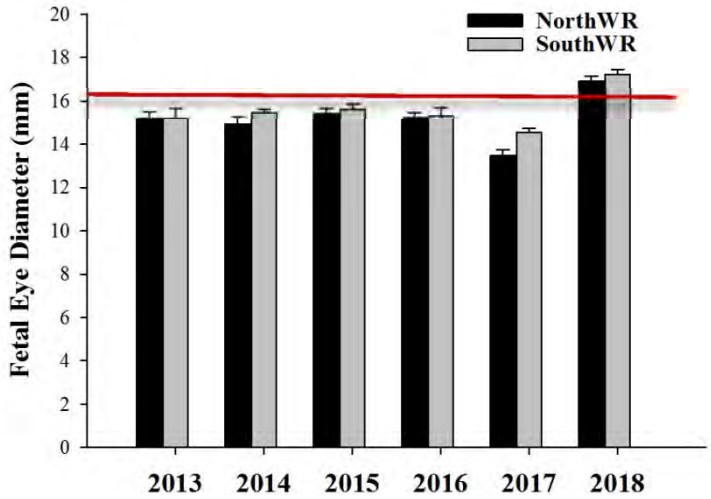


Figure 16. Average fetal eye diameter (mm) measured in March 2013-2018. Fetal eye diameter was significantly higher in 2018

Although nutritional condition and pregnancy in March 2018 were not significantly greater than what has been observed previously, we did observe notable differences in investment in reproduction throughout winter 2017/2018. More specifically, fetuses were significantly larger in March 2018 than in previous years (fetal eye diameter of 17.08 ± 0.16mm compared with a study average of 15.40 ± 0.09; figure 16), and fetuses were 22% larger in March 2018 than in March 2017. This increased investment in fetal development may be a direct result from the high fat stores that Wyoming Range mule deer had coming into the winter. We are excited to see how such investment in fetal development influences timing of birth and the size of young born in May and June.

Spring Migration Ecology of Mule Deer

At the largest spatial scale, migration is recognized as a strategy that allows migrants to exploit high-quality resources available on one seasonal range, while avoiding resource deficiencies on the other. Much less is known, however, about the fine scale movement behaviors that animals make during migration. This portion of the Wyoming Range Mule Deer Project aims to understand the importance of food resources available during migration, and how the habitat quality of migratory routes influences survival and reproduction of migratory mule deer in the Wyoming Range.

Spring migration is a critical time for migrants, in which they must recover from harsh winter conditions and prepare for upcoming reproductive costs. It is hypothesized that movement from low elevation winter ranges to high elevation summer ranges, allows migrants to extend the amount of time they are exposed to young, highly palatable forage. Following a wave of newly emergent, high-quality forage along elevational gradients, is known as “surfing the green wave”. This project will investigate the role of the migration route as critical habitat, with the aim to better understand the importance of migration as well as to inform management strategies to protect migration in the Wyoming Range and beyond.

Project Objectives

1. Test the green wave hypothesis in migratory mule deer and explore the source of individual variability in green-wave surfing (Completed, see below).

2. Investigate the influence of drought on green-wave surfing (In progress).

3. Understand the relative importance of green-wave surfing to fitness (In progress).

Testing the Green Wave Hypothesis

Deer should select plants that are at intermediate growth stages (i.e. not too old or not too young) because plants which are greening up are both easy to digest and available in large enough quantities to maximize energetic gains. If deer surf a wave of plant green-up, then the timing of their movements during spring migration should be perfectly matched with the timing of peak green-up in plants. When we tested this prediction, this is indeed what we found (Figure 1). We noticed, however, that there was a lot of variability in the green-wave surfing ability of individuals. To further investigate the source of this difference in green-wave surfing we considered how the progression of the green-wave across individual routes may differ. We found that some routes had long, easy to follow gradients in plant green-up, while other routes had short, rapid and difficult to follow gradients in plant green-up. Together this difference in the amount of time when green-up was available along a migration route (i.e. the green-up duration) and the gradient of green-up from winter range to summer range (i.e. the order of green-up), which we refer to as the "greenscape", largely explained the differences in green-wave surfing across individual deer using different migration routes.

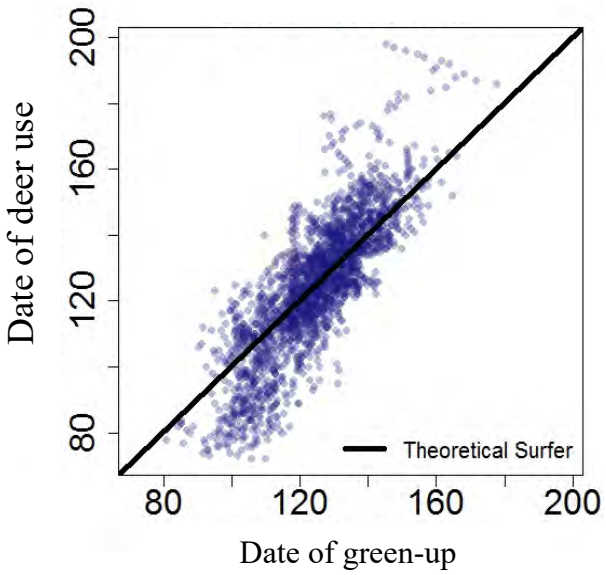


Figure 16. Evidence for green-wave surfing by mule deer in the Wyoming Range. The black line represents the theoretical prediction of a perfect match between the date of green-up and the date of deer use. Data points fall close to this line, suggesting that in general deer are surfing the green wave.

What have we learned?

- Green wave surfing is key to the foraging benefit of migration.
- The migration route provides critical habitat.
- Timing is key, thus activities that may alter the ability of deer to exploit the green wave should be avoided or minimized during the spring migration period.
- The greenscape (i.e. the duration and order of green-up along a migration route) determines the quality of a route.

This research is published! For more information, see:

Aikens, E.O., M. J. Kauffman, J. A. Merkle, S. P. H. Dwinnell, G. L. Fralick, and K. L. Monteith. 2017. The greenscape shapes surfing of resource waves in a large migratory herbivore. *Ecology Letters* 20:741-750.

The Rose Petal Project

While seasonal migration occurs in diverse animals and habitats, large ungulate migrations are some of the most spectacular wildlife events in the world. Migration is crucial to maintaining large, robust populations of large ungulates, and the western US boasts many populations of migratory ungulates, such as pronghorn (*Antilocapra americana*), elk (*Cervus elaphus*), moose (*Alces alces*), and mule deer (*Odocoileus hemionus*). Among ungulate migrations, mule deer migrations are extraordinary because animals can migrate extensive distances (up to 260 km) over extremely rugged terrain. Despite being able to travel all over a landscape, mule deer tend to move over this rugged terrain using the same migratory routes and seasonal ranges year after year, yet the question remains: how do mule deer know how to migrate?

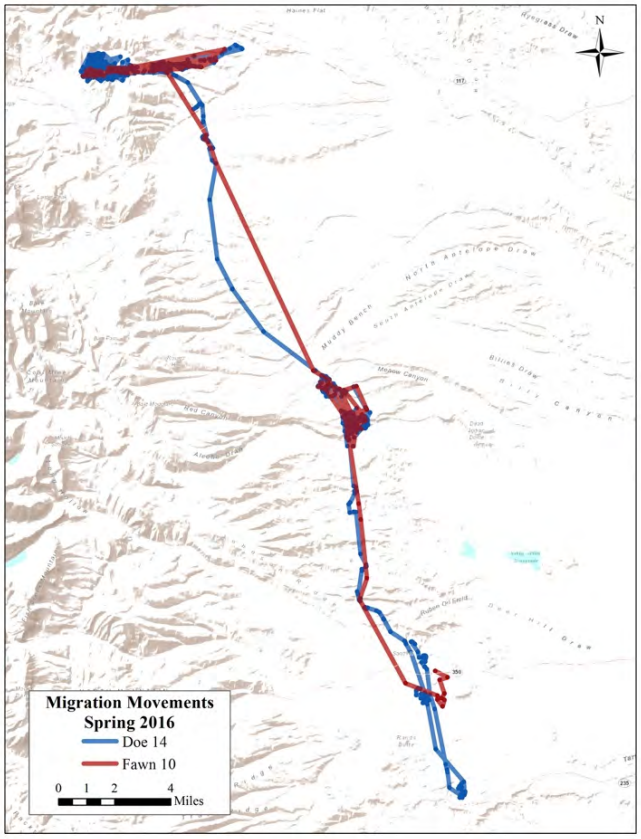
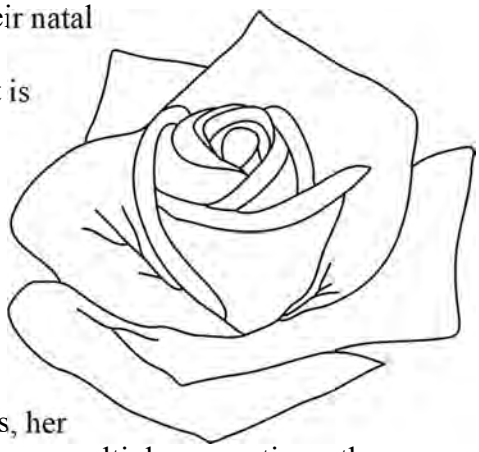


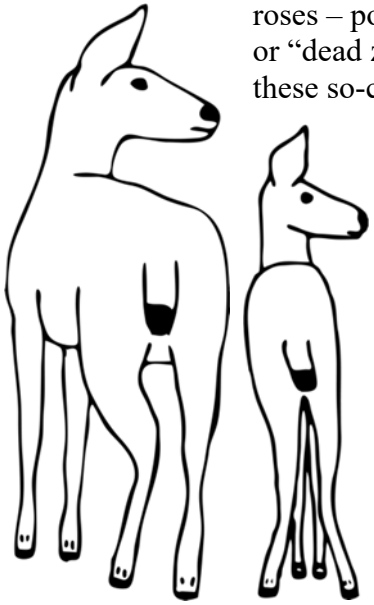
Fig 17. Paired migratory movements of mother (blue) and daughter (red) mule deer in Wyoming, USA. The migration paths of mother and daughter overlap considerably, and warrant investigation of the role of cultural inheritance in shaping migratory behaviors.
Credit: S. Dwinnell.

Ungulates may know how to migrate if information on migratory traits (e.g., timing to initiate migration, rate of movement, migration path, seasonal range characteristics) is passed down from parent to offspring. Two potential mechanism could facilitate this transmission from parent to offspring: genetic inheritance and cultural inheritance. While genetics may underpin migratory traits in some bird species, whether genetics underpin ungulate migration remains to be discovered. Additionally, migratory traits may be passed from mother to offspring if offspring migrate alongside and learn the behaviors of the mother – in other words, through cultural inheritance. Depending on the mechanism responsible for determining the transmission of migratory traits, we may need to alter our management strategies to ensure robust deer populations. Before we can understand these mechanisms, however, we need to test an overlooked assumption: that migration is passed from generation to generation at all, regardless of the mechanism responsible.

In mule deer, managers and scientists currently assume that mothers migrate with their newborn offspring from summer range to winter range, and return with their offspring to summer range the following spring (Fig. 1). The transmission of migratory traits (through either genetic or cultural inheritance) could allow parents to pass information about already successful or familiar habitats and routes to their offspring. While scientists have largely overlooked the transmission of migratory behaviors from parent to offspring, studying whether information is transmitted across generations has huge ramifications for understanding the ontogeny – or development – of migratory behaviors.

In addition to being fascinating, understanding the ontogeny of migration could change how we manage populations of migratory mule deer and other migratory ungulates. Because the females in many species of ungulates do not disperse far from their natal range, clusters of closely related females will form when mothers successfully raise offspring. This behavior of spatial arrangement is deemed the *rose petal hypothesis*, and results in clusters of mule deer families while they are on summer range. Passing migratory behaviors from parent to offspring could have population-level consequences if inherited behaviors constrain the habitat which family lineages can access. For example, if a mother mule deer transmits information about high-quality habitat to her daughter, that daughter may be more successful at having and raising offspring of her own. Alternatively, if a mother transmits information that leads her daughter to low-quality seasonal ranges, her daughter may have lower reproductive success. When combined over multiple generations, the inheritance of migratory traits of differing quality could produce differences in the sizes of these roses – potentially creating areas analogous to mule deer "hot spots" (robust rose) or "dead zones" (dilapidated rose). Identifying the migratory traits that result in these so-called "hot spots" could provide managers with information about which individuals, management areas, or behaviors to prioritize.





Are migratory traits transmitted from mother to daughter?

We aim to identify whether migratory traits are transmitted from generation to generation in mule deer. We expect that if migratory traits are transmitted, offspring will display migratory traits (e.g., migration timing, rate of movement, migration route, and quality of seasonal ranges) resembling their mothers (Fig. 2a).

To test whether migratory traits are transmitted, we will compare migration characteristics among and between mother-daughter pairs of Wyoming Range mule deer fitted with GPS collars. We began collaring efforts in 2016, and expect to collar approximately 50 mother-daughter

pairs by the end of the project. We will use a suite of analyses including movement coordinate index, linear regression, and utilization distribution overlap index to quantify similarities between mother-offspring migratory traits.

What are the population consequences of transmitting migratory traits?

If migratory traits are transmitted, lineages may be constrained in the habitat they can occupy, such that transmission of certain combinations of migratory traits will lead to differential reproduction and local density. We expect founding mothers that inherit access to advantageous habitat will successfully raise more offspring over their lifetime, while mothers that inherit access to low-quality habitat will raise fewer offspring (Fig. 2b). Differences in reproduction, and the resulting differences in local density, may then influence landscape-scale spatial distribution.

To test whether the inheritance of migration traits has consequences of mule deer populations, we will compare local density around each collared female with mother-offspring migration trait similarities. We will determine local density by searching for fecal samples along belt transects centered around the summer range of each collared mother-daughter pair. Using genetic information extracted from fecal pellets, we will determine individual identification and genetic relatedness to the collared female. We will then test whether similarities in migration traits between mother and offspring influence local density.

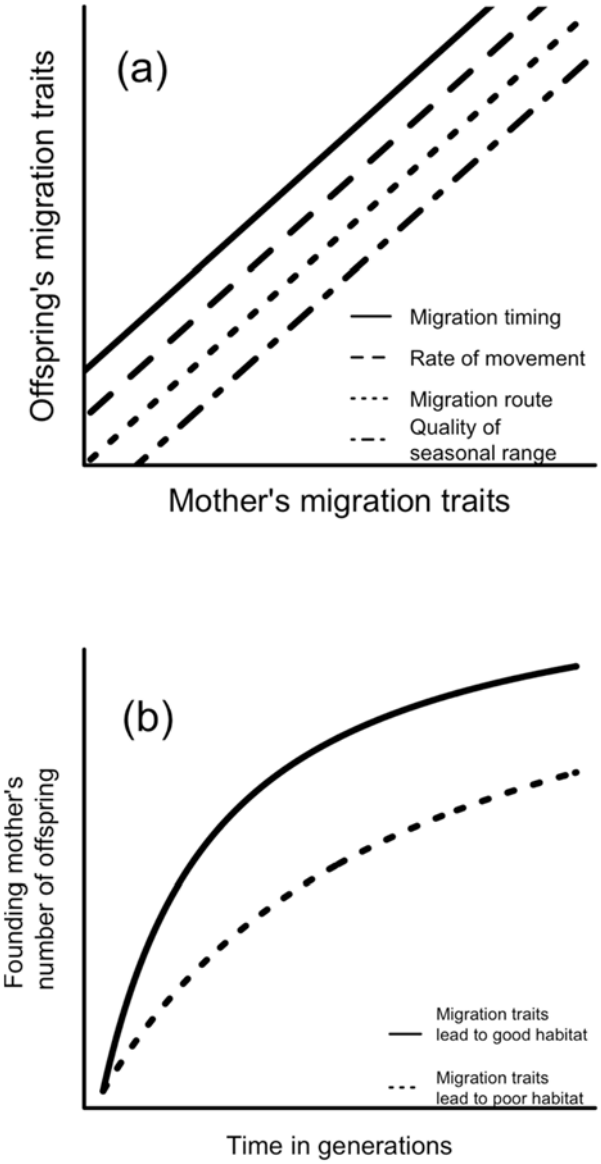


Fig. 18. Predictions associated with the cultural inheritance hypothesis (a) and the population consequences hypothesis (b).

Management implications

Despite the importance of migration to many ungulate species, anthropogenic change is rapidly altering landscapes and, consequently, migratory behaviors. Halting or altering migratory behaviors could impact ungulate population trajectories by rendering segments of seasonal habitats unused, ultimately constraining species abundance, occupancy, and distribution. Because migration strategies developed under past conditions, properly managing ungulates in a rapidly changing world relies on characterizing the factors shaping migratory traits and the subsequent population ramifications.

Future Directions

The effects of the 2016-17 winter has been distressing, but we now are uniquely poised to document the long-term effects severe winters and understand the factors that will influence population recovery from the devastating losses. We have been extremely fortunate to have been conducting research on this herd, not only through the course of this harsh winter, but for several years prior, which will yield the data to address questions associated with how severe winters may affect mule deer herds throughout the state. With dramatic reductions in density, forage resources available per individual should be bolstered and thus, nutritional condition, reproductive success, and survival may well all respond very favorably. Nevertheless, with lower deer density compared with recent decades, the role of predators in this population also may change in either positive or negative ways. The marked decline of the Wyoming Range deer population following the 1992-93 winter, and the near absence of any substantial recovery thereafter, also begs the question to what extent recovery will occur given historic patterns. Regardless, the overwhelming management desire is for recovery, and our aim is to document recovery and the mechanisms that underpin it.

The overall goal of our continued work in the Wyoming Range will be to build on our understanding of the nutritional and population ecology of this herd to document the carryover effects of the severe winter of 2016-17, and how and to what extent the population will rebound from the dramatic reduction in abundance. As before, our overall approach will continue to mesh data on nutritional condition, habitat condition, and population performance to understand factors regulating Wyoming Range mule deer and the ability of the current habitat to support mule deer—with now a distinct reduction in density, habitat and density-dependent feedbacks onto the population should illuminate ever more so than previously. Our approach will allow us to continue to elucidate the relative roles of habitat, nutrition, predation, and disease on the regulation of deer in western WY, and fully grasp the magnitude and extent of the effects of the transient, but clearly regulatory role of winter.

Partners

The Wyoming Range Deer Project is a collaborative partnership in inception, development, operations, and funding. Without all the active partners, this work would not be possible. Funds have been provided by the Wyoming Game and Fish Department, Wyoming Game and Fish Commission, Wyoming Wildlife and Natural Resource Trust, Muley Fanatic Foundation, Bureau of Land Management, Knobloch Family Foundation, U.S. Geological Survey, National Science Foundation, Wyoming Governor's Big Game License Coalition, Boone and Crockett Club, Animal Damage Management Board, Ridgeline Energy Atlantic Power, Bowhunters of Wyoming, and the Wyoming Outfitters and Guides Association. Special thanks to the Wyoming Game and Fish Department, Bureau of Land Management, and Wyoming State Veterinary Lab for assistance with logistics, lab analyses, and fieldwork. Also, thanks to the Cokeville Meadows National Wildlife Refuge and U.S. Forest Service for providing field housing.

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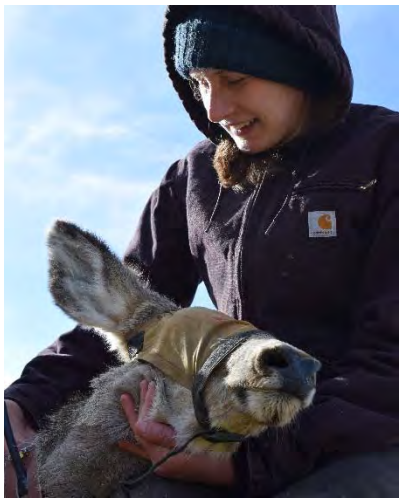
PROJECT TEAM MEMBERS

Kevin Monteith

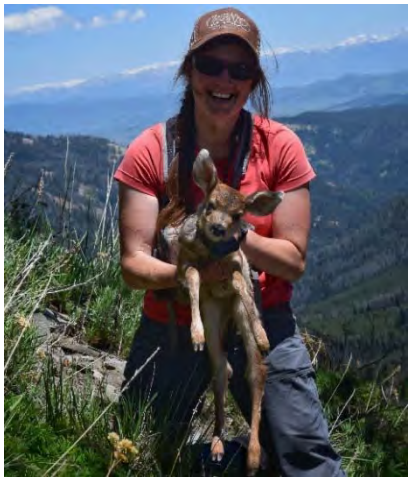
Kevin Monteith is an Assistant Professor of the Haub School of Environment and Natural Resources and the Wyoming Cooperative Fish and Wildlife Research Unit, Department of Zoology and Physiology at the University of Wyoming. After receiving his BSc and MSc in Wildlife and Fisheries Sciences from South Dakota State University, he went on to obtain his PhD in Biology from Idaho State University in 2011. Kevin's research program is focused on integrating nutritional ecology with intensive field studies of large ungulates to elucidate the mechanisms that underpin behavior, growth, reproductive allocation, predator-prey dynamics, and ultimately, the factors affecting population growth. Kevin and his graduate students are currently conducting research on most of Wyoming's large ungulates; topics are centered on establishing a protocol for habitat-based, sustainable management of ungulate populations, while investigating the effects of predation, habitat alteration, climate change, migration tactics, and novel disturbance.

Ellen Aikens



Ellen is a PhD candidate in the Program in Ecology at the University of Wyoming. Ellen is fascinated by animal movement, especially migration. Ellen plans to pursue a career in research, with a focus on the interface between fundamental research and applied conservation and management. Before coming to Wyoming, Ellen worked at the Smithsonian Conservation Biology Institute's GIS lab, where she analyzed remote sensing and GPS telemetry data for conservation research projects across the globe. Ellen is a recipient of the National Science Foundation Graduate Research Fellowship and the Berry Fellowship. Ellen earned her bachelor's degree in Biology and Environmental Studies from Ursinus College.

Samantha Dwinnell



Samantha Dwinnell is a Research Scientist with the Haub School of Environment and Natural Resources. Samantha is the first student to miraculously graduate (May 2017) with a MSc from the Monteith Shop. Immediately following her defense that was made successful through bribery, she foolishly convinced Dr. Monteith to hire her as a Research Scientist to manage the Wyoming Range Mule Deer Project. Samantha's graduate research was focused on the nutritional relationships among mule deer behavior, forage, and human disturbance. Currently, her research is focused on disentangling the relative influence of various factors that affect fawn survival. Although Samantha is most interested in research aimed at informing management and conservation of wildlife, she also dedicates research efforts into finding ways to mountain bike and ski without her boss knowing.

Rhiannon Jakopak

Rhiannon is currently a master's student in the Cooperative Fish and Wildlife Research Unit at the University of Wyoming. She received dual bachelor's degrees in Wildlife and Fisheries Biology and Management and Religious Studies at the University of Wyoming in 2016. She is broadly interested in population ecology and mammalogy, and more specifically interested in the processes regulating the distribution of species. Her master's project seeks to identify the factors which influence the development of migration and the subsequent population consequences.

Tayler LaSharr

Tayler LaSharr is a MSc student in the Cooperative Fish and Wildlife Research Unit. Tayler grew up in Phoenix, AZ and attended the University of Arizona where she obtained a BSc in Natural Resources with an emphasis in Conservation Biology and a minor in Chemistry in May of 2015. During her time at the University of Arizona, she studied life history tradeoffs in Western and Mountain Bluebirds and the effects of aggression in closely related species on habitat and range dynamics. In the summer of 2015, she began work in the Wyoming Cooperative Fish and Wildlife Research Unit as a technician on a fawn survival study of mule deer in the Wyoming Range. In the fall of 2015, she began work on her own research, which focuses on understanding the effects of harvest on horn size of mountain sheep. Following the completion of her MSc work in the spring of 2018, she will transition to a PhD working on a component of the Wyoming Range Mule Deer Project assessing population recovery following a severe winter.

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Wyoming Range Mule Deer Project

Winter 2018-19 Update

MONTEITH SHOP
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WYOMING COOPERATIVE FISH & WILDLIFE RESEARCH UNIT

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WYOMING RANGE MULE DEER PROJECT

Project Background

In recent decades, mule deer abundance throughout the West has struggled to reach historic numbers, and Wyoming is no exception to the nearly ubiquitous trend of population declines. In response to concerns of mule deer populations in Wyoming, in 2007, the Wyoming Game and Fish Commission adopted the *Wyoming Mule Deer Initiative* (MDI) with the intent to develop individual management plans for key populations. Of particular concern was the Wyoming Range mule deer population in western Wyoming—one of the largest mule deer herds in the state and a premier destination for mule deer hunting in the country. The Wyoming Range mule deer population has undergone dynamic changes in recent decades from a population high of >50,000 in the late 1980s, to a sustained population of ~30,000 during much of the last decade (Fig. 1). Consequently, the Wyoming Range mule deer population was identified as a top priority for the development of a management plan according to the MDI. The first of the population-specific management plans, the *Wyoming Range Mule Deer Initiative* (WRMDI), was finalized in 2011 following a collaborative public input process. To direct development of an effective management plan, it was recognized by the Mule Deer Working Group (2007) that the *"Success and implementation of these plans will depend upon our ability to identify limiting factors to mule deer populations and their habitats"*. Accordingly, the Wyoming Range Mule Deer Project was initiated 2013 to address the need for research in identifying the factors that regulate the Wyoming Range mule deer population.

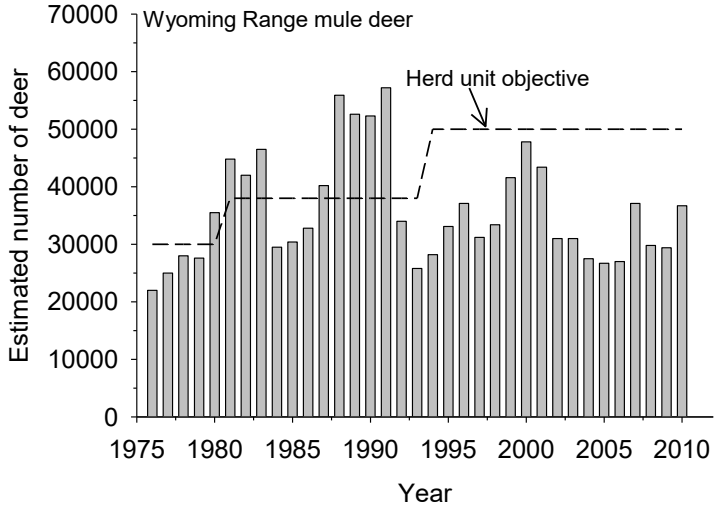


Figure 1. Estimated population size of the Wyoming Range mule deer herd relative to herd unit objective, 1976-2010.

The overarching goal of the Wyoming Range Mule Deer Project is to investigate the nutritional relationships among habitat conditions, climate, and behavior to understand how these factors interact to regulate population performance. We initiated the project in March 2013 with the capture of 70 adult, female mule deer on two discrete winter ranges for migratory, Wyoming Range mule deer (Fig. 2). In summer 2015, we initiated Phase II of the Wyoming Range Mule Deer Project that focuses on survival and cause-specific mortality of neonate mule deer. In the fall of

2018, we began Phase III of the project, which is focused on the recovery of the population following the severe winter of 2016-17 in the Wyoming Range that resulted in almost complete removal of a cohort from the population and high adult mortality. Since the initiation of the project, we have tracked and monitored the survival, behaviors, reproduction, and habitat conditions of 202 adult female and 277 juvenile mule deer of the Wyoming Range. This update highlights some of our many discoveries on mule deer ecology since the initiation of the project.

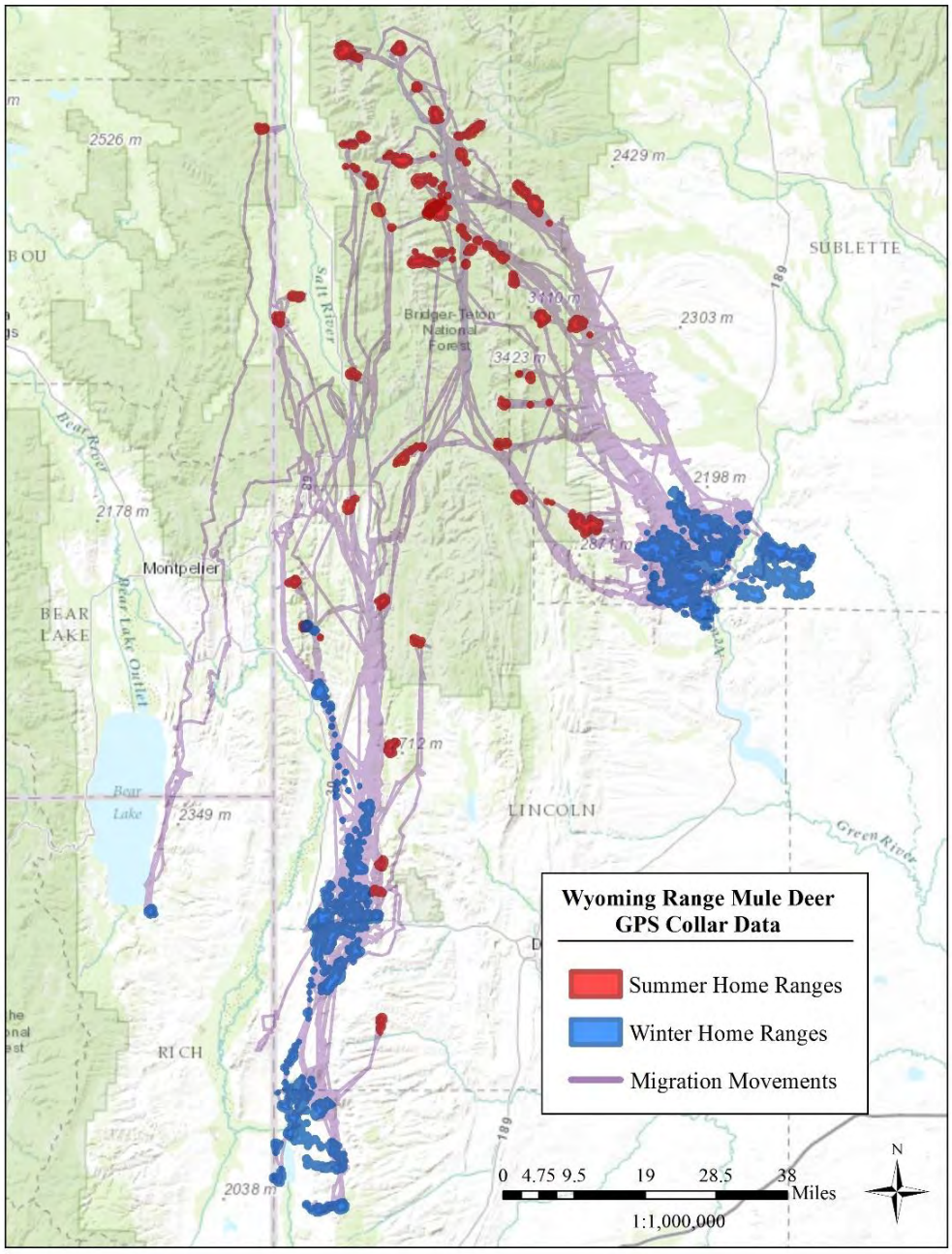


Figure 2. Winter and summer home ranges (based on 95% Kernel Utilization Distribution of GPS collar data) as well as migration movements of Wyoming Range mule deer.

The Wyoming Range Mule Deer Project

Using a nutritional ecology framework, we aim to evaluate how conditions of seasonal ranges mule deer encounter throughout the year—ranges used during summer, winter, and migration—affect individual animals. Using this unique approach, we aim to develop a comprehensive understanding of how the connections individual deer have with their environments influences population dynamics.

Adult Captures

Since March 2013, we have captured and recaptured 202 adult, female mule deer. Upon each capture, in addition to fitting each animal with a GPS collar, we collect a suite of data on each animal including age, nutritional condition, morphometry, pregnancy, and fetal rates. Animals are recaptured each spring (in March) and autumn (in December) to monitor longitudinal changes in nutritional condition and reproduction. In doing this, we can link various life-history characteristics with behaviors and habitat conditions of individual animals.

At each capture event, we use ultrasonography to measure fat reserves (i.e., % body fat). By recapturing collared mule deer and measuring body fat each autumn and spring, we are able to track changes in nutritional condition between summer and winter seasons.

Although most animals lost fat in the winter and gained fat in the summer, the rate at which fat reserves increased or decreased varied widely among individual animals. A suite of factors can influence fat dynamics between winter and summer seasons, but availability of food on seasonal ranges and number of fawns a female raises have the greatest effect on fat dynamics.

Reproductive success of individual animals greatly influences population dynamics; therefore, we closely monitor pregnancy and recruitment of young for each of our study animals. We use ultrasonography to monitor pregnancy rates of our study animals during spring capture events. Each autumn, as animals arrive to winter range, we evaluate fall recruitment using on-the-ground observations of the number of fawns at heel of our collared adults.

Neonate Captures

In March 2015, we initiated Phase II of the Wyoming Range Mule Deer Project by recapturing collared deer and deploying a vaginal implant transmitter (VIT) in pregnant females. VITs were used to indicate where and when birth occurred. Once birth events were identified, we captured and collared fawns born to our collared females as well as fawns that were found opportunistically throughout the Wyoming Range. Since 2015, we have successfully tracked 277 fawns and have been continually monitoring their survival.

To evaluate cause-specific mortality of fawns, we tracked daily survival of all collared fawns each summer beginning in 2015. When a mortality was detected, we immediately investigated the event to ensure an accurate assessment of the cause of mortality. We have detected a breadth of various causes for fawn mortality including predation, disease, malnutrition, drowning, hypothermia, vehicle-collision, and just being caught in vegetation.

In 2015, disease was the leading cause of death for collared fawns and accounted for 28% of all mortalities. The most prevalent disease, adenovirus hemorrhagic disease (AHD), is a viral disease that can cause internal hemorrhaging and pulmonary edema. In 2017, 26% of fawn mortalities were the result of stillborns. Conversely, in 2018, only 1 of the 83 fawns collared was stillborn. We are still waiting on results from the Wyoming State Vet Lab to determine the leading cause of death for fawns in the summer of 2018.

	2015	**2016**	**2017**	**2018**
Number of Fawns Tracked	58	70	67	83
Median Birthdate	June 10	June 13	June 17	June 11
Average Birthweight	7.9 lb	7.5 lb	6.7 lb	7.6 lb
Summer Mortality	45%	56%	52%	49%
Winter Mortality	9%	44%	7%	3%*
Total Mortality	54%	100%	59%	NA

Summer mortality is based on survival until October 31st in the year a fawn was born. Winter mortality is based on survival from November 1st to April 30th.

** Winter mortality as of 7 January 2019*

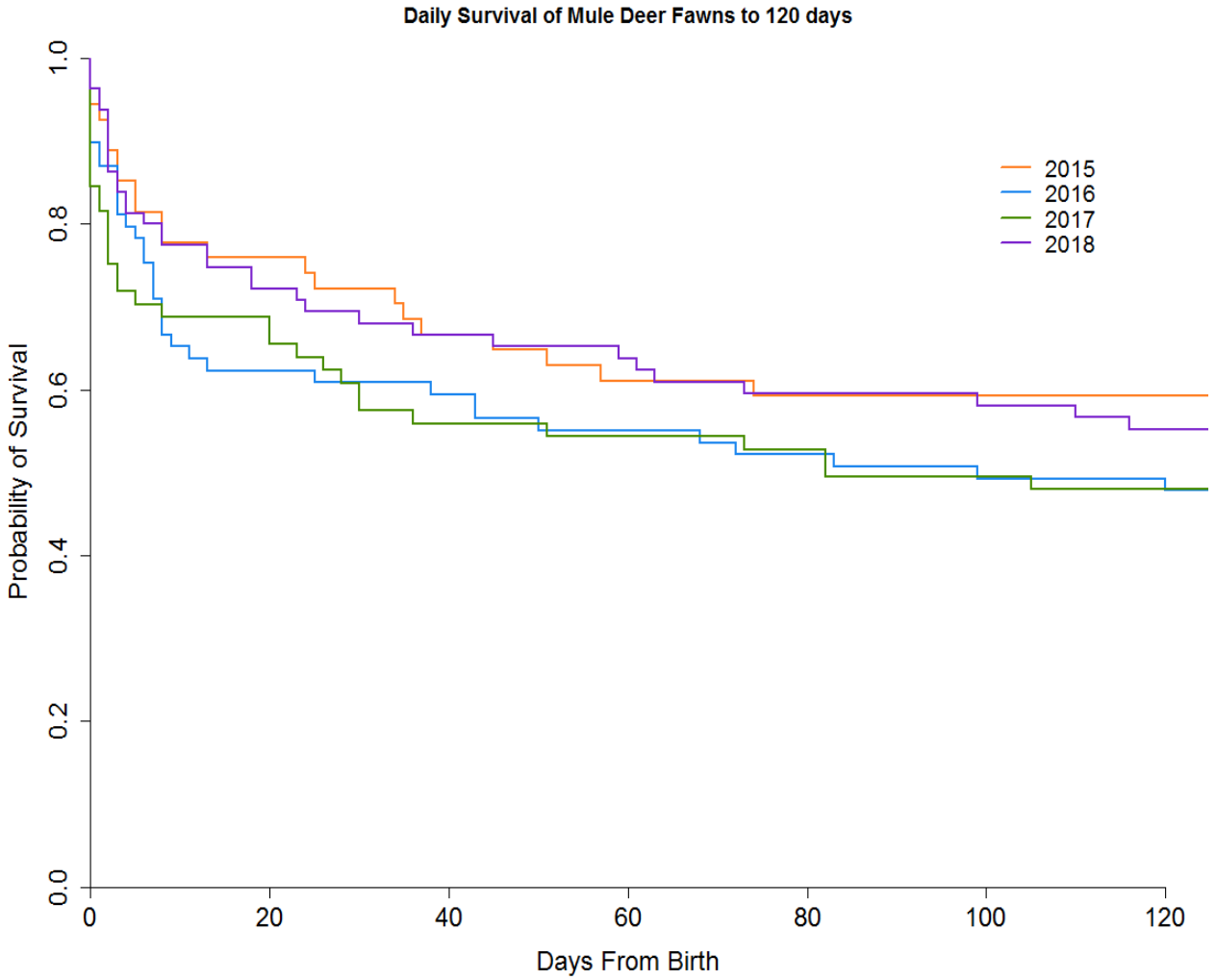
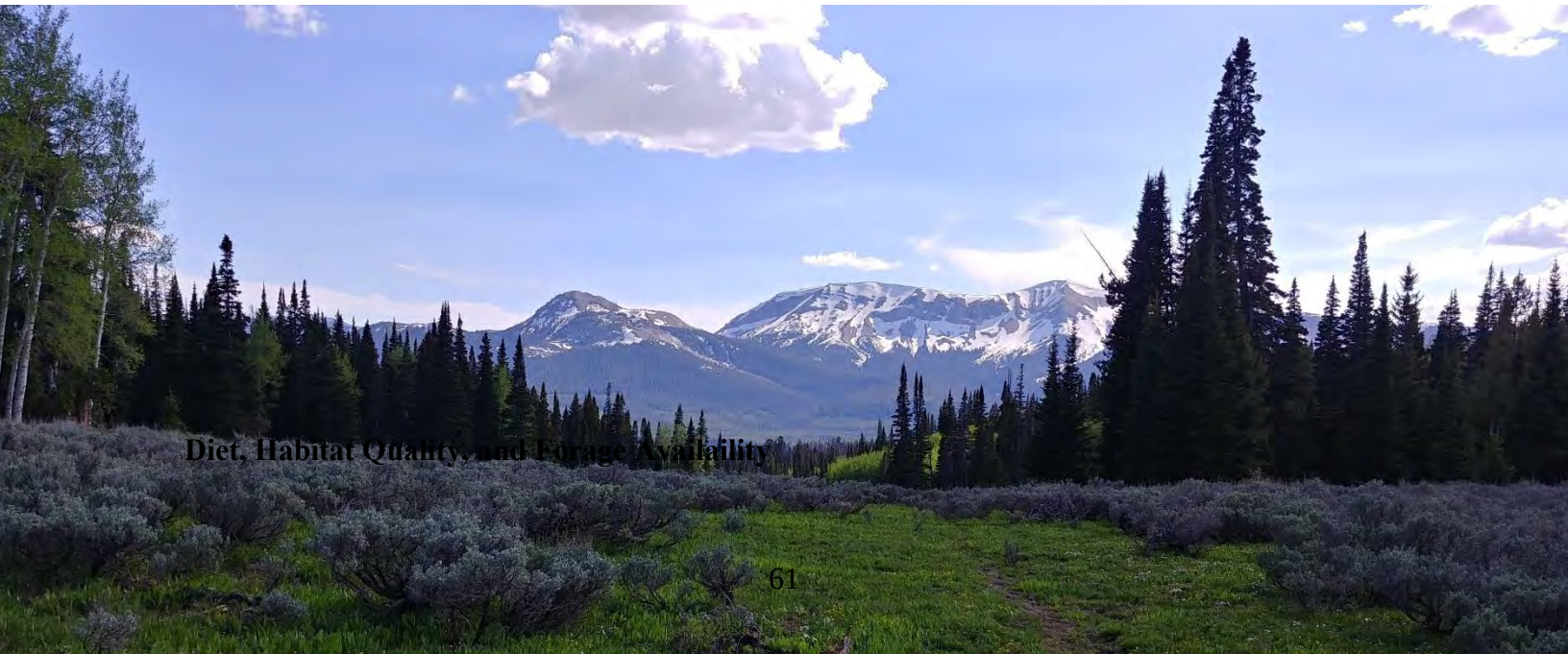


Figure 3. Probability of surival of neonatal mule deer in the Wyoming Range from birth up to 120 days in each summer from 2015 to 2018.



The condition of a female and the habitat conditions she experiences in the summer may be very important in predicting and understanding fawn survival—especially in understanding the relative contributions of nutrition and disease to vulnerability to mortality. Therefore, we are coupling data on summer habitat conditions with information on maternal condition (i.e., nutritional condition) to evaluate how it influences fawn survival.

In 2013 and 2014, we evaluated the quality and availability of plants within the diets of Wyoming Range mule deer during summer. To assess mule deer diets, we collected fecal samples from summer home ranges of collared deer and used microhistology and DNA metabarcoding to identify plant species within their diets in summer 2013 and 2014. Based on frequency of plants within mule deer diets, we then collected plant clippings that we analyzed for quality (e.g., crude protein and digestibility). We began collecting fecal samples from summer home ranges again in the summer of 2018.

In addition to assessing quality and diet composition, we have been evaluating key species of forage in summer home ranges of collared females at known locations during different periods of reproduction (i.e., partition and peak lactation) since the summer of 2015.

Ecology of Spring Migration

At the largest spatial scale, migration is recognized as a strategy that allows migrants to exploit high-quality resources available on one seasonal range, while avoiding resource deficiencies on the other. Much less is known, however, about the fine scale movement behaviors that animals make during migration. This portion of the Wyoming Range Mule Deer Project aims to understand the importance of food resources available during migration, and how the habitat quality of migratory routes influences survival and reproduction of migratory mule deer in the Wyoming Range.

Spring migration is a critical time for migrants, in which they must recover from harsh winter conditions and prepare for upcoming reproductive costs. It is hypothesized that movement from low elevation winter ranges to high elevation summer ranges, allows migrants to extend the amount of time they are exposed to young, highly palatable forage. Following a wave of newly emergent, high-quality forage along elevational gradients, is known as "surfing the green wave". This project will investigate the role of the migratory route as critical habitat, with the aim to better understand the importance of migration as well as to inform management strategies to protect migration in the Wyoming Range and beyond.

Project Objectives

1. Test the green wave hypothesis in migratory mule deer and explore the source of individual variability in green-wave surfing (Completed, see below).

2. Investigate the influence of drought on green-wave surfing (In progress).

3. Understand the relative importance of green-wave surfing to fitness (In progress).

Testing the Green Wave Hypothesis

Deer should select plants that are at intermediate growth stages (i.e. not too old or not too young) because plants which are greening up are both easy to digest and available in large enough quantities to maximize energetic gains. If deer surf a wave of plant green-up, then the timing of their movements during spring migration should be perfectly matched with the timing of peak green-up in plants. When we tested this prediction, this is indeed what we found (Figure 3). We noticed, however, that there was a lot of variability in the green-wave surfing ability of individuals. To further investigate the source of this difference in green-wave surfing we considered how the progression of the green-wave across individual routes may differ. We found that some routes had long, easy to follow gradients in plant green-up, while other routes had short, rapid and difficult to follow gradients in plant green-up. Together this difference in the amount of time when green-up was available along a migration route (i.e. the green-up duration) and the gradient of green-up from winter range to summer range (i.e. the order of green-up), which we refer to as the "greenscape", largely explained the differences in green-wave surfing across individual deer using different migration routes.

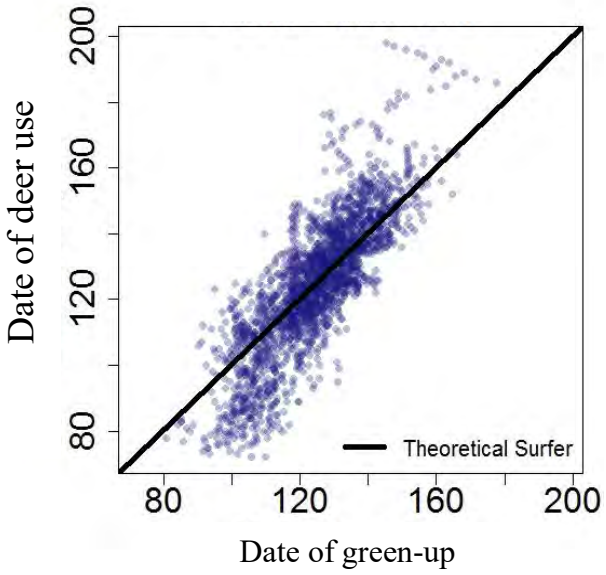


Figure 3. Evidence for green-wave surfing by mule deer in the Wyoming Range. The black line represents the theoretical prediction of a perfect match between the date of green-up and the date of deer use. Data points fall close to this line, suggesting that in general deer are surfing the green wave.

What have we learned?

- Green wave surfing is key to the foraging benefit of migration.
- The migration route provides critical habitat.
- Timing is key, thus activities that may alter the ability of deer to exploit the green wave should be avoided or minimized during the spring migration period.
- The greenscape (i.e. the duration and order of green-up along a migration route) determines the quality of a route.

This research is published! For more information, see:

Aikens, E.O., M. J. Kauffman, J. A. Merkle, S. P. H. Dwinnell, G. L. Fralick, and K. L. Monteith. 2017. The greenscape shapes surfing of resource waves in a large migratory herbivore. *Ecology Letters* 20:741-750.

Evaluating the ontogeny of ungulate migration

Each year, millions of animals migrate between distinct portions of their home ranges. This behavior allows animals to increase fitness by prolonging or increasing access to high-quality resources and at times reducing predation risk. Through both their seasonal ranges and migratory routes, animals can access markedly more resources without diminishing them because of their diffuse presence on a landscape, potentially bolstering carrying capacity and promoting larger populations of migratory animals than non-migratory animals. Despite its central role in a variety of ecological processes, we lack a mechanistic understanding of how these behaviors originate and are maintained.

Figure 1. Year-round GPS points of F014 (2 years old) and her mother, 108.

In ungulates, migration is thought to be maintained via cultural inheritance. Mule deer, for example, are a social species that exhibit maternal care for the first year of life, which may allow for the cultural transmission of migratory information if offspring migrate with their mother for their first migration. Additionally, mule deer are faithful to their migratory routes and seasonal ranges. Whereas fidelity might boost familiarity or indicate strategies that have already been successful, rigidity that may have ensured success in the past may challenge persistence in a changing world.

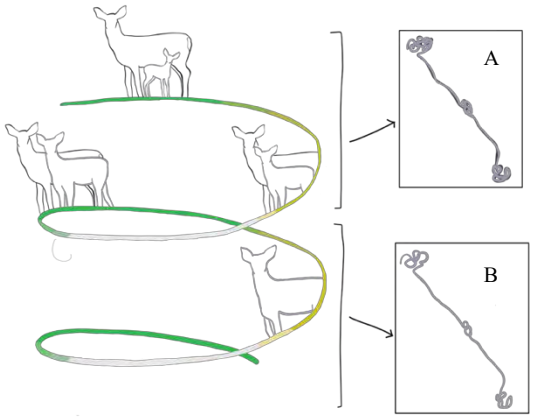
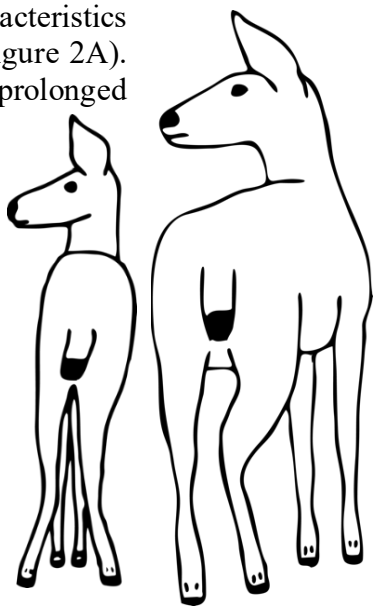


Figure 2. Fawns (purple) live with through at least their first fall (right side of spiral) and spring (left side of spiral) migrations. Fawn and mother's migrations should overlap considerably during the first year of life (A). If migration is culturally inherited from mother during the first year of life, fawn will migrate similarly to their mother, even after maternal investment has ended (B).

Despite mounting evidence for the cultural inheritance of migratory behaviors and its potential ramifications for populations, we still lack a mechanistic understanding of how migratory behaviors are maintained in a population, and the degree to which this mechanism is flexible. To that end, we are working to identify the mechanism underpinning migration in mule deer. We hypothesize that an individual's migratory characteristics are inherited from their mother (Figure 2A). Additionally, we hypothesize that prolonged maternal investment will facilitate the cultural transmission of migratory behaviors (Figure 2B) by establishing patterns that are followed into adulthood.



Using the Wyoming Range Mule Deer project as a study system, we will evaluate these hypotheses using mother-daughter pairs that have been fitted with GPS collars. Through understanding how migration originates, we will gain a deeper understanding of how to protect migratory behaviors into the future.

Assessing public beliefs of ecological concepts regarding mule deer management

Communication with the public makes up an increasing proportion of wildlife management and research. As reflected by the North American Model of Wildlife Conservation, wildlife are a public resource; communicating with stakeholders therefore is part of wildlife professionals' ethical obligation to ensure that the public is informed and has a voice regarding wildlife-related actions. Although communication is an integral part of any wildlife professional's job, many struggle to effectively communicating with the public, in large part because we still lack fundamental understandings of the public.

When wildlife professionals communicate information to members of the public, this message must navigate through a variety of cognitive levels to be absorbed by an individual. Wildlife value orientations provide a useful framework for relating how fundamental aspects of an individual, such as their values and beliefs, will shape their engagement with a variety of wildlife issues through their attitudes and behaviors. Despite the utility of wildlife value orientations as a framework, the explicit roles of beliefs in shaping attitudes and behaviors are often overlooked in wildlife-related issues. Beliefs can shift through time as an individual learns additional information and incorporates it into their belief structure. Therefore, assessing wildlife-related beliefs among members of the public and identifying mismatches with scientific facts could assist in promoting effective communication of wildlife-related issues.

Although all wildlife-related issues likely have potential for mismatch between individual beliefs and knowledge gained via science, management issues concerning ungulates frequently create division among members of the public and wildlife professionals or within sections of the public. Mule deer, for example, are a popular game species in the western United States, but population numbers are declining or stagnant throughout most of their range. In Wyoming in 2017, resident and non-

resident hunters purchased 69,558 licenses and provide a substantial amount revenue to the state wildlife agency (Wyoming Game and Fish Department 2017). Because of the substantial public interest in big game management, wildlife professionals frequently communicate with the public regarding management decisions. It is often unclear, however, whether these messages are constructed and delivered in a way that is poised to be understood by the public.

To aid in improving communication efforts between wildlife managers and the public, we are beginning a study to identify mismatches between information held by citizens of Wyoming who are invested in Wyoming's mule deer populations and knowledge generated by the scientific community related to mule deer management. We aim to work collaboratively with Wyoming Game and Fish Department, non-profits, NGOs, and individual stakeholders to broadly deliver a survey assessing the public's values and beliefs regarding mule deer management. Through these surveys, we aim for this information to provide specific ways for wildlife professionals to improve communication efforts with members of the public.

Assessing Carryover Effects of a Severe Winter

The winter of 2016-17 proved to be tough on mule deer in the Wyoming Range. Conditions on winter ranges for Wyoming Range mule deer were severe with snowpack levels exceeding 200% and numerous days of sub-zero weather. These harsh winter conditions strongly affected winter survival and only 63% of our collared adults survived from November until summer 2017 (compared with >90% in years past). For adults, survival was dependent on both age and condition; older animals and animals that entered winter in poor condition were more susceptible to succumbing to winter exposure than young or fat indivdiuals. Furthermore, we saw a dramatic effect of the harsh winter on survival of fawns. Winter conditions tend to have the greatest effect on survival of fawns, and the 2016-17 winter was no exception. We observed 100% mortality of the radiocollared fawns that entered the winter. Mortality rates of that caliber can have substantial repercussions on population dynamics because the majority of an entire cohort of deer is gone. Although these numbers are staggering, winter die-offs, as the one observed this winter, do occasionally occur and populations do eventually rebound. We have now found ourselves with a unique opportunity to evaluate how mule deer populations rebound from harsh winters.

Nutritional condition in March 2017, measured as % body fat, was the lowest we have observed in our research (2.3% in 2017 compared with 4.0–5.3% in 2013–2016). Although it is rare to see animals in this poor of condition, it was surely a product of deep snow restricting access to forage and heightened energy expenditures associated with locomotion in deep snow and thermoregulation in plummeting temperatures. Following the summer of 2017, we saw collared individuals entering the 2017/2018 winter in the best condition that we have observed in this population, with body fat levels close to two times the levels what we had seen in the autumn of 2016.

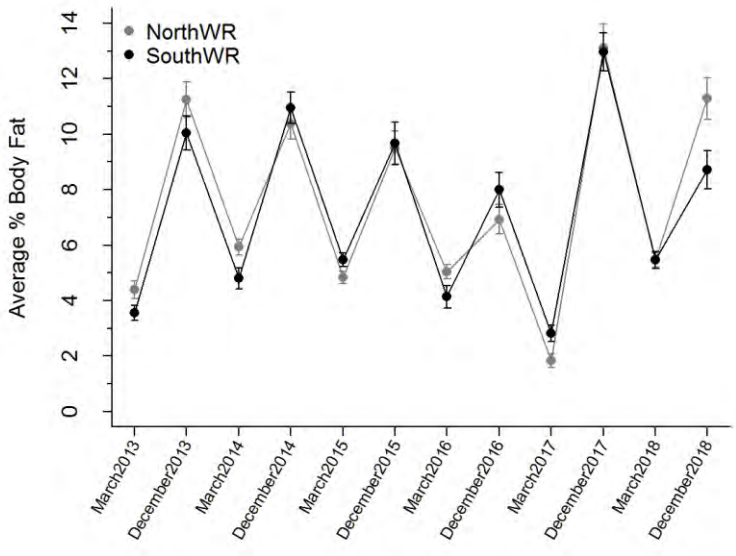
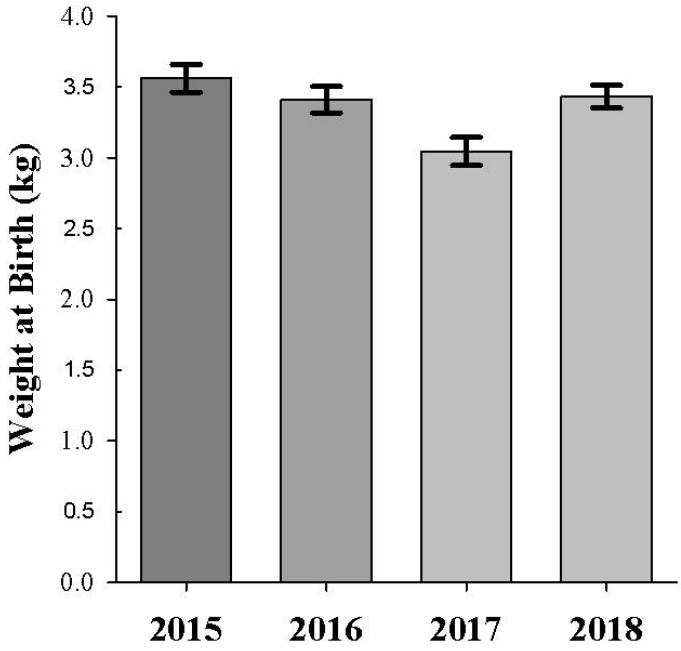


Figure 4. Average percent of ingesta-free body fat of adult, female mule deer in the Wyoming Range from March 2013 to December 2018.

We saw the effects of the harsh winter in 2016-17 in fawns born in the summer of 2017. Newborn fawns caught in 2017 were significantly lighter than newborn fawns caught in previous years, and over a quarter of the summer mortalities that year were from collared females giving birth to stillborns. In line with poor development of offspring at birth was the smallest eye diameter of fetuses measured in March 2017. In 2018, not only had eye diameter of developing fetuses climb to higher levels that we had seen previously, birth weights also increased back to levels that were comparable to what had been seen in the population before the summer of 2017. With this information, we are now in a position to better evaluate the influence of birth weight and maternal condition on summer survival of fawns.

Following the severe winter of 2016-17, the Wyoming Range mule deer population had found itself in an interesting place. The high adult morality and depressed reproduction in the summer following undoubtedly resulted in decreased abundance of deer in the Wyoming Range. The silver lining to the decrease in the population is that population growth is often higher when abundance is low.

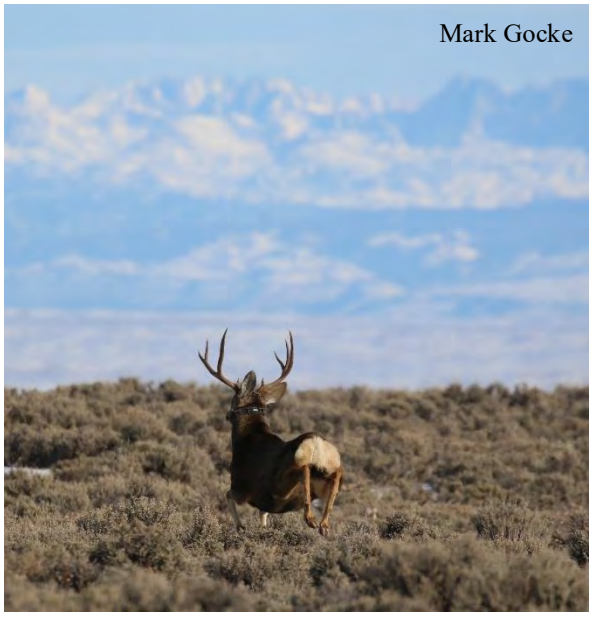


As the density of deer decreases, the food available to each individual on a landscape increases. Consequently, populations at low abundance, relative to the capacity that their landscape can support, tend to be in overall better nutritional condition because each individual has access to more food. Conversely, deer populations that are at or exceeding the capacity a landscape can support tend to be in overall worse nutritional condition

because deer are competing with each other for food. Some of these trends are reflected in our longitudinal data of trends in fat dynamics since 2013. Deer were in the poorest nutritional condition we had observed in March 2017, and following the population crash and reduction of individuals on the landscape, we observed the best nutritional condition we've ever seen in this population in December of 2017.

The effects of the 2016-17 winter has been distressing, but we now are uniquely poised to document the long-term effects of severe winters and understand the factors that will influence population recovery from the devastating losses. We have been extremely fortunate to have been conducting research on this herd, not only through the course of this harsh winter, but for several years prior, which will yield the data to address questions associated with how severe winters may affect mule deer herds throughout the state. With dramatic reductions in density, forage resources available per individual should be bolstered and thus, nutritional condition, reproductive success, and survival may well all respond very favorably. Nevertheless, with lower deer density compared with recent decades, the role of predators in this population also may change in either positive or negative ways. The marked decline of the Wyoming Range deer population following the 1992-93 winter, and the near absence of any substantial recovery thereafter, also begs the question to what extent recovery will occur given historic patterns. Regardless, the overwhelming management desire is for recovery, and our aim is to document recovery and the mechanisms that underpin it

Understanding the Ecology of Male Mule Deer in the Wyoming Range


Mark Gocke

The Wyoming Range mule deer herd holds substantial cultural and economic importance, in part, because of the opportunities it provides for hunters from both Wyoming and throughout the West to harvest male deer, and for some, to harvest large males. Despite the importance of male mule deer in the Wyoming Range to both the public and economy, we still lack fundamental understandings of much of the ecology of males (i.e., migratory behaviors, vulnerability to harvest, dispersal from natal home ranges), and thus, many questions arise as to how season dates should be established, how male deer respond to harvest pressure, and whether males are being recruited into older age segments. Or for example, even more basic questions associated with how population processes are stocking high-elevation basins with male deer remains largely unknown.

Beginning in the autumn of 2018, we began to collar male mule deer as part of the Wyoming Range Mule Deer project, and hope to continue these efforts over the next three years. The Wyoming Range Mule Deer project has begun to disentangle many of the factors that may regulate mule deer herds in Wyoming, but there is still a critical gap in understanding the ecology of this herd. Despite the fact that males are often the segment of the population most valued by the public, there exists little information on how their ecology differs from females, and thus, how males may behave or respond differently from females to regulating or limiting factors. Indeed, harvest of females has been restricted almost completely in the Wyoming Range since 1993 and thus, almost all harvest-related opportunity in the population is provided by the male segment. The Wyoming Range herd is universally considered by many as one of the premier herds for hunting large mule

deer in North America. Accordingly, most conversations associated with management of the Wyoming Range herd, and many others for that matter, is focused around harvest of males. Outside of antler morphology characteristics and age specific data that is collected in the field by managers subsequent to harvest, little information is available that contributes to the management of the male cohort. In fact, other than posthunt male:female ratios, there are no other long-term, consistently obtained or reliable data sets that describe the annual population dynamic, or effects of management action on the 1+-year old cohort of males. Consequently, we generally lack empirical information to help inform discussions as to management of males. This discussion occurs at a time when segments of the hunting public are asking for a dichotomous, and inherently conflicting, set of management actions be implemented that dramatically restricts hunting of males, as well as providing increased opportunity to harvest trophy class males during the migratory period (i.e., longer hunting seasons) or when males arrive on winter ranges.

Existing evidence and theory indicates that male ungulates differ markedly in their behavior, nutritional dynamics, and growth, and as a consequence, can exhibit demographics divergent to that of females. It has been recommended that male ungulates be considered as essentially a different species compared with females, because of their striking differences in life history. Although they represent a flexible resource within populations because harvest of males plays little role in affecting population dynamics for polygynous ungulates, increasing interest in maintaining male:female ratios at specified levels and maintaining a specific age structure has become common criteria in management plans. Moreover, heightened discussions on harvest pressure and the topic of limited quota harvest regimes exemplify the need for additional insight into the ecology of male deer.

Future Directions

The overall goal of our continued work in the Wyoming Range will be to build on our understanding of nutritional and population ecology of this herd to answer a suite of questions that can only be addressed using long-term and continuous data. The mule deer of the Wyoming Range are one of the most cherished populations of wildlife in western North America, and we seek to gain a better understanding of how this population is responding to an increasingly changing environment, while simultaneously answering complex questions critical to advancing our understanding of this species that have long eluded ecologists. By following individuals from birth throughout their life, we can begin to better understand the behavioral and physiological adaptations these animals possess to persist in such a stochastic landscape, and identify what factors may play crucial roles on long-term population dynamics. Our work has begun to identify the effects of a severe winter on this population of mule deer, and we are now equipped to identify the severity and longevity of carryover effects on a population following an extreme winter. Further, we are beginning to understand how migratory patterns are passed from generation to generation, and will soon be able to assess how those patterns differ between males and females, and ultimately what dictates patterns of occupancy by deer across a diverse landscape. Our approach will allow us to continue to elucidate the relative roles of habitat, nutrition, predation, and disease on the regulation of deer in western Wyoming, and to begin to address questions that require long-term data but are crucial to the successful management of mule deer in Wyoming.

Partners

The Wyoming Range Deer Project is a collaborative partnership in inception, development, operations, and funding. Without all the active partners, this work would not be possible. Funds have been provided by the Wyoming Game and Fish Department, Wyoming Game and Fish Commission, Wyoming Wildlife and Natural Resource Trust, Muley Fanatic Foundation, Bureau of Land Management, Knobloch Family Foundation, U.S. Geological Survey, National Science Foundation, Wyoming Governor's Big Game License Coalition, Boone and Crockett Club, Animal Damage Management Board, Ridgeline Energy Atlantic Power, Bowhunters of Wyoming, and the Wyoming Outfitters and Guides Association. Special thanks to the Wyoming Game and Fish Department, Bureau of Land Management, and Wyoming State Veterinary Lab for assistance with logistics, lab analyses, and fieldwork. Also, thanks to the Cokeville Meadows National Wildlife Refuge and U.S. Forest Service for providing field housing.

MONTEITH SHOP

HAUB SCHOOL OF ENVIRONMENT & NATURAL RESOURCES

WYOMING COOPERATIVE FISH & WILDLIFE RESEARCH UNIT

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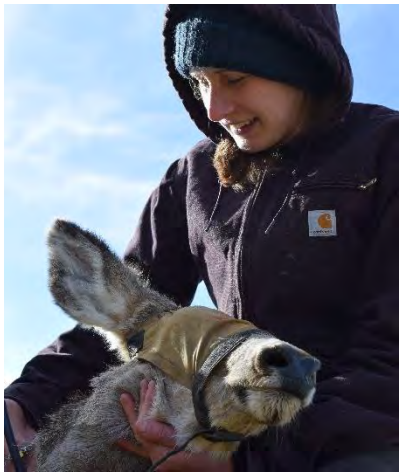
PROJECT TEAM MEMBERS

Kevin Monteith

Kevin Monteith is an Assistant Professor of the Haub School of Environment and Natural Resources and the Wyoming Cooperative Fish and Wildlife Research Unit, Department of Zoology and Physiology at the University of Wyoming. After receiving his BSc and MSc in Wildlife and Fisheries Sciences from South Dakota State University, he went on to obtain his PhD in Biology from Idaho State University in 2011. Kevin's research program is focused on integrating nutritional ecology with intensive field studies of large ungulates to elucidate the mechanisms that underpin behavior, growth, reproductive allocation, predator-prey dynamics, and ultimately, the factors affecting population growth. Kevin and his graduate students are currently conducting research on most of Wyoming's large ungulates; topics are centered on establishing a protocol for habitat-based, sustainable management of ungulate populations, while investigating the effects of predation, habitat alteration, climate change, migration tactics, and novel disturbance.

Ellen Aikens



Ellen is a PhD candidate in the Program in Ecology at the University of Wyoming. Ellen is fascinated by animal movement, especially migration. Ellen plans to pursue a career in research, with a focus on the interface between fundamental research and applied conservation and management. Before coming to Wyoming, Ellen worked at the Smithsonian Conservation Biology Institute's GIS lab, where she analyzed remote sensing and GPS telemetry data for conservation research projects across the globe. Ellen is a recipient of the National Science Foundation Graduate Research Fellowship and the Berry Fellowship. Ellen earned her bachelor's degree in Biology and Environmental Studies from Ursinus College.

Samantha Dwinnell

Samantha Dwinnell is a Research Scientist with the Haub School of Environment and Natural Resources. Samantha is the first student to miraculously graduate (May 2017) with a MSc from the Monteith Shop. Immediately following her defense that was made successful through bribery, she foolishly convinced Dr. Monteith to hire her as a Research Scientist to manage the Wyoming Range Mule Deer Project. Samantha's graduate research was focused on the nutritional relationships among mule deer behavior, forage, and human disturbance. Currently, her research is focused on disentangling the relative influence of various factors that affect fawn survival. Although Samantha is most interested in research aimed at informing management and conservation of wildlife, she also dedicates research efforts into finding ways to mountain bike and ski without her boss knowing.

Rhiannon Jakopak

Rhiannon is currently a master's student in the Cooperative Fish and Wildlife Research Unit at the University of Wyoming. She received dual bachelor's degrees in Wildlife and Fisheries Biology and Management and Religious Studies at the University of Wyoming in 2016. She is broadly interested in population ecology and mammalogy, and more specifically interested in the processes regulating the distribution of species. Her master's project seeks to identify the factors which influence the development of migration and the subsequent population consequences.

Tayler LaSharr

Tayler LaSharr is a PhD student in the Cooperative Fish and Wildlife Research Unit. Tayler is originally from Phoenix, AZ and attended the University of Arizona where she obtained a BSc in Natural Resources with an emphasis in Conservation Biology and a minor in Chemistry in May of 2015. During her time at the University of Arizona, she studied life history tradeoffs in Western and Mountain Bluebirds and the effects of aggression in closely related species on habitat and range dynamics. She completed her MSc in the Monteith shop in the spring of 2018 assessing the effects of harvest on horn size of mountain sheep. She now is working on a component of the Wyoming Range Mule Deer Project assessing population recovery following a severe winter for her PhD research.

Haub School of Environment and Natural Resources

Academic Programs | Biodiversity Institute | Ruckelshaus Institute

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Appendix D. Wyoming Range Mule Deer Herd, posthunt herd composition data, 2012-2018.										
							Ratio:100 Females			
2012	Yrlng Males	Adult Males	Total Males	Does	Fawns	Total	Yrlng Males	Adult Males	Total Males	Fawns
HA134	55	103	158	635	404	1197	9	16	25	64
HA135	80	159	239	822	647	1708	10	19	29	79
HA143	116	177	293	799	505	1597	14	22	37	63
144/145	Survey conducted in February 2013					764				
TOTAL	251	439	690	2256	1556	5266	11	19	30	69
2013										
HA134	99	175	274	660	496	1430	15	26	41	75
HA135	145	203	348	913	672	1933	16	22	38	74
HA143	300	326	626	1373	897	2896	22	24	46	65
144/145	Survey conducted in March 2014					805				
TOTAL	544	704	1248	2946	2065	7064	18	24	42	70
2014										
HA134	100	138	238	565	466	1269	18	24	42	82
HA135	191	322	513	1386	1128	3027	14	23	37	81
HA143	291	271	562	1288	884	2734	22	21	43	68
144/145	Survey conducted in February 2015					1005				
TOTAL	582	731	1313	3239	2478	8035	18	22	40	76
2015										
HA134	81	173	254	737	406	1397	11	23	34	55
HA135	176	302	478	1188	828	2494	15	25	40	70
HA143	415	399	814	2005	1147	3966	21	20	41	57
144/145	Survey conducted in February 2016					440				
TOTAL	672	874	1546	3930	2381	8297	17	22	39	60
2016										
HA134	95	190	285	774	489	1549	12	24	36	63
HA135	182	380	562	1605	1008	3175	11	24	35	63
HA143	256	260	516	1430	723	2669	18	18	36	50
144/145	Survey conducted in February 2017					517				
TOTAL	533	830	1363	3809	2220	7910	14	22	36	58
2017										
HA134	14	153	167	672	389	1228	2	23	25	58
HA135	47	282	329	1105	701	2135	4	25	30	63
HA143	111	348	459	1547	701	2707	7	22	30	45
144/145	Sightability Survey Conducted in February 2018					1405				
TOTAL	172	783	955	3324	1791	7475	5	23	29	54
2018										
HA134	134	135	269	1223	721	2213	11	11	22	59
HA135	197	375	572	1752	1070	3394	11	21	33	61
HA143	178	239	417	1277	742	2436	14	19	33	58
144/145	Survey to be conducted in February 2019									
TOTAL	509	749	1258	4252	2533	8,043	12	18	29	59

1

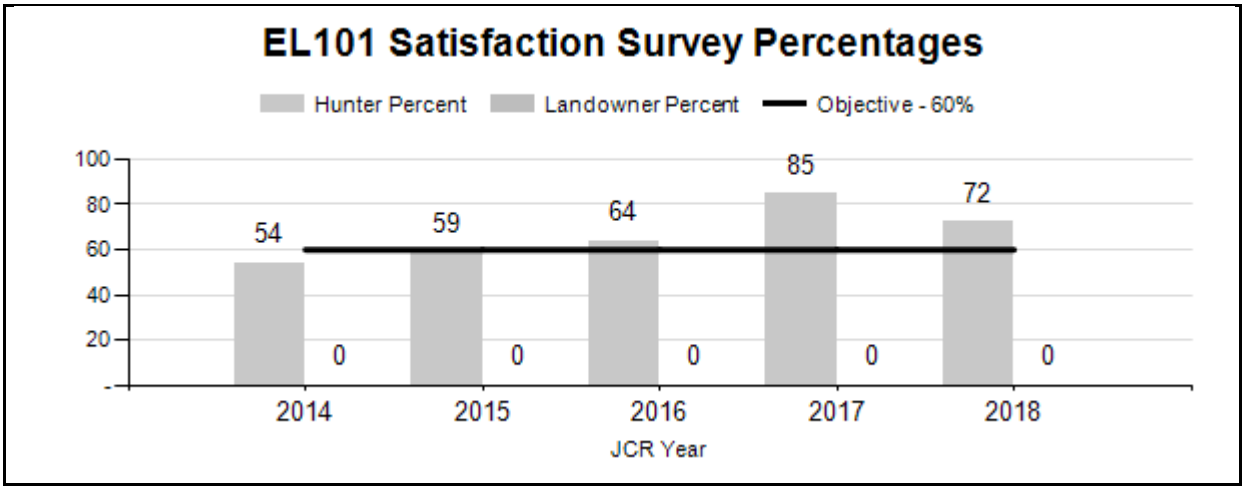
2018 - JCR Evaluation Form

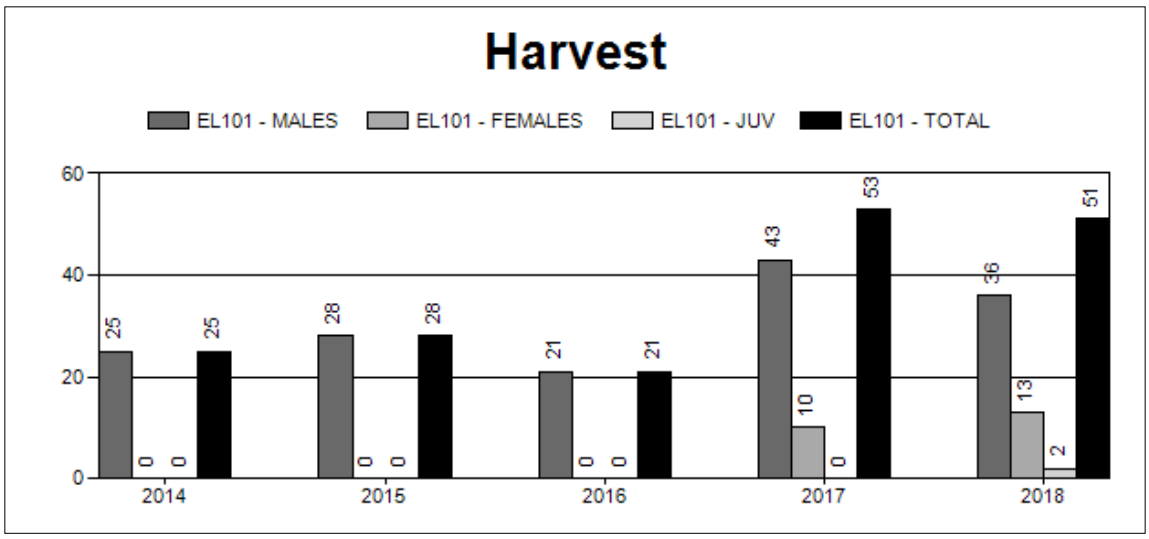
SPECIES: Elk
HERD: EL101 - TARGHEE
HUNT AREAS: 73

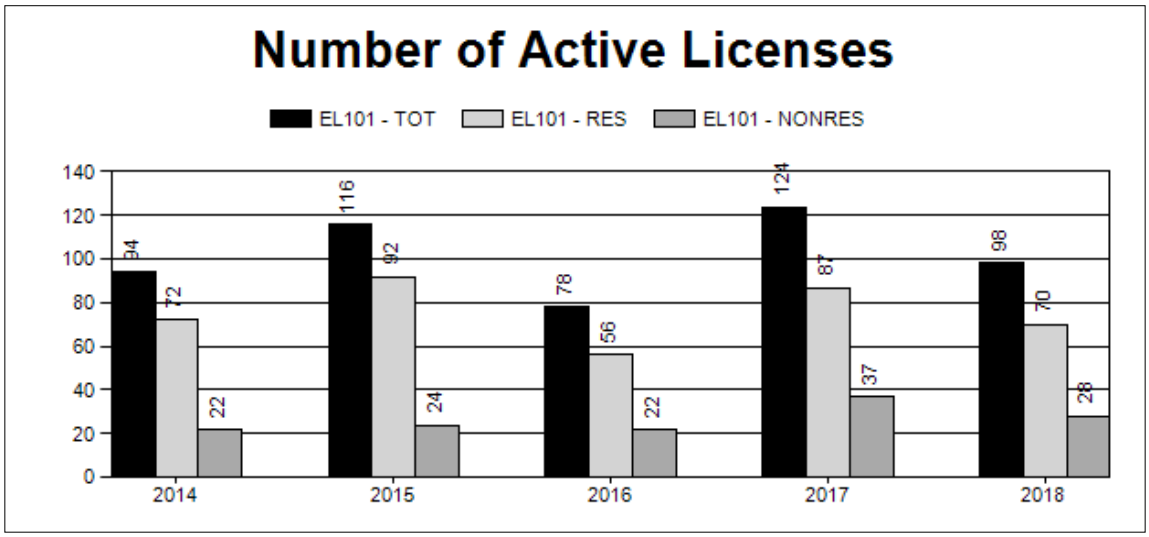
PERIOD: 6/1/2018 - 5/31/2019
PREPARED BY: ALYSON COURTEMANCH

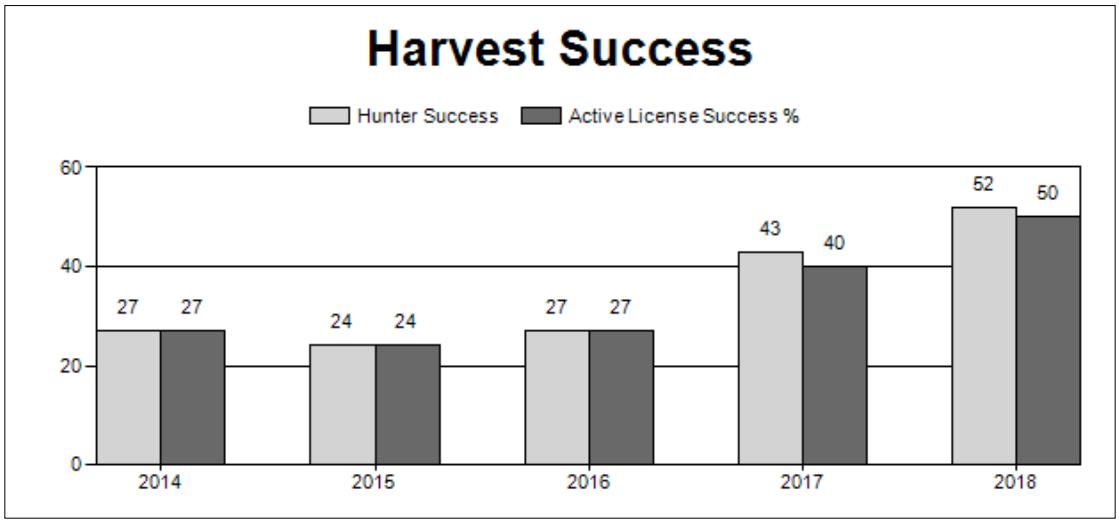
	2013 - 2017 Average	2018	2019 Proposed
Hunter Satisfaction Percent	67%	72%	75%
Landowner Satisfaction Percent	--	--	--
Harvest:	31	51	50
Hunters:	102	98	100
Hunter Success:	30%	52%	50 %
Active Licenses:	104	103	100
Active License Success:	30%	50%	50 %
Recreation Days:	633	600	600
Days Per Animal:	20.4	11.8	12
Males per 100 Females:	--	--	
Juveniles per 100 Females	--	--	

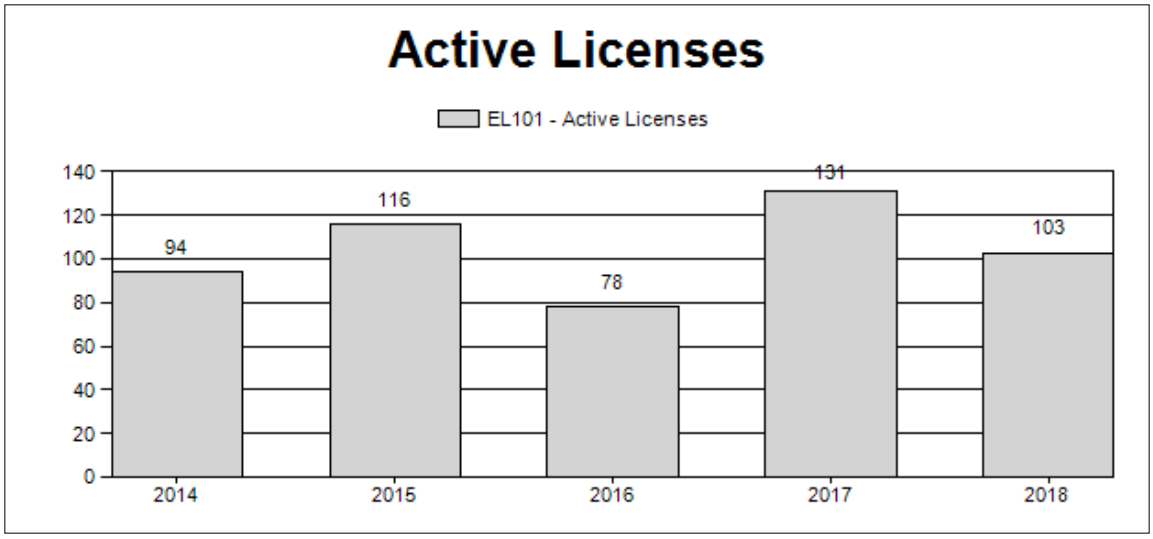
Satisfaction Based Objective	60%
Management Strategy:	Recreational
Percent population is above (+) or (-) objective:	N/A%
Number of years population has been + or - objective in recent trend:	3 years above

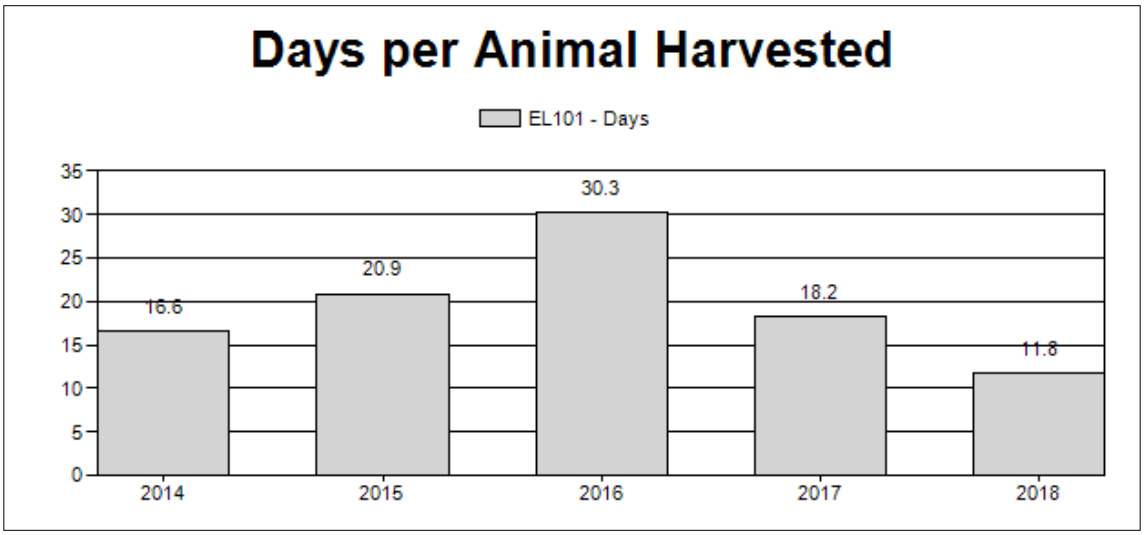


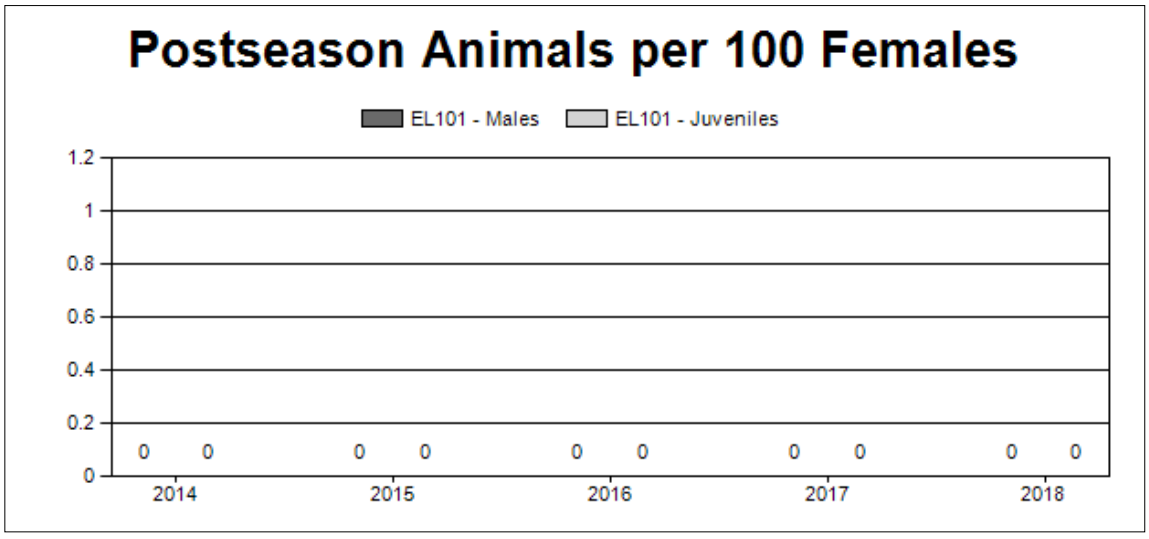

Harvest
EL101 - MALES
EL101 - FEMALES
EL101 - JUV
EL101 - TOTAL
60
40
20
0
25
0
0
25
28
0
0
28
21
0
0
21
43
10
0
53
36
13
2
51
2014
2015
2016
2017
2018


Number of Active Licenses
EL101 - TOT
EL101 - RES
EL101 - NONRES
140
120
100
80
60
40
20
0
94
72
22
116
92
24
78
56
22
124
87
37
98
70
28
2014
2015
2016
2017
2018


Harvest Success
Hunter Success
Active License Success %
60
40
20
0
27
27
24
24
27
27
43
40
52
50
2014
2015
2016
2017
2018


Active Licenses
EL101 - Active Licenses
140
120
100
80
60
40
20
0
94
116
78
131
103
2014
2015
2016
2017
2018


Days per Animal Harvested
EL101 - Days
35
30
25
20
15
10
5
0
16.6
20.9
30.3
18.2
11.8
2014
2015
2016
2017
2018


Postseason Animals per 100 Females
EL101 - Males
EL101 - Juveniles
1.2
1
0.8
0.6
0.4
0.2
0
0 0
0 0
0 0
0 0
0 0
2014
2015
2016
2017
2018

2019 HUNTING SEASONS
TARGHEE ELK HERD (EL101)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
73		Sep. 20	Oct. 25		General	Antlered elk, spikes excluded
	6	Aug. 15	Jan. 31	25	Limited quota	Cow or calf valid on private land

Special Archery Seasons

Hunt Area	Type	Dates of Seasons		Limitations
		Opens	Closes	
73	All	Sep. 1	Sep. 19	Valid in the entire area

Management Evaluation

Management Strategy: Recreational

Population Objective Type: Hunter Satisfaction
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 ≥25% harvest success.
Evaluation: meeting objectives

The Wyoming Game and Fish Department (WGFD) proposed changing the objective for the Targhee Elk 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 since the majority of elk winter in Idaho. A hunter satisfaction objective was adopted in 2014 after public review, and included primary and secondary objectives (listed above). The region did not adopt a landowner satisfaction objective because the majority of the herd unit is located on public lands during the hunting season.

In 2018, 72% of hunters indicated they were "satisfied" or "very satisfied" with hunting in the Targhee Elk Herd. The average satisfaction for the past 3 years is 74%. Therefore, the herd is meeting the primary objective of an average of ≥60% hunter satisfaction over 3 years. In 2018, 52% of hunters were successful in the Targhee Elk Herd. The 3-year average of hunter success is 41%. Therefore, the herd is meeting the secondary objective of an average of ≥25% harvest success over 3 years.

Herd Unit Issues

The current objective and management strategy for this herd will be maintained based on internal discussions and conversations with our constituents. Population status was evaluated and it was determined a change is not warranted at this time. These objectives will be reviewed again in 2024; however, if a situation arises that requires immediate change, proposals will be developed and submitted as needed.

Post-season classification surveys are not flown in this herd due to budget constraints and the fact that the majority of the herd winters in Idaho. 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.

Elk causing damage on private lands is beginning to become a concern for some landowners near Alta, Wyoming. Therefore, 25 Type 6 cow/calf licenses were offered beginning in 2018 and will be offered again in 2019 valid for private lands only to help disperse elk off private lands and prevent damage.

Weather

Spring and summer 2018 produced average moisture. Fall and early winter weather was very mild with warm temperatures and little snowfall at high elevations. However, several large snowstorms occurred in February that resulted in the rapid accumulation of a deep snowpack. 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 elk winter and transitional ranges, but these have not been monitored in the past 7 years. Several habitat improvement projects are being planned in this herd unit, including the Hill Creek Prescribed Burn, which is scheduled for completion in 2019. In addition, a habitat treatment in Teton Canyon is currently in the planning stages to improve mountain shrub and aspen communities for elk and other big game with potential for implementation beginning in 2019. The WGFD is assisting Caribou-Targhee National Forest (CTNF) with vegetation monitoring in aspen stands pre and post-treatment. Please refer to the 2018 Annual Report Strategic Habitat Plan Accomplishments for Jackson Region habitat improvement project summaries (https://wgfd.wyo.gov/Habitat/Habitat-Plans/Strategic-Habitat-Plan-Annual-Reports).

Field Data

No field data were collected in the Targhee Herd Unit during the 2018 biological year.

Harvest Data

Based on harvest statistics, the availability of elk in the Targhee Herd continues to be a concern. However, the harvest survey indicates that hunters had high success and satisfaction during the 2018

hunting season. The overall number of elk harvested remained low in 2018 (n=51) but doubled from harvest over recent years, which usually ranged from 20-30 elk. Antlerless elk seasons were eliminated in 2010 in this herd unit, however, a Type 6 license valid for cow or calf elk on private lands was added in 2016 to help address damage concerns. Fifteen elk were harvested on this license type in 2018.

Population

This population likely declined following the elimination of the supplemental feeding program in Idaho and liberal hunting seasons to address damage to private lands and comingling with livestock. Data are limited in this population and spreadsheet models developed for this population do not simulate observed trends. Elk winter and transitional ranges in Wyoming are dominated by conifer-encroached aspen stands.

A new research project was started in 2018 on the Targhee Elk Herd to gain information on elk seasonal migration patterns, pregnancy, and survival. Twenty-seven cow elk were collared in February 2018 on winter ranges in Idaho between Ashton and Victor. An additional 5 elk were collared in February 2019. This is a collaborative project between WGFD, Idaho Department of Fish and Game, Yellowstone National Park, and the University of California – Berkeley. Information from this project will help inform future population management and hunting seasons.

Management Summary

Due to the "interstate" nature of this population, managing this herd is difficult. This population spends the summer and early fall in Wyoming and winters along drainages in the foothills of the Teton Range. The WGFD continues to work closely with CTNF to develop habitat improvement projects to benefit elk in Wyoming. Observations of elk along the state line indicate this population remains at a low density even though hunting seasons are conservative.

Elk causing damage on private lands is beginning to become a concern for some landowners near Alta, Wyoming. Therefore, 25 Type 6 cow/calf licenses will be offered again in 2019 valid for private lands only to help disperse elk off private lands and prevent damage.

2018 - JCR Evaluation Form

SPECIES: Elk

PERIOD: 6/1/2018 - 5/31/2019

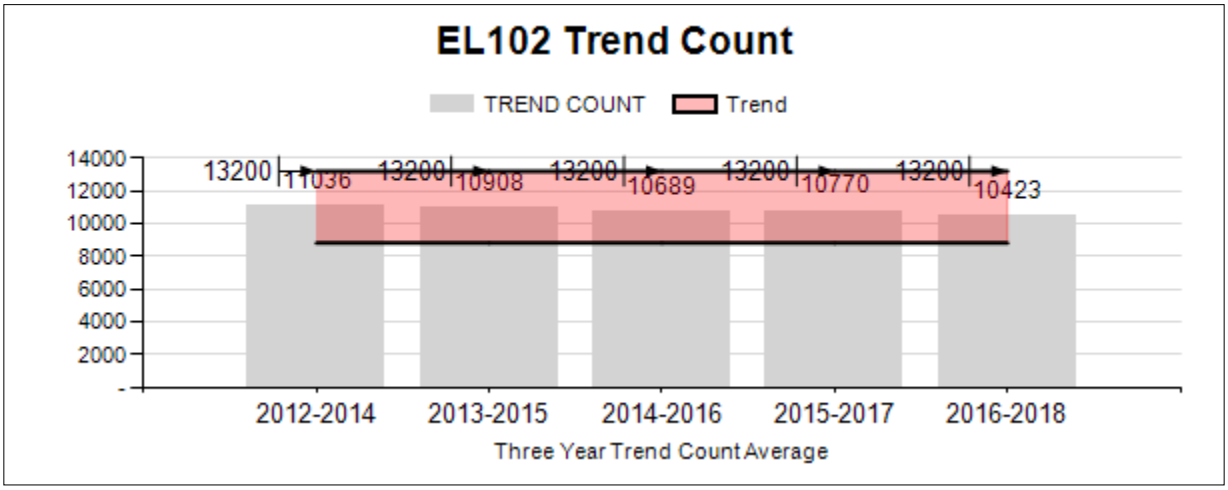
HERD: EL102 - JACKSON

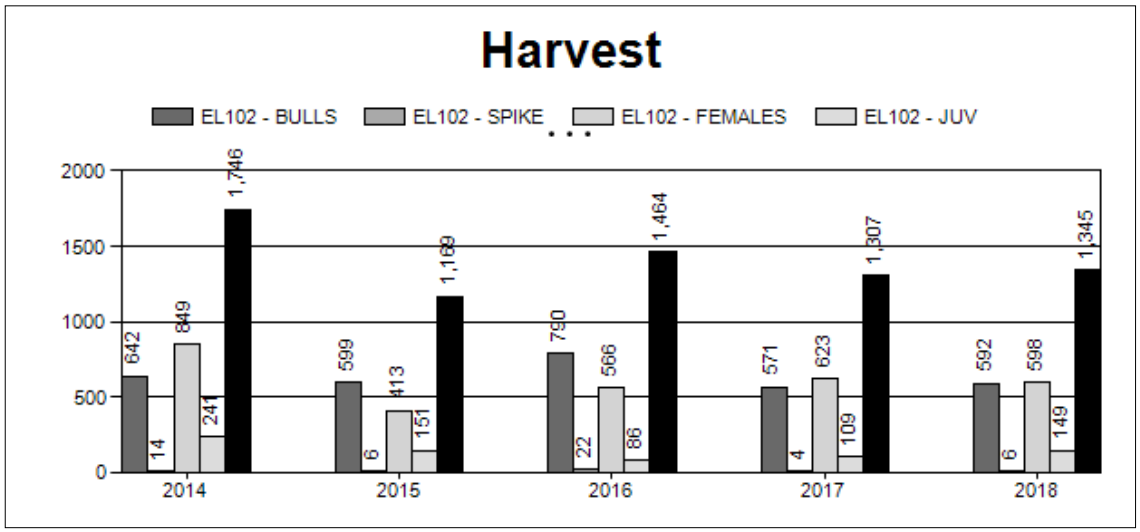
HUNT AREAS: 70-72, 75, 77-83

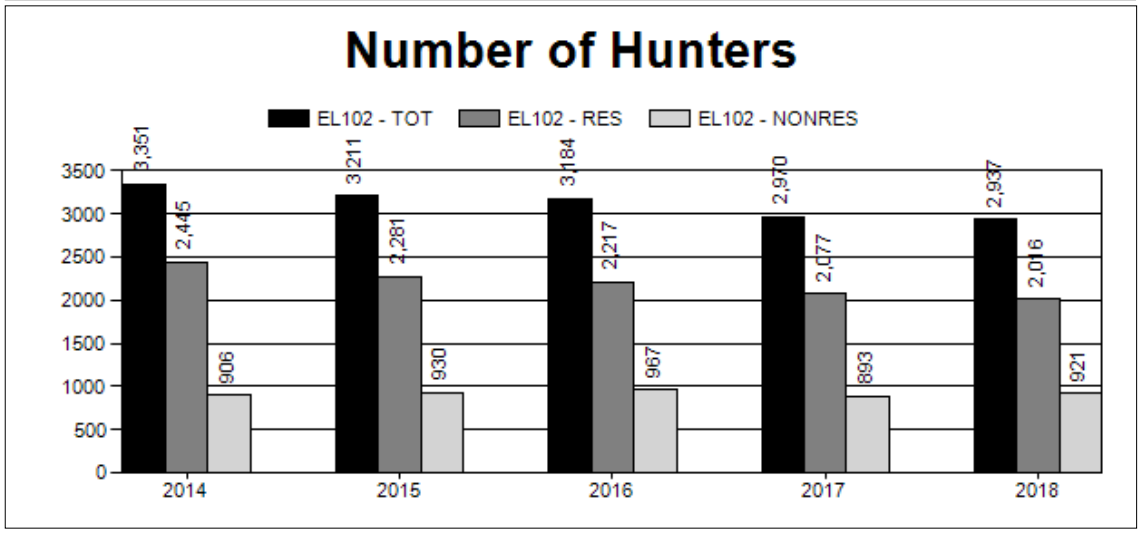
PREPARED BY: ALYSON COURTEMANCH

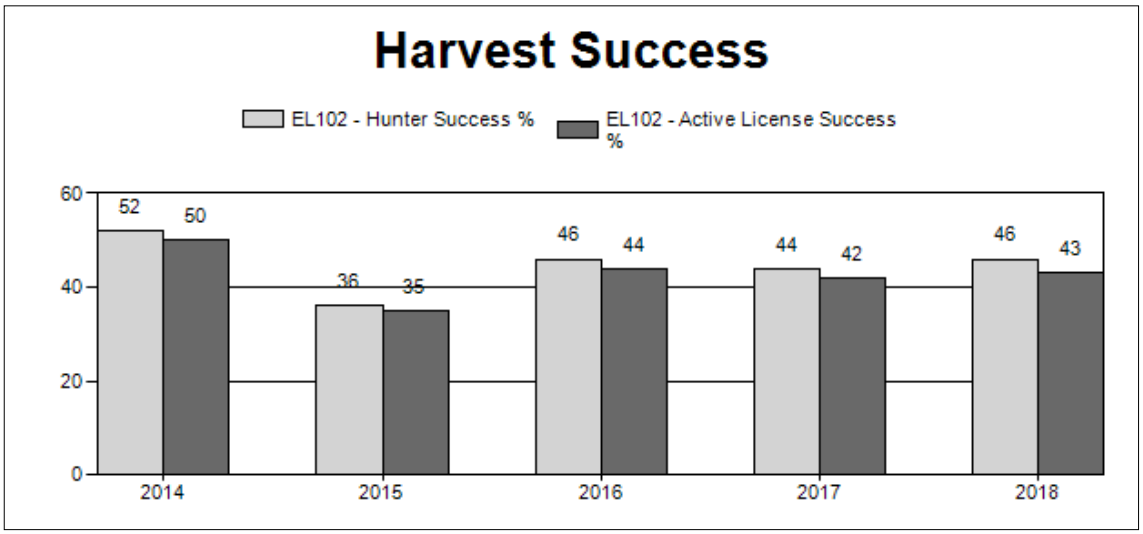
	2013 - 2017 Average	2018	2019 Proposed
Trend Count:	10,873	9,627	11,000
Harvest:	1,425	1,345	1,200
Hunters:	3,118	2,937	3,000
Hunter Success:	46%	46%	40 %
Active Licenses:	3,240	3,114	3,000
Active License Success	44%	43%	40 %
Recreation Days:	20,793	19,231	18,000
Days Per Animal:	14.6	14.3	15
Males per 100 Females:	36	26	
Juveniles per 100 Females	20	21	

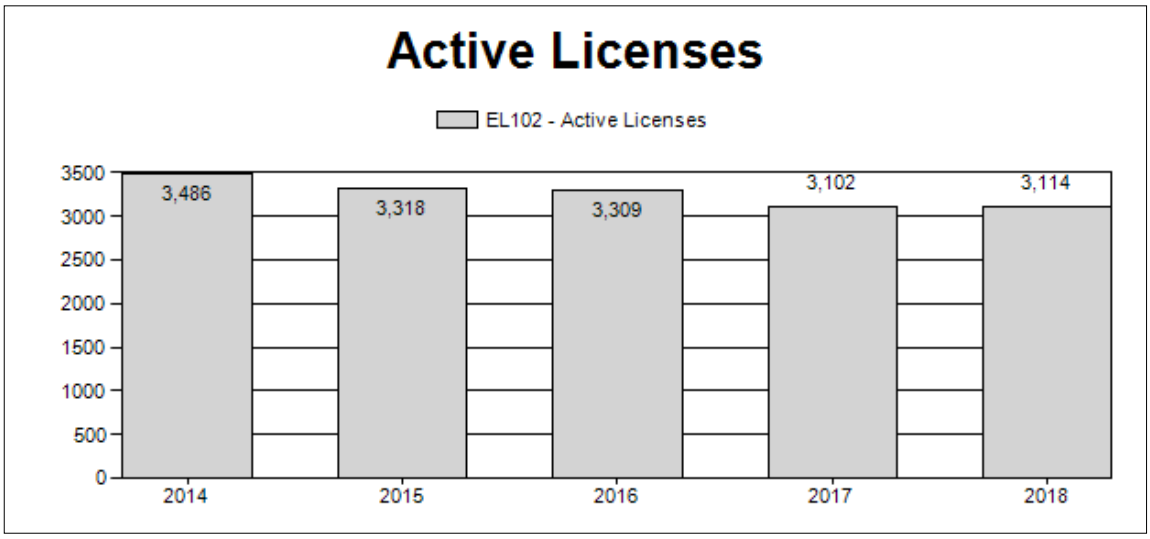
Trend Based Objective (± 20%)	11,000 (8800 - 13200)
Management Strategy:	Recreational
Percent population is above (+) or (-) objective:	-12.5%
Number of years population has been + or - objective in recent trend:	0

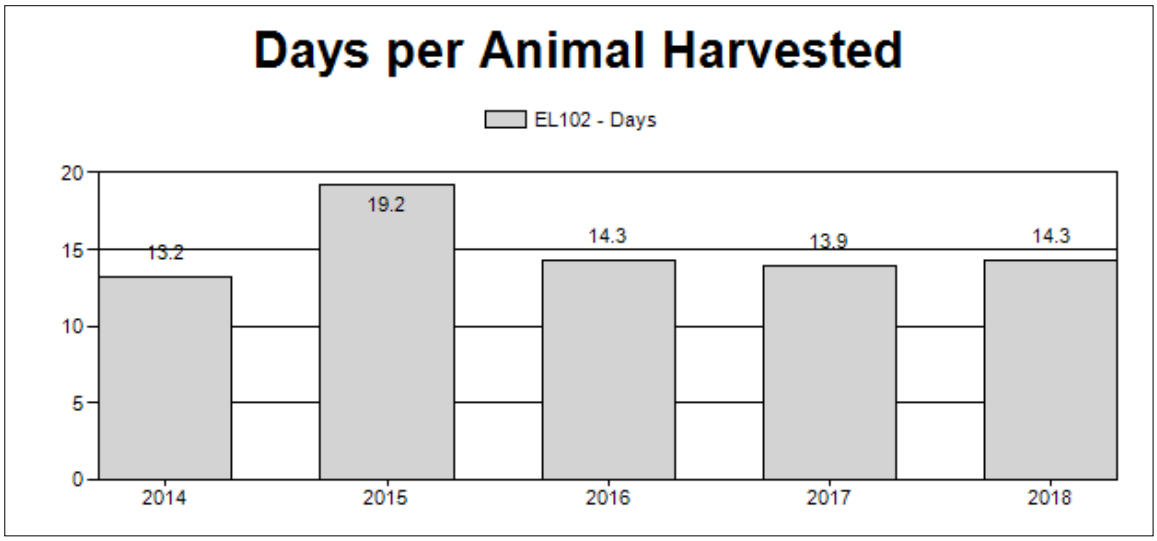


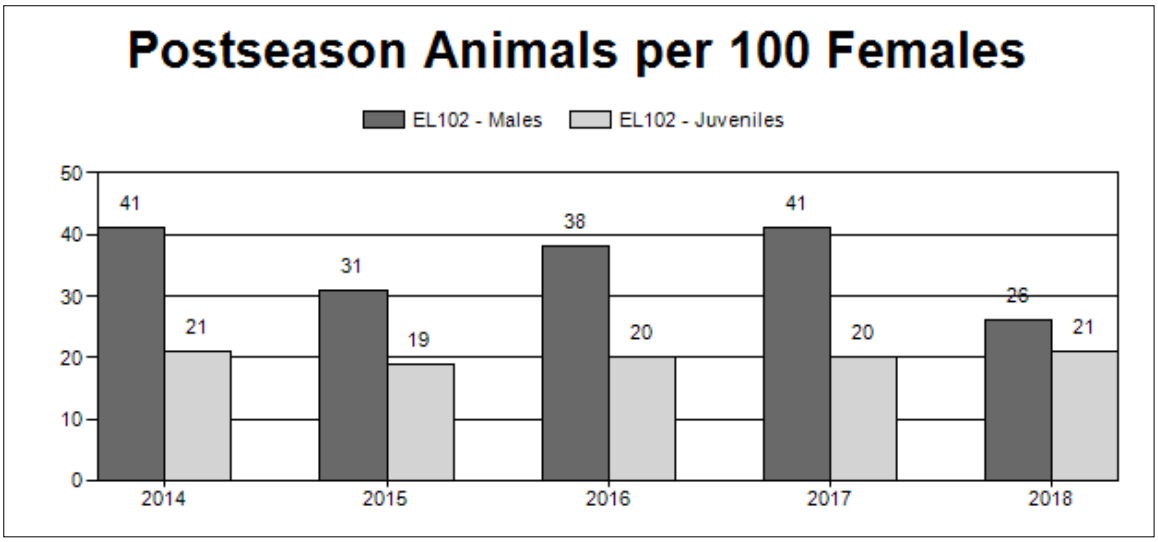

Harvest
EL102 - BULLS
EL102 - SPIKE
EL102 - FEMALES
EL102 - JUV
2000
1500
1000
500
0
642
14
849
241
1,746
599
6
413
151
1,169
790
22
566
86
1,464
571
4
623
109
1,307
592
6
598
149
1,345
2014
2015
2016
2017
2018


Number of Hunters
EL102 - TOT
EL102 - RES
EL102 - NONRES
3500
3000
2500
2000
1500
1000
500
0
3,351
2,445
906
3,211
2,281
930
3,184
2,217
967
2,970
2,077
893
2,937
2,016
921
2014
2015
2016
2017
2018


Harvest Success
EL102 - Hunter Success %
EL102 - Active License Success %
60
40
20
0
52
50
36
35
46
44
44
42
46
43
2014
2015
2016
2017
2018


Active Licenses
EL102 - Active Licenses
3500
3000
2500
2000
1500
1000
500
0
3,486
3,318
3,309
3,102
3,114
2014
2015
2016
2017
2018


Days per Animal Harvested
EL102 - Days
20
15
10
5
0
13.2
19.2
14.3
13.9
14.3
2014
2015
2016
2017
2018


Postseason Animals per 100 Females
EL102 - Males
EL102 - Juveniles
50
40
30
20
10
0
41
21
31
19
38
20
41
20
26
21
2014
2015
2016
2017
2018

2014 - 2018 Postseason Classification Summary

for Elk Herd EL102 - JACKSON

		MALES				FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Post Pop	Ylg	Adult	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Ylng	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2014	11,000	679	2,028	2,707	25%	6,570	62%	1,356	13%	10,633	584	10	31	41	± 0	21	± 0	15
2015	11,200	497	1,703	2,200	21%	7,117	67%	1,351	13%	10,668	387	7	24	31	± 0	19	± 0	15
2016	10,766	476	1,829	2,402	24%	6,262	63%	1,257	13%	9,921	355	8	29	38	± 0	20	± 0	15
2017	10,877	363	1,611	1,974	26%	4,760	62%	935	12%	7,669	580	8	34	41	± 0	20	± 0	14
2018	9,627	464	1,226	1,690	18%	6,517	68%	1,338	14%	9,545	229	7	19	26	± 0	21	± 0	16

2019 HUNTING SEASONS
JACKSON ELK HERD (EL102)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
70		Sep. 20	Oct. 31		General	Antlered elk, spikes excluded
71		Sep. 20	Oct. 31		General	Antlered elk, spikes excluded
72						Closed
75	4	Nov. 2	Nov. 24	25	Limited quota	Antlerless elk; the Snake River Bottom portion of Area 75 shall be closed, also valid in that portion of Area 81 west of the Shadow Mountain Loop Road (U.S.F.S. Road 30340)
75	4	Nov. 25	Dec. 8			Antlerless elk; the Snake River Bottom and Antelope Flats portions shall be closed
75	6	Nov. 2	Nov. 24	350	Limited quota	Cow or calf; the Snake River Bottom portion of Area 75 shall be closed
75	6	Nov. 25	Dec. 8			Cow or calf; the Snake River Bottom and Antelope Flats portions shall be closed
77		Oct. 12	Oct. 21			General license and unused limited quota licenses, excluding limited quota cow or calf licenses, valid for any elk
77		Oct.22	Nov. 27			General license and unused limited quota licenses; antlerless elk
77		Nov. 28	Nov. 30			National Elk Refuge permits shall be issued only for those in possession of a full price youth elk license, any elk
77		Dec. 1	Dec. 13			General license and unused limited quota licenses, antlerless elk

78		Aug. 15	Oct. 31		General	Antlerless elk valid on private land
78	1	Aug. 15	Sep. 25	75	Limited quota	Any elk valid off national forest
78	1	Sep. 26	Jan. 31			Any elk valid in the entire area
78	2	Aug. 15	Oct. 31	50	Limited quota	Any elk valid on private land
78	6	Aug. 15	Sep. 25	200	Limited quota	Cow or calf valid off national forest
78	6	Sep. 26	Jan. 31			Cow or calf valid in the entire area
79						Closed
80		Sep. 26	Oct. 31		General	Any elk
80	6	Oct. 12	Nov. 10	300	Limited quota	Cow or calf
80	6	Nov. 11	Nov. 30			Cow or calf valid south of the Curtis Canyon and Sheep Creek Roads (U.S.F.S. Road 30440 and 30445)
81		Sep. 26	Oct. 25		General	Antlered elk, spikes excluded
82		Sep. 26	Oct. 25		General	Antlered elk, spikes excluded
82	4	Sep. 10	Oct. 25	25	Limited quota	Antlerless elk
83		Oct. 1	Oct. 25		General	Antlered elk, spikes excluded

Special Archery Seasons

Hunt Area	Type	Season Dates		Limitations
		Opens	Closes	
83	All	Sep. 1	Sep. 30	Valid in the entire area(s)
70, 71	All	Sep. 1	Sep. 19	Valid in the entire area(s)
78, 80-82	All	Sep. 1	Sep. 25	Valid in the entire area(s)

Summary of 2019 License Changes

Hunt Area	Type	Quota change
75	4	-25
	6	-175
78	2	-25
78	6	+25
78	7	-25

82	4	+10
Herd Unit Total	2	-25
	4	-25
	6	-150
	7	-25

Management Evaluation

Current Mid-Winter Trend Count Objective: 11,000 ± 20%
Management Strategy: Recreational
2018 Mid-Winter Trend Count: 9,627
3-Year Running Average: 10,423
Evaluation: At objective

The mid-winter trend count objective for the Jackson Elk Herd is a 3-year running average of 11,000 elk ± 20%. The management strategy is recreational. The objective and management strategy were reviewed by WGFD managers and the public in spring 2016. At that time, WGFD managers proposed changing from a modeled post-season population estimate to a mid-winter trend count objective because spreadsheet population models do not adequately simulate Jackson Elk Herd trends. The Wyoming Game and Fish Commission approved the proposed mid-winter trend count objective of 11,000 elk ± 20% in June 2016.

The current mid-winter trend count is 9,627 elk. This count is relatively low due to more elk widely distributed on native winter ranges than has been typical for this herd, which affected sightability during the survey. The 3-year running average is 10,423. The population is currently at objective.

Herd Unit Issues

Management of this herd is complicated because occupied habitat includes two National Parks and the National Elk Refuge (NER). Complex hunting seasons are typically used to address management concerns for various population segments in this herd. Recent pre-season classification surveys indicate that elk in the southern portion of the herd unit in southern GTNP and private lands near the Snake River reproduce at twice the rate of long-distance migratory elk from the northern herd segments. These different recruitment rates are likely driven by lower predator densities and supplemental forage from agricultural areas and suburban landscapes in the southern herd segments.

In the past, herd management was structured around the following winter distribution targets: 1) a maximum of 5,000 elk on the NER (Bison and Elk Management Plan, 2007), 2) 3,500 elk in the Gros Ventre drainage, and 3) 2,500 elk on other native winter ranges. Achieving these goals has been challenging due to high calf recruitment in southern herd segments, low harvest on private lands, co-mingling issues with livestock, changing elk movement patterns, weather, and

influences from predators. In recent years, elk winter distribution has changed significantly (Fig. 1) and there are few management tools available to achieve the winter distribution goals listed above. Since 2010, there has been a general trend of a larger proportion of the herd wintering on the NER while proportions utilizing other areas such as the Gros Ventre and Buffalo Valley/Spread Creek are decreasing. However, the trend changed this winter when fewer elk utilized the NER and more elk wintered in the Gros Ventre (Fig. 1). There was also a slight increase in the number of elk observed on other winter ranges. Elk GPS-collar data indicate that these recent winter range shifts are largely due to changes in elk behavior and not differential mortality between winter segments. In recognition of the lack of management tools available to achieve these winter distribution goals, these winter range goals were removed during the herd unit objective review process in 2016. However, WGFD managers continue to structure hunting seasons with these herd segments and winter distribution desires in mind.

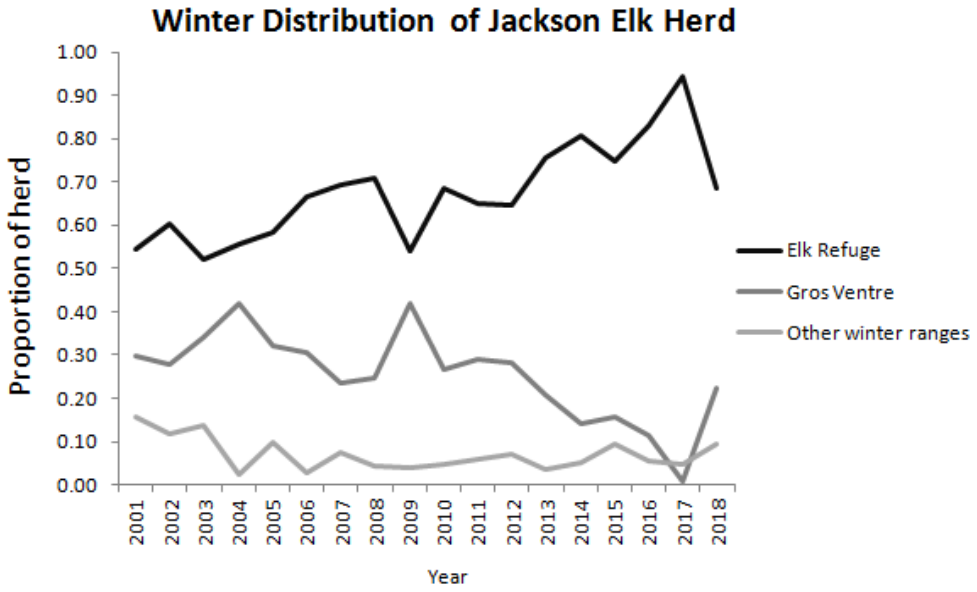


Fig. 1. Proportions of the Jackson Elk Herd wintering on the National Elk Refuge (on and off feed), in the Gros Ventre drainage (on and off feed), and on other winter ranges, 2001-2018.

In fall 2018, a road-killed mule deer buck near Kelly in GTNP tested positive for chronic wasting disease (CWD). This is the first CWD-positive cervid found within the Jackson Elk Herd Unit. Although no elk have tested positive for CWD in the Jackson Elk Herd, this led to increased public concern about CWD and its potential effects within the elk feedground system and on the NER. In 2018, 550 elk samples from the Jackson Herd Unit were analyzed at the Wyoming State Vet Lab for CWD and none tested positive. A statewide CWD stakeholder group is being convened in 2019 and there are plans to form local stakeholder groups within the next 1 - 2 years to address deer and elk management with CWD.

Weather

Spring and summer 2018 produced average moisture. Fall and early winter weather was very mild with warm temperatures and little snowfall at high elevations. However, several large snowstorms occurred in early February that resulted in the rapid accumulation of a deep snowpack. Snowfall totals in February nearly surpassed the local record in Jackson Hole. At the time of the mid-winter survey in February 2019, winter snowpack was reported at 115% of average in the Snake River Basin. Above average snowpack persisted through March and April 2019. In general snow depths were greater in the low elevation valleys in Jackson Hole compared to the Gros Ventre drainage where snow depth was approximately 50% less. 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 were no significant habitat treatment projects or wildfires in the herd unit this year. Please refer to the 2018 Annual Report Strategic Habitat Plan Accomplishments for Jackson Region habitat improvement project summaries (https://wgfd.wyo.gov/Habitat/Habitat-Plans/Strategic-Habitat-Plan-Annual-Reports).

Field Data

Elk supplemental feeding was initiated on the National Elk Refuge on February 6, which is 10 days later than the long term average feeding initiation date of January 27. Postseason classification surveys were conducted February 19 - 23 and February 28 - March 2, 2019. The ground classification on the National Elk Refuge (NER) occurred February 19. A total of 9,627 elk were counted in the herd unit, including 6,517 cows, 1,338 calves, 1,226 adult bulls, 464 spike bulls, and 82 unclassified elk. Herd unit ratios were 21 calves:100 cows, 19 adult bulls:100 cows, and 7 yearling bulls:100 cows. Of these, 6,586 elk (68%) were on the NER, 2,136 elk (22%) were in the Gros Ventre drainage, and 905 elk (10%) were on other native winter ranges. Of the 2,136 elk in the Gros Ventre, the majority were on Patrol Cabin feedground (1,720 elk). Overall, 85% of elk in the herd unit were classified on feed and 15% on native winter ranges.

Elk winter distribution this year was strikingly different than the past two winters. Early, deep snow in winter 2016/2017 resulted in the majority of the herd (8,129 elk) wintering on supplemental feed on the NER. Likewise, the majority of the herd (10,255 elk) wintered on the NER in 2017/2018 despite mild winter conditions that never caused snow or forage conditions to meet criteria for supplemental feeding. That same winter, only 86 elk wintered in the Gros Ventre drainage. Elk distribution changed in winter 2018/2019 with more elk utilizing the Gros Ventre drainage as well as many other winter ranges where elk have not been observed in recent years (Shadow Mountain, upper Spread Creek, Rosie's Ridge, Cache Creek, etc.) (Fig. 2).

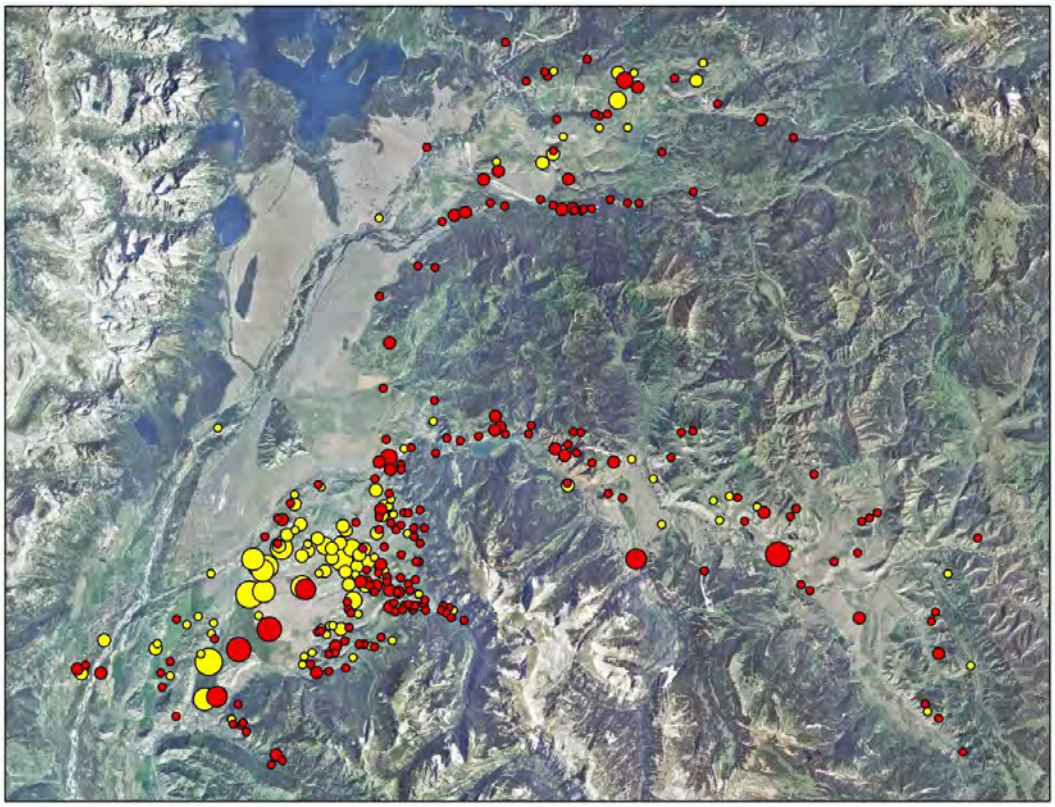


Fig. 2. Elk group distribution in the Jackson Herd Unit during the 2018 mid-winter trend count (red dots) and 2017 mid-winter trend count (yellow dots). The size of the dots corresponds to elk group size.

Gros Ventre

The dynamics of elk wintering in the Gros Ventre drainage have changed substantially in recent years. Significant concern exists about the current status of Gros Ventre elk due to recent declines in winter trend counts (Fig. 3). As recently as 2012, over 3,000 elk wintered in the Gros Ventre. However, that number has been steadily declining and reached as low as 86 elk in winter 2017/2018. However, this trend showed a promising sign this year when 2,136 elk were classified in the Gros Ventre. The calf:cow ratio was 26 calves:100 cows. The adult bull and yearling bull ratios were 7:100 and 5:100, respectively. The low bull and yearling ratios are likely due to wider distribution of elk on native winter ranges, which caused decreased sightability of bull groups during the survey.

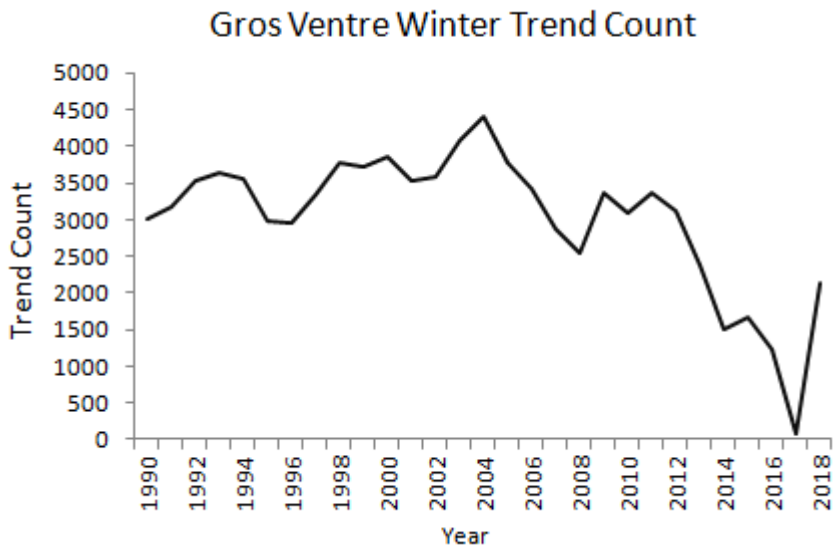


Fig. 3. Total elk numbers in the Gros Ventre drainage (feedgrounds and native winter ranges) from 1990-2018.

Elk GPS-collar data and remote cameras suggest that the declines in the number of elk wintering in the Gros Ventre in recent years have been due to elk shifting their winter ranges versus direct mortality. In spring 2018, approximately 2,100 elk were counted on remote cameras at the Red Hills migrating from the NER to higher elevations in the Gros Ventre. All of the GPS-collared cow elk that vacated the Gros Ventre in winter 2017/2018 returned to their traditional summer ranges. An additional 18 cow elk were collared in the Gros Ventre in fall 2018. During winter 2018/2019, 75% of the collared Gros Ventre elk wintered in the Gros Ventre (on Fish Creek and Patrol Cabin feedgrounds and on native winter range) and 25% of them wintered on the NER. None of these collared cow elk have died. These elk will be monitored for an additional 2 years.

Although the reasons for the winter range shifts in recent years are not yet entirely understood, there is correlative evidence that suggests elk may be avoiding high wolf density in the Gros Ventre. However, snowfall timing and amounts are also likely a contributing factor. Wolf numbers in the Gros Ventre declined during 2018, which may have been one of several factors that caused more elk to stay in the Gros Ventre in winter 2018/2019. Managers have increased monitoring through deploying additional GPS collars, remote cameras on migration routes, spring survey flights, and collaborating with researchers at the University of California at Berkeley on a wolf/elk interaction study.

Harvest Data

A total of 1,345 elk were harvested in the Jackson Elk Herd in 2018. This is similar to last year when 1,307 elk were harvested. The 2018 harvest continued to focus hunting pressure on antlerless elk from southern herd segments, with the majority of harvest occurring in Hunt Area 77 (315 antlerless elk), followed by Hunt Area 75 (233 antlerless elk), and Hunt Area 78 (102 antlerless elk). For the first time, Hunt Area 78 surpassed Hunt Area 80 for antlerless harvest,

which only had 85 cow and calf elk harvested due to mild fall weather. Backcountry hunting was difficult again this year due to mild fall weather conditions and a later elk migration. Total bull harvest for the herd unit was 597, which is similar to the last year's total of 575. The majority of mature bull harvest occurred in the Teton Wilderness in Hunt Areas 70 and 71 (277 bulls) followed by the Gros Ventre Hunt Areas 81, 82, 83 (212 bulls). Eighty-nine bulls were also harvested in Hunt Area 78. Hunter success in the Jackson Herd was 46%.

Total antlerless harvest in 2018 was 747, which is very similar to recent years. Seasons are structured to increase antlerless harvest in southern herd segments that have high calf production rates and contribute to high elk numbers on supplemental feed on the NER. Seasons are structured to achieve cow harvest on southern herd segments while protecting elk from declining northern herd segments.

Population

The 2018 mid-winter trend count was low due to difficult sightability of elk on native winter ranges. A total of 9,627 elk were counted in the herd. The 3-year trend count average is 10,423, therefore the herd is meeting the objective of 11,000 elk +/- 20%. The calf ratio this year was 21 calves:100 cows, which matches the 5-year average of 21 calves:100 cows. Managers are attributing the drop in the bull ratio this year (26:100) due to poor sightability conditions and difficulty of locating bull groups in forested areas. Managers will continue to structure hunting seasons to support calf survival in the long-distance migratory herd segments in the Teton Wilderness and Gros Ventre areas, while focusing harvest pressure on the increasing resident herd segments.

Management Summary

The current hunting season structure continues to result in a stable population trend. Therefore, few changes are planned for 2019. Hunting seasons in 2019 will again focus hunting pressure on southern resident elk that spend the summer along the Snake River corridor and in southern GTNP. To prevent further declines in the Yellowstone and Teton Wilderness long-distance migratory segments, elk hunting seasons in Hunt Areas 70 and 71 will remain the same as last year. In addition, Hunt Area 79 will be closed beginning this year to protect long-distance migrant elk that have lower calf recruitment. No significant changes to Gros Ventre Hunt Areas 81, 82, or 83 are planned at this time, although Type 4 licenses in Hunt Area 82 will be increased from 15 to 25. Due to the lower winter trend count this year, license quotas in Hunt Area 75 will be more conservative this year. Type 4 licenses will be reduced from 50 to 25 and Type 6 from 525 to 350. State Trust Land in Hunt Area 75 will be open for the entire season due to decreased concerns and better information about the Gros Ventre Herd segment. The youth-only hunt period in Hunt Area 77 (NER) will be offered again this year during the Thanksgiving time period. Due to the high demand for permits to access the NER, hunter crowding has become more of an issue in adjacent Hunt Area 80 in recent years. Season changes to Hunt Area 80 in 2018 yielded positive results by reducing hunter crowding. These changes will be retained for the 2019 season. The Hunt Area 78 Type 7 license was removed for 2019 due to issues with wounded elk on private lands.

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2018 - JCR Evaluation Form

SPECIES: Elk
HERD: EL103 - FALL CREEK
HUNT AREAS: 84-85

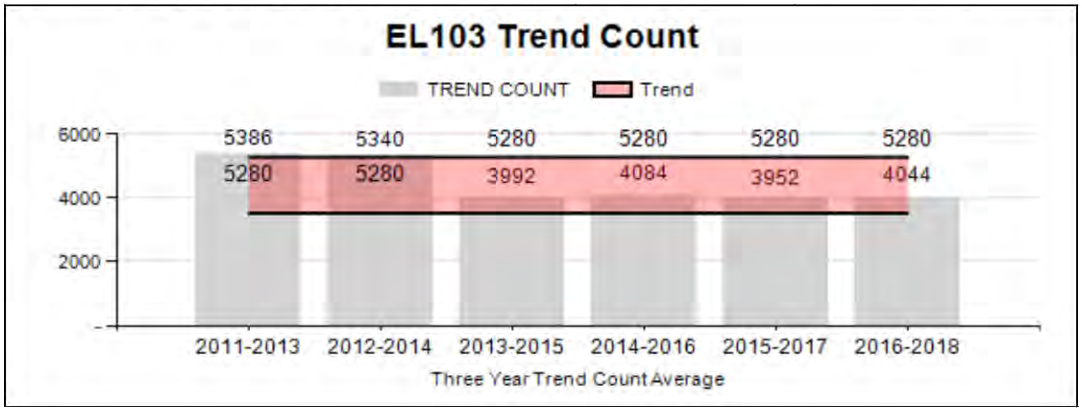
PERIOD: 6/1/2018 - 5/31/2019
PREPARED BY: GARY FRALICK

	2013 - 2017 Average	2018	2019 Proposed
Trend Count:	4,004	4,090	4,100
Harvest:	526	520	530
Hunters:	1,750	1,557	1,650
Hunter Success:	30%	33%	32 %
Active Licenses:	1,804	1,599	1,750
Active License Success	29%	33%	30 %
Recreation Days:	11,376	10,308	10,500
Days Per Animal:	21.6	19.8	19.8
Males per 100 Females:	23	20	
Juveniles per 100 Females	29	29	

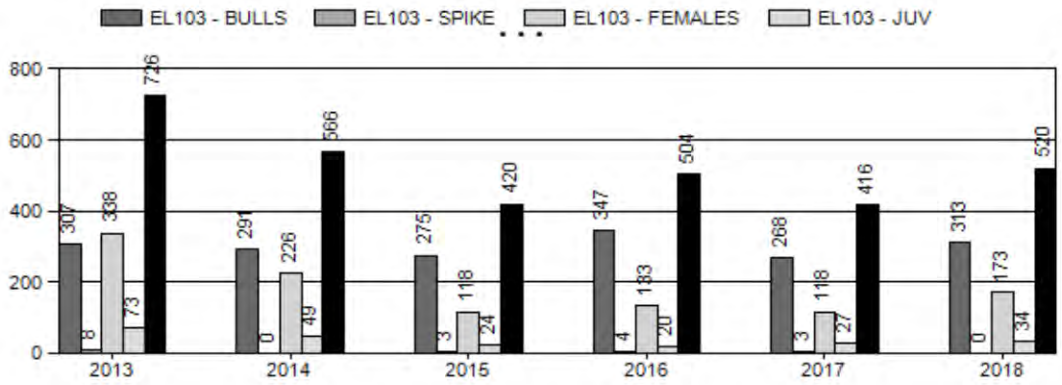
Trend Based Objective (± 20%)	4,400 (3520 - 5280)
Management Strategy:	Recreational
Percent population is above (+) or (-) objective:	-7.0%
Number of years population has been + or - objective in recent trend:	2

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

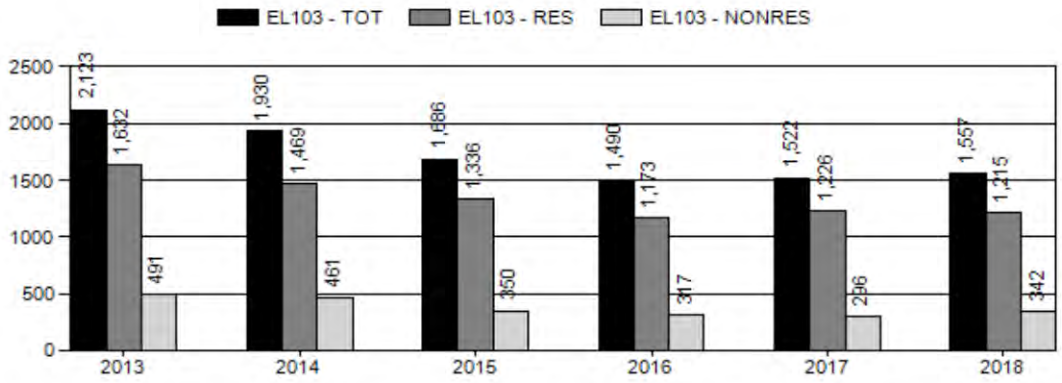
	JCR Year	Proposed
Females ≥ 1 year old:	NA%	NA%
Males ≥ 1 year old:	NA%	NA%
Juveniles (< 1 year old):	NA%	NA%
Total:	NA%	NA%
Proposed change in post-season population:	NA%	NA%



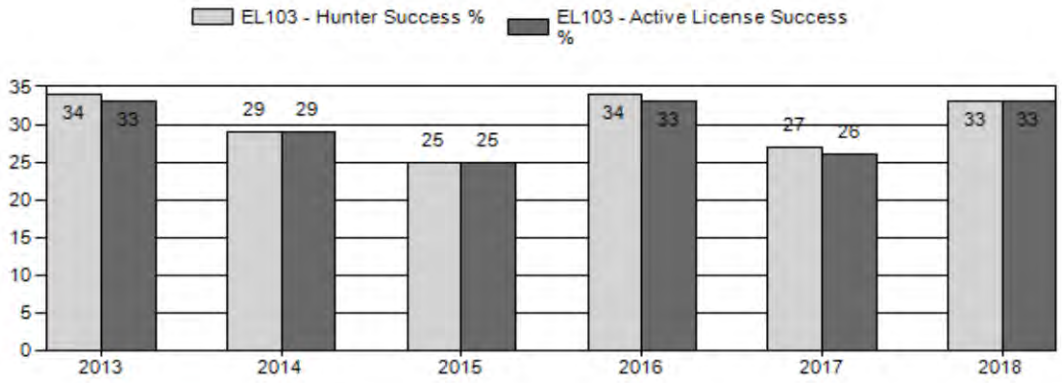
Harvest



Number of Hunters



Harvest Success



2013 - 2018 Postseason Classification Summary

for Elk Herd EL103 - FALL CREEK

		MALES				FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Post Pop	Ylg	Adult	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Yling	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2013	4,800	318	309	627	16%	2,498	63%	842	21%	3,967	0	13	12	25	± 1	34	± 1	27
2014	4,700	261	441	702	17%	2,692	66%	682	17%	4,076	0	10	16	26	± 1	25	± 1	20
2015	4,500	130	369	499	13%	2,446	66%	768	21%	3,713	0	5	15	20	± 1	31	± 1	26
2016	5,100	273	376	649	16%	2,612	63%	898	22%	4,159	0	10	14	25	± 1	34	± 1	28
2017	0	158	251	409	12%	2,501	72%	547	16%	3,457	0	6	10	16	± 0	22	± 0	19
2018	0	166	370	536	13%	2,719	67%	789	20%	4,044	0	6	14	20	± 0	29	± 0	24

2019 HUNTING SEASONS
FALL CREEK ELK HERD (EL103)

Hunt Area	Type	Season Dates Opens	Closes	Quota	License	Limitations
84		Sep.26	Oct. 13		General	Any elk , spikes excluded
84		Oct. 14	Oct. 31		General	Antlered elk, spikes excluded
84	1	Nov. 1	Jan. 31	20	Limited quota	Any elk valid on private land west of U.S. Highway 191 and north and east of the Snake River starting at the South Park Bridge
84	6	Sep. 26	Nov. 20	50	Limited quota	Cow or calf; that portion of Area 84 east and south of Granite Creek to the Hoback River shall be closed after October 31
84,85	7	Aug. 15	Jan. 31	175	Limited quota	Cow or calf valid on private land in Area 84; also valid in that portion of Area 85 on or within 200 yards of irrigated land north of Fall Creek
85		Sep. 26	Oct. 13		General	Any elk, spikes excluded
85		Oct. 14	Oct. 31		General	Antlered elk, spikes excluded
85	6	Sep. 26	Oct. 31	75	Limited quota	Cow or calf
84, 85		Sep. 1	Sep.25		General	Archery only, Refer to Section 3 of this Chapter

SUMMARY OF PROPOSED CHANGES BY LICENSE NUMBER

Area	License Type	Change from 2018
84	General	Extend any elk closure date from Oct. 9 to Oct. 13
84	Type 6	+25
85	General	Extend any elk closure date from Oct. 9 to Oct. 13
84.85	Type 7	+50, increase area where valid
85	Type 7	+25
Herd Unit Total	Type 6 and 7	+100

Management Evaluation

Current Mid-Winter Trend Count Management Objective: 4,400
Management Strategy: Recreational
2018 Mid-Winter Trend Count: 4,090
Most Recent 3-Year Running Average Trend Count: 4,044

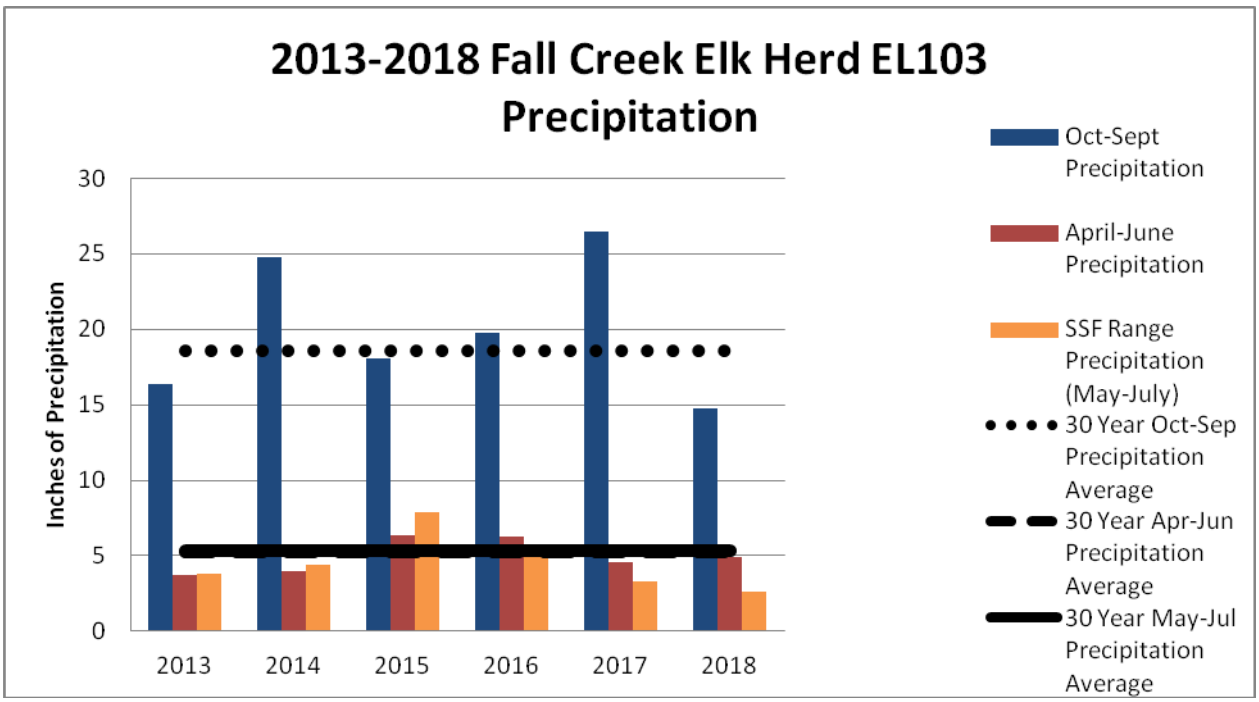
The mid-winter trend count population objective for Fall Creek elk herd is 4400 elk. The management strategy is recreational management. The objective and management strategy were last revised in 2017. The current mid-winter trend count was 4090 elk which is within +/- 20% of the population objective. Low calf productivity and survival and management strategies associated with November hunting seasons that targeted the antlerless segment of the population have stabilized the population within the parameters of the population mid winter trend count objective. The higher trend count this year is due to a generally reduced elk harvest in 2018, and higher percent snow cover on native winter ranges that forced elk to lower, more concentrated winter ranges and onto elk feedgrounds.

Herd Unit Issues

The most substantial herd unit issues continue to be associated with elk numbers inhabiting private property along the Snake River Bottomlands and sustaining calf survival and recruitment. Late season hunts have been implemented over the last 20 years in an effort to encourage elk to move to the South Park feedground thereby minimizing potential conflict. In other areas of the herd unit, low numbers of elk have habituated to areas near or on private lands in close proximity to livestock. Elk have visited these livestock operations in search of forage. There has been a marked reduction in the number of limited quota cow/calf only licenses issued over the last 8 years, which has resulted in reduced hunter opportunity.

The implementation of a general season, spikes excluded season in 2013 has been a concern with some elements of the public voicing opposition to loss of opportunity and recreation. Simultaneously, other segments of the hunting public have supported the restrictive spikes excluded hunting opportunity. Concurrent with reductions in cow/calf only licenses has been reduced number of days for general license, any elk hunting because of fewer elk being counted on trend counts. Calf production and survival has been the primary management issue associated with reduced hunting opportunity.

Weather



Precipatation

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 and rain in September and early October began to deposit snowpack in the Snake River Mountain Range. 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 2018 snowpack in western Wyoming watersheds were estimated to be significantly above 110% of normal. For additional weather and precipitation 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.

Winter Severity

The 2018-2019 winter started mild but the months of January and February became increasingly tough for wildlife with regard to snow accumulation and cold temperatures on winter ranges. SNOWTEL locations in the high elevations of the Snake River watershed indicated snow water equivalents well above average, and these increased snow levels persisted well into the spring.

Habitat

No habitat data has been collected on elk summer and winter ranges. There are no established vegetation transects in this herd unit. Please refer to the 2018 Annual Report Strategic Habitat Plan Accomplishments for the Jackson Region habitat improvement project summaries **(http://wgfd.wyo.gov/web2011/wildlife-1000708.aspx)**.

Field Data

Since 2010, population growth has been suppressed by lower calf survival and recruitment. November antlerless elk hunts have targeted the reproductive segment of the population since 2008. This management strategy has resulted in the desired management objective of reducing the population to within 20% of the population objective.

In general, management over the last eight years has been successful at maintaining bull:cow ratios at or higher than the management goal of 20 bulls:100 cows. Bull:cow ratios in 2014 – 2016 were observed at some of the highest levels (≥24 bulls:100 cows) the highest levels in 10 years, and are likely a result of very warm temperatures which encouraged elk to remain at higher, inaccessible elevations, absence of weather during the October portion of the hunting season, and a shorter general license any elk portion of the hunt which likely discouraged hunter participation. However, total bull:cow ratios observed during the 2017 and 2018 trend counts were 16 bulls:100 cows and 15 bulls:100 cows, respectively, which is attributed to the fewer bulls being counted on native winter ranges.

Since 2011 reductions in antlerless elk hunting opportunity have been implemented in response to declining trend counts which were largely management induced. As recently as 2008 and 2009 trend counts documented over 5000 elk in the herd unit, and subsequent management options focused on greater hunter opportunity to affect a decline in elk numbers. Concurrent with a more nuanced management approach since 2012 was an effort to still provide opportunity but a slightly reduced level. Segments of the public voiced support for spikes excluded seasons which were incorporated into the herd unit management strategy in 2013. The prevailing public perception was hunting pressure would increase in this area if spikes excluded seasons were not adopted. The 2018 hunt season was the 6th consecutive year of spikes excluded general license hunting seasons.

Harvest Data

The fewest number of hunters to hunt the fall Creek elk herd in at least 15 years occurred in 2016 and 2017. An estimated 1480 hunters attempted to harvest an elk in 2016, which increased only slightly in 2017 to 1520 hunters. The lower number of elk hunters continued in 2018 when only 1557 hunters pursued elk in this herd unit.

Concurrent with the low hunter numbers was the fifth consecutive year of relatively low elk harvest. A total of 566, 420 and 500 elk where estimated in the 2014 - 2016 harvest, respectively. For comparative purposes, approximately 430 elk and 520 elk were harvested in 2017 and 2018 respectively. Hunter success decreased from 34% in 2016 to 28% in 2017, but exhibited only an insignificant increase to 33% in 2018.

The spikes excluded hunt the last six years has resulted in antlered harvest being focused on the 2+-year old bulls. Since 2012 the number of 2+-year old bulls estimated in the annual harvest has declined as a result of reduced hunter participation and opportunity, more conservative hunting seasons, and decreased calf survival and recruitment in 2014 and 2017. Calf ratios increased from 22 calves:100 cows in 2017 to 29 calves:100 cows in 2018.

Since spikes excluded hunting seasons were first initiated in 2013, the number of 2+-year bulls in the annual harvest has remained relatively unchanged through the 2015 hunting season. During the period from 2013 – 2015, approximately 307 bulls, 291 bulls, and 275 bulls aged 2+-years of age were estimated in the annual harvest, respectively. In 2016 and 2017, the number of 2+-year old bulls in the harvest was reported at 346 bulls and 275 bulls, respectively. In 2018, an estimated 313 adult bulls were recorded in the harvest. For comparative purposes, during the 5-year period form 2008-2012 without the spikes excluded regulation, an average of 337 bulls aged 2+-years of age were reported in the annual harvest.

The reduction in yearling harvest because of the spikes excluded regulation has not resulted in the sustained or desired increase in recruitment of the yearling cohort. From 2013 - 2015 the number of yearling bulls documented in the herd composition surveys has exhibited an annual, incremental decrease (Figure 1). The number (Figure 1) and proportion (Figure 2) of yearling bulls in the current year's postseason trend count declined dramatically in 2017, and did not respond to the conservative management actions that were designed to promulgated yearling recruitment in 2018. In general, yearling bull ratios have exhibited a sustained suppression in comparison to those years in which spike excluded seasons were not in place.

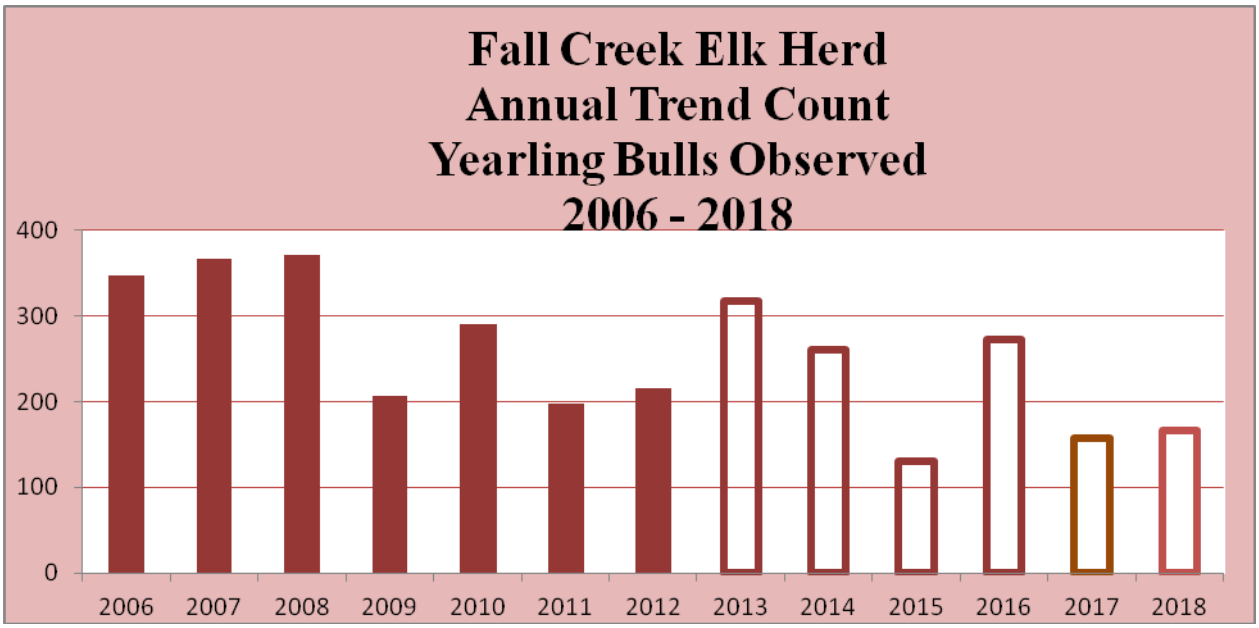


Figure 1. A depiction of the number of yearling bulls counted during the annual trend count during years of general license, any elk hunting seasons (2006-2012) versus general license, any elk spikes excluded hunting seasons (2013-2018).

In 2015, the observed ratio of 5 yearling bulls:100 cows was the lowest yearling bull ratio observed since spikes excluded hunting was first implemented in 2013. Since that time yearling bull ratios have exhibited annual declines from 13 yarlings:100 cows in 2013, to 9, 5, and 10 yearling bulls:100 cows from 2014 - 2016, respectively. A total of 6 yearling bulls:100 cows were observed during the 2017 and 2018 postseason herd unit surveys, respectively.

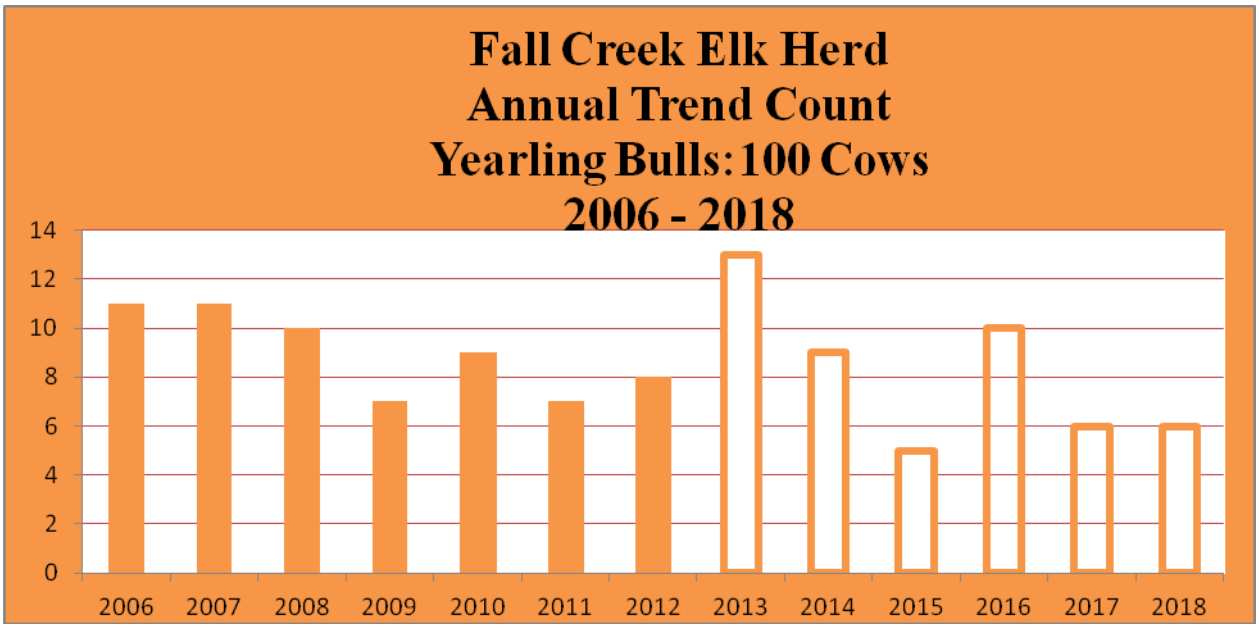


Figure 2. A depiction of the yearling bulls:100 cows ratio observed during the annual trend count during years of general license, any elk hunting seasons (2006-2012) versus general license, any elk spikes excluded hunting seasons (2013-2018).

Population

Management efforts that focused on assessing population performance were based on annual trend counts since 2007. The mid-winter trend count objective was developed and implemented following public review and Commission approval in 2017 to better utilize observed data to estimate population trend and size. The mid-winter trend count provides managers with a more realistic and justifiable assessment of population performance in this elk herd.

Management Summary

The 2019 hunting season is designed to maintain a stable population near the objective. Because of the slightly increased trend count hunting seasons are proposed to offer additional hunter opportunity and recreation. The general any elk spikes excluded hunting season will be continued in Areas 84 and 85.

The proposed hunting season structure will promote any elk hunting, spikes excluded opportunity for 18 days instead of the 14 days offered the previous two years. The portion of the general license any elk season will begin on September 26 and end on October 13. Beginning on October 14 and continuing through October 31, antlered only elk, spikes excluded may be taken with general licenses. In order to provide limited quota license hunters recreation days, the limited quota Type 6 licenses will be increased from 25 licenses to 50 licenses in Hunt Area 84; a total of 50 Type 6 licenses will be maintained in Area 85. This management strategy will not substantially increase overall antlerless harvest, but is designed to provide increased opportunity

to the hunting public and reduce pressure on the antlered segment of the population. It will also maintain the population within 20% of the 3-year mid winter population trend count objective.

In Area 84 the limited quota Type 6 licenses will be valid through November 20. The continuation of the November portion of the hunting season and maintaining the number of Type 6 licenses will be increased to 50 licenses in response to a higher trend count, and the associated opportunity for increased recreation. The number of additional limited quota Type 7 licenses will increase from 125 to 175 licenses in order to address chronic damages and commingling on private lands. The opening date for the Type 7 license will be August 15. This private land hunt will address landowner concerns regarding elk numbers on private property along the Snake River Bottomlands and provide hunters with an extended hunting opportunity to harvest antlerless elk in areas that have been historically prone to chronic elk damage and comingling with livestock.

In Area 85, hunting pressure will focus on providing additional recreation based on more elk counted during the annual trend count. Consequently, the general any elk, spikes excluded season is proposed to close on October 13 instead of October 9, and the number of Type 6 cow/calf licenses will remain at 50 licenses. Population management objectives have been achieved in the Area 85 portion of the herd unit, and therefore the appropriate management response is to initiate season limitations that are designed to provide additional recreation in this segment of the population that spends the winter in Hunt Area 85.

The 2019 hunting seasons are projected to harvest an estimated 530 elk. The projected harvest should result in approximately 4100 elk being counted in the 2019 posthunt trend count.

Appendix B. Fall Creek Elk Herd, posthunt herd composition data, 2013-2018.										
							Ratio:100 Females			
2013	Adult Males	Yrlng Males	Total Males	Cows	Calves	Total	Adult Males	Yrlng Males	Total Males	Calves
84 HCFG	162	110	272	1225	337	1834				
84 CCGF	2	20	22	204	56	282				
84 SPFG	83	97	180	509	210	899				
84 NR	21	13	34	51	45	130				
85 DCFG	38	71	109	498	191	798				
85 NR	3	7	10	11	3(45)	69				
TOTAL	309	318	627	2498	842(45)	4012	12	13	25	34
2014										
84 HCFG	160	48	208	1096	178	1482				
84 CCGF	24	15	39	184	97	320				
84 SPFG	128	107	235	626	202	1063				
84 NR	54	24	78	149	57(3)	287				
85 DCFG	65	52	117	579	119	815				
85 NR	21	15	36	58	29(62)	185				
TOTAL	452	261	713	2692	682	4152	17	9	26	25
2015										
84 HCFG	101	18	119	384	74	577				
84 CCGF	51	21	72	847	242	1161				
84 SPFG	120	46	166	603	214	983				
84 NR	6	5	11	7	19(68)	105				
85 DCFG	76	35	111	569	212	892				
85 NR	6	6	12	36	7(41)	96				
TOTAL	360	130	490	2446	768(109)	3813	15	5	20	31
2016										
84 HCFG	116	76	192	833	281	1306				
84 CCGF	37	46	83	485	118	686				
84 SPFG	117	90	207	647	250	1104				
84 NR	25	3	28	19	9(92)	148				
85 DCFG	72	57	129	627	240	996				
85 NR	9	1	10	1	0(35)	46				
TOTAL	376	273	649	2612	898(127)	4286	14	10	24	34
2017										
84 HCFG	115	52	167	787	148	1102				
84 CCGF	5	12	17	446	47	510				
84 SPFG	73	42	115	609	218	942				
84 NR	24	7	31	64	25(59)	179				
85 DCFG	23	30	53	551	85	689				
85 NR	11	15	26	44	24(240)	334				
TOTAL	251	158	409	2501	547(299)	3756	10	6	16	22
2018										
84 HCFG	78	50	128	927	203	1258				
84 CCGF	11	28	39	512	157	708				
84 SPFG	74	42	116	513	167(50)	846				
84 NR	22	9	31	61	36(110)	238				
85 DCFG	48	29	77	595	201	873				
85 NR	8	8	16	111	25(15)	167				
TOTAL	241	166	407	2719	789(175)	4090	9	6	15	29

2018 - JCR Evaluation Form

SPECIES: Elk
HERD: EL105 - AFTON
HUNT AREAS: 88-91

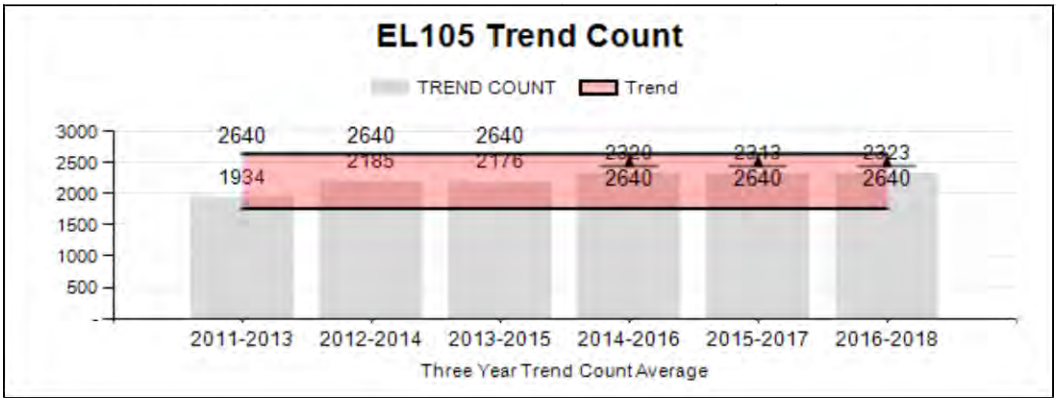
PERIOD: 6/1/2018 - 5/31/2019
PREPARED BY: GARY FRALICK

	2013 - 2017 Average	2018	2019 Proposed
Trend Count:	2,326	1,867	2,150
Harvest:	839	888	800
Hunters:	2,591	2,454	2,600
Hunter Success:	32%	36%	31 %
Active Licenses:	2,684	2,573	2,505
Active License Success	31%	35%	32 %
Recreation Days:	17,492	15,892	16,225
Days Per Animal:	20.8	17.9	20.3
Males per 100 Females:	18	16	
Juveniles per 100 Females	35	36	

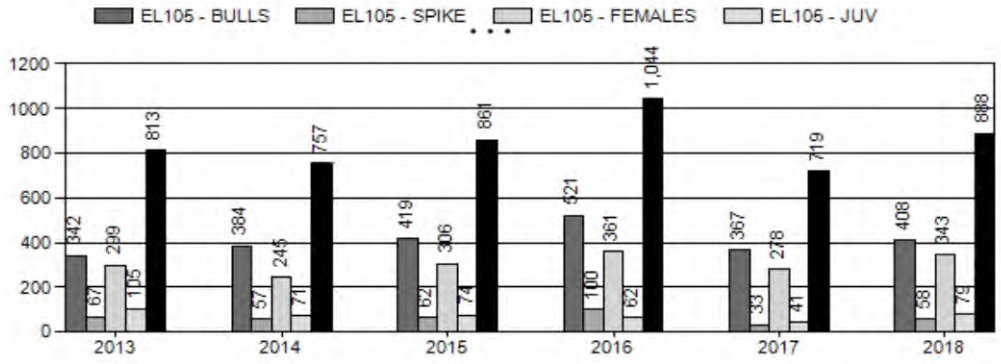
Trend Based Objective (± 20%)	2,200 (1760 - 2640)
Management Strategy:	Recreational
Percent population is above (+) or (-) objective:	-15.1%
Number of years population has been + or - objective in recent trend:	2

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

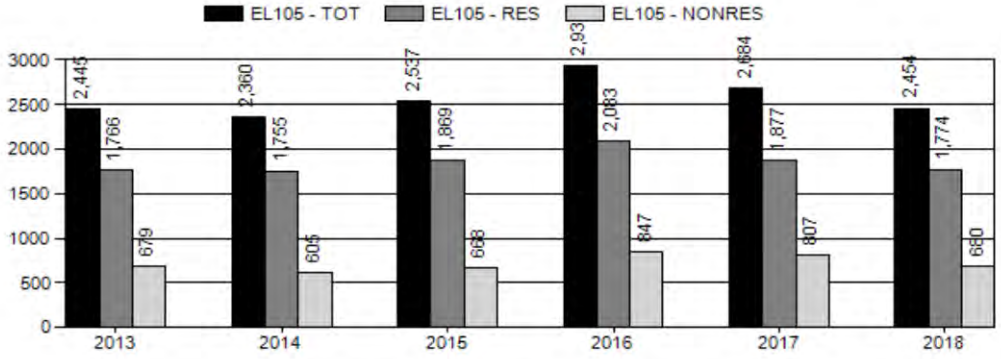
	JCR Year	Proposed
Females ≥ 1 year old:	NA%	NA%
Males ≥ 1 year old:	NA%	NA%
Juveniles (< 1 year old):	NA%	NA%
Total:	NA%	NA%
Proposed change in post-season population:	NA%	NA%



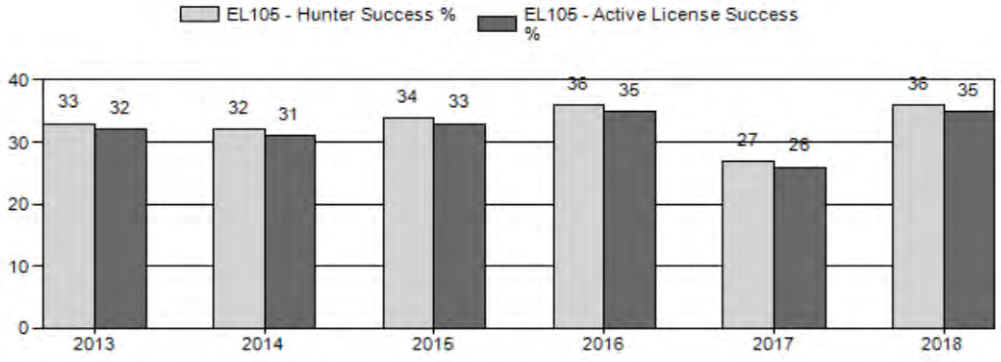
Harvest



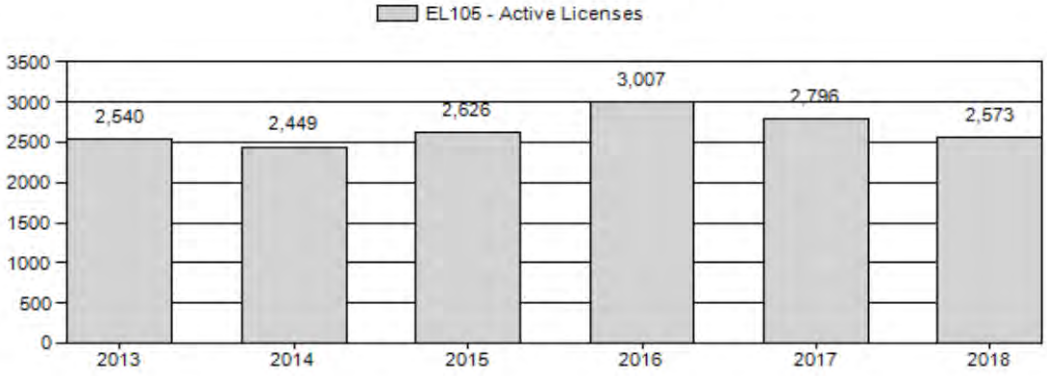
Number of Hunters



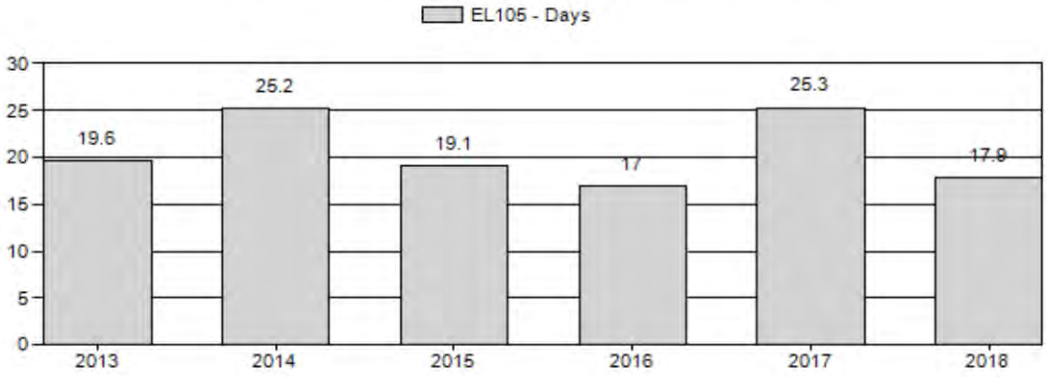
Harvest Success



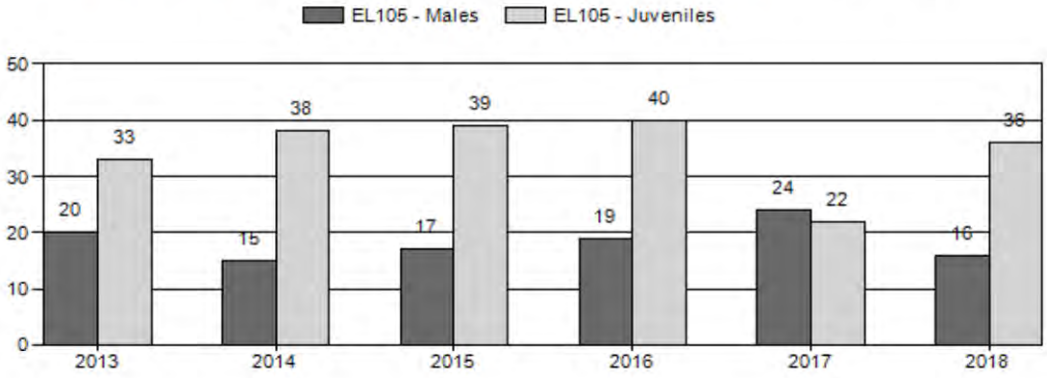
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2013 - 2018 Postseason Classification Summary

for Elk Herd EL105 - AFTON

		MALES				FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Post Pop	Ylg	Adult	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Yng	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2013	2,400	109	166	275	13%	1,409	66%	461	21%	2,145	0	8	12	20	± 1	33	± 1	27
2014	0	77	152	229	10%	1,564	66%	592	25%	2,385	0	5	10	15	± 0	38	± 0	33
2015	0	53	121	174	11%	1,045	64%	411	25%	1,630	0	5	12	17	± 0	39	± 0	34
2016	0	100	149	249	12%	1,280	63%	511	25%	2,040	0	8	12	19	± 0	40	± 0	33
2017	0	38	159	197	17%	812	69%	176	15%	1,185	0	5	20	24	± 0	22	± 0	17
2018	0	57	104	170	11%	1,042	65%	379	24%	1,591	0	5	10	16	± 0	36	± 0	31

2019 HUNTING SEASONS
AFTON ELK HERD (EL105)

Hunt Area	Type	Season Dates Opens	Closes	Quota	License	Limitations
88	1	Oct.1	Oct. 31	40	Limited quota	Any elk
89		Oct. 15	Oct. 17		General	Any elk
		Oct. 18	Oct. 31		General	Antlered Elk
90		Oct. 15	Oct. 31		General	Any elk
		Nov. 1	Nov. 15		General	Antlerless elk
	6	Oct. 15	Nov. 15	250	Limited quota	Cow or calf
91		Oct. 15	Oct. 31		General	Any elk
	1	Oct. 1	Oct. 31	100	Limited quota	Any elk
		Nov. 1	Dec. 31			Antlerless elk
	6	Oct. 1	Dec. 31	175	Limited quota	Cow or calf
		Jan. 1	Jan. 31			Cow or calf valid in the entire area. Archery, muzzleloading firearm or shotgun only in that portion of Area 91 south of Cedar Creek and east of Muddy String Road (Lincoln County Road 117), north of Lost Creek Road (Lincoln County Road 120) and north of Lost Creek, off national forest
88, 89, 90, 91		Sep. 1	Sep. 30			Archery only, Refer to Section 3 of this Chapter

SUMMARY OF CHANGES BY LICENSE NUMBER

Area	License Type	Change from 2018
Herd Unit Total		No Changes

Management Evaluation
Current Mid-Winter Trend Count Management Objective: 2,200
Management Strategy: Recreational
2018 Mid-Winter Trend Count: 1,870
Most Recent 3-Year Running Average Trend Count: 2,300

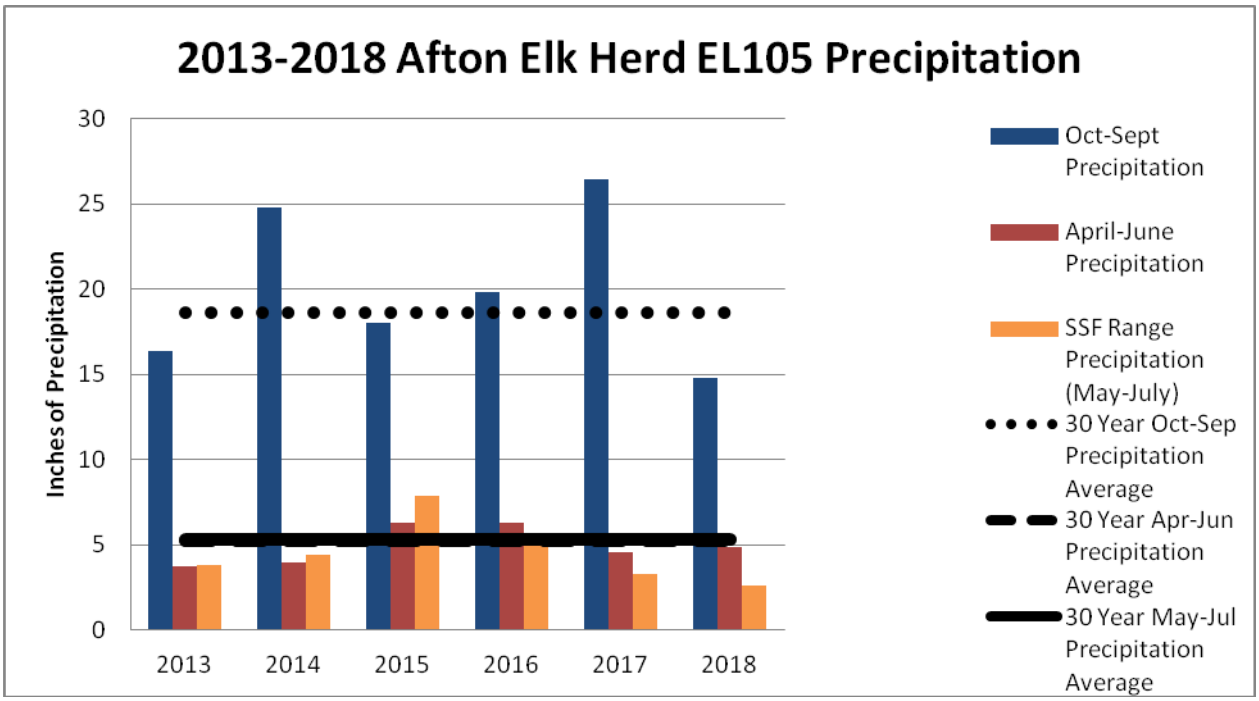
The current mid-winter trend count management objective for Afton elk herd is 2200 elk. The management strategy is recreational management. The objective and management strategy were last reviewed in 2018. The current mid-winter trend count was approximately 1870 elk.

Herd Unit Issues

Management strategies have reflected the diverse issues observed in the four hunt areas over the last 15 years. Each management strategy reflects issues unique and relevant to the individual hunt areas in an effort to be responsive to public sentiment and adhere to objectives essential to herd management. Several issues have emerged over the last 10 years associated with length of the any elk portion of the hunting season in the Lower Greys River (Hunt Area 89) and the presence of elk occupying habitats during winter in close proximity to human development and livestock operations.

Hunting pressure has been maintained in the upper Greys River (Area 90) where elk numbers exceed the Commission-established quota for the Forest Park elk feedground. In the lower Greys River (Area 89) hunting opportunity has been more restricted with shorter overall season length and fewer days to harvest antlerless elk than in Area 90. This strategy is designed to increase overall elk numbers on the Greys River feedground and native winter ranges in Area 89. Based on the current year's trend count, this strategy was successful as elk numbers have decreased on Forest Park feedground and increased on the Greys River feedground and native winter ranges in Area 89. Hunt seasons in the Salt River (Area 91), have maintained elk numbers at desired levels to minimize damage to stored crops and comingling with livestock.

Weather



Precipitation

Overall precipitation from October 2017 through September 2018 was well below average when evaluated across the entire herd unit, over the water year (October through September of the following year). The general characteristics included a very mild and dry winter followed by average spring precipitation. Although growing season (April through June) precipitation was near average due to several significant precipitation events, summer (May-July) precipitation was significantly below average and resulted in less than ideal growing conditions on summer range.

Winter Severity

The 2018-2019 winter started mild but the months of January and February have been increasingly tough for wildlife with regard to snow accumulation and cold temperatures on winter ranges. SNOWTEL locations in the high elevations of the Snake River watershed indicated snow water equivalents well above average, and these increased snow levels persisted well into the spring.

Habitat

No habitat data has been collected on elk summer and winter ranges. There are no established vegetation transects in this herd unit. Please refer to the 2018 Annual Report Strategic Habitat Plan Accomplishments for the Jackson Region habitat improvement project summaries (**http://wgfd.wyo.gov/web2011/wildlife-1000708.aspx**).

Field Data

The Afton elk herd has been managed to maintain the population within +/-20% of the trend objective of 2200 elk. Population trends are relatively stable; however, there have been periodic increases in the total elk counted during the last four years. Hunt seasons have been successful at targeting elk numbers, notably in upper Greys River segment of the population, where rapid and sustained growth has been observed.

Hunting seasons have suppressed population growth in an elk herd where moderate to high calf survival and calf: cow ratios are frequently observed at 38 – 43 calves: 100 cows. Since 2011 bull: cow ratios have been observed at or slightly below the management goal of at least 20 bulls: 100 cows. The observed bull:cow ratio of 24 bulls:100 cows in 2017 was the highest proportion of bulls observed in postseason surveys in at least 10 years. However, the observed ratio dropped in 2018 to 15 bulls:100 cows largely due to the inability to survey all native winter ranges effectively during aerial surveys.

Over the last four years the number of elk documented on native winter ranges has increased to levels not observed in at least 20 years, especially in Greys River. The importance of this native winter range is essential to long-term maintenance of elk that spend the summer and fall in the lower Greys River. During open and relatively snow-free winters, many elk spend the winter on Greys River winter ranges instead of migrating to the Greys River elk feedground at Alpine. This winter range is located in Hunt Area 89 and encompasses the area from Deadman Creek northward to the confluence of Greys River and Snake River. In 2018 the number elk decreased from 625 elk counted in 2017 to 317 elk observed in 2018 in Hunt Area 89.

Harvest Data

Hunters harvested an estimated 888 elk in 2018 which is substantially more than the 713 elk taken in 2017, but less than the 1064 elk harvested in 2016. Hunting conditions have varied considerably over the last five years, and conditions associated with hot dry conditions were some of the more challenging conditions in 2018.

The slight increase in elk harvested in 2018 from 2017 levels reflects more elk available during the current hunt based on a higher 2017 trend count prior to the hunt. It also is symptomatic of a population dynamic in the Aton herd that clearly depicts a lack of a sustained harvest trend between years. While the 5-year average of 2400 hunters did not change significantly in 2018 (N=2500 hunters), the slightly increased elk harvest in the current year is inexplicable in response to sustained hunting pressure over the last 5 years.

Concurrently, there has been no significant variation observed in hunter success over the last four years. Success has varied, though not significantly, from 32% and 34% in 2014 and 2015 respectively, to 36% in 2016. Hunter success in 2017 was estimated at 25%, and 36% in 2018. The number of days hunters needed to harvest an elk has decreased each successive year since 2014. Hunters spent 25 days to harvest an elk in 2014; the amount of effort continued to

decrease to 19 days and 17 days in 2015 and 2016, respectively. However, days/harvest increased in 2017 in response to fewer elk harvested. In 2017, days/elk harvested increased to 25 days. Hunters harvested an elk in approximately 18 days of hunting effort in 2018.

Hunting seasons and the associated harvest observed in the Greys River, Areas 89 and 90 have enabled the current management program to maintain elk numbers near the desired 3-year average trend count objective of 2200 elk. Sufficient opportunity for general license, any and antlerless elk hunts that extend into November has resulted in the maintenance of a stable elk population that is capable of sustaining a reasonably liberal hunting structure over the last 10 years in some areas.

The hunting season in 2019 will focus on harvesting predominately any elk in Area 89 during the first three days of the hunting seasons to compensate for the generally higher trend counts in that area and on the Greys River feedground the last three years. The percentage of antlered elk taken continues to exceed the number and percentage of cow elk in this herd unit. Since 2016 antlered elk comprised approximately 58% of the annual total harvest, while cow elk comprised approximately 42%. In 2017, 56% of all taken were antlered elk. Interestingly, 52% of the total harvest in 2017 was comprised of 2+-year old bulls. In 2018, 52% of the herd unit elk harvest was comprised of antlered elk. During the current hunt 2+-year old bulls tallied 87% of the antlered harvest. The estimated high percentage of 2+-year old bulls taken each year is indicative of generally high calf and yearling recruitment into the adult cohorts.

Population

A concerted effort was attempted to develop a representative spreadsheet model over the last 5 years. Poor alignment of the bull: cow ratios, harvest percentages of males, and population estimates have rendered the development of a representative and accurate spreadsheet model unsuitable.

As a result, the mid-winter trend count management objective was developed and implemented in 2015 to better utilize observed data to estimate population. The mid-winter trend count provides managers with a realistic assessment of population dynamics in this elk herd. Furthermore, the annual trend counts present a depiction of this population's performance where, on average, 65% - 85% of all elk are counted on feedgrounds.

Management Summary

The 2019 hunting season is designed to maintain the mid-winter trend objective. The lower Greys River (HA 89) will close on October 31, which is the same season closing date as in 2018. The general any elk portion of the hunting season in Area 89 will remain October 15 – October 17 in an effort to provide continued hunting recreation and reduce pressure on antlered elk. Antlered elk only hunting will continue on October 18 and close on October 31.

Management will continue to emphasize antlerless elk harvest in Area 90 by allowing general and limited quota type 6 license holders to hunt into November. The Area 90 Type 6 additional

cow or calf licenses will remain at 250 licenses in an effort to increase harvest. The season length for limited quota Type 6 licenses will extend into November as it has since 2006 in an effort to encourage hunters to harvest antlerless elk in an area where the Forest Park feedground quota has met or exceeded the Commission-established quota during most years since 1993.

In Area 91 the number of Type 6 cow or calf only licenses will be maintained at 175 licenses in response to higher elk numbers being observed on native winter ranges in 2016, 2017, and during the current year. The Type 6 licenses will address elk damage concerns along the eastern portion of area 91. Season dates for this license will continue to extend through the end of January.

Based on past harvest statistics, the 2019 hunting seasons will result in a harvest of 800 elk. The proposed 2019 harvest should maintain the population within +/- 20% of the annual three-year trend count average of 2200 elk. The projected 2019 mid-winter trend count is estimated at 2150 elk.

Appendix A. Afton Elk Herd, posthunt herd composition data, 2014-2018.										
							Ratio:100 Females			
Year	Adult Males	Yrlng Males	Total Males	Cows	Calves	Total	Adult Males	Yrlng Males	Total Males	Calves
2014										
88 GRFG	59	22	81	570	164	815				
88 NR	0	0	0	3	0	3				
89 NR	6	24	30	329	201(5)	565				
90 FPFG	63	18	81	500	172	753				
90 NR	0	0	0	0	0	0				
91 NR	24	13	37	162	55(42)	296				
TOTAL	152	77	229	1564	592(47)	2432	10	5	15	38
2015										
88 GRFG	43	24	67	441	152	660				
88 NR	0	0	0	1	0	1				
89 NR	6	6	12	101	57 (24)	194				
90 FPFG	59	18	77	476	188	741				
90 NR	0	0	0	0	0	0				
91 NR	13	5	18	26	14(183)	241				
TOTAL	121	53	174	1045	411(207)	1837	11	5	17	39
2016										
88 GRFG	43	13	56	532	144	732				
88 NR	0	1	1	3	1(5)	10				
89 NR	4	3	7	88	44(52)	191				
90 FPFG	61	48	109	507	198	814				
90 NR	0	2	2	2	2(1)	7				
91 NR	41	33	74	148	122((592)	936				
TOTAL	149	100	249	1280	511(650)	2690	11	8	19	40
2017										
88 GRFG	29	7	36	358	82	476				
88 NR	0	0	0	0	0	0				
89 NR	7	4	11	37	15(562)	625				
90 FPFG	66	25	91	409	79	579				
90 NR	0	1	1	0	0(8)	9				
91 NR	57	1	58	8	0(658)	724				
TOTAL	159	38	197	812	176(1228)	2413	19	5	24	22
2018										
88 GRFG	18	13	31	378	110	519				
88 NR	0	0	0	0	0	NS				
89 NR	1	12	13	111	85(108)	317				
90 FPFG	36	11	47	326	94	467				
90 NR	0	0	0	0	0	NS				
91 NR	49	21	70	227	90(177)	564				
TOTAL	104	57	161	1042	379(285)	1867	10	5	15	36

2018 - JCR Evaluation Form

SPECIES: Moose

PERIOD: 6/1/2018 - 5/31/2019

HERD: MO101 - TARGHEE

HUNT AREAS: 16, 37

PREPARED BY: ALYSON COURTEMANCH

	2013 - 2017 Average	2018	2019 Proposed
Population:		N/A	N/A
Harvest:	4	5	5
Hunters:	5	5	5
Hunter Success:	80%	100%	100 %
Active Licenses:	5	5	5
Active License Success:	80%	100%	100 %
Recreation Days:	30	57	50
Days Per Animal:	7.5	11.4	10

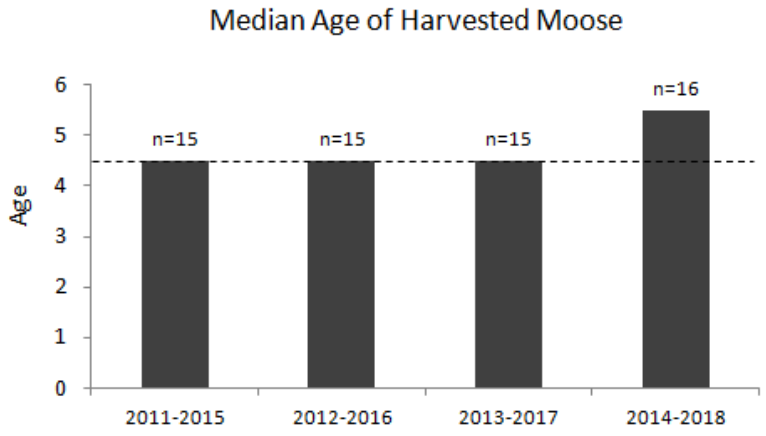
Limited Opportunity Objective:

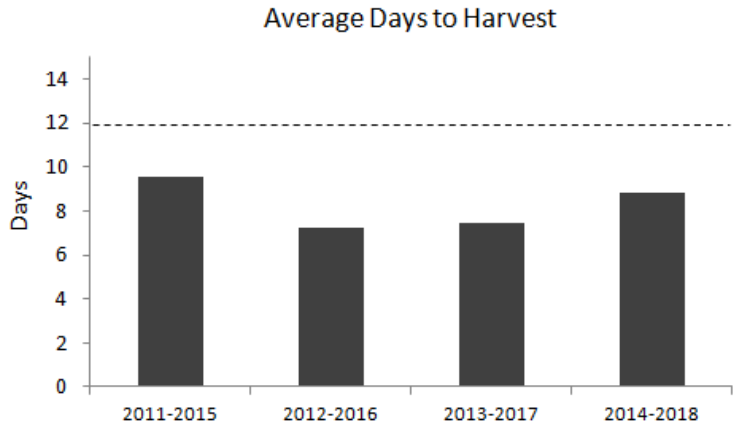
5-year median age of > 4.5 years for harvested moose

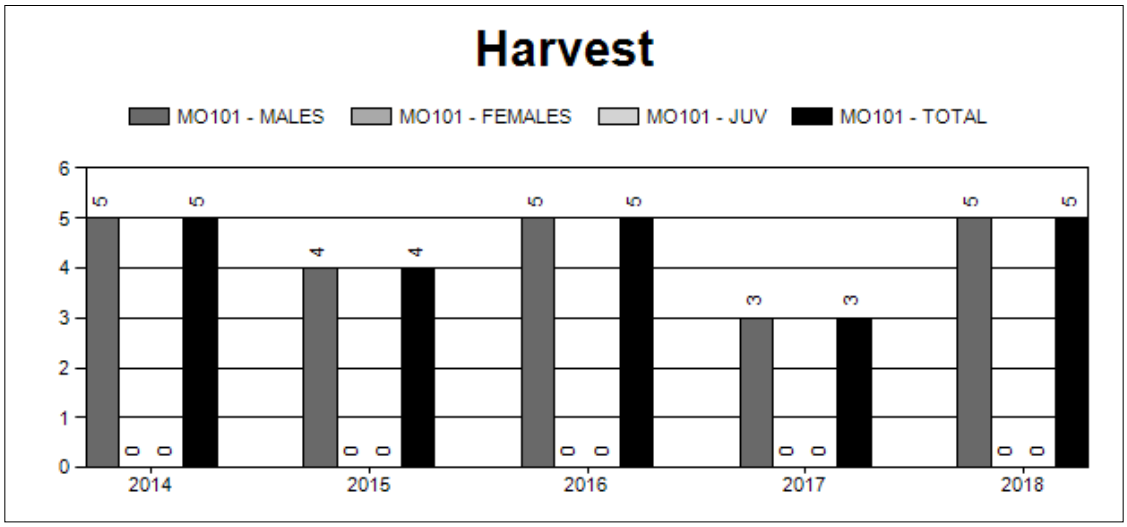
5-year average of <= 12 days/animal to harvest

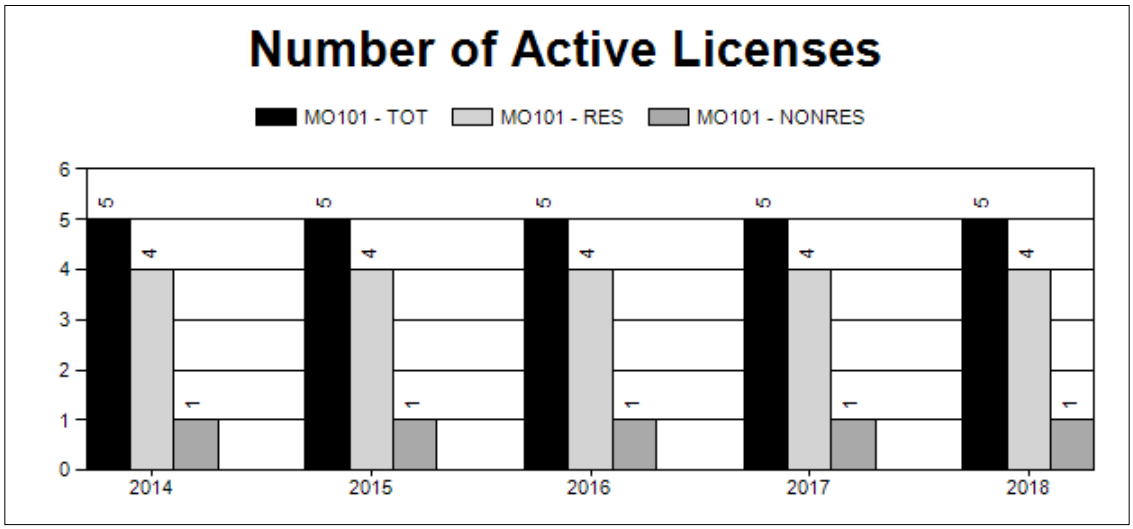
Secondary Objective:

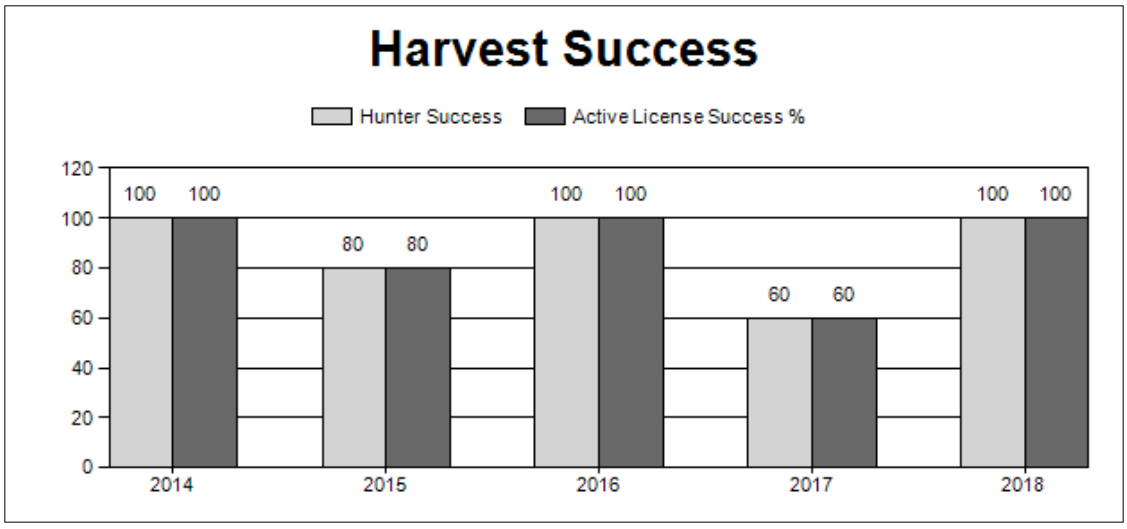
5-year average of 40% of harvested moose are > 5 years of age

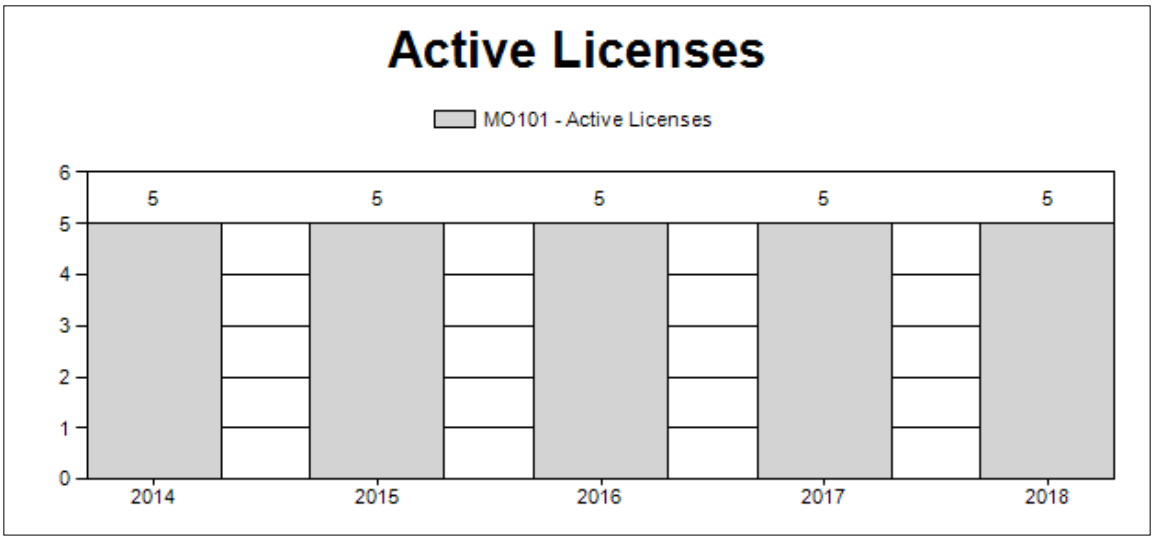


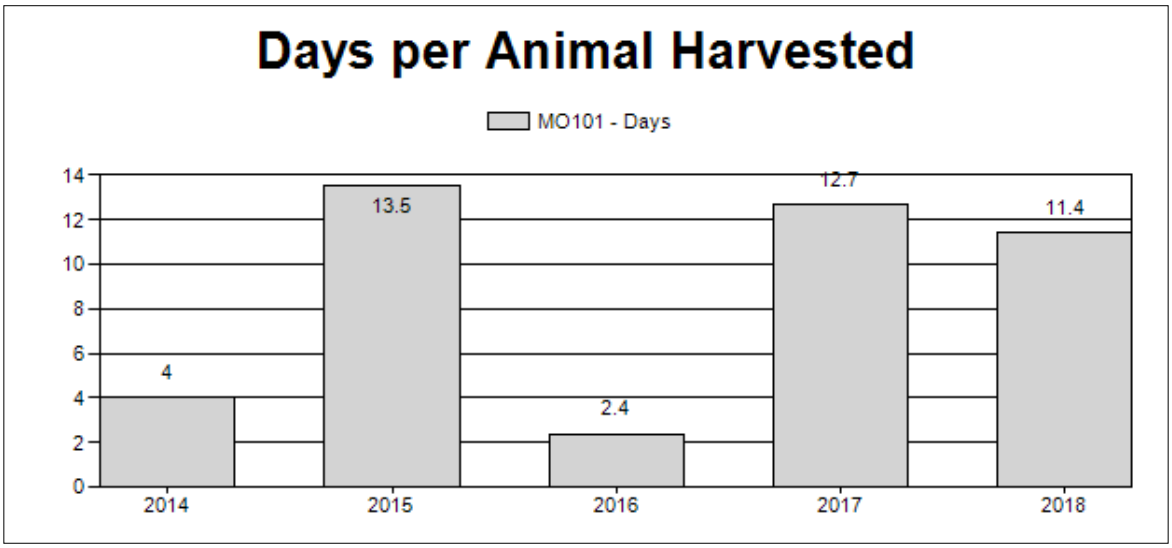


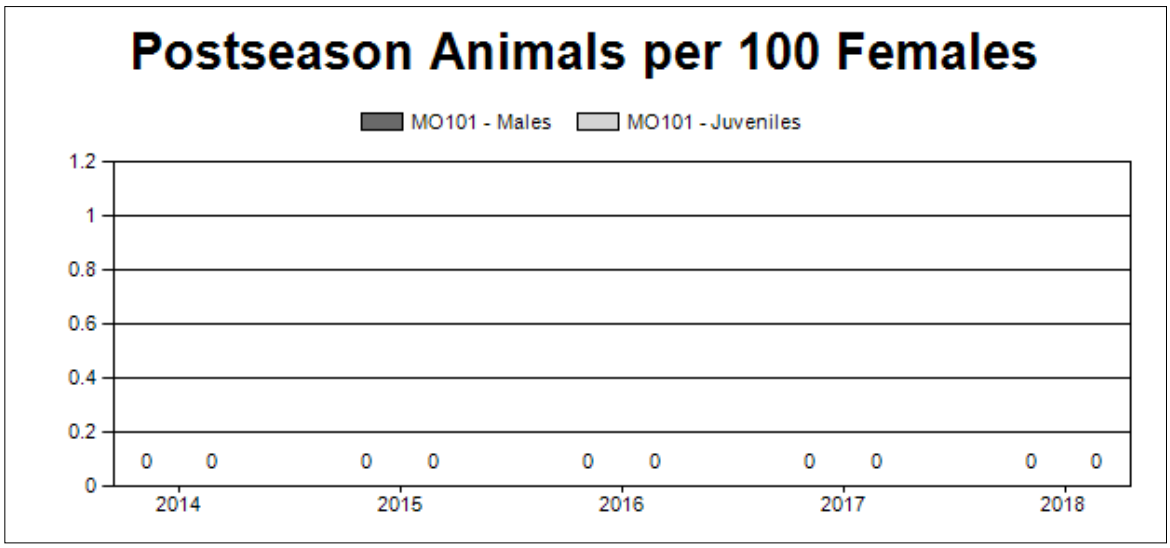

Harvest
MO101 - MALES
MO101 - FEMALES
MO101 - JUV
MO101 - TOTAL
2014
2015
2016
2017
2018


Number of Active Licenses
MO101 - TOT
MO101 - RES
MO101 - NONRES
2014
2015
2016
2017
2018


Harvest Success
Hunter Success
Active License Success %
2014
2015
2016
2017
2018


Active Licenses
MO101 - Active Licenses
6
5
4
3
2
1
0
5
5
5
5
5
2014
2015
2016
2017
2018


Days per Animal Harvested
MO101 - Days
14
12
10
8
6
4
2
0
4
13.5
2.4
12.7
11.4
2014
2015
2016
2017
2018


Postseason Animals per 100 Females
MO101 - Males
MO101 - Juveniles
1.2
1
0.8
0.6
0.4
0.2
0
0 0
0 0
0 0
0 0
0 0
2014
2015
2016
2017
2018

2019 HUNTING SEASONS
TARGHEE MOOSE HERD (MO101)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
16, 37	1	Sep. 15	Nov. 15	5	Limited quota	Antlered moose

Special Archery Seasons

Hunt Area	Type	Season Dates		Limitations
		Opens	Closes	
16, 37	1	Sep. 1	Sep. 14	Refer to Section 2 in Chapter 8

Management Evaluation

Management Strategy: Special

Population Objective Type: Limited Opportunity
Primary Objectives:
1. Achieve a 5-year median age of ≥ 4.5 years for harvested moose, and
2. Achieve a 5-year average of ≤ 12 days/animal to harvest.
Secondary Objective:
Achieve a 5-year average of 40% of harvested moose are > 5 years of age.
Evaluation: Meeting all objectives

The Wyoming Game and Fish Department (WGFD) proposed changing the objective for the Targhee Moose Herd from a postseason population objective to a limited opportunity objective in 2014. The objective change was needed because the herd is rarely surveyed due to budget priorities elsewhere, difficult sightability due to forested habitats, 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 limited opportunity objective was adopted in 2014 after public review, and included primary and secondary objectives (listed above).

Objective 1 - *currently met*
In 2018, the median age of harvested moose was 5.5 years (n = 2 samples, range = 4.5-6.5 years old). The median age of harvested moose for the past 5 years is 5.5 years old (n = 16 samples). Therefore, the first primary objective of a 5-year median age of ≥ 4.5 years for harvested moose is currently being met.

Objective 2 – *currently met*
In 2018, the average number of days per animal to harvest was 11.4. The 5-year average of number of days per animal to harvest is 8.4 days. Therefore, the second primary objective of a 5-year average of ≤ 12 days/animal to harvest is currently being met.

Objective 3 – *currently met*
In 2018, two hunters submitted tooth samples from harvested moose for aging. One moose was 4.5 years old and one was 6.5. During the past 5 years, 16 hunters have submitted tooth samples for aging. Of those, 8 moose were aged at > 5 years. Therefore, the secondary objective of at least 40% of harvested moose being > 5 years of age is currently met, although sample sizes are low.

Herd Unit Issues

The current objective and management strategy for this herd will be maintained based on internal discussions and conversations with our constituents. Population status was evaluated and it was determined a change is not warranted at this time. These objectives will be reviewed again in 2024; however, if a situation arises that requires immediate change, proposals will be developed and submitted as needed.

Spreadsheet models developed for this moose herd do not appear to adequately simulate observed trends, which is why managers proposed changing this herd's objective to Limited Opportunity. This population is very difficult to survey and manage through harvest due to its interstate nature. Post-season classification surveys are not flown in this herd due to budget constraints and sightability issues in forested habitats. Winter ranges are primarily low elevation mountain shrub and aspen communities and riparian willow and spruce/fir communities. On more severe winters, moose may move west along riparian corridors toward the Teton River in Idaho. Many of the mountain shrub and aspen communities along the state line are old and decadent. Serviceberry, chokecherry, and mountain mahogany are often over 10 feet tall, above the browse zone for moose. Harvest was as high as 70 moose in 1990 and 1991. License quotas were then decreased as harvest statistics and public comments indicated the population was decreasing. The license quota has been 5 antlered moose in recent years.

Weather

Spring and summer 20187 produced average moisture. Fall and early winter weather was very mild with warm temperatures and little snowfall at high elevations. This may have increased days to harvest for hunters. However, several large snowstorms occurred in February that resulted in the rapid accumulation of a deep snowpack. 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 no permanent vegetation transects in moose winter ranges for the Targhee Herd. Several habitat improvement projects are being planned in this herd unit, including the Hill Creek Prescribed Burn, which is scheduled for completion in 2019. In addition, a habitat treatment in Teton Canyon is currently in the planning stages to improve mountain shrub and aspen communities for moose and other big game with potential for implementation beginning in 2019. The WGFD is assisting Caribou-Targhee National Forest (CTNF) with vegetation monitoring in aspen stands pre and post-treatment. Please refer to the 2018 Annual Report

Strategic Habitat Plan Accomplishments for Jackson Region habitat improvement project summaries (https://wgfd.wyo.gov/Habitat/Habitat-Plans/Strategic-Habitat-Plan-Annual-Reports).

Field Data

There were no field data collected in the Targhee Herd Unit during the 2018 biological year.

Harvest Data

To offset observed population declines, antlerless harvest was eliminated from the Targhee moose herd in 2006 and the two hunt areas were combined in 2011. In spite of these changes the moose population did not increase significantly. Five hunters harvested 5 bulls (100% success) in 2018. Harvest success has been consistently high in recent years (>80%), with the exception of 2017 (60% success).

Population

Due to budget constraints and difficult sightability, there have been no mid-winter surveys in the Targhee herd since 2009. Based on the 2009 survey this population is likely 150-200 moose. Similar to the Jackson Moose Herd, this population appeared to decline during the early 2000s.

Management Summary

Due to the "interstate" nature of this population, managing this herd is difficult. Moose along the state line spend summer and early fall in Wyoming and winter along drainages in the foothills of the Teton Range. The population has not responded in a significant way to hunting season changes and it is likely that numerous factors are influencing recruitment and survival of moose including long-term drought, warming climate, parasites, disease, and predation. Managers plan to maintain limited hunting opportunity west of the Teton Range. The herd unit continues to offer high quality antlered moose hunting. Managers did not increase licenses in 2018 but will continue to monitor average age and harvest statistics to evaluate potential license increases in the future. Additional effort to contact hunters and increase tooth sample returns will be made. The WGFD continues to work closely with CTNF to develop habitat improvement projects for moose and other big game species.

2018 - JCR Evaluation Form

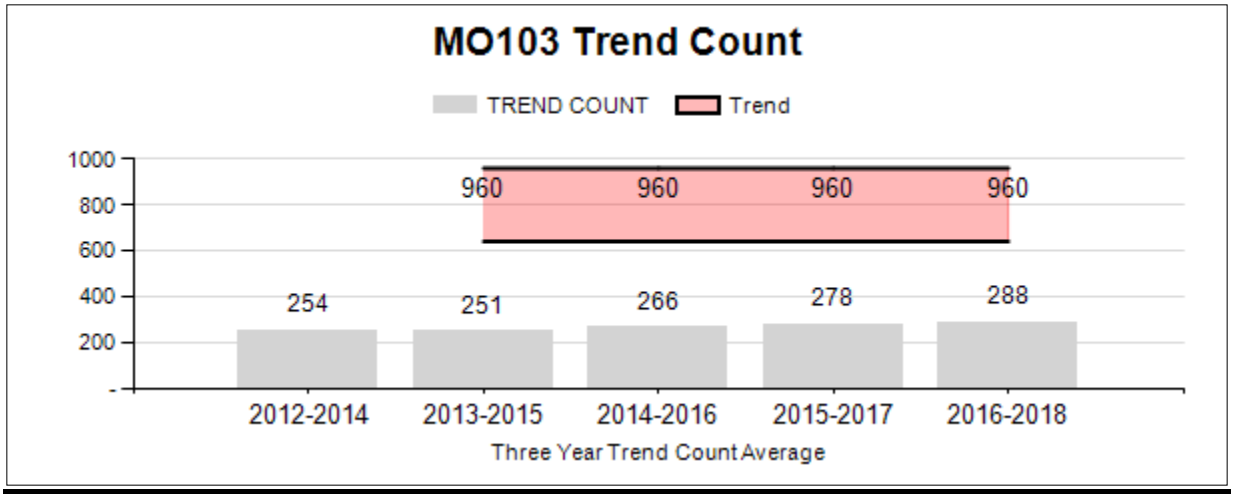
SPECIES: Moose
PERIOD: 6/1/2018 - 5/31/2019

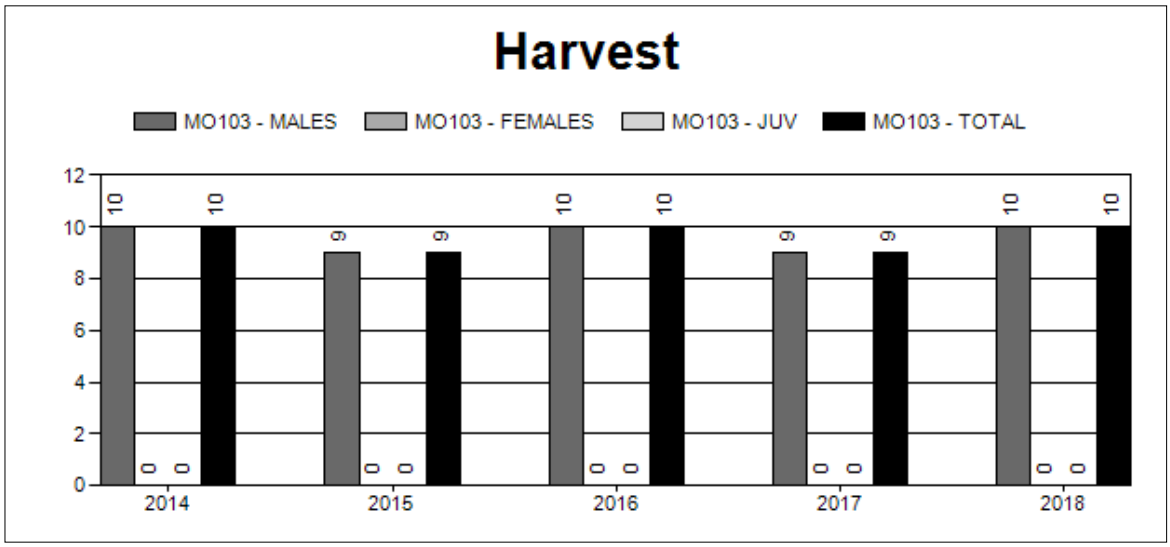
HERD: MO103 - JACKSON

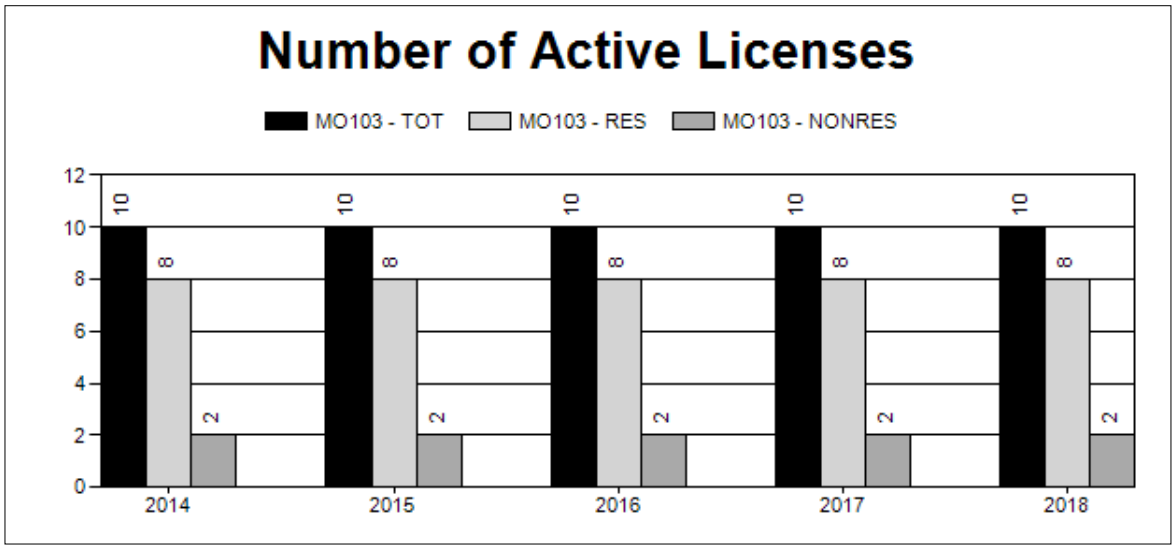
HUNT AREAS: 7, 14-15, 17-19, 28, 32
PREPARED BY: ALYSON COURTEMANCH

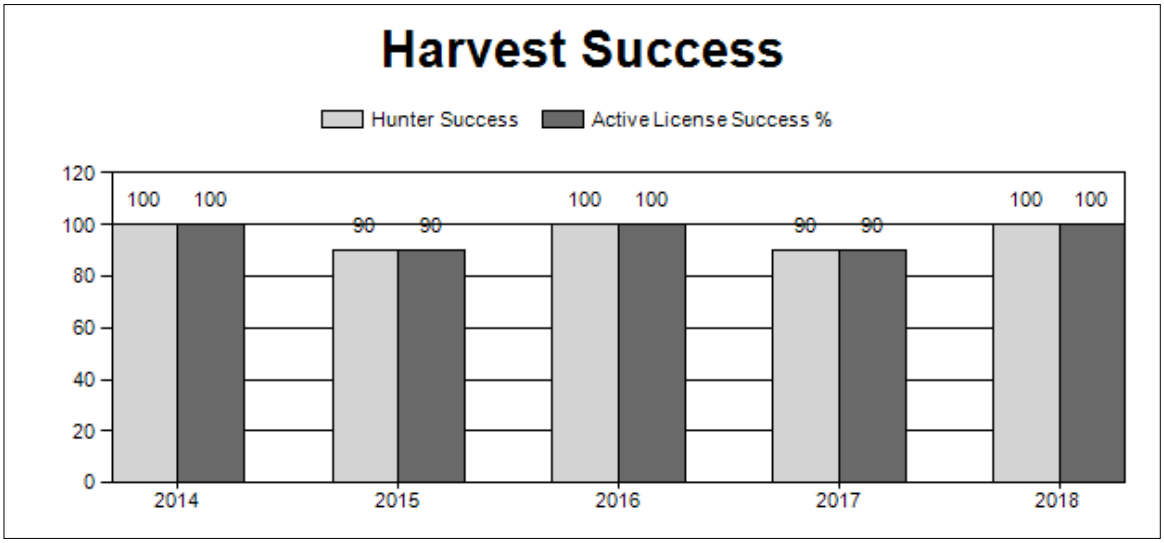
	2013 - 2017 Average	2018	2019 Proposed
Trend Count:	272	258	350
Harvest:	9	10	10
Hunters:	10	10	10
Hunter Success:	90%	100%	100%
Active Licenses:	10	10	10
Active License Success	90%	100%	100%
Recreation Days:	68	103	100
Days Per Animal:	7.6	10.3	10
Males per 100 Females:	84	91	
Juveniles per 100 Females	40	52	

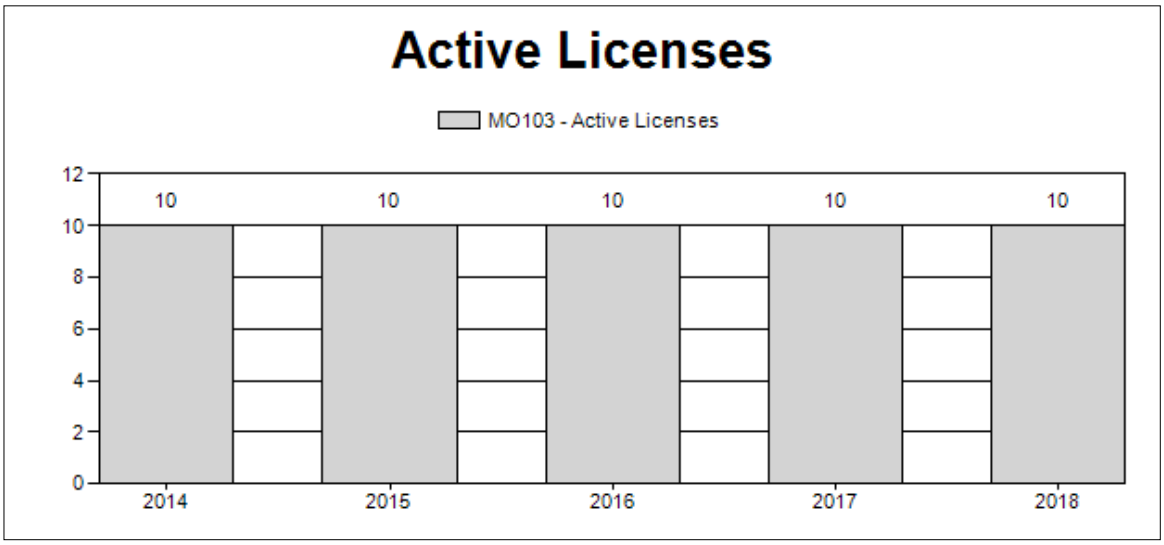
Trend Based Objective (± 20%)	800 (640 - 960)
Management Strategy:	Special
Percent population is above (+) or (-) objective:	-67.8%
Number of years population has been + or - objective in recent trend:	15

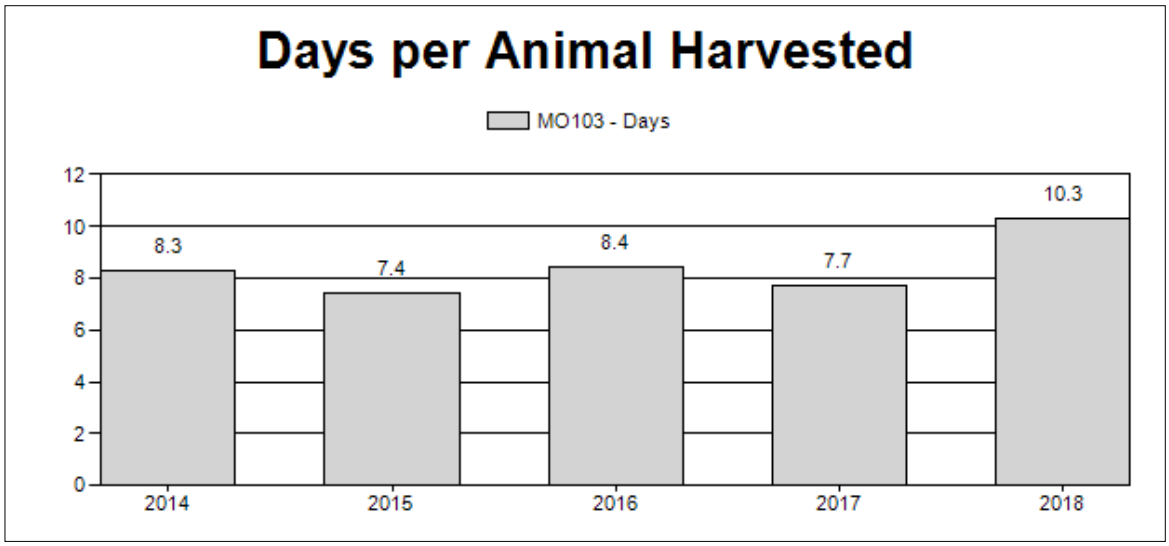


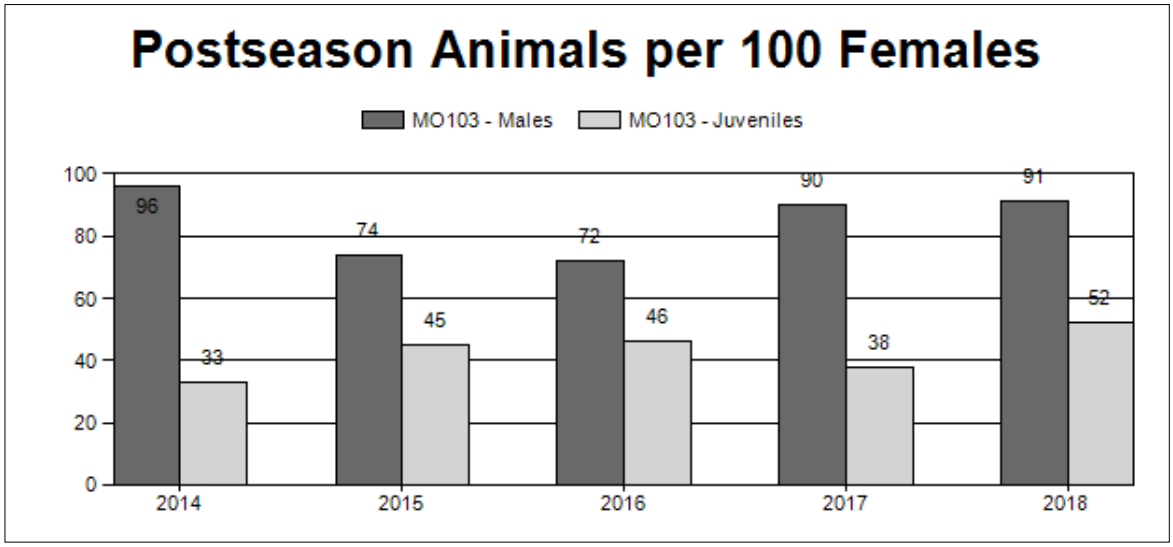

Harvest
MO103 - MALES
MO103 - FEMALES
MO103 - JUV
MO103 - TOTAL
12
10
8
6
4
2
0
10 0 0 10
9 0 0 9
10 0 0 10
9 0 0 9
10 0 0 10
2014
2015
2016
2017
2018


Number of Active Licenses
MO103 - TOT
MO103 - RES
MO103 - NONRES
12
10
8
6
4
2
0
10 8 2
10 8 2
10 8 2
10 8 2
10 8 2
2014
2015
2016
2017
2018


Harvest Success
Hunter Success
Active License Success %
120
100
80
60
40
20
0
100 100
90 90
100 100
90 90
100 100
2014
2015
2016
2017
2018


Active Licenses
MO103 - Active Licenses
12
10
8
6
4
2
0
10
10
10
10
10
2014
2015
2016
2017
2018


Days per Animal Harvested
MO103 - Days
12
10
8
6
4
2
0
8.3
7.4
8.4
7.7
10.3
2014
2015
2016
2017
2018


Postseason Animals per 100 Females
MO103 - Males
MO103 - Juveniles
100
80
60
40
20
0
96
33
74
45
72
46
90
38
91
52
2014
2015
2016
2017
2018

2014 - 2018 Postseason Classification Summary
for Moose Herd MO103 - JACKSON

		MALES				FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Post Pop	Ylg	Adult	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Ylng	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2014	0	0	101	101	42%	105	44%	35	15%	241	389	0	96	96	± 12	33	± 6	17
2015	0	0	77	77	34%	104	46%	47	21%	228	395	0	74	74	± 0	45	± 0	26
2016	0	0	108	108	33%	149	46%	69	21%	326	280	0	72	72	± 0	46	± 0	27
2017	0	0	100	100	40%	111	44%	42	17%	253	250	0	90	90	± 0	38	± 0	20
2018	0	0	93	93	38%	102	41%	53	21%	248	383	0	91	91	± 0	52	± 0	27

2019 HUNTING SEASONS
JACKSON MOOSE HERD (MO103)

Hunt Area	Type	Dates of Seasons		Quota	License	Limitations
		Opens	Closes			
7, 14, 15, 19, 32						Closed
17, 28	1	Sep. 15	Oct. 31	5	Limited quota	Antlered moose
18	1	Oct. 1	Oct. 31	5	Limited quota	Antlered moose

Special Archery Seasons

Hunt Area	Type	Dates of Seasons		Limitations
		Opens	Closes	
17, 28	1	Sep. 1	Sep. 14	Refer to Section 2 in Chapter 8
18	1	Sep. 1	Sep. 30	Refer to Section 2 in Chapter 8

Management Evaluation

Mid-Winter Trend Count Objective: 800
Secondary Objectives:

1. Maintain a 5-year running average of at least 40% of male harvest ≥ 5 years of age, and
2. Maintain a 3-year median age of ≥ 4.5 years old for harvested moose.

Management Strategy: Special
2018 Mid-Winter Trend Count: 258
3-Year Mid-Winter Trend Average (2016-2018): 288
Evaluation: Below objective

The mid-winter trend count objective for the Jackson Moose Herd is 800 moose. The management strategy is special and the objective and management strategy were last revised in 2015. The herd objective was publicly reviewed in 2015 and changed to a mid-winter trend count objective of 800 moose. The 2018 mid-winter trend count is 258 moose and the 3-year

average is 288 moose, which is well below the objective.

The first of the secondary management objectives is currently being met. The average percent male harvest ≥ 5 years of age from 2014-2018 was 42% (n=36 samples). The second of the secondary objectives is currently being met. The 3-year median age for harvested moose is 5.5 years for 2016-2018 (n=22 samples). In general, managers would like to see the average age of harvested moose increase in the herd unit.

Herd Unit Issues

This population is 65% below its mid-winter trend count objective of 800 moose. Native moose populations naturally expanded and colonized the Jackson area in the late 19th century. The species' arrival was followed by a classic exponential population increase, peaking at approximately 3,000-5,000 animals (depending on modeling techniques). For many years, the Jackson Herd served as a source for moose transplants in multiple states and supported nearly 500 hunting licenses. However, the population underwent a dramatic population crash beginning in the early 1990s. Despite drastic reductions in hunting licenses, the population has failed to recover and has stagnated at low numbers. Research on moose in the northern portion of the herd unit indicated that a number of factors are influencing this population (Houston 1968, Berger 2004, Becker 2008, Vartanian 2011). Similar to other moose herds throughout the western United States and New England, the Jackson Herd is impacted by a combination of factors including long-term drought, habitat conversion from wildfires, warming termperature trends, predation, parasites, and disease. Moose in the Jackson Herd are exposed to predation by several large carnivore species. Large scale wildfires during the late 1980s and more recently have influenced summer moose habitat. Parasites such as carotid artery worm and winter ticks, as well as re-colonization by large carnivores pose additional challenges. Despite hunting season closures and a large reduction in the number of licenses, overall population numbers have not responded. In recent years, calf ratios have shown a promising upward trend. Ratios were as low as 15 calves:100 cows in 2008 but were 46:100, 38:100, and 52:100 in 2016, 2017, and 2018, respectively. Even if calf recruitment is improving, overall population numbers will take longer to increase.

Weather

Spring and summer 2018 produced average moisture. Fall and early winter weather was very mild with warm temperatures and little snowfall at high elevations. However, several large snowstorms occurred in February that resulted in the rapid accumulation of a deep snowpack. Snowfall totals in February nearly surpassed the local record in Jackson Hole. At the time of the mid-winter survey in February 2019, winter snowpack was reported at 115% of average in the Snake River Basin. In general snow depths were greater in the low elevation valleys in Jackson Hole compared to the Gros Ventre drainage where snow depth was approximately 50% less. 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

Recent vegetation monitoring indicates that moose winter ranges are slowly improving north of Jackson after decades of over-browsing in the 1980s and 1990s. Summer habitat has been modified by several large-scale wildfires in recent years, greatly reducing thermal cover for moose. There were no significant habitat treatments or wildfires in this herd unit in 2018. Please refer to the 2018 Strategic Habitat Plan Annual Report for Jackson Region habitat improvement project summaries (https://wgfd.wyo.gov/Habitat/Habitat-Plans/Strategic-Habitat-Plan-Annual-Reports).

Field Data

In February 2019, classification surveys were flown over low elevation moose winter ranges. We observed 258 moose this year. This total is similar to totals observed since 2012, with the exception of a higher count of 330 moose in February 2017 due to deep snow conditions that congregated moose in willow riparian areas and increased sightability. The calf ratio this year was 52 calves:100 cows, which is the highest it has been since 1994. This ratio has been slowly improving since 2008 when a ratio of 15:100 was observed. The overall bull ratio also remained high this year at 91:100.

Moose densities in the Willow Flat/Oxbow Bend Area have declined from an average of 4 moose per km^2 in 2000 to 0.16 moose per km^2 in 2010 and 2012. Moose were observed during the February 2018 survey in the Willow Flats area for the first time in many years and again in Februry 2019, which is a promising sign.

Harvest Data

During the 2018 season, 10 hunters harvested 10 bull moose in the Jackson Herd in Hunt Areas 17/28 and 18 in the Gros Ventre drainage. Hunter success remained high at 100% and hunter effort was 10.3 days per animal. Eight hunters submitted tooth samples and antler widths from harvested moose. Moose harvested from Area 17/28 were 3, 3,7, 8, and 10 years old and moose harvested from Area 18 were 3, 3, and 4 years old. Hunters self-reported an average of 44.5 inches antler spread from in Hunt Area 17/28 and an average of 39 inches in Hunt Area 18.

Population

Past POP II model simulations likely overestimated moose numbers in the Jackson population. Spreadsheet models developed for this herd also do not appear to adequately simulate observed trends. Based on the sightability of marked animals during recent research projects it is likely there are fewer than 500 animals in this population. Although the population remains low, aerial survey data from recent postseason classifications indicate a high number of bull moose and an improving calf:cow ratio. However, the low number of cows in the population suggests that any present or future recovery will be slow.

Management Summary

To offset observed population declines, antlerless moose hunting was eliminated in the Teton

Wilderness in 2001 and in the Gros Ventre drainage in 2004. Antlered moose hunting seasons were closed in the Teton Wilderness in 2011 (Areas 7, 14, 15 and 32), and Areas 17 and 28 were combined into one unit beginning in the 2012 season. Despite these changes the moose population north of Jackson has not recovered. Although calf:cow ratios have improved in recent years, overall numbers of moose remain low. Even with current calf:cow ratios, any population recovery will be slow due to the low numbers of cow moose.

Conservative hunting seasons are again planned for 2019 with 10 licenses offered for the Gros Ventre drainage. The herd will continue to be closely monitored in future years to evaluate whether additional hunting opportunities can be provided. The high bull:cow ratios indicate that some harvest is sustainable at this time and complete closure to moose hunting in the Jackson Herd is not warranted for 2019.

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2018 - JCR Evaluation Form

SPECIES: Bighorn Sheep
PERIOD: 6/1/2018 - 5/31/2019

HERD: BS106 - TARGHEE

HUNT AREAS: 6
PREPARED BY: ALYSON COURTEMANCH

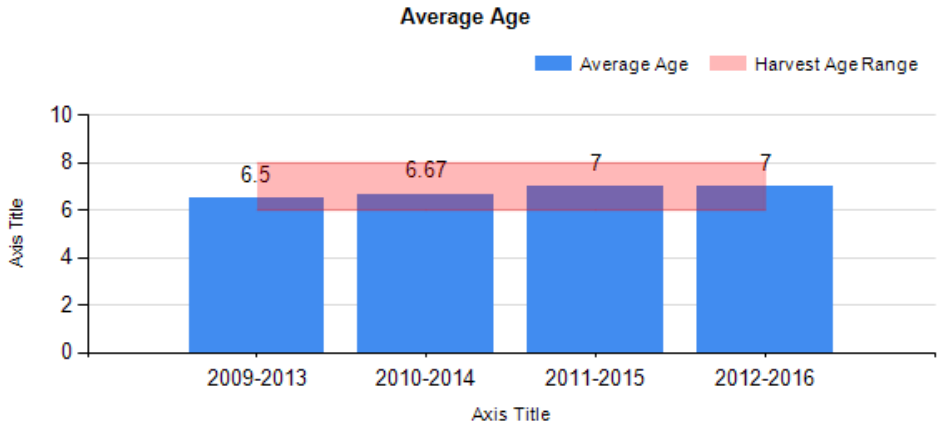
	2013 - 2017 Average	2018	2019 Proposed
Population:		N/A	N/A
Harvest:	1	0	1
Hunters:	2	1	1
Hunter Success:	50%	0%	100 %
Active Licenses:	2	1	1
Active License Success:	50%	0%	100 %
Recreation Days:	22	45	14
Days Per Animal:	22	0	14

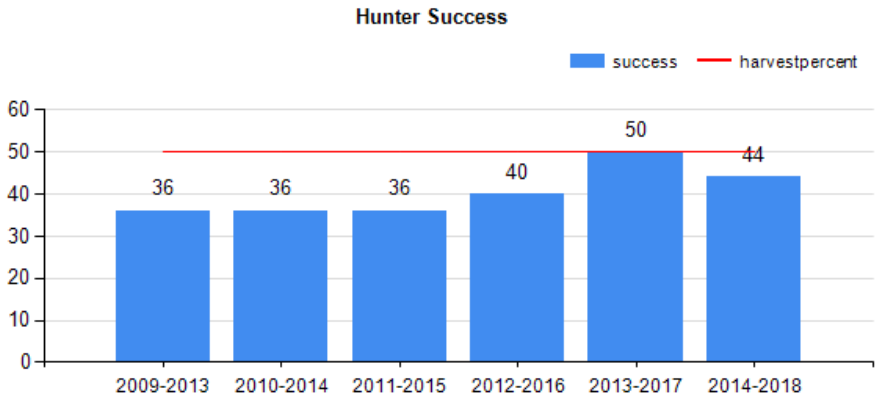
Limited Opportunity Objective:

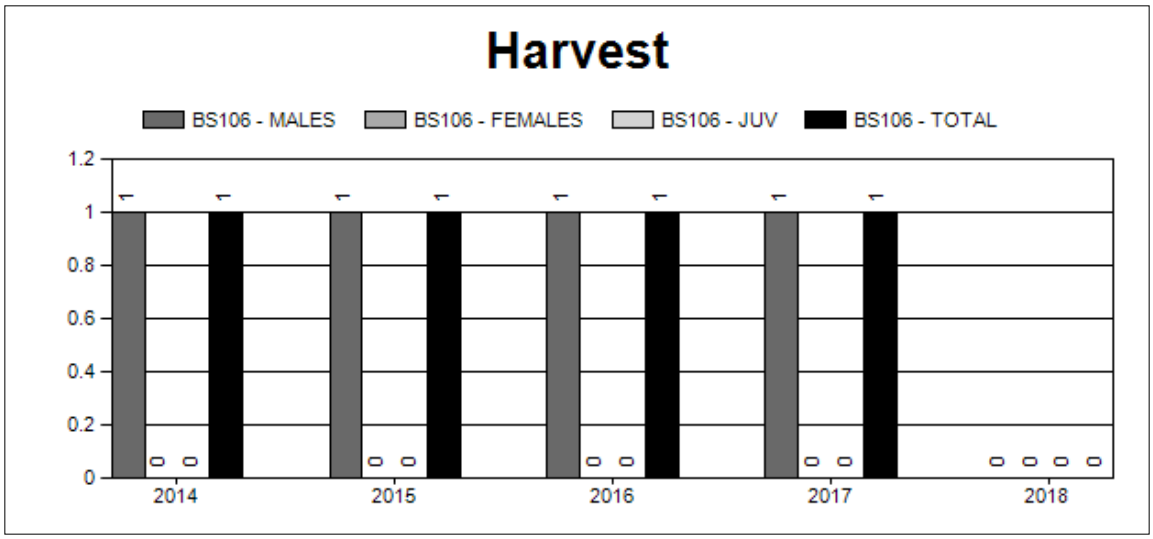
5-year average harvest age of 6-8 years

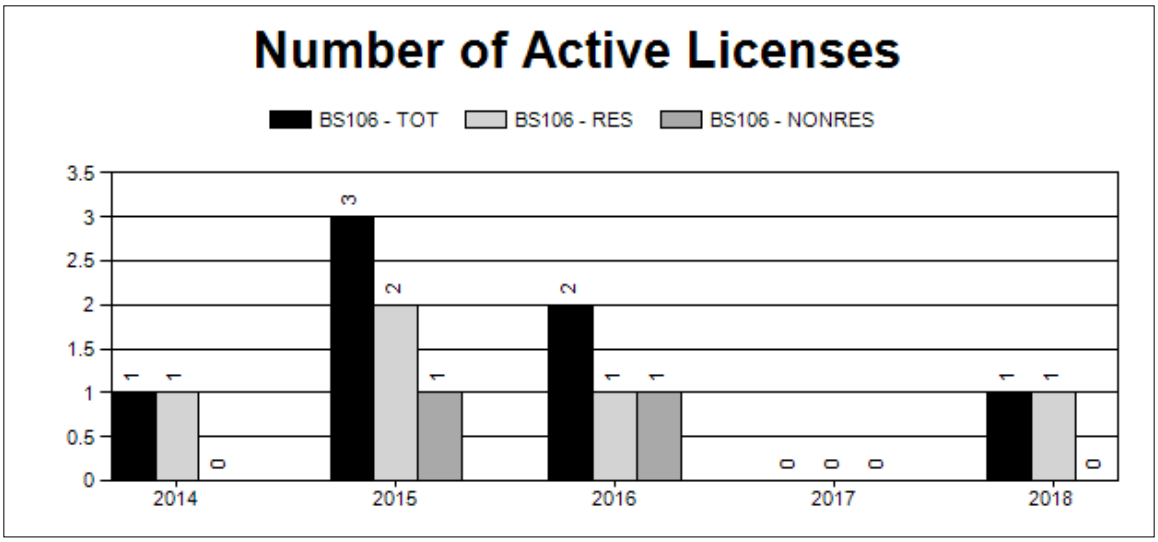
5-year average hunter success of >= 50%

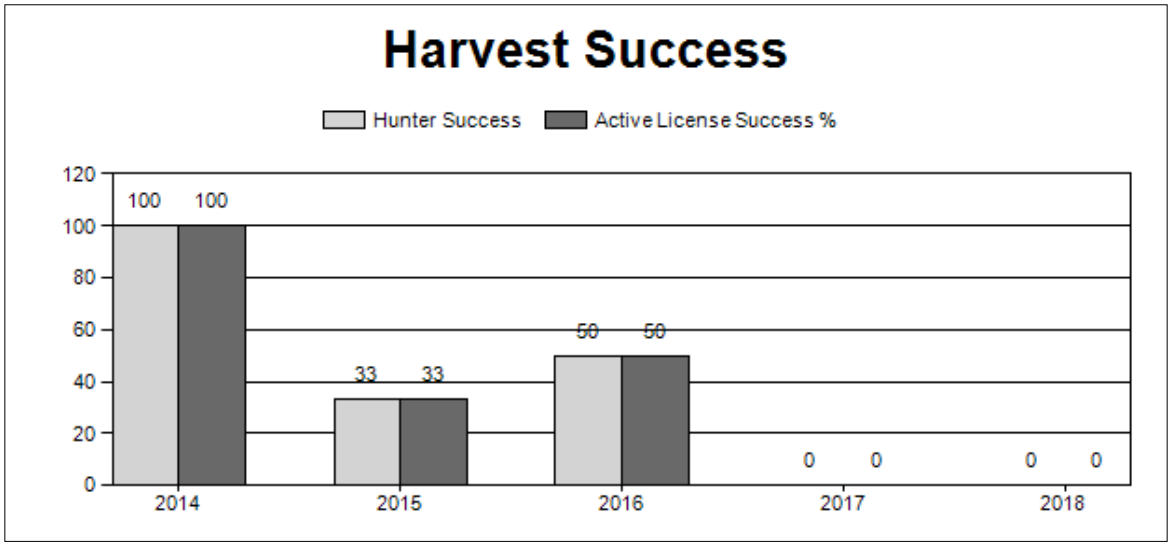
Management Strategy: Special

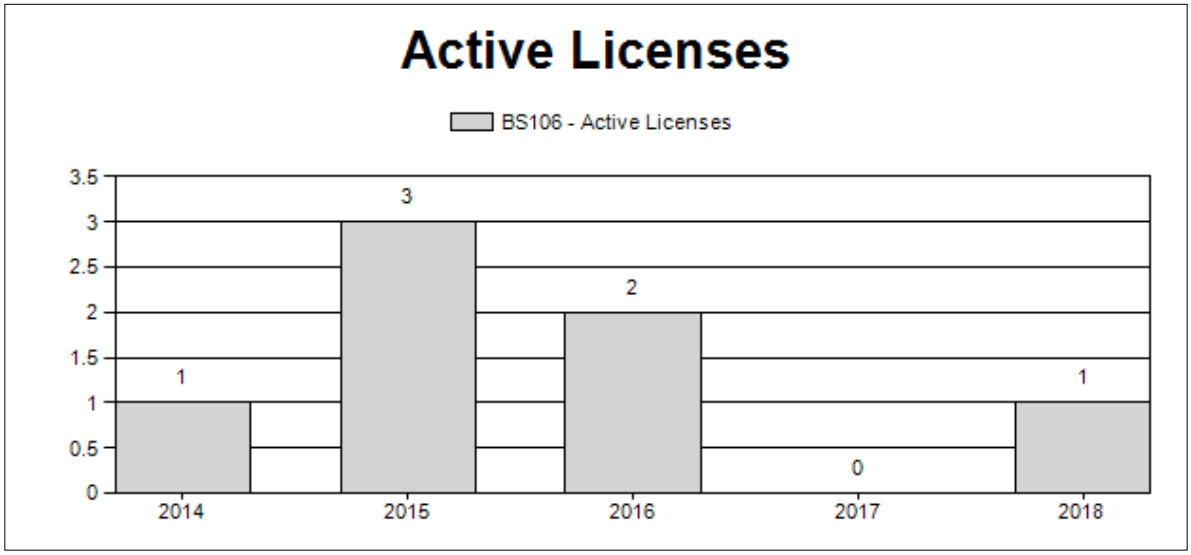


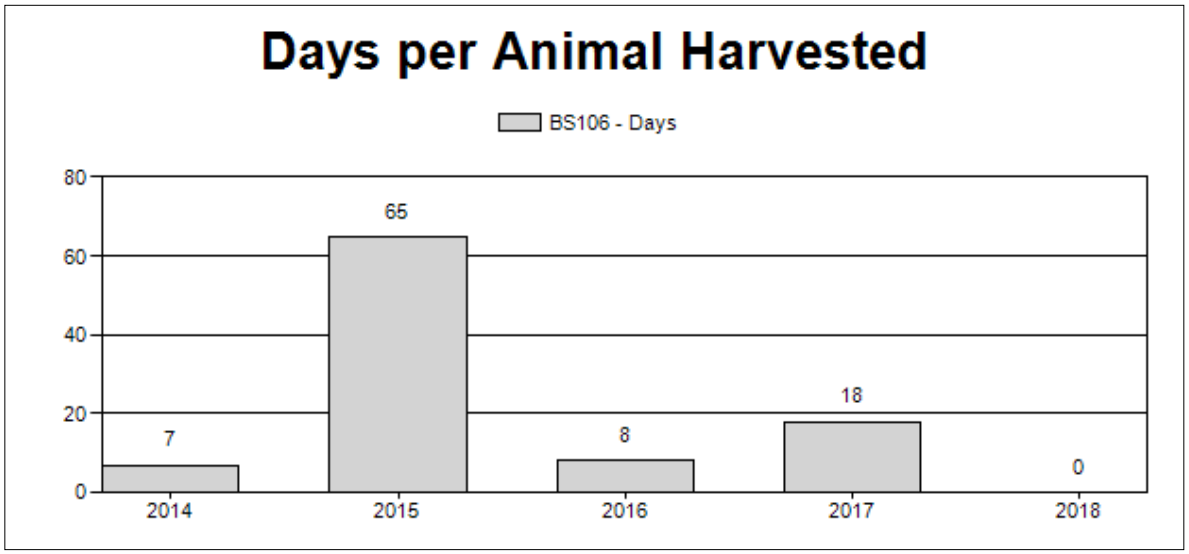


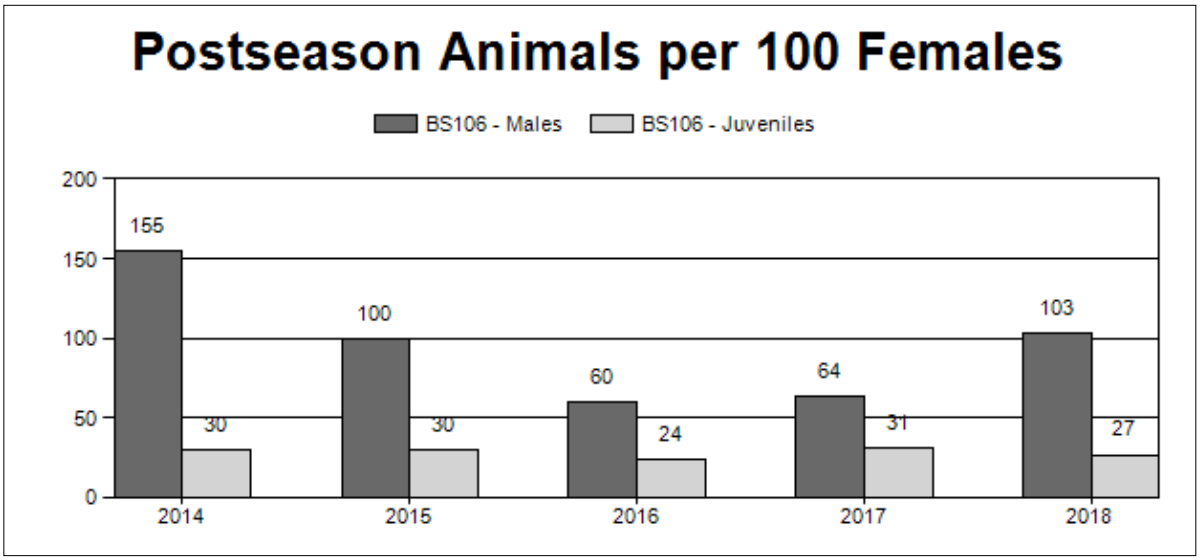

Harvest
BS106 - MALES
BS106 - FEMALES
BS106 - JUV
BS106 - TOTAL
1.2
1
0.8
0.6
0.4
0.2
0
2014
2015
2016
2017
2018


Number of Active Licenses
BS106 - TOT
BS106 - RES
BS106 - NONRES
3.5
3
2.5
2
1.5
1
0.5
0
2014
2015
2016
2017
2018


Harvest Success
Hunter Success
Active License Success %
120
100
80
60
40
20
0
100 100
33 33
50 50
0 0
0 0
2014
2015
2016
2017
2018


Active Licenses
BS106 - Active Licenses
3.5
3
2.5
2
1.5
1
0.5
0
1
3
2
0
1
2014
2015
2016
2017
2018


Days per Animal Harvested
BS106 - Days
80
60
40
20
0
7
65
8
18
0
2014
2015
2016
2017
2018


Postseason Animals per 100 Females
BS106 - Males
BS106 - Juveniles
200
150
100
50
0
155
30
100
30
60
24
64
31
103
27
2014
2015
2016
2017
2018

2014 - 2018 Postseason Classification Summary
for Bighorn Sheep Herd BS106 - TARGHEE

		MALES				FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Post Pop	Ylg	Adult	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Yling	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2014		3	28	31	54%	20	35%	6	11%	57	123	15	140	155	± 42	30	± 13	12
2015		1	19	20	43%	20	43%	6	13%	46	120	5	95	100	± 0	30	± 0	15
2016		0	15	15	33%	25	54%	6	13%	46	0	0	60	60	± 0	24	± 0	15
2017		3	22	25	33%	39	51%	12	16%	76	76	8	56	64	± 0	31	± 0	19
2018		1	33	34	45%	33	43%	9	12%	76	76	3	100	103	± 0	27	± 0	13

2019 HUNTING SEASONS
TARGHEE BIGHORN SHEEP HERD (BS106)

Hunt Area	Type	Dates of Seasons		Quota	License	Limitations
		Opens	Closes			
6	1	Aug. 15	Oct. 31	1	Limited quota	Any ram (1 nonresident)

Special Archery Seasons

Hunt Area	Season Dates		Limitations
	Opens	Closes	
6	Aug. 1	Aug. 14	Refer to Section 3 of Chapter 9

Management Evaluation

Management Strategy: Special
Population Objective Type: Alternative, Bighorn Sheep

Objectives:
1. Achieve a 5-year average harvest age of 6-8 years,
2. Achieve a 5-year average hunter success of ≥ 50%, and
3. Document occurrence of adult rams in the population, especially on National Forest lands.

The Wyoming Game and Fish Department (WGFD) proposed changing the objective for the Targhee Bighorn Sheep Herd from a postseason population objective to an alternative population objective in 2014. The objective change was needed at the time because the herd was rarely surveyed due to budget constraints, challenging weather conditions, and spreadsheet models do

not appear to adequately simulate observed population trends. Alternative population objectives were adopted in 2014 (listed above).

Objective 1 – *currently met*
One hunter hunted in the Targhee Herd in 2018 (1 resident), but was not successful. The 5-year average age of harvested rams is 7 years-old. Therefore, the first objective of a 5-year average harvest age of 6-8 years is currently met.

Objective 2 – *not currently met*
In 2018, hunter success was 0%. The 5-year average hunter success is 44%, which is below the objective of ≥ 50%. Success is highly variable year to year due to extremely challenging terrain and movement of sheep between the open hunt area and Grand Teton National Park (GTNP).

Objective 3 – *partially met*
Staff from WGFD, GTNP, Bridger-Teton National Forest (BTNF), and CTNF conducted 5 days of bighorn sheep ground surveys in GTNP and Hunt Area 6 during August 2018. No rams were observed in Hunt Area 6, although some were observed in GTNP. Mature rams were observed in Hunt Area 6 and GTNP during the December 2018 mid-winter trend count. This objective was therefore only partially met in 2018.

Herd Unit Issues

The current objective and management strategy for this herd will be maintained based on internal discussions and conversations with our constituents. Population status was evaluated and it was determined a change is not warranted at this time. These objectives will be reviewed again in 2024; however, if a situation arises that requires immediate change, proposals will be developed and submitted as needed.

This is Wyoming's smallest and most isolated core, native bighorn sheep herd. Current bighorn sheep occupied habitat is located at high elevations year-round in the Teton Range, mostly in GTNP. Bighorn sheep winter on high elevation, windswept ridgelines and winter habitat is most likely the limiting factor for this population. The herd is vulnerable to several stressors including disturbance from winter recreation, competition and risk of disease transmission from an overlapping and increasing mountain goat herd, loss of historical migration and low elevation winter ranges, and low genetic diversity.

Weather

Spring and summer 2018 produced average moisture. Fall and early winter weather was relatively mild in the Teton Range. However, the Teton Range received a record amount of snowfall in February 2019, which caused windswept bighorn sheep winter ranges to become more constricted than normal. In addition, an unstable snowpack with high avalanche danger likely increased bighorn sheep mortality this winter. 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

A habitat treatment in Teton Canyon is currently in the planning stages to improve historical bighorn sheep winter and summer habitat. The WGFD is assisting Caribou-Targhee National Forest (CTNF) with vegetation monitoring pre and post-treatment. A prescribed burn is also planned to occur in Phillips Canyon on Bridger-Teton National Forest (BTNF) in the next 3-5 years, which would benefit bighorn sheep habitat. Please refer to the 2018 Annual Report Strategic Habitat Plan Accomplishments for Jackson Region habitat improvement project summaries (https://wgfd.wyo.gov/Habitat/Habitat-Plans/Strategic-Habitat-Plan-Annual-Reports).

Field Data

Winter aerial surveys of the Targhee Bighorn Sheep Herd and mountain goats were conducted in December 2018. A total of 81 sheep were observed during the 2018 survey (33 ewes, 9 lambs, 1 yearling ram, 33 mature rams (26 of these had >3/4 curl horns), and 5 unclassified sheep. This count was higher than the last four surveys when a total of 76 sheep (2017), 48 sheep (2016), 46 sheep (2015), and 57 sheep (2014) were observed. Sightability of sheep was very good this year due to fresh snow that allowed tracking sheep and also sheep were concentrated in open, high elevation areas.

Mountain goats were also surveyed at the same time in December 2018. A total of 88 mountain goats were observed (65 adults, 20 kids, 3 yearlings), which was an increase from 66 last year and 43 in 2016. The kid:adult ratio was 31:100. Assuming that half of the adults are nannies, the kid:nanny ratio is approximately 62:100. The mountain goat population is continuing to grow rapidly in the Teton Range. Mountain goats were also observed expanding into new areas and occurring in close proximity to bighorn sheep.

Harvest Data

In 2018, there was 1 hunter in the Targhee Herd (1 resident). The hunter was unsuccessful in harvesting a sheep.

Over the past 19 years (2000-2018), a total of 15 rams have been harvested in Hunt Area 6. All 15 rams have been harvested from the southern portion of the hunt area (generally from Teton Canyon to Moose Creek). The majority of harvest (12 of 15 rams) has occurred in the Teton Canyon/Wedge/Darby Canyon/Fossil Mountain area. This trend is likely due to relatively easier access on the southern end of the range. There are places in the north such as Red Mountain where sheep have been harvested in the past, but they require longer trips to access.

Population

This population is estimated to be approximately 100 animals.

Management Summary

It is encouraging that more bighorn sheep were observed during the 2018 winter survey than during surveys the previous four winters. However, WGFD managers are concerned that this herd remains vulnerable to local extirpation due to small numbers, low genetic diversity and isolation, increasing disturbance from backcountry recreation, loss of historic winter ranges, and a growing mountain goat population. Several of these issues are receiving prioritization and attention in 2019 from the Teton Range Bighorn Sheep Working Group. One license will be offered for this herd in 2019 (1 nonresident hunter).

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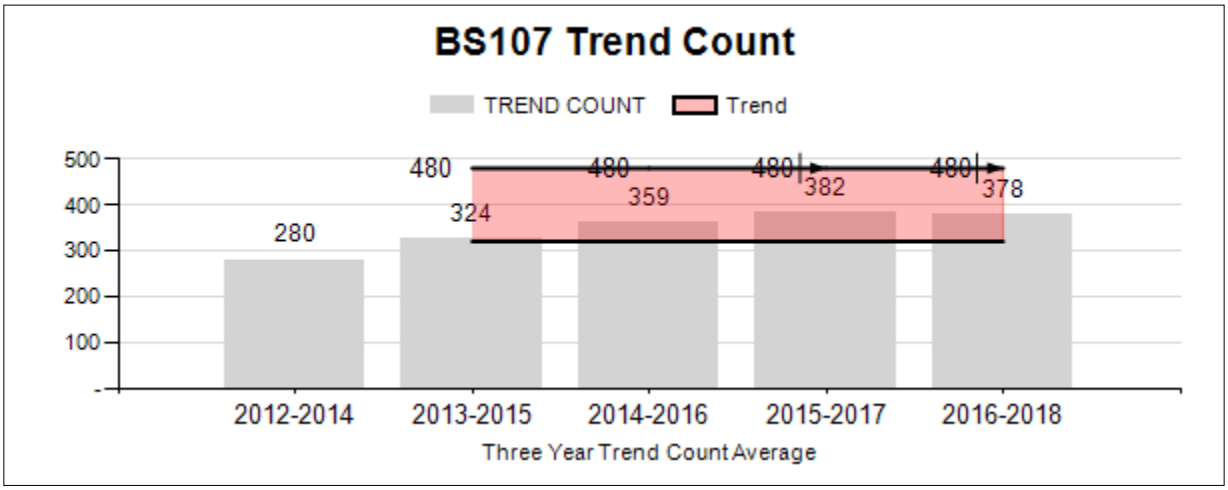
2018 - JCR Evaluation Form

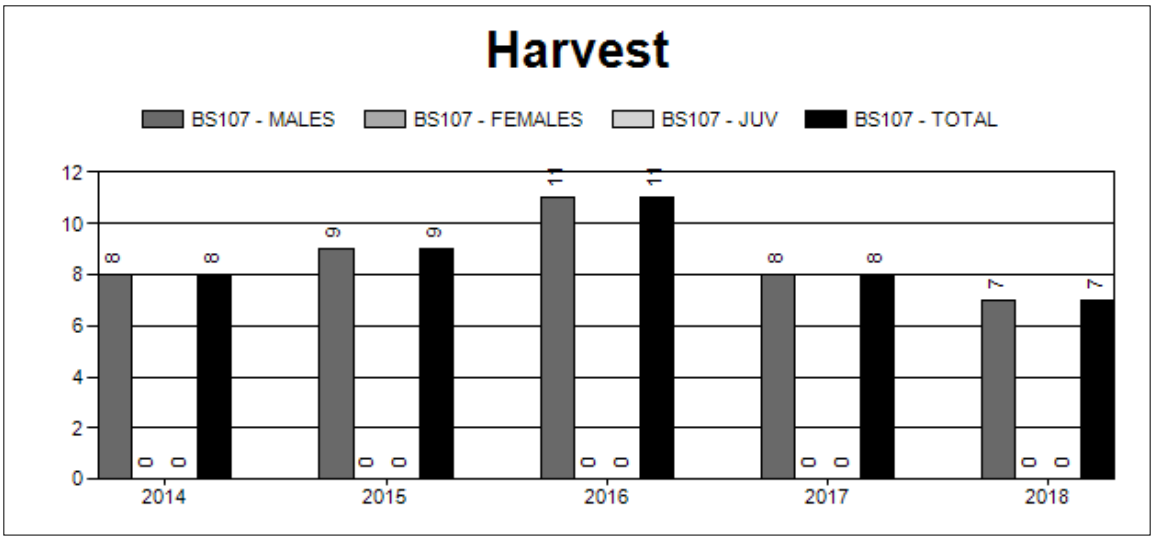
SPECIES: Bighorn Sheep
HERD: BS107 - JACKSON
HUNT AREAS: 7

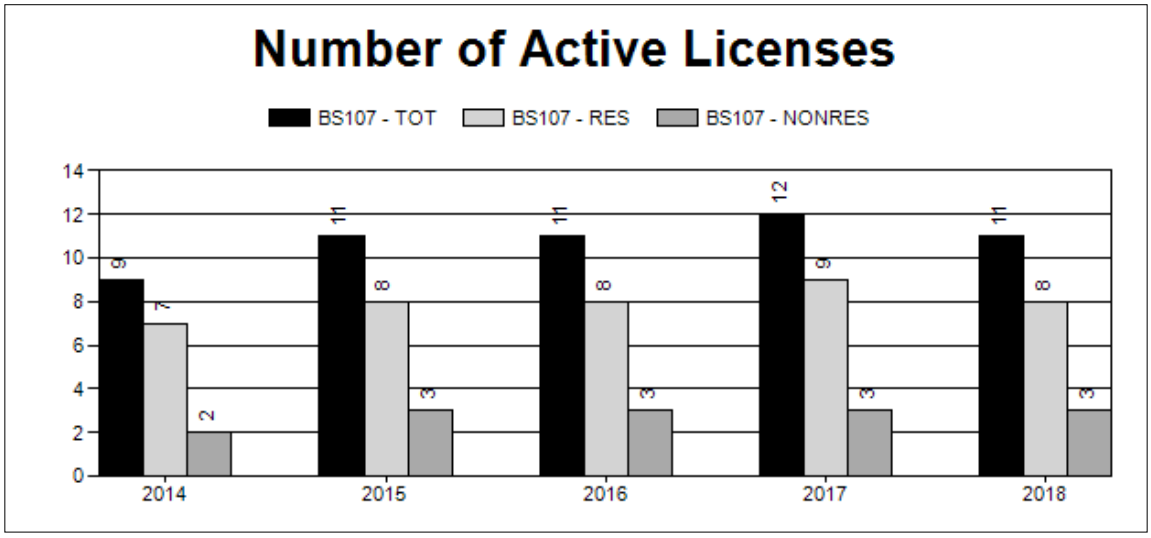
PERIOD: 6/1/2018 - 5/31/2019
PREPARED BY: ALYSON COURTEMANCH

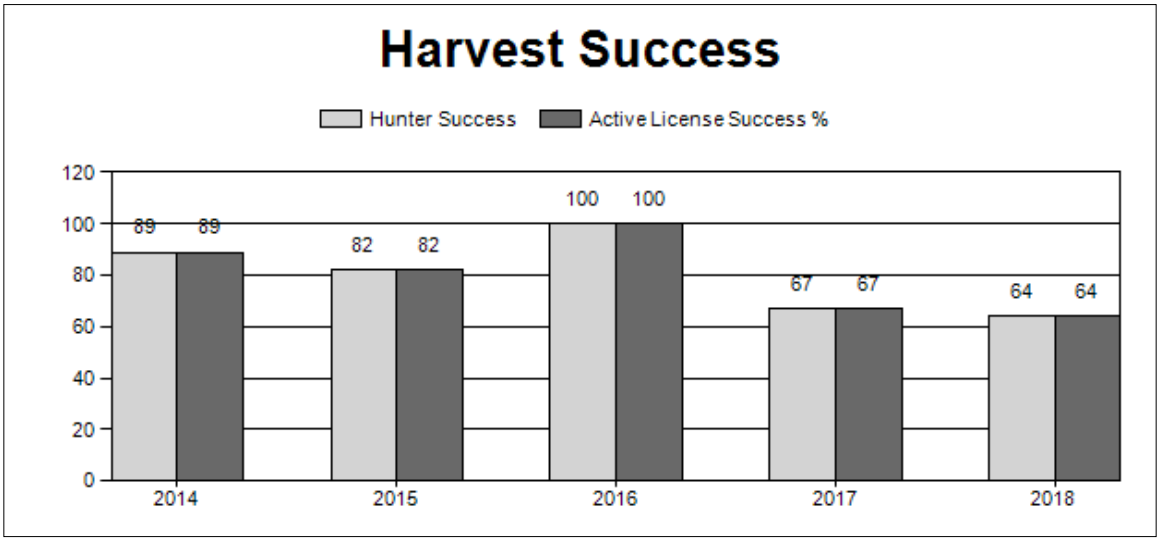
	2013 - 2017 Average	2018	2019 Proposed
Trend Count:	349	363	400
Harvest:	8	7	12
Hunters:	10	11	12
Hunter Success:	80%	64%	100 %
Active Licenses:	10	11	12
Active License Success	80%	64%	100 %
Recreation Days:	99	118	150
Days Per Animal:	12.4	16.9	12.5
Males per 100 Females:	47	41	
Juveniles per 100 Females	34	49	

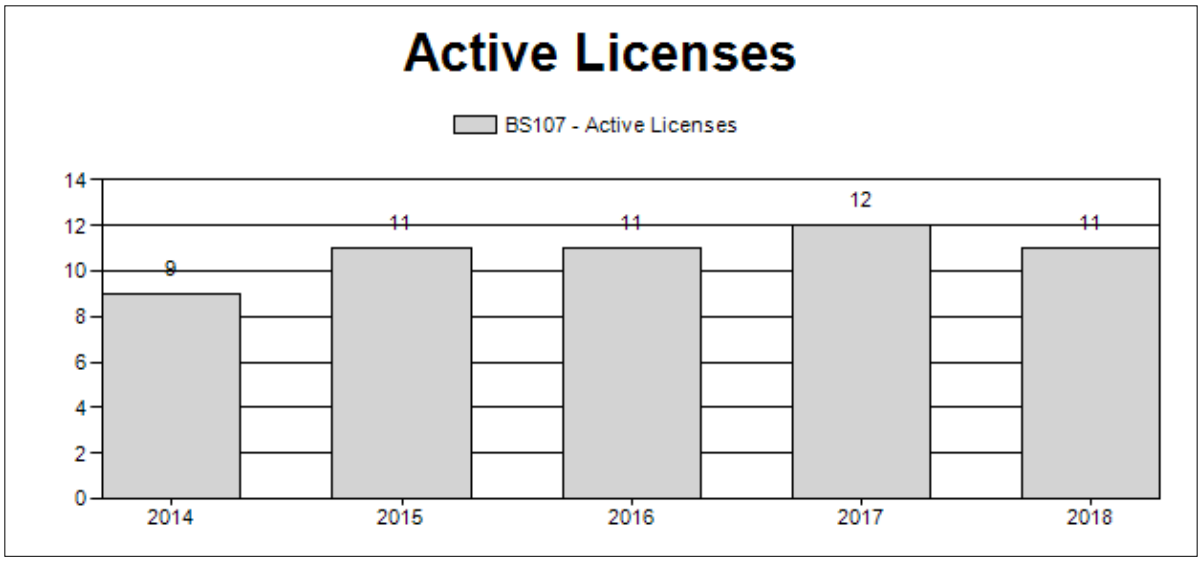
Trend Based Objective (± 20%)	400 (320 - 480)
Management Strategy:	Special
Percent population is above (+) or (-) objective:	-9.2%
Number of years population has been + or - objective in recent trend:	7

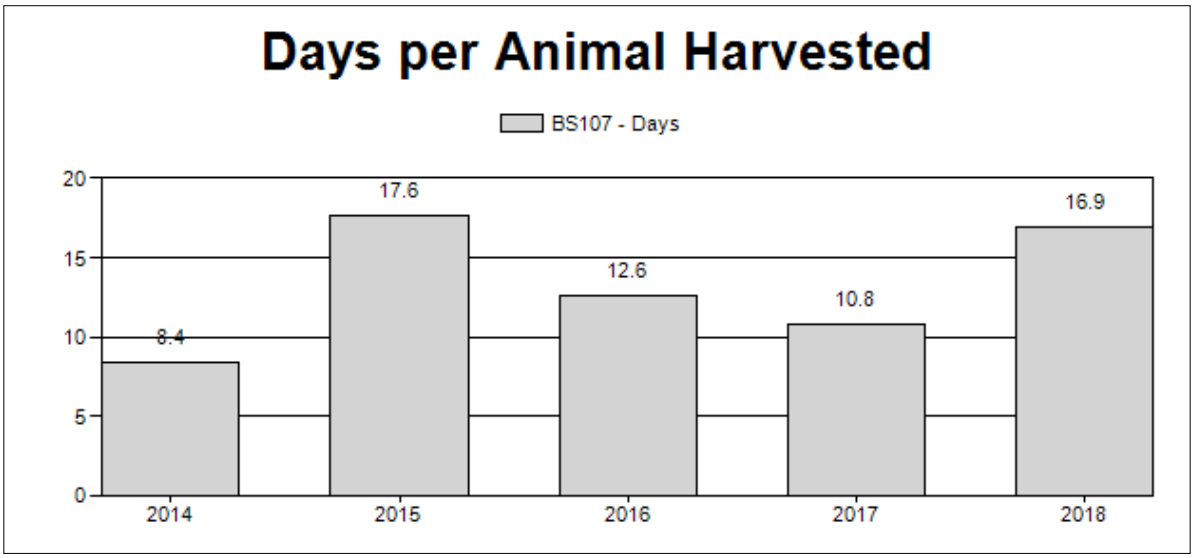


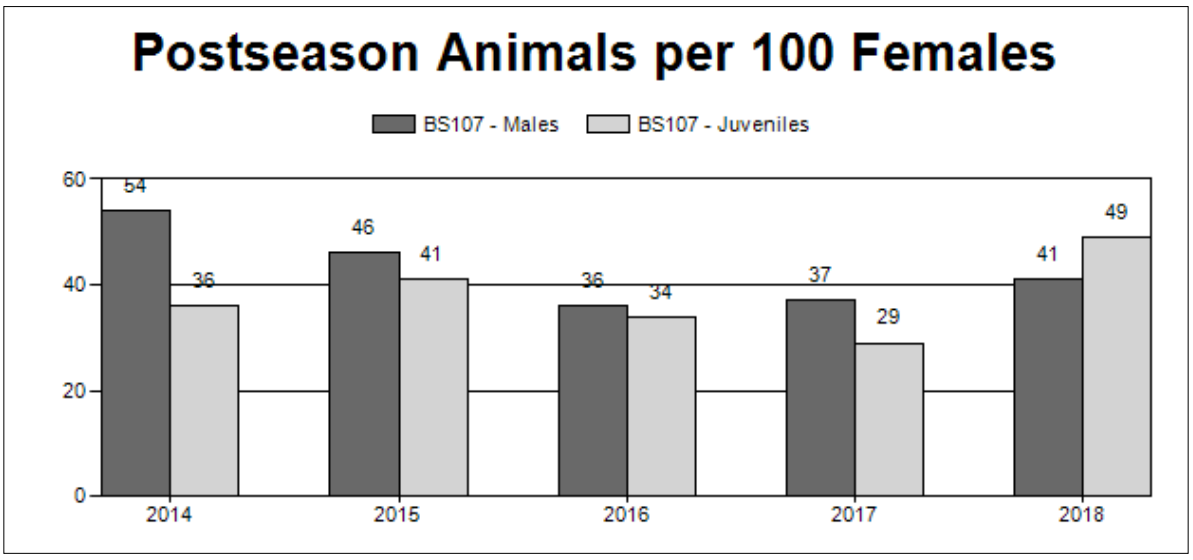

Harvest
BS107 - MALES
BS107 - FEMALES
BS107 - JUV
BS107 - TOTAL
12
10
8
6
4
2
0
8 0 0 8
9 0 0 9
11 0 0 11
8 0 0 8
7 0 0 7
2014
2015
2016
2017
2018


Number of Active Licenses
BS107 - TOT
BS107 - RES
BS107 - NONRES
14
12
10
8
6
4
2
0
9 7 2
11 8 3
11 8 3
12 9 3
11 8 3
2014
2015
2016
2017
2018


Harvest Success
Hunter Success
Active License Success %
120
100
80
60
40
20
0
89 89
82 82
100 100
67 67
64 64
2014
2015
2016
2017
2018


Active Licenses
BS107 - Active Licenses
14
12
10
8
6
4
2
0
9
11
11
12
11
2014
2015
2016
2017
2018


Days per Animal Harvested
BS107 - Days
20
15
10
5
0
8.4
17.6
12.6
10.8
16.9
2014
2015
2016
2017
2018


Postseason Animals per 100 Females
BS107 - Males
BS107 - Juveniles
60
40
20
0
54
36
46
41
36
34
37
29
41
49
2014
2015
2016
2017
2018

2014 - 2018 Postseason Classification Summary
for Bighorn Sheep Herd BS107 - JACKSON

		MALES				FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Post Pop	Ylg	Adult	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Yling	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2014		10	84	94	28%	173	52%	63	19%	330	285	6	49	54	± 4	36	± 3	24
2015		12	75	87	25%	188	53%	77	22%	352	0	6	40	46	± 0	41	± 0	28
2016		7	70	77	21%	215	59%	74	20%	366	221	3	33	36	± 0	34	± 0	25
2017		4	84	88	22%	240	60%	70	18%	398	240	2	35	37	± 0	29	± 0	21
2018		3	76	79	22%	191	53%	93	26%	363	260	2	40	41	± 0	49	± 0	34

2019 HUNTING SEASONS
JACKSON BIGHORN SHEEP HERD (BS107)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
7	1	Sep. 1	Oct. 31	12	Limited quota	Any bighorn sheep

Special Archery Seasons

Hunt Area	Type	Season Dates		Limitations
		Opens	Closes	
7	1	Aug. 15	Aug. 31	Refer to Section 3 of Chapter 9

Management Evaluation

Mid-Winter Trend Count Objective: 400 ± 20% (320-480 sheep)
Secondary Objective: Maintain a 3-year running average age of harvest rams 6-8 years old
Management Strategy: Special
2018 Mid-Winter Trend Count: 363
3-Year Mid-Winter Trend Average (2016-2018): 378
Evaluation: At objective

The mid-winter trend count objective for the Jackson Bighorn Sheep Herd is 400 sheep ± 20% (320-480 sheep). The management strategy is special and the objective and management strategy were last revised in 2015. The herd objective was publicly reviewed in 2015 and changed to a mid-winter trend count objective of 400 sheep because spreadsheet models do not adequately

simulate population trends. The current trend count is 363 sheep, which is within the objective range.

The secondary objective for the herd is to maintain a 3-year running average age of harvested rams between 6-8 years old. Currently, this objective is being met. The average age of harvested rams in 2018 was relatively low at 5.5 years (max = 11.5 years). However, the average age from 2016-2018 is 7.5 years.

Herd Unit Issues

This population is currently within the objective of 400 sheep ± 20% (320-480 sheep). Although the trend count is within the objective range, managers would like to see this herd continue to grow. The population experienced a pneumonia-related die-off in 2002 and again in 2012. An estimated 30% of the population died during the latest pneumonia event. However, lamb survival rebounded within a couple of years after both outbreaks, leading to relatively quick herd recoveries. The lamb ratio was relatively high again during the 2018 mid-winter trend count at 49 lambs:100 ewes. There is ongoing surveillance in the herd to detect pneumonia symptoms and potential die-off events.

Weather

Spring and summer 2018 produced average moisture. Fall and early winter weather was very mild with warm temperatures and little snowfall at high elevations. The mild fall weather may have impacted hunter success because bighorn sheep migrated to low elevations after the season was over. Large snowstorms occurred in February that resulted in the rapid accumulation of a deep snowpack. Snowfall totals in February nearly surpassed the local record in Jackson Hole. At the time of the mid-winter survey in February 2019, winter snowpack was reported at 115% of average in the Snake River Basin. In general snow depths were greater in the low elevation valleys in Jackson Hole compared to the Gros Ventre drainage. 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 were no significant habitat treatment projects or wildfires in the herd unit in 2018. Please refer to the 2018 Annual Report Strategic Habitat Plan Accomplishments for Jackson Region habitat improvement project summaries (https://wgfd.wyo.gov/Habitat/Habitat-Plans/Strategic-Habitat-Plan-Annual-Reports).

Field Data

In February 2019, classification surveys were flown over low and high elevation winter ranges. A total of 363 sheep were observed including 190 females, 93 lambs, 76 adult males (including 53 rams ≥3/4 curl), 3 yearling males, and 1 unclassified sheep. Herd unit ratios were 49

lambs:100 ewes and 40 adult rams:100 ewes. The lamb ratio is the highest it has been since the last pneumonia die-off in 2011/2012.

Harvest Data

Harvest data from 2018 indicate that 11 hunters harvested 7 rams (64% success). The herd has had relatively low harvest success in 2018 and 2017. It is unclear why this has occurred. The average age of harvested rams in 2018 was 5.5 years (max 11.5 years). In 2017, it was 8.3 years (max = 10.3 years). Based on classification surveys and the number of mature rams observed, ram harvest has not affected the ability of the population to grow. Managers are maintaining licenses at 12 for 2019.

Population

The mid-winter trend count observed 363 sheep. Past trends seem to indicate that pneumonia outbreaks may occur when the population reaches 500-600 animals. Currently, the population is increasing due to lamb recruitment and may approach this number within 5 years. Therefore, the public and managers should monitor the herd closely and anticipate another pneumonia outbreak in the near future.

Management Summary

Trend data indicate that the Jackson Bighorn Sheep Herd has recovered relatively quickly from a pneumonia outbreak in 2012. Overall numbers have steadily increased since the outbreak and lamb:ewe ratios continue to be relatively high. Based on past history, pneumonia outbreaks may occur when the population reaches 500-600 animals. Therefore, another outbreak could be expected within 5 years. Due to the population growth and availability of rams, 12 licenses will be offered in 2019. The WGFD plans to continue to monitor the population using radio-collars, disease sampling, and body condition measurements in 2019 to learn more about the interaction of respiratory pathogens, body condition, and population density in causing pneumonia outbreaks.

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APPENDIX A

Wyoming Bighorn Sheep and Mountain Goat Survival Summary Report

Collaborative Greater Yellowstone Area Mountain Ungulate Research Effort

December 2018

Blake Lowrey, Jay Rotella, and Robert Garrott

Overview

Accurate estimates of vital rates are fundamental for understanding population processes and crafting effective management programs of wildlife populations. Population growth is explicitly described by several vital rates: adult survival, fecundity, juvenile survival, immigration, and emigration. Of these, adult female survival has the strongest potential to influence population growth rates of large ungulates (Gaillard 1998). We worked with regional collaborators to combine survey and collar data across multiple bighorn sheep and mountain goat herds to estimate adult female survival rates throughout Wyoming and surrounding areas. We used VHF and store-on-board GPS radio-collars equipped with mortality sensors which allowed for known-fate survival estimation. Monitoring frequency varied between herds and ranged from a single spring and fall flight for VHF signals to daily monitoring of satellite-linked collars. The wide survival monitoring intervals often precluded cause of death determination, which is not detailed in this report.

Methods

Herd delineations

Herd delineations largely adhered to state hunt areas for both bighorn sheep and mountain goats, although we combined some adjacent units to overcome small sample sizes (Table 1).

Table 1. Bighorn sheep and mountain goats herd delineations, WY, USA.

Species	Hunt areas	
	Name	**Description and aggregate areas**
Bighorn sheep	Clark's Fork	The Clark's Fork hunt area as well as animals in the northeast corner of YNP (i.e. The Thunderer) and adjacent areas.
	Franc's Peak	The Franc's and Yount's Peaks hunt areas, as well as the Dubois Badlands.
	GTNP	Grand Teton National Park
	Jackson	The Jackson hunt area
	Trout Peak	The Trout Peak hunt area
	Wapiti Ridge	The Wapiti Ridge hunt area
Mountain goats	Snake River Range (SRR)	Snake River Canyon in WY and the Palisades in ID
	Clark's Fork	Hunt areas 1 and 3 in WY as well as animals in the northeast corner of YNP (i.e. The Thunderer) and adjacent areas

Analysis

Survival rates were estimated in Program MARK using a known-fate analysis (White and Burnham 1999) conducted via the nest-survival module (Dinsmore et al. 2002, Rotella et al. 2004), which is appropriate for telemetry data collected according to an irregular schedule and where each animal's fate is known but the exact dates for mortality events are not all known. This approach has been used in a variety of studies of survival of radio-marked individuals in recent years (e.g., Colwell et al. 2007, Mong and Sandercock 2007, Buckley et al. 2015). The model estimated a unique survival rate for each species, herd, and season. Seasons were defined as 1) winter (December through May) and 2) summer (June through November) and accommodated the varied capture schedules across the region. We derived seasonal survival rates by raising estimated daily survival rates (DSR) for each season to the number of days in each season (estimated survival rate for winter = $\widehat{DSR}_{winter}^{182.5}$; estimated survival rate for summer = $\widehat{DSR}_{summer}^{182.5}$). The seasonal survival rates were then multiplied together to obtain estimates of annual survival. Although we estimated seasonal survival rates for all years, many of the beginning and ending years had low sample sizes (Table 2), and estimates from those years should be interpreted with caution. We used the delta method to derive measures of uncertainty (Seber 1982, Powell 2007) for seasonal and annual rates. We used program R (R Development Core Team 2017) to 1) implement the Program MARK analyses through the RMark package (Laake 2013) and 2) the delta method through the msm package (Jackson 2011).

Table 2. Annual sample sizes of instrumented bighorn sheep and mountain goats.

Species	Herd	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
BHS	Clarks Fork	0	0	0	0	0	13	15	21	17	16	14
	Francs Peak	0	0	0	0	0	0	13	19	15	20	12
	GTNP	20	26	23	19	0	0	0	0	0	6	11
	Jackson	0	0	2	10	17	18	19	25	24	26	19
	Trout Peak	0	0	0	0	1	4	10	13	15	12	9
	Wapiti Ridge	0	0	0	0	4	4	0	12	24	33	29
MTG	Clarks Fork	0	0	0	0	0	14	18	25	23	17	11
	SRR	0	0	0	0	3	8	21	19	19	8	0

Results

Bighorn sheep

Bighorn sheep survival rates were variable between seasons and among years and herds (Figures 1-6). Winter survival rate estimates were generally lower than estimates for the summer season, which is a common pattern in large ungulate populations occupying higher latitudes. Variability in annual survival rate estimates was most notable for the Jackson and Trout Peak herds. Caution should be exercised in interpreting all single-season or annual survival estimates, however, as the

modest number of instrumented animals present in each herd resulted in relatively wide confidence intervals for most estimates (Table 3). In addition, for small sample sizes, it was often the case that no mortality events were recorded such that the corresponding estimated survival rate is 1.0. The estimates based on data pooled across years provide the best among-herd comparisons (Figure 7, Table 3). The pooled annual survival rates for the Wyoming bighorn sheep herds were similar across herds and ranged from 0.88 to 0.81 (mean = 0.84). Summer rates were high in all herds and ranged from 0.91 to 1.00 (mean = 0.97).

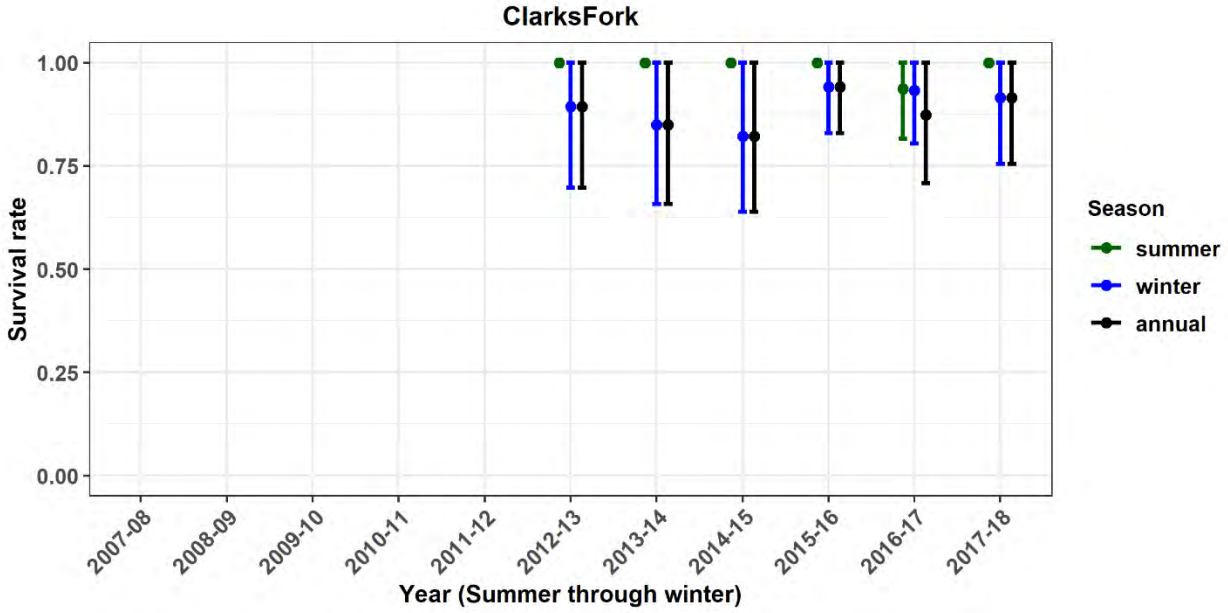

Figure 1. Yearly summer (green), winter (blue) and annual (black) survival rate estimates for bighorn sheep in the Clarks Fork hunt area.

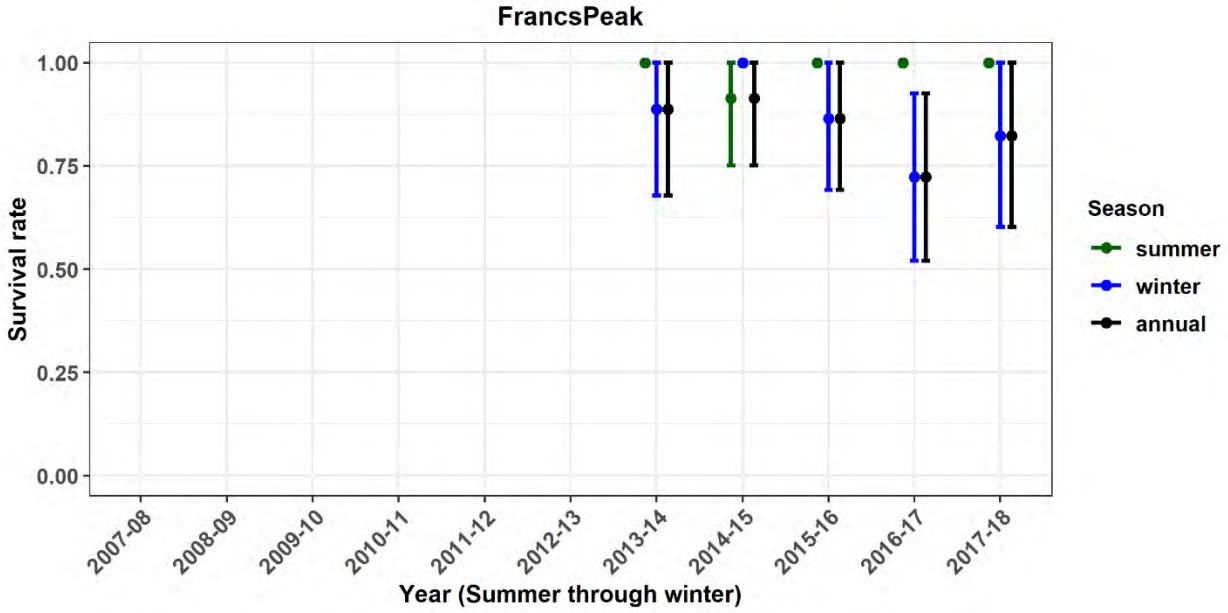

Figure 2. Yearly summer (green), winter (blue) and annual (black) survival rate estimates for bighorn sheep in the Francs Peak hunt area.

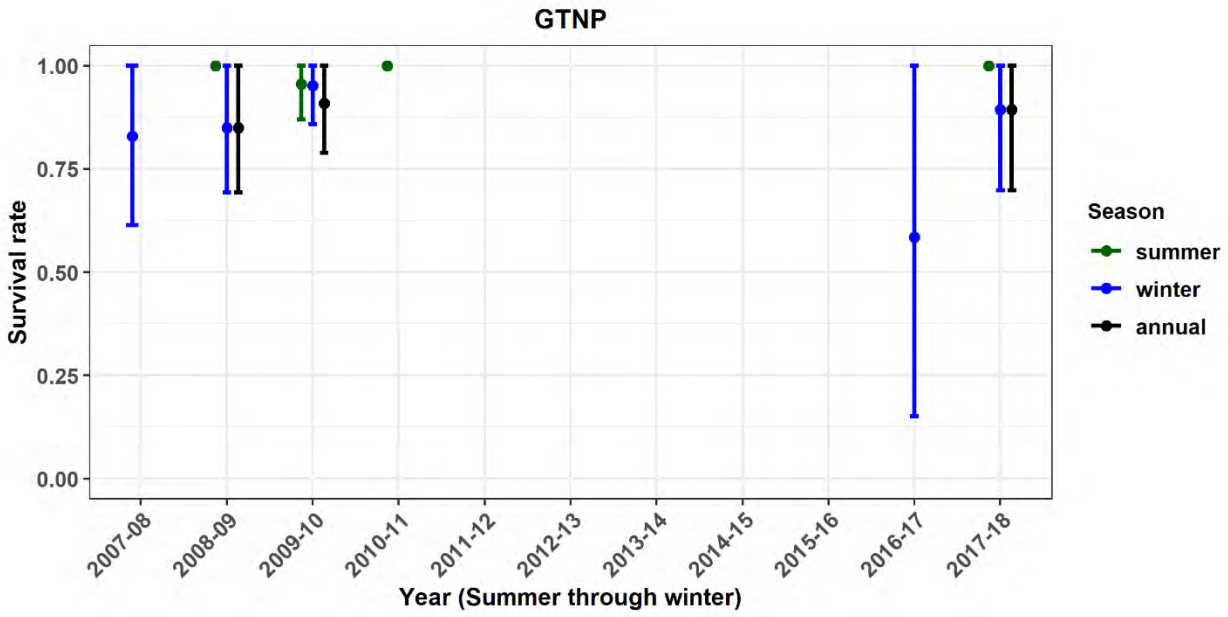

Figure 3. Yearly summer (green), winter (blue) and annual (black) survival rate estimates for bighorn sheep in Grand Teton National Park.

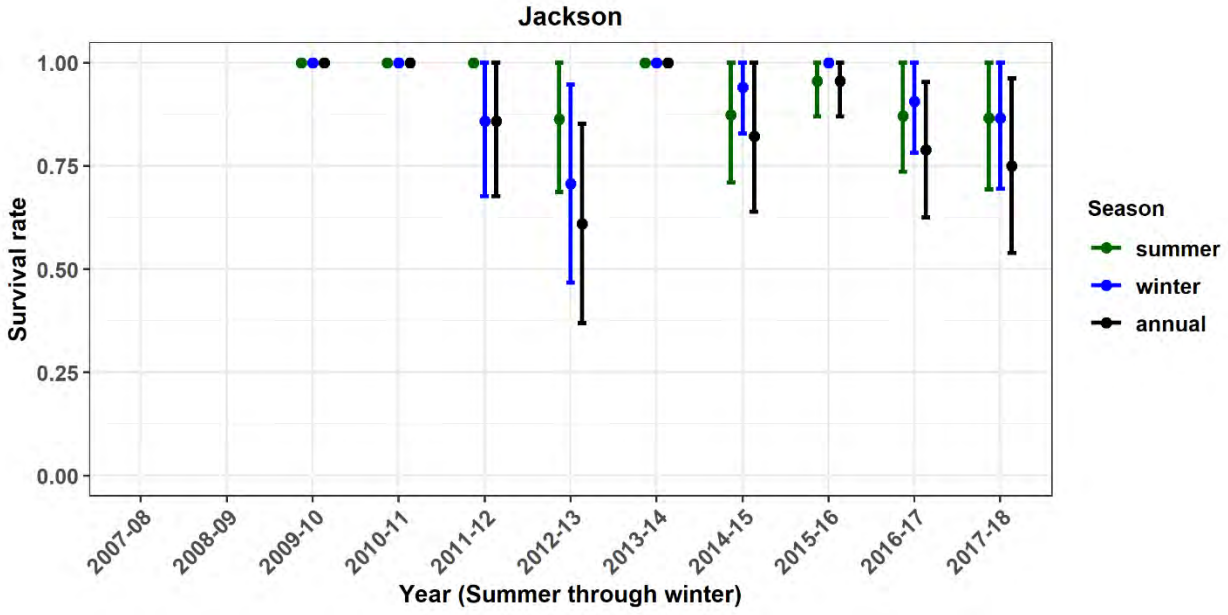

Figure 4. Yearly summer (green), winter (blue) and annual (black) survival rate estimates for bighorn sheep in the Jackson hunt area.

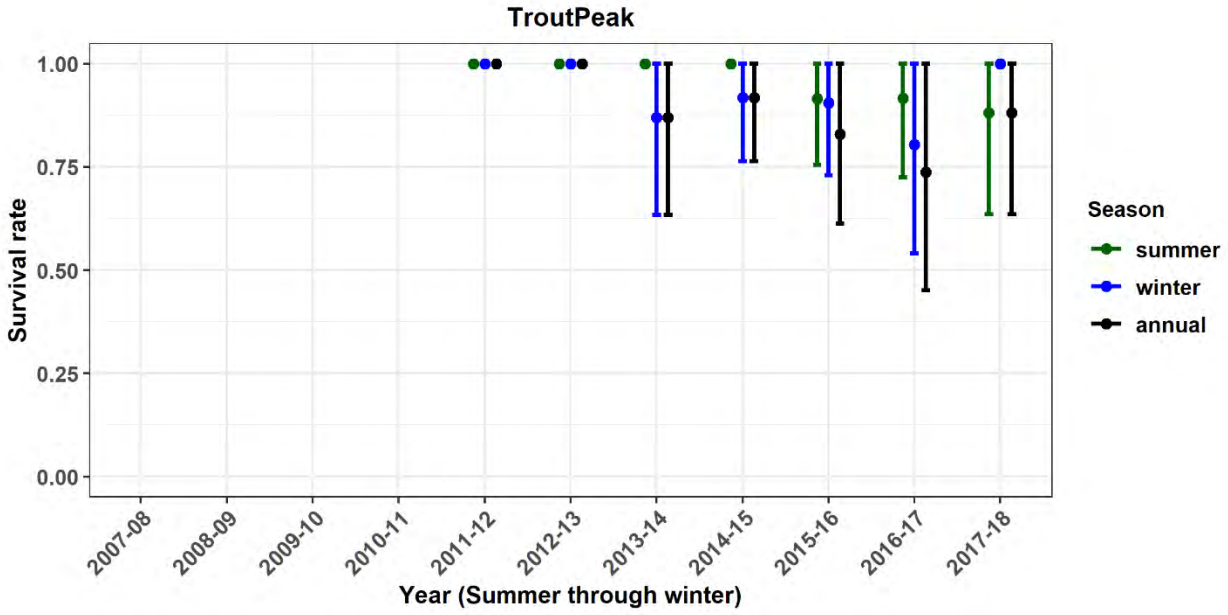

Figure 5. Yearly summer (green), winter (blue) and annual (black) survival rate estimates for bighorn sheep in the Trout Peak hunt area.

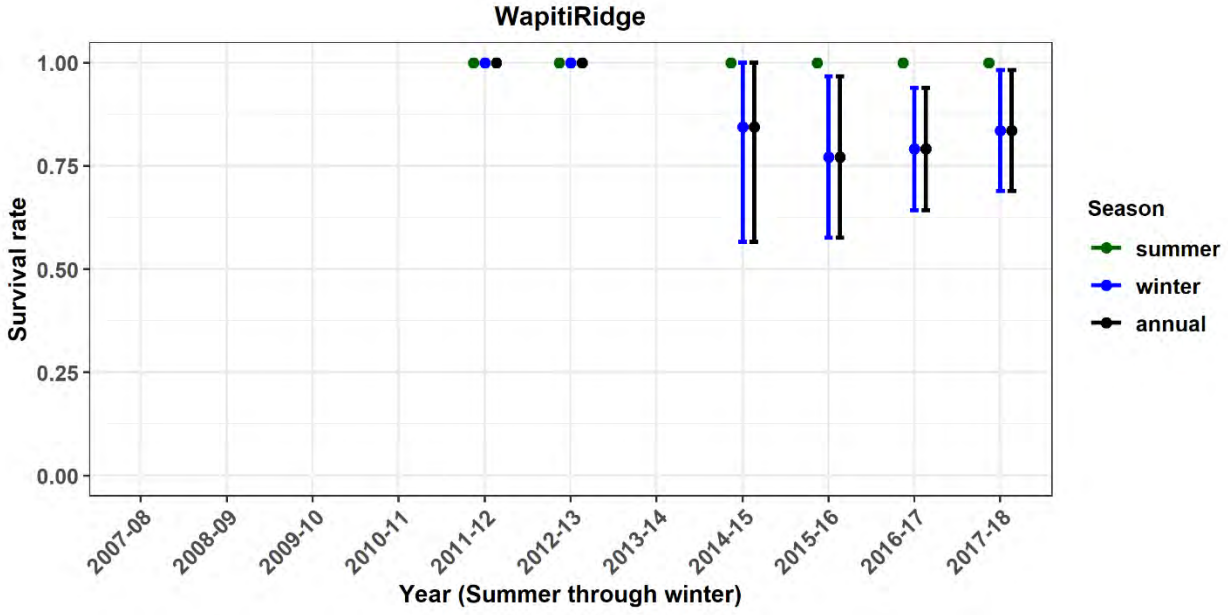

Figure 6. Yearly summer (green), winter (blue) and annual (black) survival rate estimates for bighorn sheep in the Wapiti Ridge hunt area.

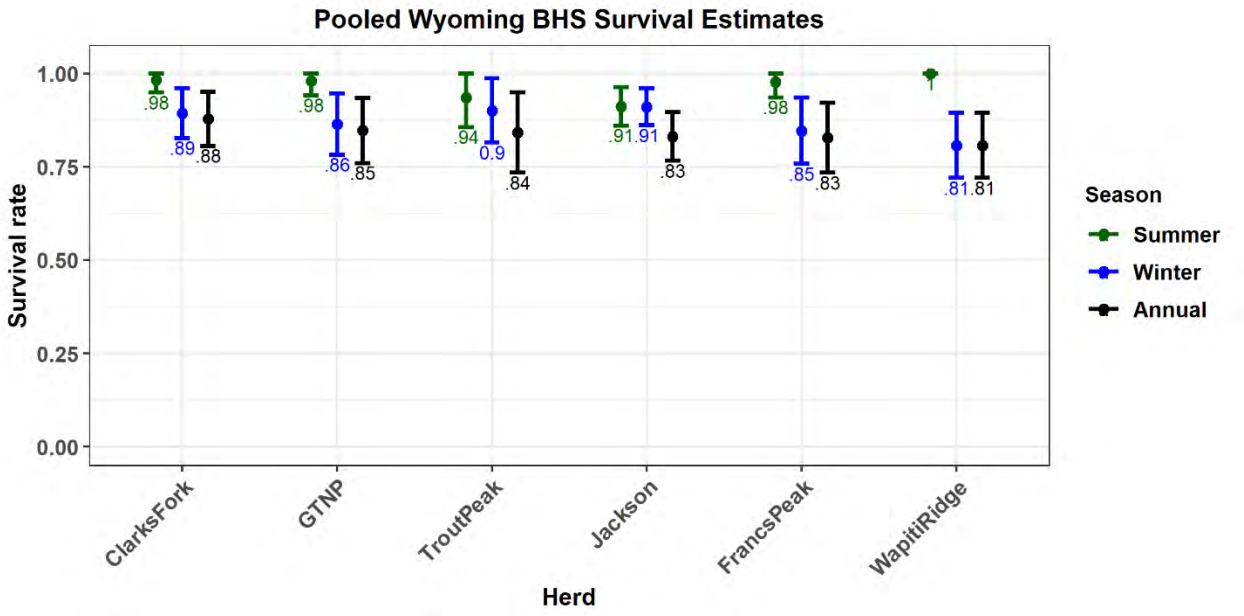

Figure 7. Pooled (across years) summer (green), winter (blue) and annual (black) survival rate, estimated for each bighorn sheep herd. Herds are ordered from highest to lowest annual survival rate. Estimated seasonal survival rates are shown below the respective point and confidence limit.

Table 3. Bighorn sheep annual, summer, and winter survival rates estimated with data pooled across multiple years (see Table 2), WY, USA.

Herd	Season	Est	Lower CI	Upper CI
Clarks Fork	Annual	0.878	0.806	0.951
	Summer	0.983	0.949	1.00
	Winter	0.894	0.827	0.961
Francs Peak	Annual	0.828	0.734	0.922
	Summer	0.978	0.936	1.00
	Winter	0.846	0.758	0.935
GTNP	Annual	0.847	0.76	0.934
	Summer	0.98	0.941	1.00
	Winter	0.864	0.782	0.947
Jackson	Annual	0.831	0.766	0.897
	Summer	0.912	0.86	0.964
	Winter	0.911	0.861	0.961
Trout Peak	Annual	0.842	0.734	0.95
	Summer	0.935	0.856	1.00
	Winter	0.901	0.815	0.987
Wapiti Ridge	Annual	0.807	0.72	0.895
	Summer	1.00	1.00	1.00
	Winter	0.807	0.72	0.895

Mountain goats

As with bighorn sheep, mountain goat survival rates were variable across seasons and years (Figures 8 and 9). In contrast to bighorn sheep, survival rates for winter were generally higher than estimates for the summer season. However, given the modest sample sizes (Table 2), the yearly estimates should be interpreted with caution. Survival rates of 1.0 or those associated with large confidence intervals are the result of low sample sizes in the beginning and ending years of the study. Among-herd comparisons are best made using survival estimates generated by pooling monitoring data across all years of the study (Figure 10) and show similarities between the Snake River Range (SRR) and Clark's Forks herds. Annual estimates ranged from 0.80 to 0.86. Survival rates were highest in winter and were similar in both study areas. Summer survival rates were slightly lower in the Clark's Fork herd when compared to rates for the SRR, although the confidence intervals broadly overlap (Figure 10, Table 4). There were three legally harvested mountain goats in each of the study areas during the summer season (June through November).

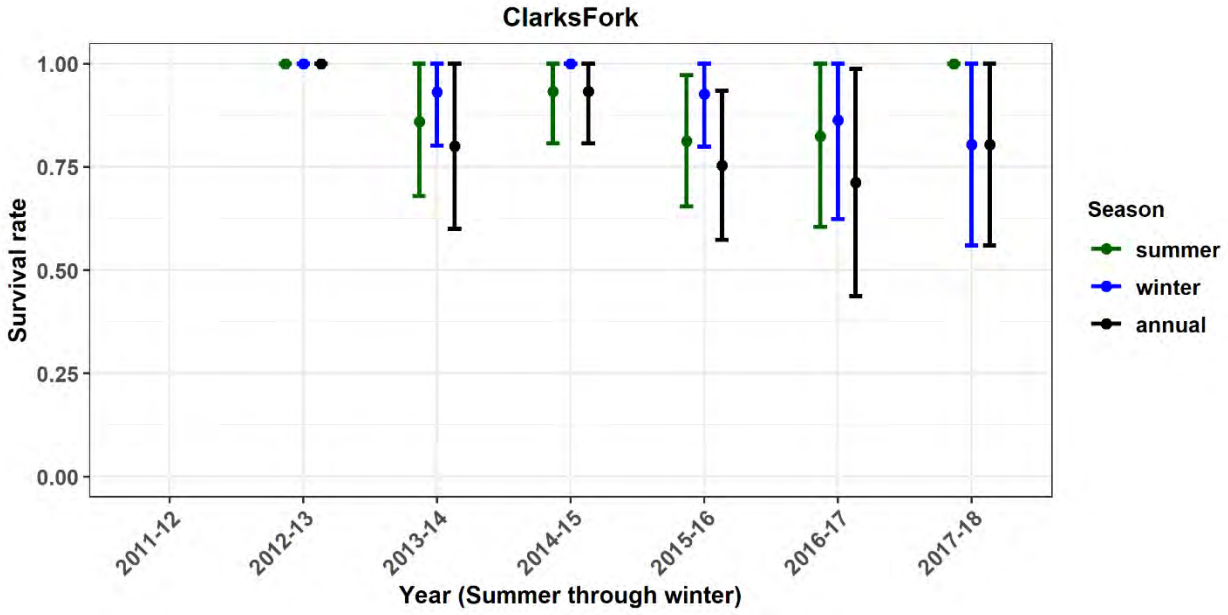

Figure 8. Yearly summer (green), winter (blue) and annual (black) survival rate estimates for mountain goats in the Clarks Fork hunt area.

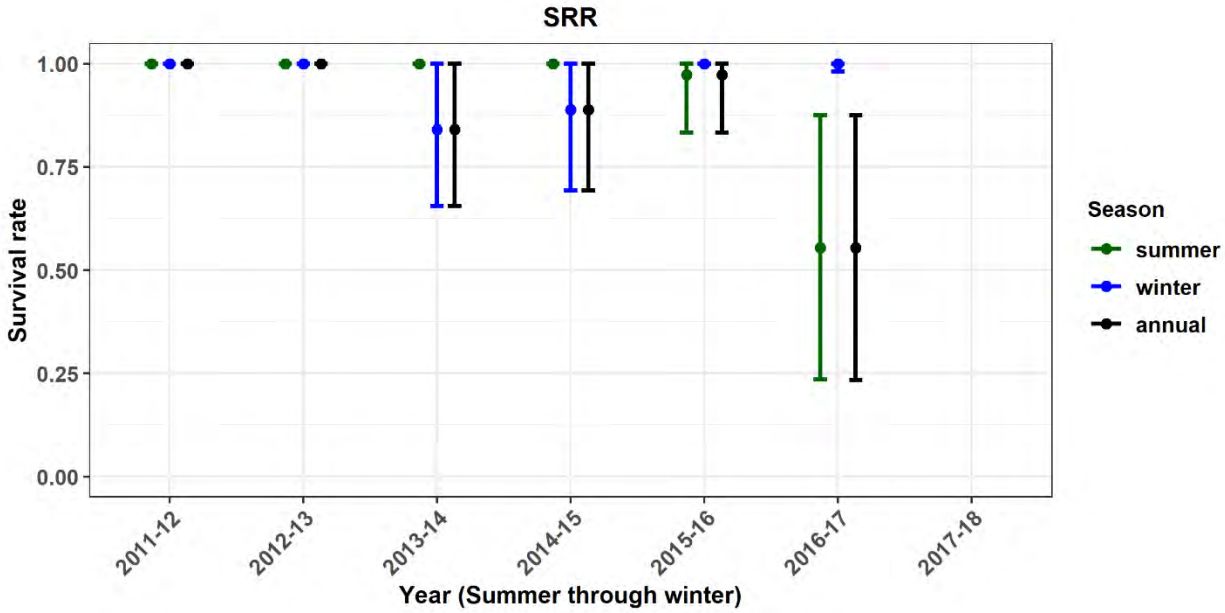

Figure 9. Yearly summer (green), winter (blue) and annual (black) survival rate estimates for mountain goats in the Snake River Range of ID and WY.

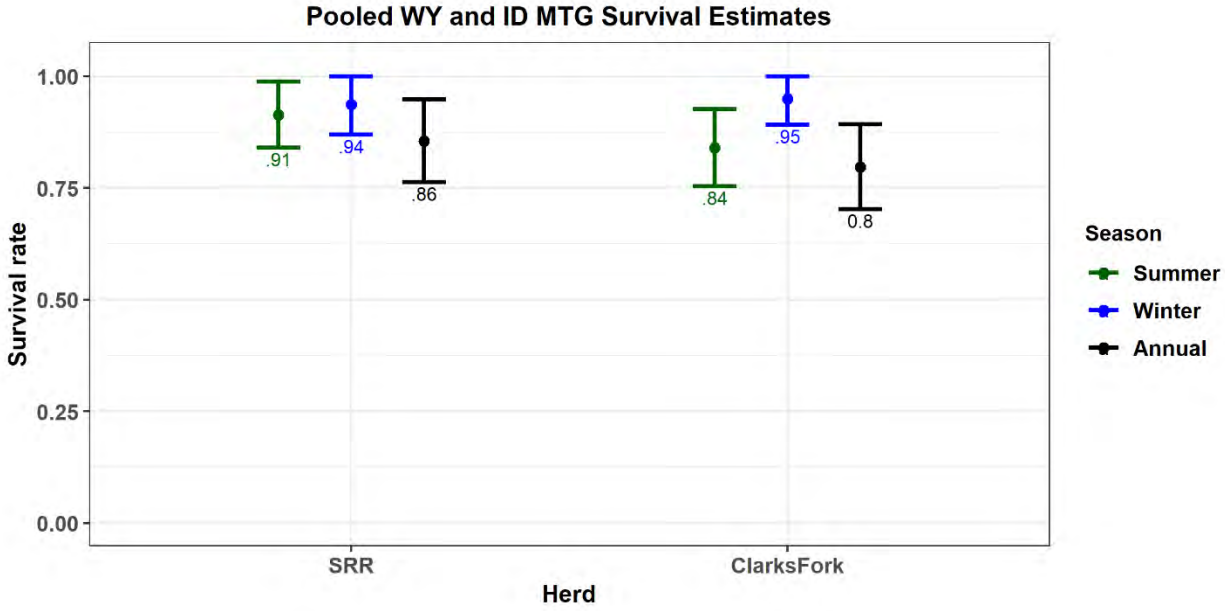

Figure 10. Pooled (across years) summer (green), winter (blue) and annual (black) survival rates, estimated for each herd. Estimated seasonal survival rates are shown below the respective point and confidence limit.

Table 4. Mountain goat annual, summer, and winter survival rates estimated with data pooled across multiple years (see Table 2), WY and ID, USA.

Herd	Season	Est	LowerCI	UpperCI
ClarksFork	Annual	0.797	0.702	0.892
	Summer	0.840	0.754	0.926
	Winter	0.949	0.891	1.000
SRR	Annual	0.855	0.762	0.948
	Summer	0.914	0.839	0.988
	Winter	0.936	0.869	1.000

Continued efforts

We will continue to work with regional collaborators to collect and aggregate monitoring data for the next 1 or 2 years before finalizing the survival estimates. We are open to including additional data not yet summarized in this report in future iterations. We also plan to investigate the annual variation in survival estimates within herd and among herd variation using climate and landscape attribute data once monitoring of instrumented animals is completed.

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APPENDIX B

BIGHORN SHEEP NUTRITION-DISEASE PROJECT

Project Background

The presence of epizootic pneumonia to bighorn sheep populations muddles the already complicated processes underlying population dynamics, and is often the culprit for massive crashes of sheep populations. Although pneumonia caused by bacterial respiratory pathogens is known to be the underlying driver of massive mortality events, the frequency and intensity of die-offs are inconsistent, and infections are not always manifested in disease. Therefore, die-offs may be dependent upon certain ecological or environmental conditions—the understanding of which could yield management alternatives to help reduce the frequency of outbreaks. Identifying how disease, nutrition, and population densities interact is critical in developing management options for and improving our understanding of pneumonia in bighorn sheep.

In Wyoming, the Statewide Bighorn Sheep Disease Surveillance Program, led by the Wyoming Game and Fish Department, has documented many bacterial pathogens in herds across the state. While some herds continue to do well, others have undergone repeated pneumonia outbreaks and recoveries, and others have never recovered from die-offs. By adding long-term research on bacterial pathogens, nutritional condition, survival, pregnancy, and lamb recruitment in female bighorn sheep from three herds over time to the ongoing Disease Surveillance Program, we can work to disentangle the relative roles of each of those components on crashes and recoveries of bighorn sheep populations throughout the state.

Bighorn Sheep Captures and Disease Sampling

Starting in March 2015, the Haub School of Environment and Natural Resources, Wyoming Cooperative Fish and Wildlife Research Unit, and the Wyoming Game and Fish Department, in collaboration with the US Fish and Wildlife Service, the Shoshone and Arapaho Tribes of the Wind River Indian Reservation, and the National Elk Refuge captured adult female bighorn sheep in the Jackson, Cody, and Whiskey herds of

northwest Wyoming. Each December and March thereafter, our objective was to recapture those same adult females to monitor how disease, nutritional condition, and reproduction of individuals varies seasonally. Adult females were captured via helicopter net-gunning (Jackson and Whiskey herds) and ground darting (Cody herd). Each subsequent winter and spring, we have attempted to recapture those females. In the spring of 2017, we expanded the project to include the Temple Peak herd and captured 11 animals from that population.

During captures, numerous disease-related samples are collected from each animal including nasal and tonsil swabs, feces, and blood by the Wyoming Game and Fish Department Wildlife Disease Laboratory and following protocols established through the Statewide Bighorn Sheep Disease Surveillance Program. We specifically test sheep for *Mycoplasma ovipneumoniae* (*M. ovi*), Leukotoxin of *Bibersteinia trechalosi*, *Manneheimia haemolytica*, other *Manneheimia* species, and *Pasteurella multocida,* all bacterial pathogens associated with symptomatic pneumonia. Based on test results from our 2015 – 2017 samples, the Cody, Jackson, and Dubois herds had similar pathogen prevalence. Future work will examine patterns of pathogen prevalence through time.

Assessing Nutritional Condition

Some of the most interesting results stem from nutritional dynamics across the different populations (Fig. 1). The Dubois herd appears to be nutritionally limited on their summer ranges, while experiencing adequate winter conditions. Conversely, the Jackson herd appears to have robust summer ranges, but experience poorer conditions when on winter ranges than the Dubois herd. Finally, the Cody winter and summer ranges appear to fall somewhere in between those in Dubois and Jackson.

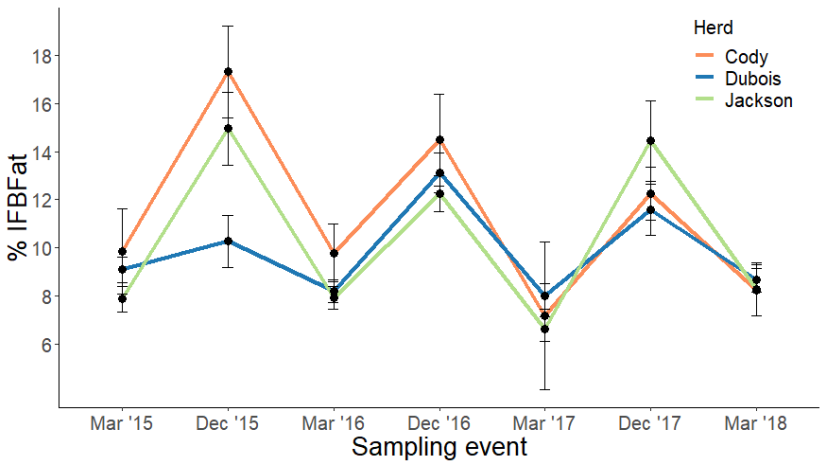


Figure 1. Ingesta-free body fat (%±SE) of adult female bighorn sheep from March 2015 to March 2018 in the Cody, Dubois, and Jackson herds.

Reproduction and Recruitment

Each spring, we determine pregnancy status of captured females, and if a female is pregnant, measure the eye diameter of her fetus. Size of eye diameters allows us to estimate growth of a fetus and predict parturition dates of the mother. Interestingly, pregnancy rate of the Dubois herd has remained relatively constant across the three years of this study, while pregnancy rate of Cody and Jackson herds has fluctuated some during the past 4 years (Fig. 2).

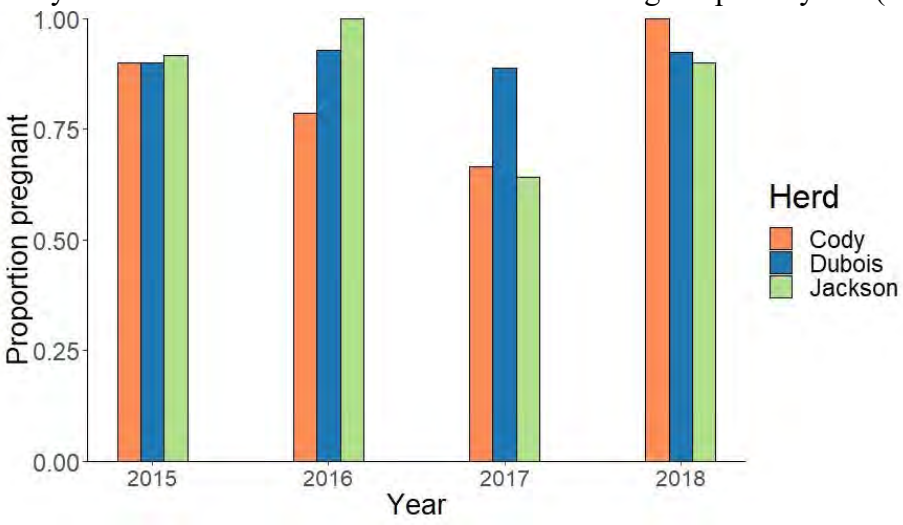


Figure 2. Proportion of pregnant adult female bighorn sheep in March 2015 - 2018 in the Cody, Dubois, and Jackson herds of northwest Wyoming.

Each fall, we conduct recruitment surveys in all three populations to determine which females successfully raised offspring through the summer. During winter captures, we also assess lactation status of females, which can provide additional evidence of recruitment (if a female is still lactating), or if she lost her offspring earlier in the summer or fall (if she is no longer lactating; Fig. 3). Successfully recruiting young often results in females entering winter in lower nutritional condition, which could have important implications for survival over winter. Notably, recruitment of young in Dubois has been very poor during most years.

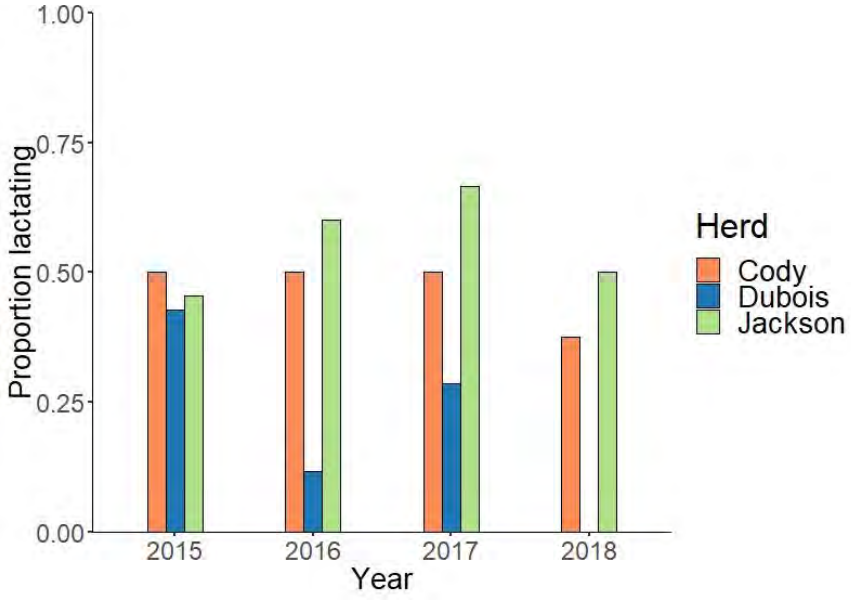


Figure 3. Proportion of adult female bighorn sheep that were lactating in December 2015, 2016, and 2017 in the Cody, Dubois, and Jackson herds of northwest Wyoming.

Disentangling the Interaction of Disease and the Environment on Bighorn Sheep Populations

Piecing together how nutrition, disease, and other vital rates of populations interact to influence the overall health and success of a herd is paramount in effective management of bighorn sheep populations. Our work thus far has demonstrated that nutrition is an important part of the equation when attempting to understand how population characteristics influence crashes and recoveries of bighorn sheep populations and may play one of the most important roles in regulating populations of bighorn sheep.

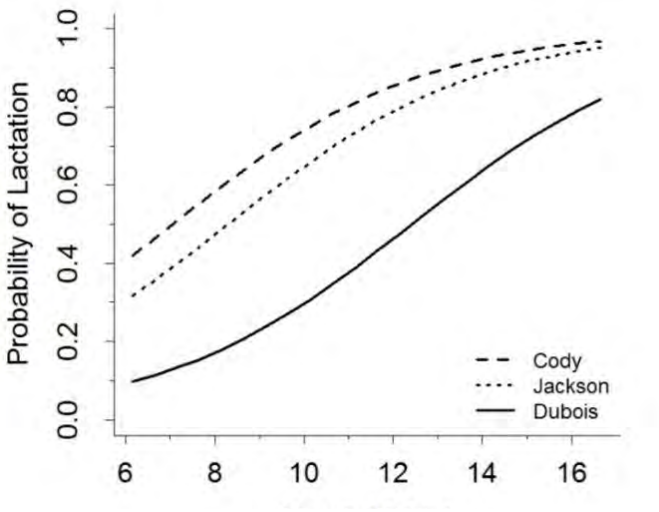


Figure 4. Probability that a female bighorn sheep was lactating (and therefore likely recruited offspring) in fall based on her ingesta-free body fat in spring for the Cody, Jackson, and Dubois herds.

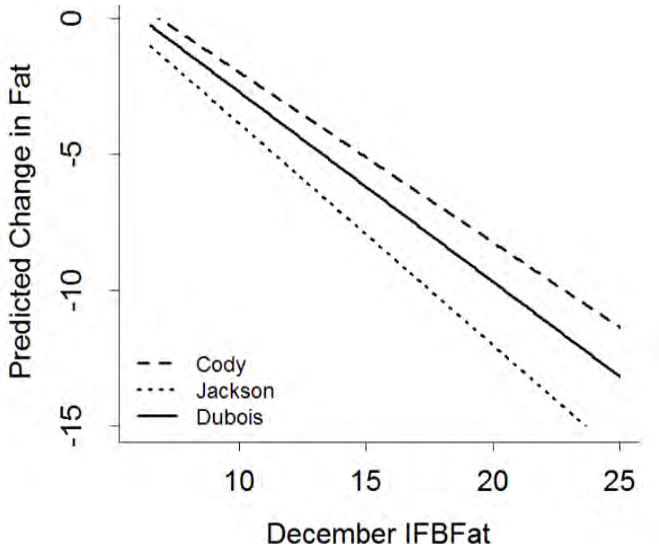


Figure 5. Predicted change in fat from fall to spring of female bighorn sheep based on her ingesta-free body fat in fall, weight in fall, age, and pregnancy status in spring, for the Cody, Jackson and Dubois herds.

Although efforts are still underway to process and analyze current data, a few meaningful and yet, intriguing patterns have emerged. First, through the longitudinal study design, which includes recaptures in both winter and spring, we have identified potential differences in the seasonal ranges of the three herds. This is especially important in Dubois, where summer ranges appear to be lacking in nutritional quality and potentially influencing recruitment of offspring, despite a relatively high and constant rate of pregnancy. In 2016, recruitment in the Dubois herd was surprisingly low and the costs of lactation (when females did successfully recruit young) was much higher in Dubois than in the other two ranges, providing further evidence that there are differences in the summer ranges among the three populations that influence performance and the condition that a female enters winter in.

We also observed a decline in the nutritional condition (in both autumn and spring) of females in the Jackson herd through time, which is linked to a decline in pregnancy rates of that population during those years. That corresponding change in both nutritional condition and pregnancy could be evidence of the Jackson herd reaching nutritional carrying capacity. Finally, despite some differences across the three ranges,

seasonal nutritional condition was linked strongly to pregnancy, recruitment of young and seasonal change in condition of bighorn sheep in northwestern Wyoming (Fig. 4 and 5).

Additionally, we saw that some individuals appear to be able to clear pathogens, while some individuals test positive every sampling event. Future work will dig into how nutritional condition and immune function interact for an individual to be able to tolerate and/or clear pathogens.

Understanding how nutrition, disease, survival, pregnancy, and lamb recruitment in female bighorn sheep from these three herds interact to influence population dynamics is critical in developing management plans to maintain healthy populations of one of our most cherished ungulate species in Wyoming.

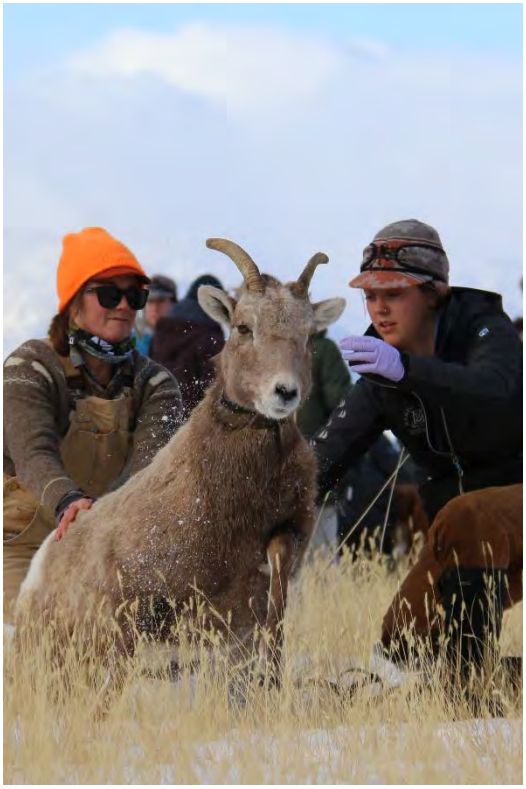
Summer 2018 Field Work

Two new Monteith Shop graduate students spent the summer in the Fitzpatrick and Gros Ventre Wilderness planning logistics for the next phases of the project. They hiked in on several collared animals to record group composition and collect fecal samples to use for preliminary analysis of summer diet. This will help inform us which plants are preferred throughout the summer in both ranges.

This mother-offspring pair had visible symptoms of pneumonia. Mom had not yet shed her winter coat long into July 2018 and was in very poor body condition. The lamb was audibly and visibly coughing. They were hanging out with another ewe-lamb pair in the same condition.

Moving Forward

Our efforts over the past four years of captures and monitoring of bighorn sheep in northwest Wyoming marks the first stage of a long-term research project to explore the disease-nutrition interface in bighorn sheep, and to develop an understanding of the range limits (i.e., nutritional carrying capacity) of our sheep populations in northwest Wyoming. With time, our goal is to piece together each female's history to describe how she interacts with her environment, understand her success to survive and reproduce or lack thereof, and how she fits within the population in which she resides. By piecing together the histories of each female we monitor, we hope to add an important piece to the puzzle of the complex interactions of environment, disease, and dynamics of our cherished bighorn sheep populations.



We will continue to recapture and monitor sheep in the Jackson, Cody, and Dubois herds until the winter of 2021, and expand several aspects of the study to assess the interaction of disease and the environment on success of bighorn sheep populations more carefully. First, to monitor the reproductive efforts of these populations more closely, we will capture and collar neonate bighorn sheep in the Dubois and Jackson herds in the summers of 2019, 2020, and 2021, monitor their survival, and identify causes of mortality. In addition to lamb captures, we will conduct small habitat and grazing treatments on the summer ranges of both the Dubois and Jackson herds to investigate links between historical grazing pressures and to investigate potential management tools. Furthermore, we hope to gain a better understanding of the foraging conditions of these populations and what factors limits those conditions through diet analysis and vegetation work on both summer ranges.

The fundamental components underlying any large ungulate population (e.g., habitat quality and quantity, and density dependent interactions) remain operational and yet, are often neglected when considering disease dynamics. Our work to date has demonstrated that indeed, infected populations are not immune from fundamental nutritional dynamics and instead, suggests that nutrition may well be a key explanatory factor, along with disease, of the disparity in performance across sheep herds in northwest Wyoming.

Through this work, we have the opportunity to more effectively manage bighorn sheep and their habitat through science, potentially demonstrate the value of hunting as a conservation and management tool if doing so may mitigate the effects of pneumonia. Moreover, implicit with our continued work is calibrating models of animal-indicated nutritional carrying capacity for Wyoming sheep, which will increase the toolset for managers to understand how habitat, density, and extrinsic factors such as predation or perhaps disease are regulating these and other populations of bighorn sheep.

Partners and Funders

This project would not be possible without the financial and logistical support of our research partners. Funding has been provided by the Wyoming Wildlife/Livestock Disease Research Partnership, Wyoming Governor's Big Game License Coalition, the Wyoming Wild Sheep Foundation, National Wild Sheep Foundation, Bureau of Land Management, Animal Damage Management Board, and Wyoming Game and Fish Department. We thank the Shoshone and Arapaho tribes for access to lands on the Wind River Indian Reservation, and to the US Fish and Wildlife Service for access to the National Elk Refuge for capture and research. We also thank the numerous folks who took time out of their busy schedules to assist with captures. Thanks to M. Gocke, T. LaSharr, and B. Wagler for photographs contained herein.

Wyoming Wildlife/Livestock Disease Research Partnership

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2018 - JCR Evaluation Form

SPECIES: Mountain Goat
HERD: MG101 - PALISADES
HUNT AREAS: 2

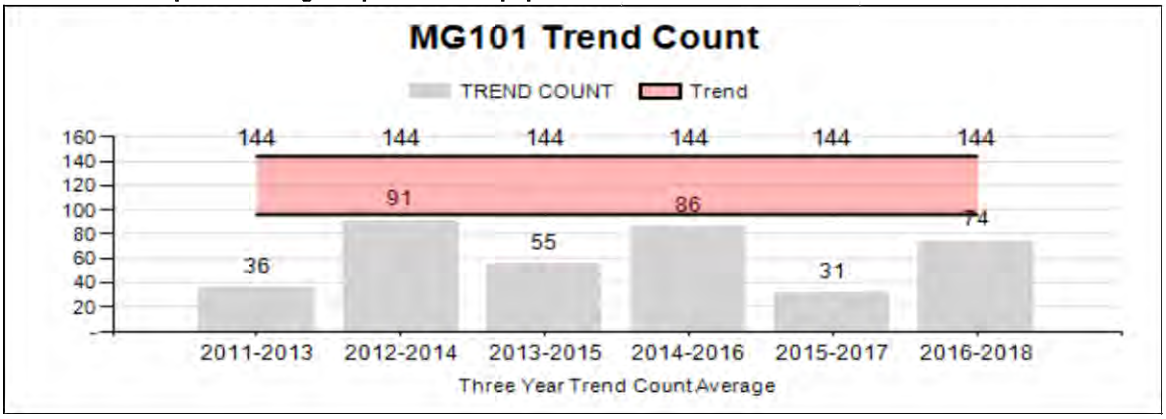
PERIOD: 6/1/2018 - 5/31/2019
PREPARED BY: GARY FRALICK

	2013 - 2017 Average	2018	2019 Proposed
Trend Count:	129	129	115
Harvest:	9	6	6
Hunters:	10	9	8
Hunter Success:	90%	67%	75 %
Active Licenses:	10	9	8
Active License Success	90%	67%	75 %
Recreation Days:	54	54	45
Days Per Animal:	6	9	7.5
Males per 100 Females:	0	0	
Juveniles per 100 Females	23	34	

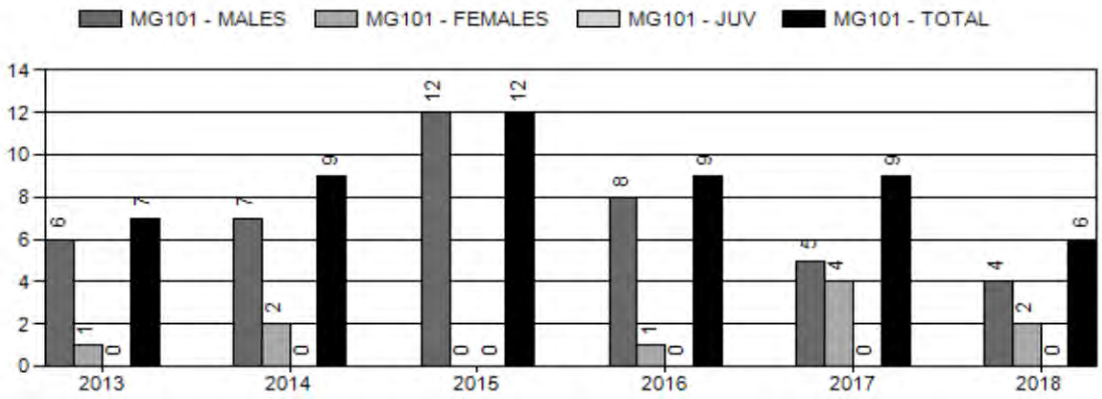
Trend Based Objective (± 20%)	120 (96 - 144)
Management Strategy:	Special
Percent population is above (+) or (-) objective:	8%
Number of years population has been + or - objective in recent trend:	7

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

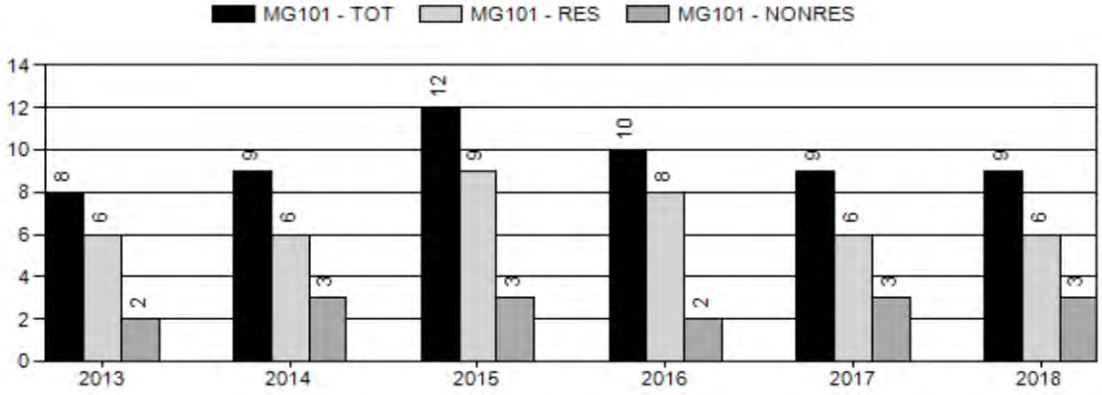
	JCR Year	Proposed
Females ≥ 1 year old:	NA%	NA%
Males ≥ 1 year old:	NA%	NA%
Juveniles (< 1 year old):	NA%	NA%
Total:	NA%	NA%
Proposed change in post-season population:	NA%	NA%



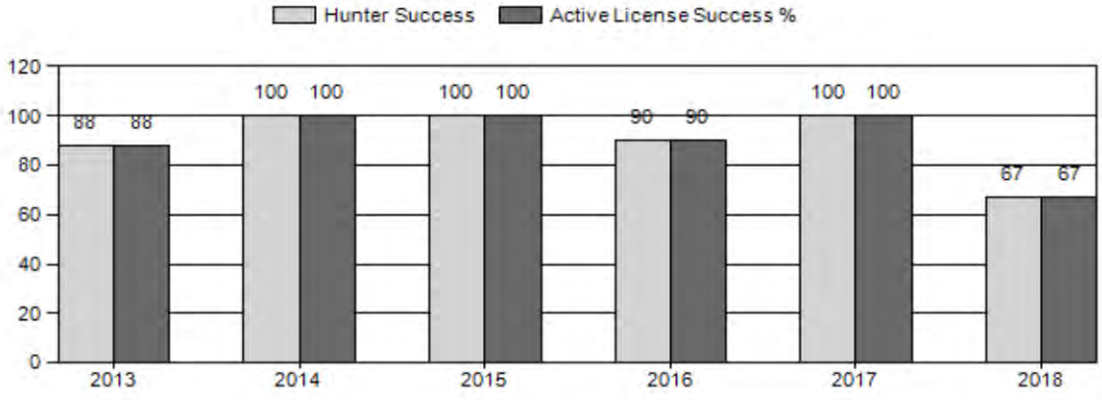
Harvest



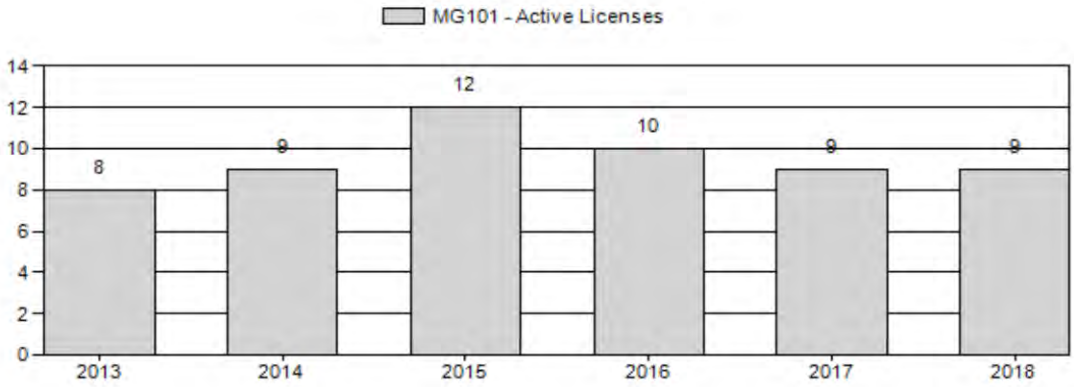
Number of Active Licenses



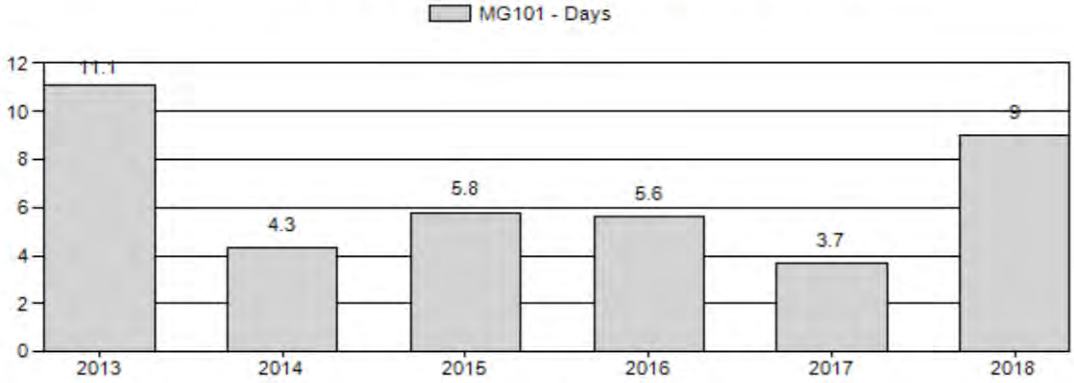
Harvest Success



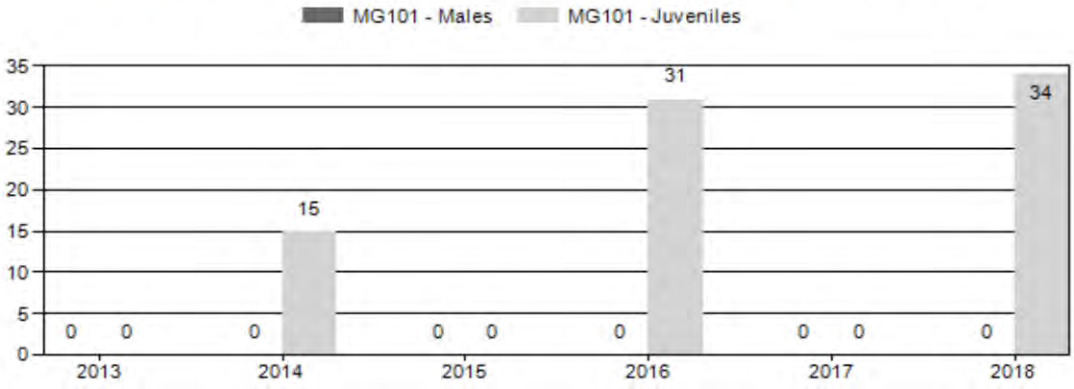
Active Licenses



Days Per Animal Harvested



Preseason Animals per 100 Females



2013 - 2018 Preseason Classification Summary

for Mountain Goat Herd MG101 - PALISADES

		MALES				FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Pre Pop	Ylg	Adult	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Ylng	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2013	130	0	0	0	0%	0	0%	0	0%	0	0	0	0	0	± 0	0	± 0	0
2014	180	0	0	0	0%	144	87%	21	13%	165	0	0	0	0	± 0	15	± 0	15
2015	0	0	0	0	0%	0	0%	0	0%	0	0	0	0	0	± 0	0	± 0	0
2016	0	0	0	0	0%	71	76%	22	24%	93	0	0	0	0	± 0	31	± 0	31
2017	0	0	0	0	0%	0	0%	0	0%	0	0	0	0	0	± 0	0	± 0	0
2018	0	0	0	0	0%	96	74%	33	26%	129	0	0	0	0	± 0	34	± 0	34

2019 HUNTING SEASONS
PALISADES MOUNTAIN GOAT HERD (MG101)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
2	1	Sep. 1	Oct. 31	8	Limited quota	Any mountain goat
		Aug. 15	Aug. 31			Archery only – See Section 8

Summary of Proposed Change by License Type

Area	License Type	Changed from 2018
2	1	No Change
Herd Unit Total	1	No Change

<u>Management Evaluation</u>
Current Mid-Summer Trend Count Management Objective: 120
Management Strategy: Special
2018 Mid-Summer Trend Count: 129
Most Recent 3-year Running Average Trend Count:111

The Palisades mountain goat mid-summer trend count objective is 120 goats (± 20% of the population objective), and was established by the Wyoming Game and Fish Commission in 2015. The initial population objective was established in 1999 at 50 goats. The most recent mid-summer trend count was conducted in August 2018. The number of mountain goats counted was 129 goats.

The three-year average mid-summer trend count is 111 goats. The next mid-summer trend count will be conducted in 2020. The population objective was reviewed by the Wyoming Game and Fish Commission in 2015, and the Special Management strategy was approved.

Herd Unit Issues

To ensure the long-term welfare and viability of this population, Idaho and Wyoming have committed to a cooperative management effort that entails sharing population data, coordinating habitat management projects, and surveying the entire goat population concurrently every two years during a mid-summer trend count. Management goals of the Wyoming subpopulation have focused on maintaining a flexible management approach through the annual issuance of 4 – 12 licenses valid for any goat since 1999. This approach has resulted in a high degree of hunter satisfaction, exceptionally high hunter success, low days/animal harvest, and trophy class males being taken in most years since the hunt was initiated in 1999.

A concurrent concern since 2014 has been the reduction in juvenile production and survival noted during winter 2017 and 2018. The observed kid:adult ratios after the 2014 mid-summer count was 14 kids:100 adults, which is the lowest population metric observed since this mountain goat population has been monitored. The 2016 mid-summer trend counted resulted in 93 mountain goats being observed and a kid:adult ratio of 31 kids:100 adults. Although the most recent trend count conducted in August 2018 increased to 129 total goats observed, which resulted in a slight increased in the mid summer kid:adult ratio, population monitoring will continue to monitor juvenile survival and recruitment.

During the intervening winters since the 2016 mid-summer trend count, aerial winter surveys were conducted in February 2017 and 2018, respectively, in conjunction with the annual elk and moose surveys (Appendix A). In February 2017 and January 2018 a total of 80 and 70 mountain goats were observed, respectively. The observed mid-winter kid:adult ratios were 8 kids:100 adults during both surveys, respectively.

Since 2013 a total of 24 mountain goats have been captured and monitored for seasonal movements, distribution, and dispersal into surrounding mountain ranges. Of the 24 goats captured, 18 were radio-collared. The primary goal of radio-collaring mountain goats was to assess productivity, evaluate survival, document daily and seasonal movements, and note identify dispersal mechanisms into surround mountain ranges. Since the initial capture efforts, the distribution and movements of mountain goats are reported in Appendices B and C.

Mountain goats that were captured in Snake River Canyon during late winter and early spring spent the summer near Ferry Peak, South Indian Creek and other tributaries of the Snake River west of Wolf Creek (Appendix B.). Those mountain goats captured by helicopter/netgun operations in North and South Indian Creeks in 2016, 2017, and 2018 did not disperse away from the watershed where they were captured in (Appendix C). These data demonstrate that dispersal, especially by reproductive age females, is not a factor affecting herd unit population dynamics and emigration, or contributing to the establishment of reproducing mountain goat populations in surrounding mountain ranges.

Weather
Weather conditions during the 2018 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 Snake River Mountain Range. By mid winter snow conditions on winter ranges had changed significantly. Significant snow accumulations were noted in January and through February 2019. These conditions persisted throughout the remainder of the winter. By late winter 2019 snowpack in western Wyoming watersheds were estimated to be significantly above normal. For additional weather and precipitation 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.

Winter Severity
The 2018-2019 winter has been relatively open through mid-December with normal average temperatures and below average snow accumulations on winter ranges. Significant snow accumulations were noted in January and through February 2019 on crucial winter ranges in the Palisades mountain goat herd. High elevation mountain ranges have received above average snow levels. The Snow Water Equivalent of the Snake River Basin has registered over 110% of normal.

Habitat
No habitat data has been collected on goat summer and winter ranges. There are no established vegetation transects in this herd unit. Please refer to the 2018 Annual Report Strategic Habitat Plan Accomplishments for Jackson Region habitat improvement project summaries (http://wgfd.wyo.gov/web2011/wildlife-1000708.aspx).

Harvest
The 2018 hunting season was the 20th year that goats were hunted in Area 2. A total of nine (9) licenses were issued; six goats were harvested. A total of four billies and two nannies were harvested in 2018. Since 1999, a total of 134 mountain goats (113 billies, 21 nannies) have been harvested in Hunt Area 2. Since 1999, 84% and 16% of the total harvest has been comprised of billies and nannies, respectively.

Population
The population trend is generally stable since the mid-summer 2016 trend count (N=93 goats). The most current 3-year average number of goats counted during the mid-summer trend count is 111 goats, which is with the ±20% threshold of the population objective of 120 goats. The population objective was reviewed in 2015. The Wyoming Game and Fish Commission approved a population objective of 120 mountain goats. A population model has not been developed because of the small size of this population. The current season structure is warranted as a means to diminish potential dispersal away from the herd unit, provide hunter recreation opportunity, while still maintaining the potential to harvest a trophy class mountain goat.

Summer and winter aerial surveys were conducted from a helicopter. The summer surveys are coordinated with Idaho Department of Fish and Game to ensure this interstate population is surveyed concurrently. Surveys are initiated every biennial. Helicopter surveys were first initiated in August 1997 (Appendix A). The highest number of goats counted in Wyoming occurred in 2014. A total of 165 goats were counted. Comprehensive winter surveys were not conducted in February 2007 - 2016. The February 2017 and January 2018 winter trend surveys were the most comprehensive winter surveys undertaken since the mid-1990s (Appendix A).

During the most recent 2018 mid-summer trend count a total of 129 mountain goats were observed. A total of 96 adults and 33 kids were observed, and the observed kid:adult ratio was 34 kids:100 adults.

Management Summary

A total of eight (8) licenses, valid for any goat, will be issued in 2019. The season will run September 1 – October 31. The number of licenses issued will be similar to the number issued in 2018 in response to the population trend estimate within management thresholds of 120 (+/- 20%) mountain goats. The size of the hunt area was expanded in 2014 in an effort to harvest goats that have dispersed from the Palisades herd into the Teton Range. The hunt area expansion area encompasses a portion of the national forest north of U.S. Highway 22. The increased hunt area size will provide additional hunter recreation and will remain in place in 2018. Since the expansion of the hunt area, no goats have been harvested in this area, which lies north of Highway 22 and along the west slope of the Teton Range.

A total of eight (8) goats are projected in the 2019 harvest. The anticipated harvest will likely consist of 6 billies, and two (2) nannies. Based on the projected harvest, approximately 115 mountain goats are projected in the 2019 postseason trend count.

Appendix A.
SNAKE RIVER MOUNTAIN RANGE
MOUNTAIN GOAT POPULATION SURVEYS
IDAHO/WYOMING

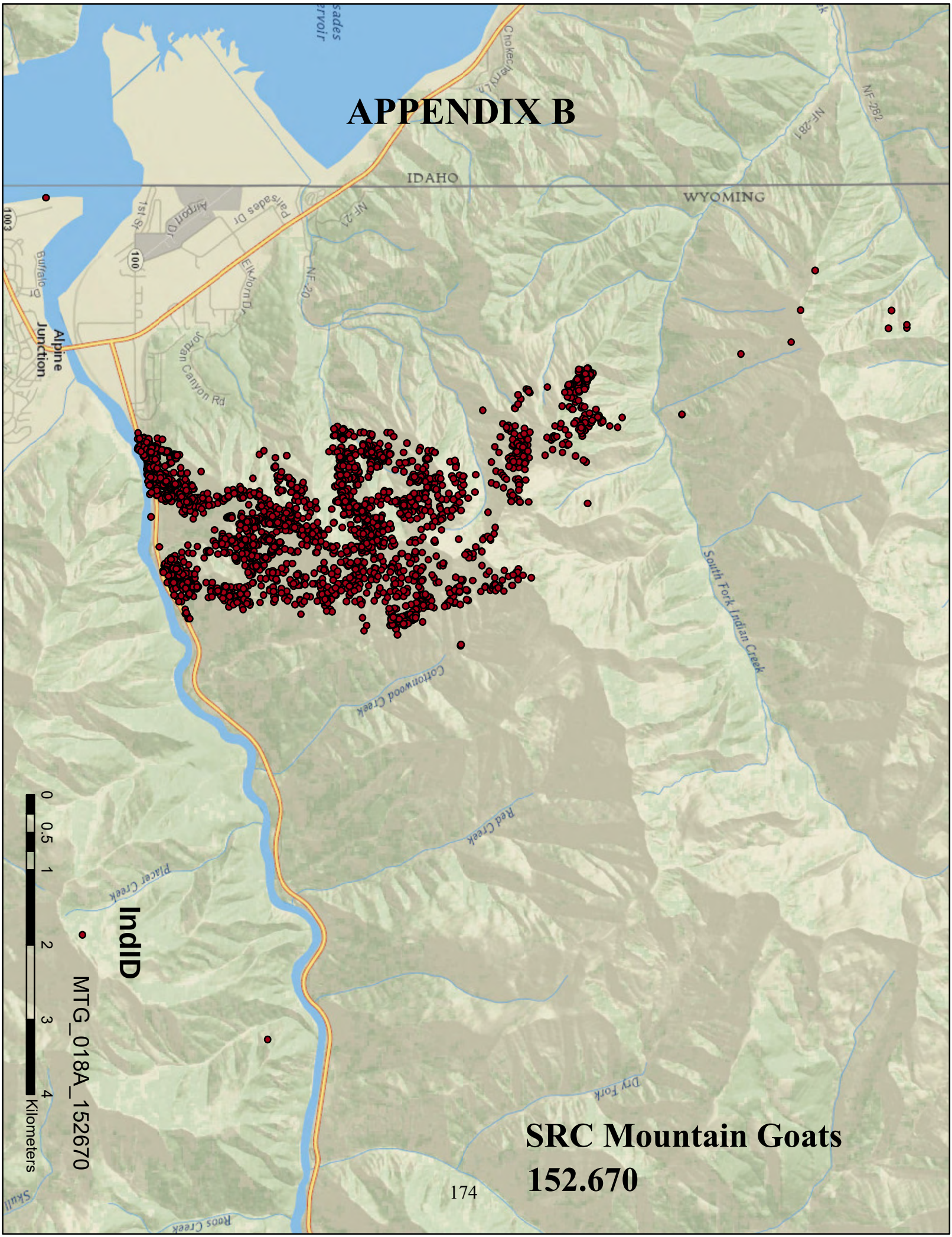
Idaho Summary of Mountain Goat Surveys in Unit 67 South of Palisades Creek, 1982-Present (Mt. Baird area).

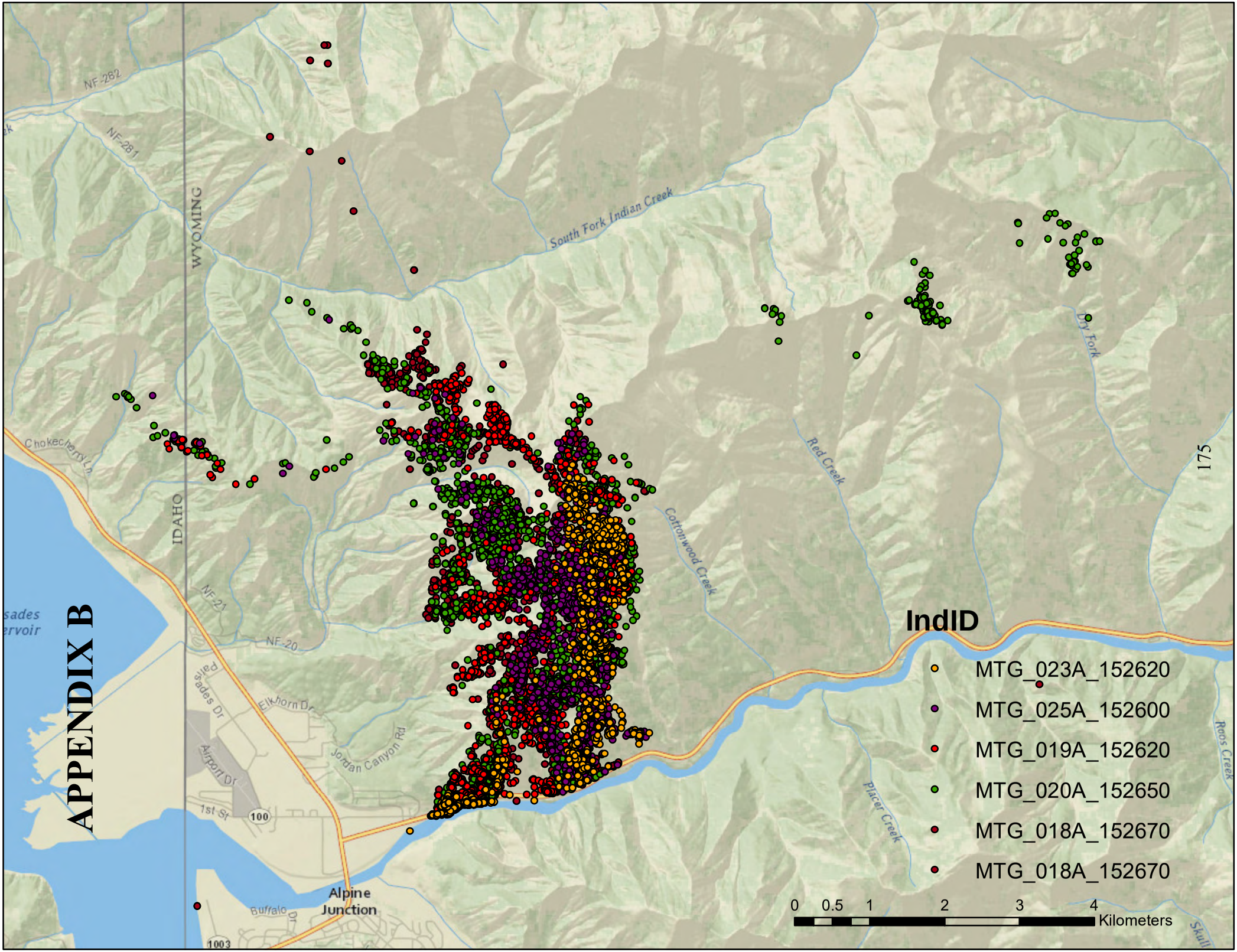
Year	Hunt Area	Inclusive Location	Adults	Kids	Unknown	Total	Ratio Kid:100 Adult
1982[a]	67-1	South of Palisades	33	13	0	46	39
1985[a]		Creek to ID./WY.	35	16	0	51	46
1986[b]		Stateline	0	0	104	104	--
1986[a]			37	15	0	52	41
1988[b]			71	21	0	92	30
1990[b]			45	18	0	63	40
1993[b]			104	33	16	153	34
1994[a]			73	42	0	115	58
1996[a]			151	66	0	217	44
1998[a]			118	45	0	163	38
2000[a]			61	29	0	90	48
2002[a]			35	7	0	42	20
2004[a]			83	24	0	107	29
2006[a]			103	19	0	122	18
2008[a]			96	27	0	123	28
2010[a]			96	33	0	129	34
2012[a]			87	23	0	113	26
2014[a]			109	26	0	135	24
2016[a]			86	34	0	120	39

Wyoming Summary of Mountain Goat Surveys, Hunt Area 2, Palisades Goat Herd, 1996-Present

Year	Hunt Area	Inclusive Location	Adults	Kids	Unknown	Total	Ratio Kid:100 Adult
1996[a]	2	Wyoming – Palisades	16	8	0	24	50
1997[a]		Goat Herd	34	20	0	54	59
1998[a]			47	15	0	62	32
2000[a]			58	18	0	76	31
2002[a]			37	17	0	54	46
2004[a]			90	31	0	121	34
2006[a]			98	32	0	130	33
2008[a]			52	13	0	65	33
2010[a]			97	30	0	127	31
2012[a]			83	25	0	108	30
2014[a]			144	21	0	165	14
2016[a]			71	22	0	93	31
2017[WH]			74	6	0	80	8
2018[WH]			65	5	0	70	8
2018[a]			96	33	0	129	34

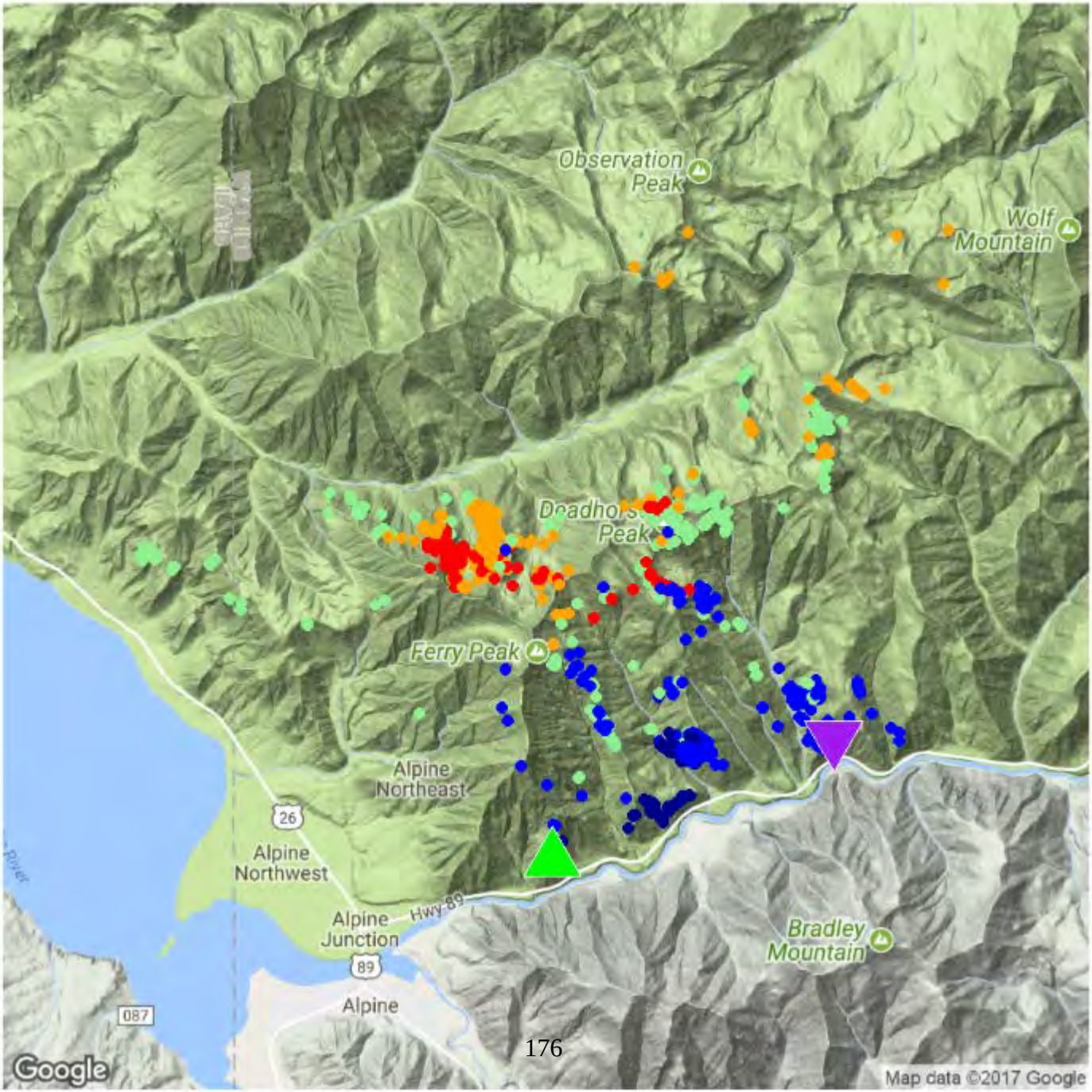
[a] Helicopter survey (August).
[b] Ground count.
[WH] Winter Helicopter Survey


APPENDIX B
IDAHO
WYOMING
Alpine Junction
South Fork Indian Creek
Cottonwood Creek
Red Creek
Placer Creek
Dry Fork
Ross Creek
Skull
IndID
MTG_018A_152670
0 0.5 1 2 3 4
Kilometers
SRC Mountain Goats
152.670


APPENDIX B
IndID
MTG_023A_152620
MTG_025A_152600
MTG_019A_152620
MTG_020A_152650
MTG_018A_152670
MTG_018A_152670
0 0.5 1 2 3 4
Kilometers
WYOMING
IDAHO
South Fork Indian Creek
Red Creek
Cottonwood Creek
Dry Fork
Placer Creek
Roos Creek
Alpine Junction
Jordan Canyon Rd
Elkhorn Dr
Airport Dr
1st St
Buffalo Dr
Chokecherry Ln
NF-282
NF-281
NF-21
NF-20
100
1003
175

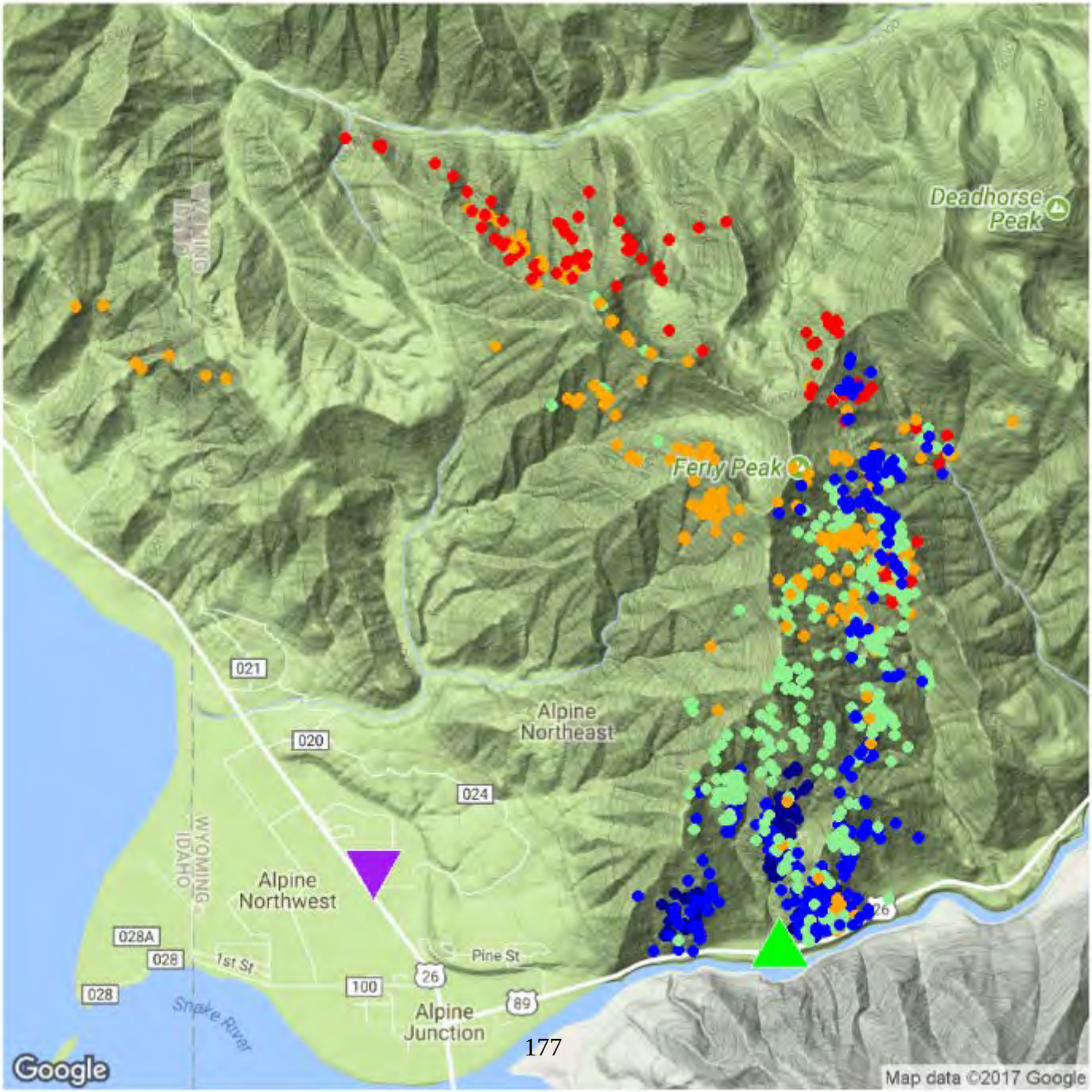
MTG_061_A Locations

APPENDIX B



MTG_062_A Locations

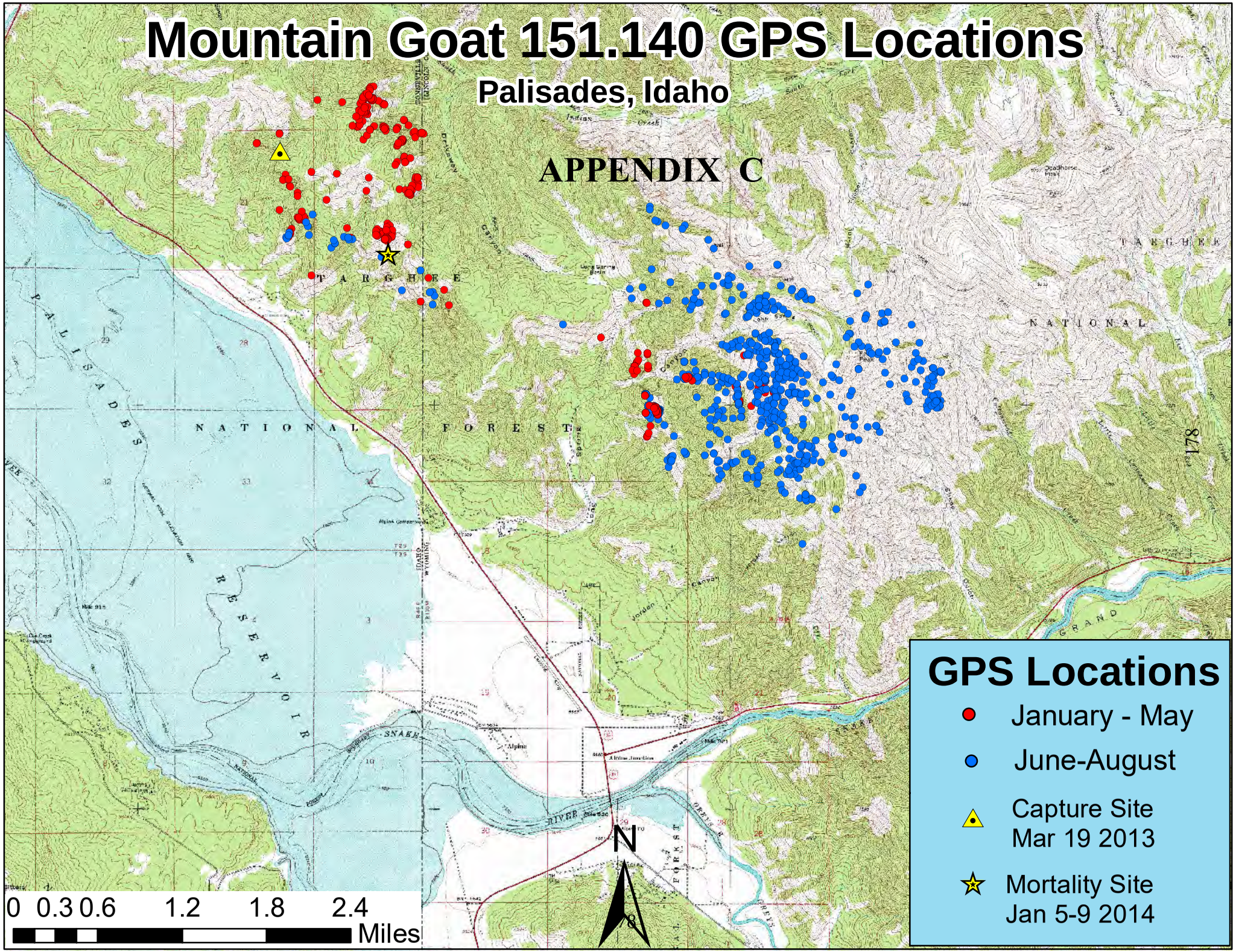
APPENDIX B



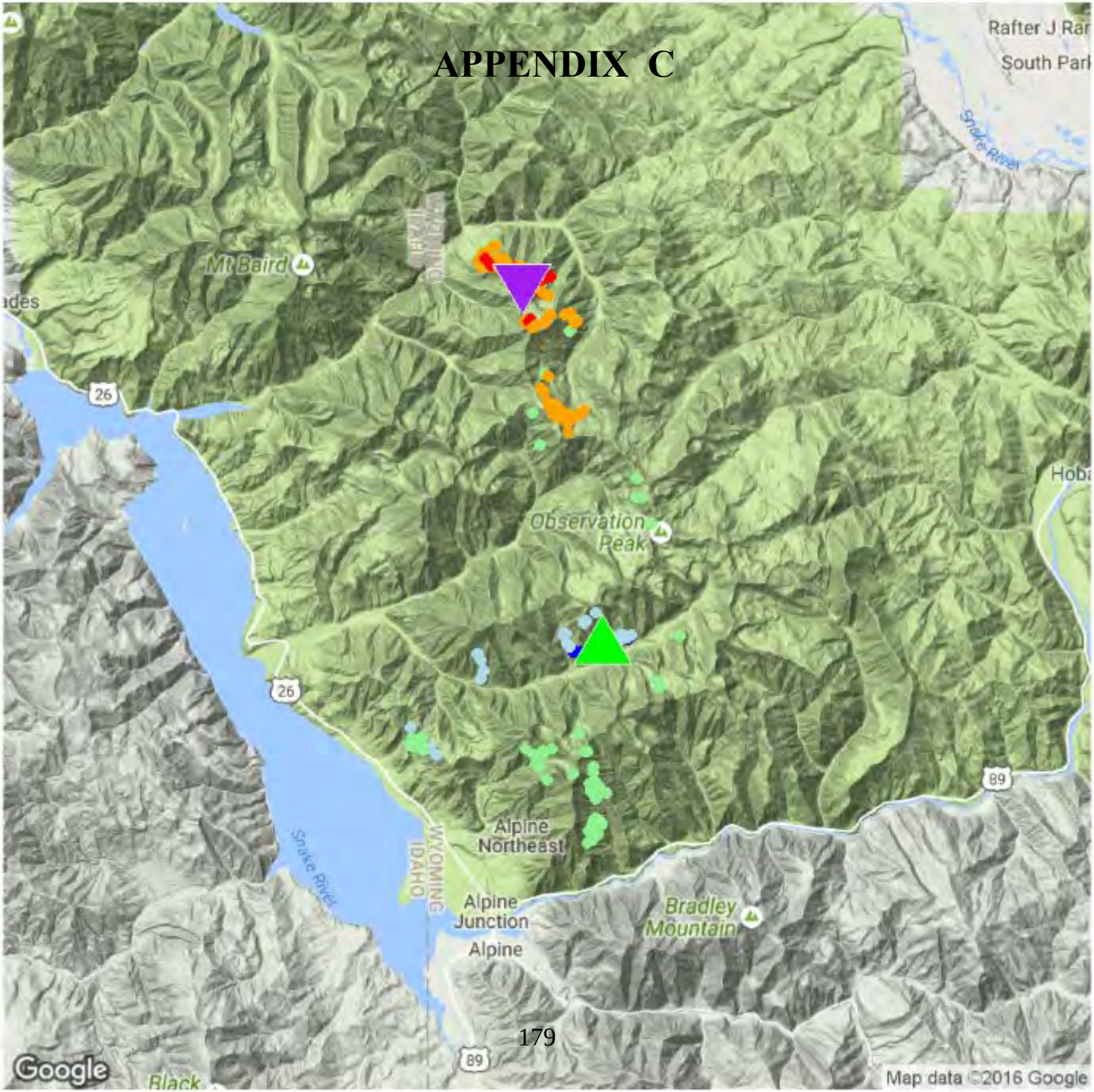
Mountain Goat 151.140 GPS Locations

Palisades, Idaho

APPENDIX C



MTG_060_A Locations



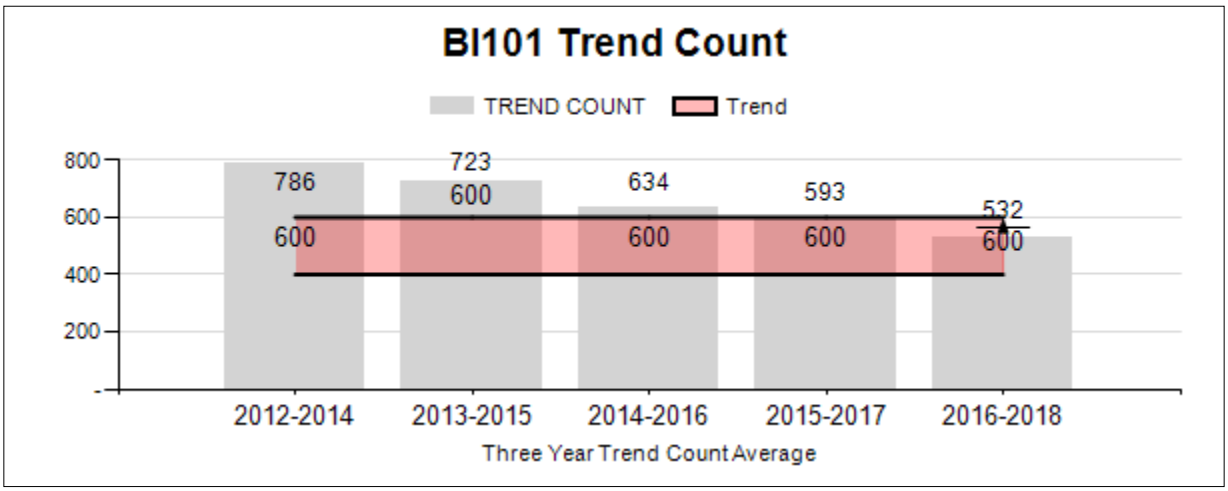
2018 - JCR Evaluation Form

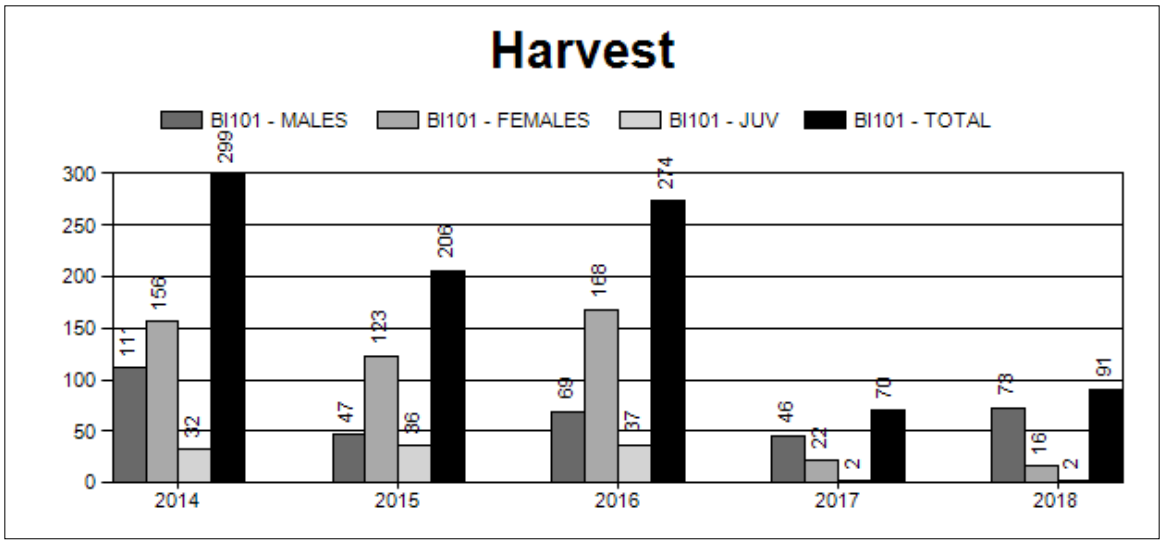
SPECIES: Bison
HERD: BI101 - JACKSON
HUNT AREAS: 2

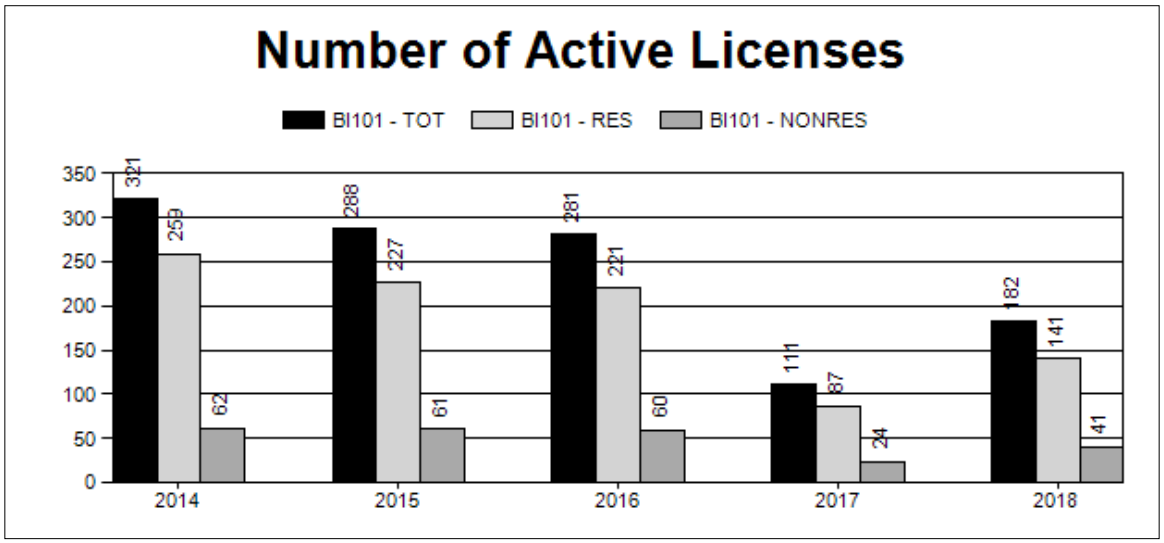
PERIOD: 6/1/2018 - 5/31/2019
PREPARED BY: ALYSON COURTEMANCH

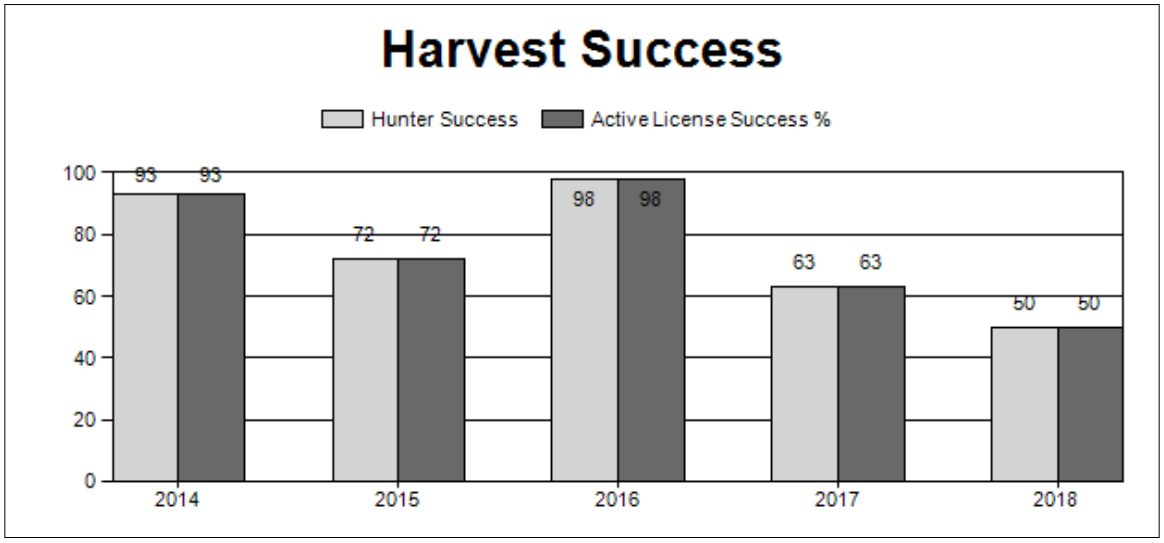
	2013 - 2017 Average	2018	2019 Proposed
Trend Count:	656	484	500
Harvest:	217	91	100
Hunters:	266	182	125
Hunter Success:	82%	50%	80 %
Active Licenses:	266	182	125
Active License Success	82%	50%	80 %
Recreation Days:	1,478	1,893	700
Days Per Animal:	6.8	20.8	7
Males per 100 Females:	83	128	
Juveniles per 100 Females	52	38	

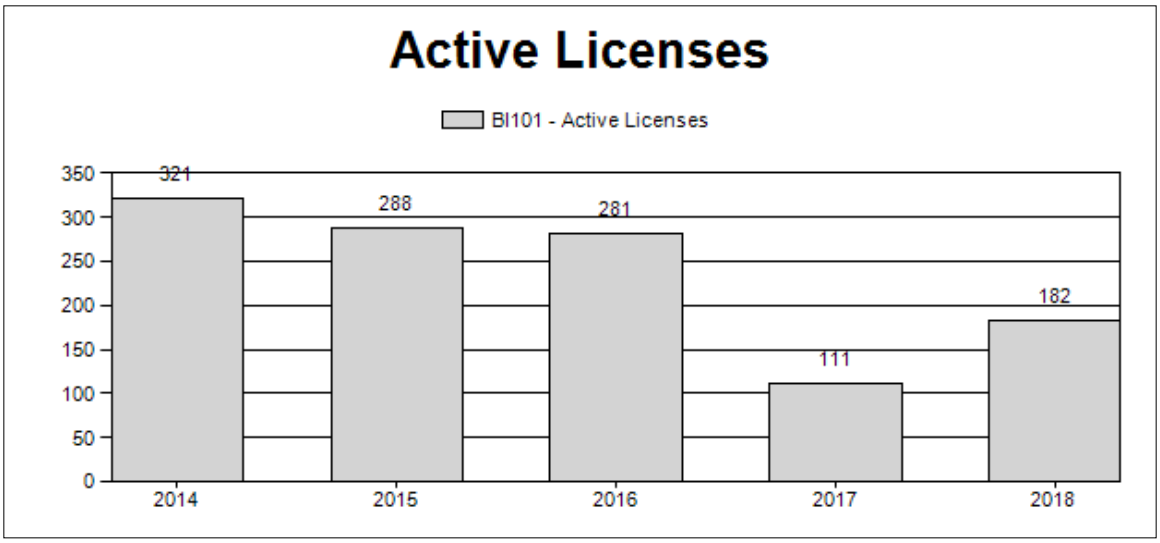
Trend Based Objective (± 20%)	500 (400 - 600)
Management Strategy:	Recreational
Percent population is above (+) or (-) objective:	-3.2%
Number of years population has been + or - objective in recent trend:	2

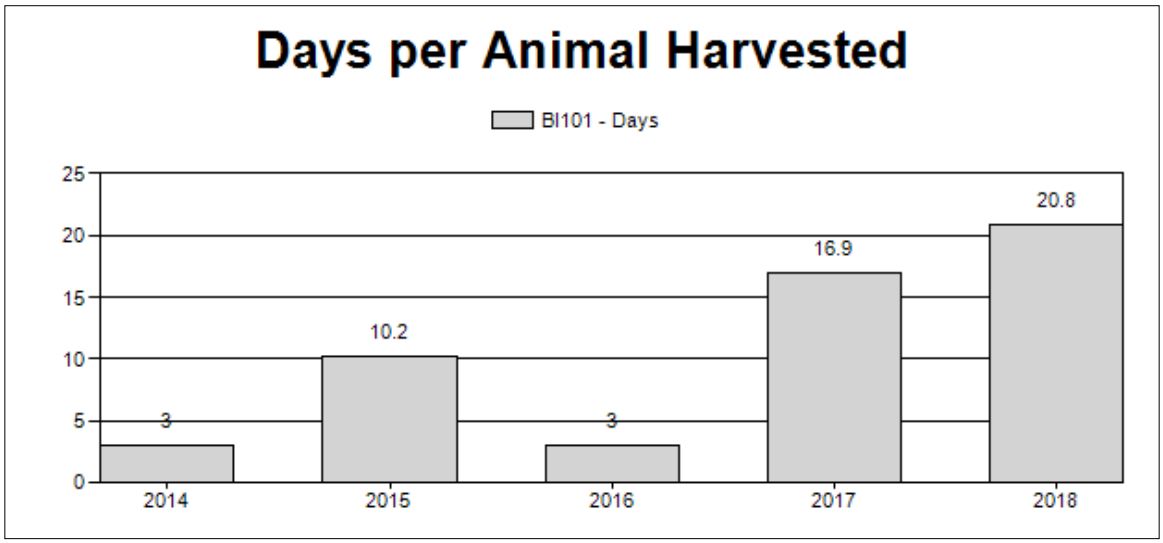


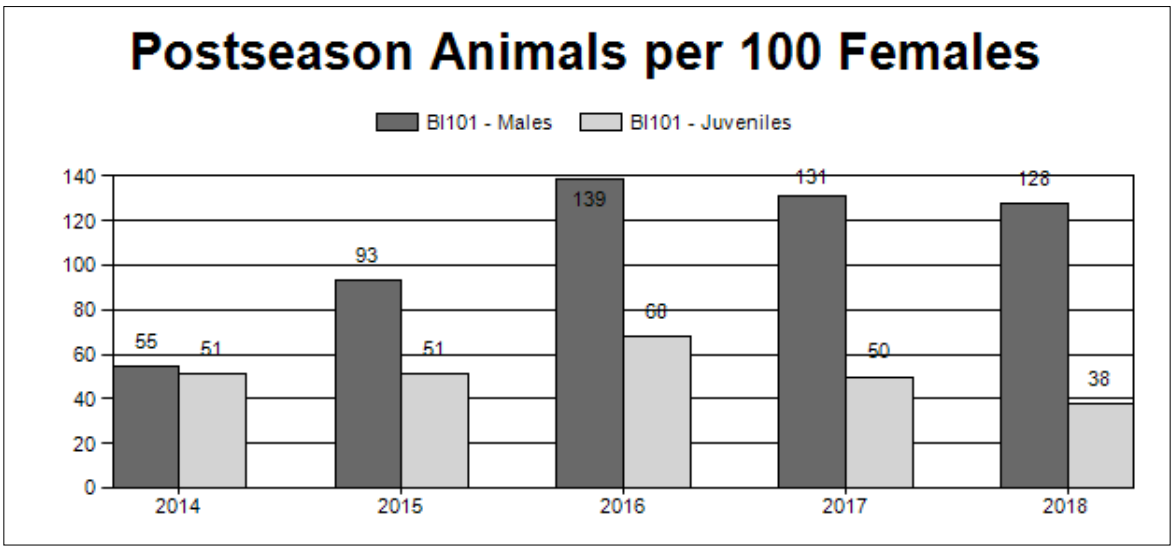

Harvest
BI101 - MALES
BI101 - FEMALES
BI101 - JUV
BI101 - TOTAL
300
250
200
150
100
50
0
111
156
32
299
47
123
36
206
69
168
37
274
46
22
2
70
73
16
2
91
2014
2015
2016
2017
2018


Number of Active Licenses
BI101 - TOT
BI101 - RES
BI101 - NONRES
350
300
250
200
150
100
50
0
321
259
62
288
227
61
281
221
60
111
87
24
182
141
41
2014
2015
2016
2017
2018


Harvest Success
Hunter Success
Active License Success %
100
80
60
40
20
0
93
93
72
72
98
98
63
63
50
50
2014
2015
2016
2017
2018


Active Licenses
BI101 - Active Licenses
350
300
250
200
150
100
50
0
321
288
281
111
182
2014
2015
2016
2017
2018


Days per Animal Harvested
BI101 - Days
25
20
15
10
5
0
3
10.2
3
16.9
20.8
2014
2015
2016
2017
2018


Postseason Animals per 100 Females
BI101 - Males
BI101 - Juveniles
140
120
100
80
60
40
20
0
55
51
93
51
139
68
131
50
128
38
2014
2015
2016
2017
2018

2014 - 2018 Postseason Classification Summary

for Bison Herd BI101 - JACKSON

		MALES				FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Post Pop	Ylg	Adult	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Yling	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2014		68	117	185	27%	336	49%	170	25%	691	0	20	35	55	± 0	51	± 0	33
2015		42	212	254	38%	273	41%	139	21%	666	0	15	78	93	± 0	51	± 0	26
2016		34	213	247	45%	178	33%	121	22%	546	0	19	120	139	± 0	68	± 0	28
2017		67	197	264	47%	202	36%	101	18%	567	0	33	98	131	± 0	50	± 0	22
2018		34	196	230	48%	180	38%	68	14%	478	0	19	109	128	± 0	38	± 0	17

2019 HUNTING SEASONS
JACKSON BISON HERD (BI101)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
2	1	Aug. 15	Jan. 1	125	Limited quota	Any wild bison; also valid in Area 1 within the Clark's Fork River and Soda Butte Creek drainages. Valid in other portions of Area 1 upon notification and authorization by the Department
2	1	Jan. 2	Jan. 31			Any wild bison. Limited alternate permits for the National Elk Refuge may be available through the Department's Jackson Regional Office on a first-come first-served basis until the season closes or forage/weather conditions dictate that supplemental feeding is necessary
2	4	Aug. 15	Jan. 1	50	Limited quota	Any female or calf wild bison; also valid in Area 1 within the Clark's Fork River and Soda Butte Creek drainages. Valid in other portions of Area 1 upon notification and authorization by the Department
2	4	Jan. 2	Jan. 31			Any female or calf wild bison. Limited alternate permits for the National Elk Refuge may be available through the Department's Jackson Regional Office on a first-come first-served basis until the season closes or forage/weather conditions dictate that supplemental feeding is necessary

Summary of 2019 License Changes

Hunt Area	Type	Quota change from 2018
2	1	+8
2	4	-25
3	1	-3 (closed)

Management Evaluation

Mid-Winter Trend Count Objective: 500 ±20%
Management Strategy: Recreational
2018 Mid-Winter Trend Count: 484
3-Year Mid-Winter Trend Average (2016-2018): 532
2019 Proposed Mid-Winter Trend Count: 500
Evaluation: At objective

The mid-winter trend count objective for the Jackson Bison Herd is 500 bison. The management strategy is recreational and the objective and management strategy were last revised in 2014. The herd objective was publicly reviewed in 2014 and changed to a mid-winter trend count objective of 500 bison. The current 3-year average trend count is 532 bison, which is within 20% of the objective of 500. Annual harvest rates have successfully reduced the population to meet objective. Beginning in 2017, hunting seasons were restructured from the goal of reducing the population to stabilizing the population close to the 500 bison objective and reducing the bull to cow ratio. However, very late migration of bison to the open hunt area on the National Elk Refuge during 2017 and 2018 caused reduced hunter success. Although the population is still near the 500 objective, numbers are expected to grow if hunter success continues to remain low in the future.

Herd Unit Issues

The current objective and management strategy for this herd will be maintained based on internal discussions and conversations with our constituents. Population status was evaluated and it was determined a change is not warranted at this time. These objectives will be reviewed again in 2024; however, if a situation arises that requires immediate change, proposals will be developed and submitted as needed.

Management of this herd is complicated because occupied habitat includes Grand Teton National Park (GTNP), the National Elk Refuge (NER) and the Bridger-Teton National Forest (BTNF). Bison remain distributed in GTNP during much of the summer and fall and are not available for hunting until they migrate to either BTNF or the NER. Over the past several years, bison have become sensitized to the presence of hunters on the NER and will vacate the open hunt area. In 2017 and 2018, bison did not migrate to the NER until very late January due to mild winter conditions, which made harvest difficult. Some bull hunting occurs on National Forest land to the east of GTNP, but bison availability is intermittent and low in that area. During winter 2018/2019, the majority of the bison herd remained in northern GTNP and did not migrate to the

NER. This resulted in reduced sightability during the mid-winter trend count since bison had to be located from the air instead of from the ground while on supplemental feed.

Weather

Spring and summer 2018 produced average moisture. Fall and early winter weather was very mild with warm temperatures and little snowfall at high elevations. However, several large snowstorms occurred in February that resulted in the rapid accumulation of a deep snowpack. Snowfall totals in February nearly surpassed the local record in Jackson Hole. At the time of the mid-winter survey in February 2019, winter snowpack was reported at 115% of average in the Snake River Basin. In general snow depths were greater in the low elevation valleys in Jackson Hole compared to areas farther north. Winter snowpack remained above average through March and April 2019, which made wintering conditions difficult for bison that stayed in GTNP. 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

Habitat data have not been collected on bison summer and winter ranges. There are no established vegetation transects in this herd unit. Please refer to the 2018 Annual Report Strategic Habitat Plan Accomplishments for Jackson Region habitat improvement project summaries (https://wgfd.wyo.gov/Habitat/Habitat-Plans/Strategic-Habitat-Plan-Annual-Reports).

Field Data

Only 155 bison were classified on supplemental feed on the NER during the mid-winter trend count in February 2019. The remainder of the herd (minimum of 329 bison) were scattered throughout native winter ranges in GTNP near Deadman's Bar, Cunningham Cabin, Spread Creek, Uhl Hill, Wolff Ridge, and east of Elk Ranch Reservoir. Many bison groups were located in forested areas during the aerial survey, making sightability difficult. A total of 484 bison were counted during the mid-winter trend count, which is approximately 100 bison lower than the expected population total. Managers estimate that approximately 578 bison are present in the population, based on previous trend counts, calf ratios, and harvest total. Managers attribute the lower count to difficult sightability conditions instead of a true population decline. Herd unit ratios were 128 bulls:100 cows and 38 calves:100 cows.

When the population was larger, prior to 2007, it was not uncommon for bison groups to spend the winter in the Elk Ranch area in GTNP, including cows and calves. However, this year over 60% of the herd did so, which is very unusual. Although the reasons for this are unknown, managers hypothesize that it could be due to a combination of 1) later migration behavior to avoid the open hunting season on the NER and 2) relatively mild to average winter conditions in January interrupted by a strong winter storm that resulted in very deep snow within a few days. This abrupt change in snow conditions seems to have trapped bison in northern GTNP and made movement to the NER extremely difficult.

In early February, a group of approximately 100 bison caused damage on the Moosehead Ranch, breaking fences and severely injuring several horses. Due to the likelihood of continued chronic damage for the rest of the winter, GTNP and WGFD staff attempted to move this group to the NER. Grand Teton National Park closed the highway for several hours, the bison were hazed onto the highway by WGFD using snowmobiles, and then were slowly pushed down the highway with vehicles. Near Hedrick Pond, the bison left the highway and moved south toward Antelope Flats. Staff from WGFD packed down a snowmobile path from Lost Creek Ranch to the south end of Shadow Mountain to encourage the bison to get to the plowed portion of Shadow Mountain Road. However, the bison were showing signs of exhaustion by the time they made it to the north end of Antelope Flats. The decision was made to not push them further and to let them find the path on their own overnight. Over the next several days, some bison moved back north toward the Snake River but stopped south of Cunningham Cabin. The rest of the group remained on the north end of Antelope Flats west of Lost Creek Ranch. They were observed in the same location a couple weeks later during the mid-winter helicopter survey. This effort was successful because it alleviated damage at Moosehead Ranch from this large group of bison, even though they did not go all the way to the NER. Throughout the month of February, GTNP responded to several groups of 5-20 bison that attempted to move south on the highway. In response, GTNP plowed the Antelope Flats Road from Blacktail Butte to Mailbox Corner and used this as a path to divert bison off the main highway. A group of approximately 15 bison spent most of the winter near Kelly Warm Springs. Another group of approximately 25 ended up on the Kelly Highlands Road. Despite efforts by WGFD and NER staff to provide cuts in snowbanks, pack trails, haze with vehicles, and lay down hay, this group of bison refused to move south onto the NER and away from private land. Managers were concerned that the several hundred bison in the Elk Ranch area in GTNP would cause chronic problems along the highway and on private lands later in the winter, however, the majority of these bison did not cause human conflict.

Since the majority of the bison herd stayed on native winter ranges in very deep snow this year, managers anticipate that calf survival could be significantly lower than previous years when bison received supplemental feed on the NER. Yellowstone National Park has documented substantial calf mortality during severe winters (up to 50%). Ground surveys will be conducted in spring and summer 2019 to estimate the yearling to cow ratio.

The population reached objective after the 2016 hunting season. The substantial reduction of cows in the herd through harvest (Fig. 1) has succeeded in significantly reducing the annual reproductive potential of the herd. As a result, substantially less harvest is needed each year to offset calf recruitment and prevent population growth than in the past. Despite two years of reduced harvest success in 2017 and 2018, total bison numbers have remained relatively flat. However, if low harvest success continues in future years, the population is expected to increase again.

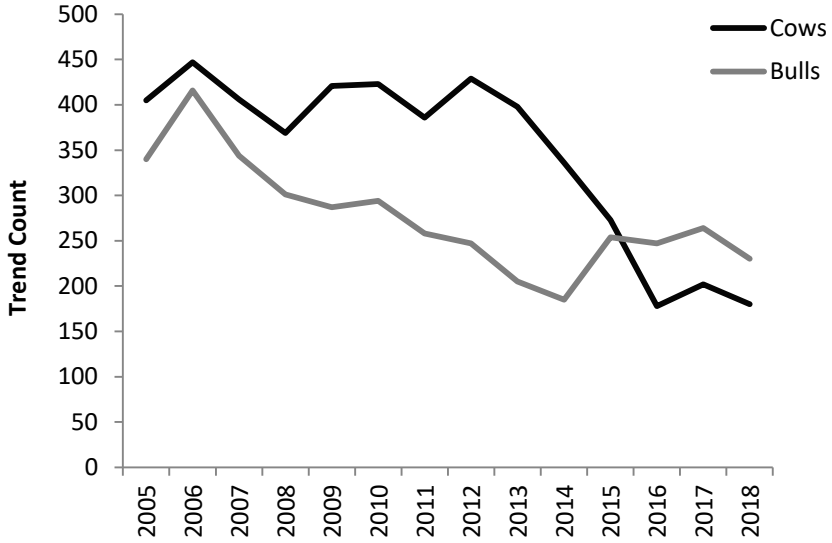


Fig. 1. Number of cows (black line) and bulls (grey line) in the Jackson Bison Herd, 2005-2018.

Harvest Data

During the 2018 hunting season, 198 hunters in Hunt Area 2 harvested 73 bulls, 16 cows, and 2 calves, totaling 91 bison. Hunter success was 50%. Days per animal harvested (20.8) was the highest ever recorded for this hunt. This was due to extremely limited bison availability in open hunt areas, especially for Type 4 license holders. The majority of bison harvest occurred during two days near the end of January when a group of bison moved to the NER. In 2018, there were 5 Governor's Licenses and 1 Super Tag holder who hunted in Hunt Area 2. There were an additional 3 hunters who harvested 3 bulls in Hunt Area 3.

When the population was high, the annual bison harvest had to exceed 200 animals to prevent population growth. This was due to the high number of cows in the herd and the consistently high reproductive rate; approximately 50 calves:100 cows during postseason classifications. As the population has been reduced toward objective, the reproductive rate remains high but the number of adult females has decreased, therefore fewer calves are recruited to the population each year. In recent years, approximately 100 bison need to be harvested to prevent population growth. Even though harvest success was low in 2018, 91 total bison were harvested, which was nearly enough to offset the annual recruitment.

Population

The Jackson Bison Herd peaked at 1,100 animals in 2007, was stabilized by harvest from 2008-2010, trended downward in recent years, and was within 20% of the population objective after the 2016 - 2018 hunting seasons. The herd is currently within 20% of the 500 objective at an estimated 578 bison, even though harvest success was low during the 2017 and 2018 hunting seasons. However, hunting seasons in 2019 are structured to reduce to herd closer to the 500 objective.

Management Summary

When the herd is at the 500 objective (and assuming a maximum of 100 bulls:100 cows ratio), the classification goal would be 200 cows, 100 calves, and 200 bulls. By the beginning of the 2019 hunting season, managers expect there will be approximately 262 cows, 119 calves, and 267 bulls for a total of 648 bison in the herd (Table 1). This is 148 bison above the objective of 500. This "surplus" of 148 animals is expected to be comprised of approximately 62 cows, 67 bulls, and 19 calves (Table 1). Due to the extremely limited hunting opportunity for Type 4 license holders (cow/calf bison) in 2017 and 2018, managers have scaled down the number of Type 4 licenses and scaled up the number of Type 1 (any bison) licenses (Table 1). If bison availability is challenging again in 2019, we anticipate that some Type 1 license holders will choose to harvest cows.

Table 1. Estimated 2018 post-season herd numbers and sex/age composition, anticipated over-winter calf mortality, predicted 2019 pre-season herd numbers and composition, surplus numbers over objective, and 2019 license quotas.

	2018 Post-season (estimated)	Anticipated winter mortality	Predicted Pre-season 2019 (after parturition)	Herd Objective	2019 Surplus	2019 License Quotas
Total	578		648	500	148	**175 Total**
Cows	237		262	200	62	**50 (Type 4)**
Bulls	242		267	200	67	**125 (Type 1)**
Calves	99	-50%	119	100	19	
Bull:cow	102:100			100:100		
Calf:cow	42:100			50:100		

License quotas for 2019 are 125 Type 1 and 50 Type 4, for a total of 175 licenses. In addition, 5 Governor's license holders and 1 Supertag holder are likely to hunt bison. This would be similar to the 2018 hunting season when 123 Type 1 and 75 Type 4 licenses were issued. Under an average harvest success scenario, the 2019 hunting season will reduce the population to 497 bison (Table 2). Under a low harvest success scenario, the population will be slightly reduced to 554 bison (Table 2).

Table 2. Projected 2019 harvest numbers and 2019 post-season classification under an average harvest success scenario* (90% success for Type 1 licenses and 75% success for Type 4 licenses) and a low harvest success scenario^ (65% success for Type 1 licenses and 26% success for Type 4 licenses).

	2019 License Quotas	**# Harvested with average* harvest success**	**Projected 2019 Post-season with average* harvest success**	**# Harvested with low* harvest success**	**Projected 2019 Post-season with low^ harvest success**
Total	**175**	151	**497**	94	**554**
Cows	**50 (Type 4)**	38	224	13	249
Bulls	**125 (Type 1)**	113	154	81	186
Calves			119		119
Bull:cow			69:100		75:100
Calf:cow			53:100		48:100

The season dates will remain the same as 2018 with the regular season remaining open through January 1 and continuing on a provisional basis from January 2 to 31 with alternate permits available for the NER until either forage/weather conditions dictate that elk supplemental feeding is necessary or January 31 is reached.

Bibliography

Berger, J. and S.L. Cain. 1999. Reproductive synchrony in brucellosis-exposed bison in the southern Greater Yellowstone Ecosystem and in noninfected populations. Conservation Biology 13:357-366.

National Elk Refuge and Grand Teton National Park. 2007. Final Bison and Elk Management Plan and Environmental Impact Statement for the National Elk Refuge/Grand Teton National Park/John D. Rockefeller, Jr., Memorial Parkway. U.S. Fish and Wildlife Service, Region 6, Denver, CO. 605 pp. http://www.fws.gov/bisonandelkplan

Williams, E.S., Thorne, E.T., Anderson, S.L., and J.D. Herriges, Jr. 1993. Brucellosis in free-ranging wild bison (*Bison bison)* from Teton County, Wyoming. Journal of Wildlife Diseases 29:118-122.