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2018 - JCR Evaluation Form

SPECIES: Pronghorn

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

HERD: PR745 - RATTLESNAKE

HUNT AREAS: 70-72

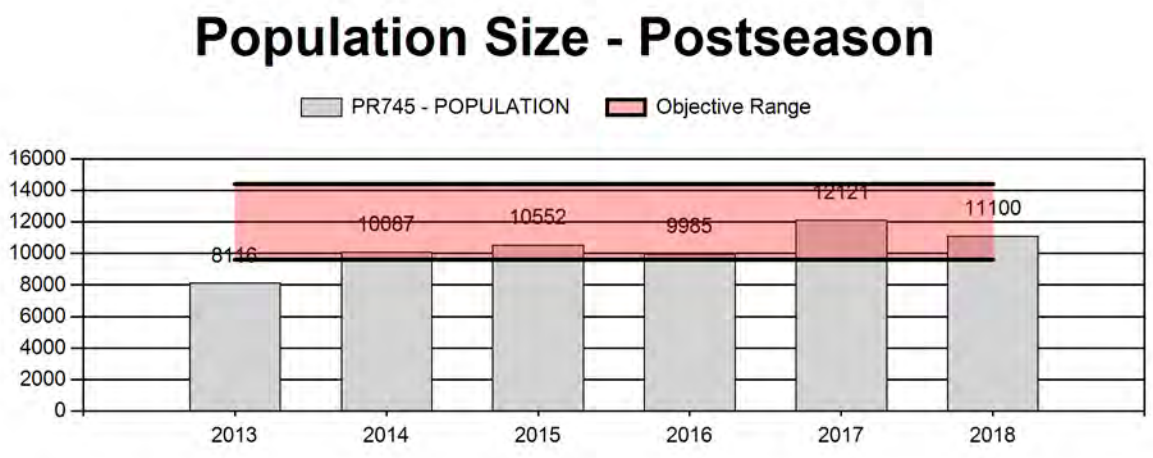
PREPARED BY: HEATHER O'BRIEN

	2013 - 2017 Average	2018	2019 Proposed
Population:	10,172	11,100	10,165
Harvest:	544	821	1,215
Hunters:	582	822	1,300
Hunter Success:	93%	100%	93%
Active Licenses:	655	936	1,400
Active License Success:	83%	88%	87%
Recreation Days:	1,977	2,134	3,900
Days Per Animal:	3.6	2.6	3.2
Males per 100 Females	45	58	
Juveniles per 100 Females	72	66	

Population Objective (± 20%) :	12000 (9600 - 14400)
Management Strategy:	Special
Percent population is above (+) or below (-) objective:	-7.5%
Number of years population has been + or - objective in recent trend:	2
Model Date:	02/25/2019

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

	JCR Year	Proposed
Females ≥ 1 year old:	8.0%	14.3%
Males ≥ 1 year old:	14.4%	18.5%
Total:	6.8%	10.6%
Proposed change in post-season population:	3.1%	8.4%



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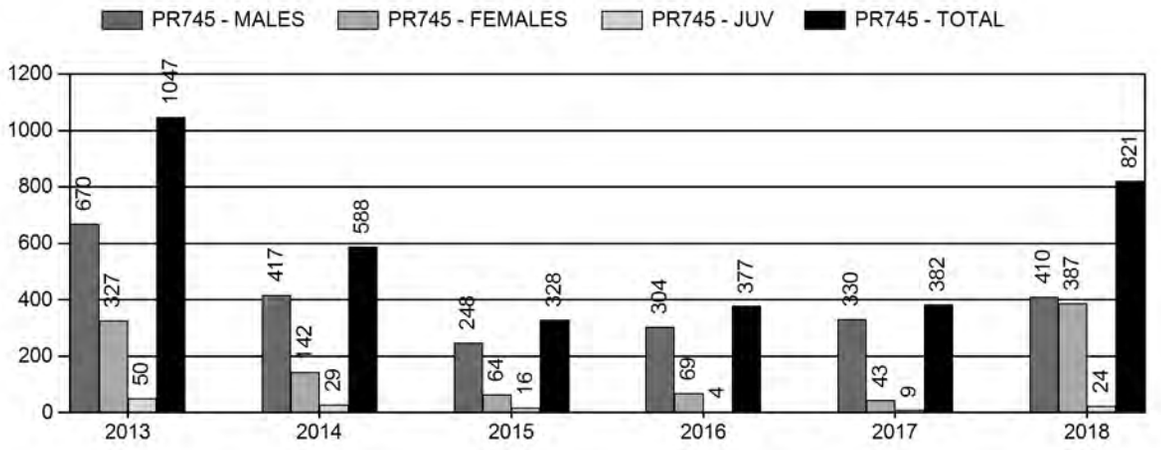

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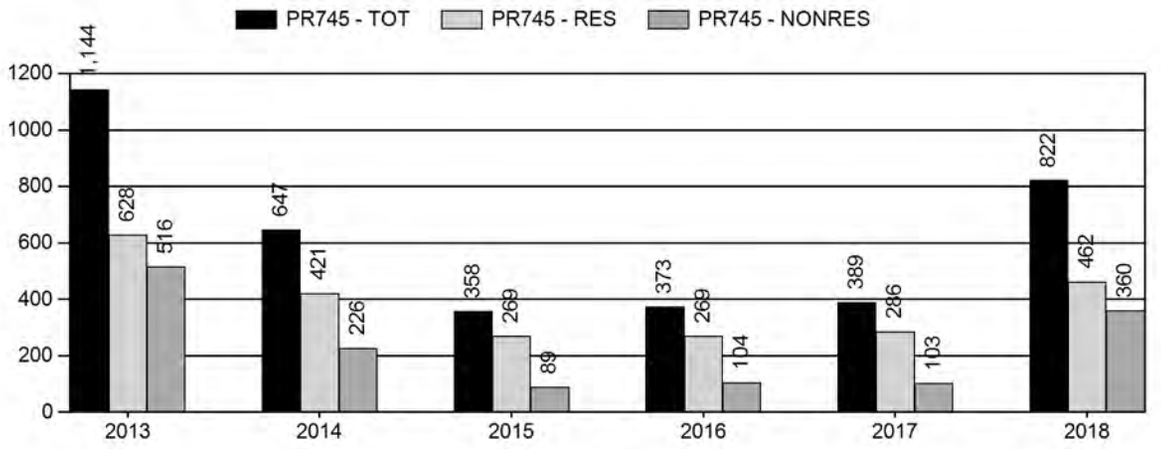

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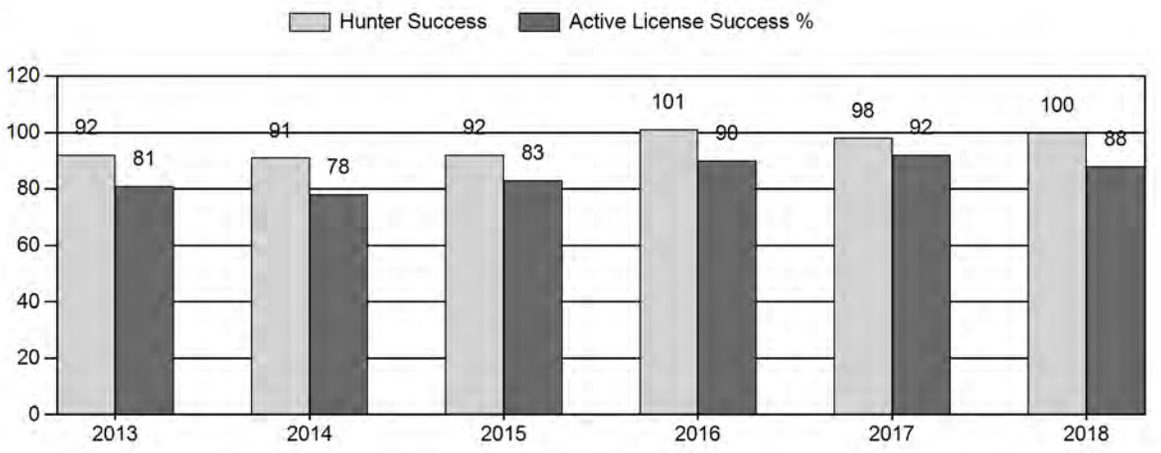

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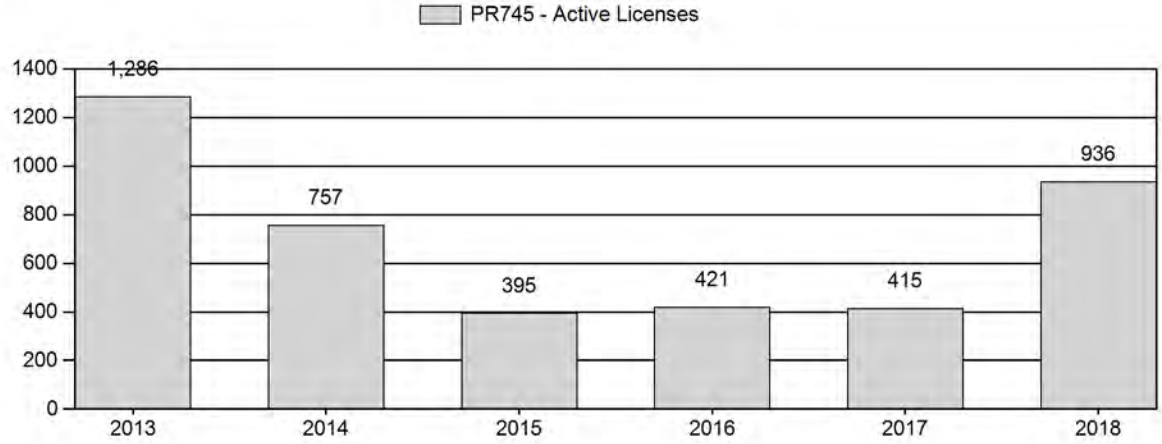
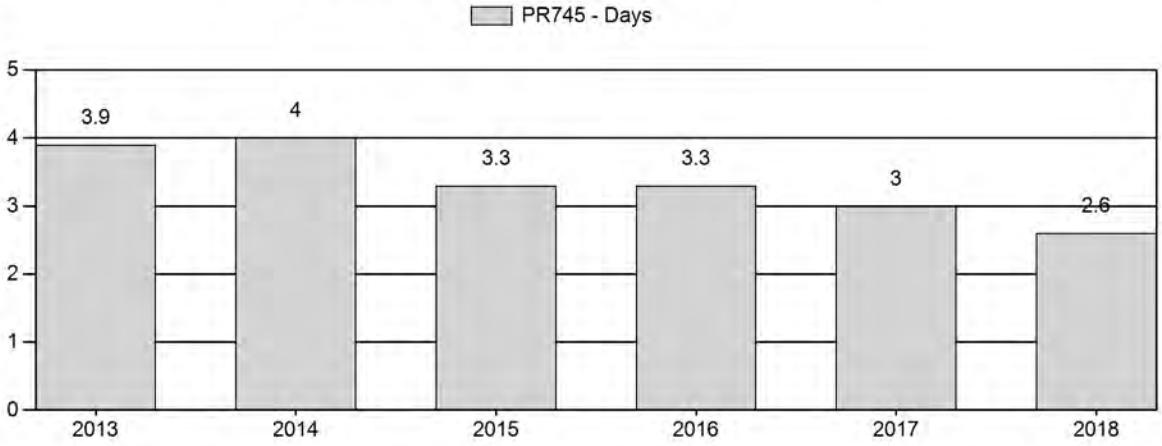
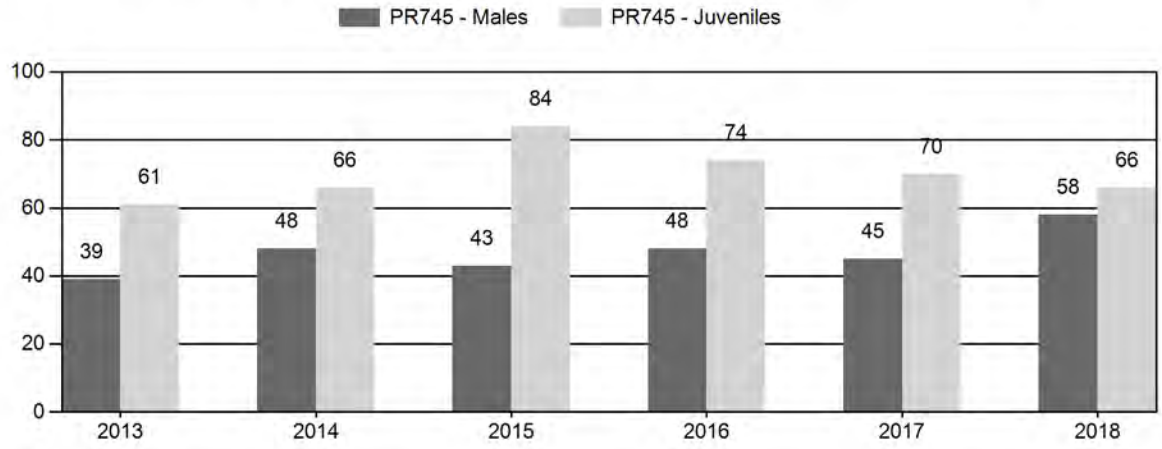


Days Per Animal Harvested



Preseason Animals per 100 Females



2013 - 2018 Preseason Classification Summary

for Pronghorn Herd PR745 - RATTLESNAKE

		MALES				FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Pre Pop	Ylg	Adult	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Yling	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2013	9,268	45	199	244	20%	624	50%	381	31%	1,249	1,901	7	32	39	± 5	61	± 6	44
2014	10,921	111	191	302	22%	634	47%	416	31%	1,352	1,734	18	30	48	± 5	66	± 6	44
2015	10,913	160	243	403	19%	947	44%	796	37%	2,146	2,231	17	26	43	± 4	84	± 6	59
2016	10,400	178	281	459	21%	965	45%	711	33%	2,135	2,635	18	29	48	± 4	74	± 5	50
2017	12,541	202	324	526	21%	1,173	46%	824	33%	2,523	2,185	17	28	45	± 3	70	± 5	48
2018	13,130	236	452	688	26%	1,187	45%	785	30%	2,660	2,290	20	38	58	± 4	66	± 4	42

2019 HUNTING SEASONS
RATTLESNAKE PRONGHORN HERD (PR745)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
70	1	Sep. 15	Oct. 31	100	Limited quota	Any antelope
	6	Sep. 15	Oct. 31	150	Limited quota	Doe or fawn antelope
71	1	Sep. 15	Oct. 31	100	Limited quota	Any antelope
	6	Sep. 15	Oct. 31	50	Limited quota	Doe or fawn antelope
72	1	Sep. 15	Oct. 31	500	Limited quota	Any antelope
	6	Sep. 15	Oct. 31	500	Limited quota	Doe or fawn antelope
Archery		Aug. 15	Sep. 14			Refer to license type and limitations in Section 2

Hunt Area	Type	Quota change from 2018
70	1	+25
	6	+50
71	1	No Change
	6	No Change
72	1	+100
	6	+200
Total	1	+125
	6	+250

Management Evaluation

Current Management Objective: 12,000
Management Strategy: Special
2018 Postseason Population Estimate: ~11,100
2019 Proposed Postseason Population Estimate: ~10,200
2018 Hunter Satisfaction: 95% Satisfied, 4% Neutral, 1% Dissatisfied

The Rattlesnake Pronghorn Herd Unit has a post-season population management objective of 12,000 pronghorn. The herd is managed using a mix of recreational and special management strategies, with the goal of maintaining preseason buck ratios between 30-59 bucks per 100 does in Area 70, and 60-70 bucks per 100 does in Areas 71 & 72. The objective and management strategy were formerly reviewed in 2015. A line transect survey was conducted in May 2014 to be used in conjunction with the formal objective review.

Herd Unit Issues

Hunting access within the herd unit is moderate, having some large tracts of public land as well as Walk-In Areas and a Hunter Management Area. Traditional ranching and grazing are the primary land use over the whole herd unit, with scattered areas of oil and gas development. Hunt Areas 70 & 71 are dominated by private lands. License issuance is typically maintained at a higher level relative to pronghorn densities in Area 70 to address damage issues on irrigated agricultural fields. Periodic disease outbreaks (i.e. hemorrhagic diseases, *Clostridium spp*. infections) are possible in this herd and can contribute to population declines when environmental conditions are suitable. However, there were no reported or confirmed cases of disease outbreak in pronghorn within the Rattlesnake Herd during 2018.

The southwest boundary of Area 70 was changed in 2017. The new boundary follows an irrigation canal, and is easier to identify than the former boundary that followed a hydrographic divide. The boundary change also shifts tracts of public lands into Area 69, which has similar proportions of public lands.

Weather

From 2013 to the present, weather trends have been generally favorable, and pronghorn have fared well within the herd. Range conditions were particularly good from 2013 to 2015, when spring and summer moisture improved and winters were mild. The winter of 2015 was fairly average, though some areas experienced prolonged periods of persistent snow. The spring of 2016 had above average precipitation but summer was extremely dry, causing rangeland habitats to cure early. Fortunately, precipitation in October resulted in a late surge of plant growth, which may have provided big game with a boost in nutrition going into the winter months. While there were several notable snow storms and cold snaps during the winter of 2016-2017, there were also periods of warm weather and high winds that melted and drifted snow to expose forage. The 2017 growing season was very similar to the previous year, with ample spring moisture followed by a dry summer with little precipitation. Moisture improved during the fall, though there was little snow to speak of over the winter of 2017-2018. Precipitation was below average for the 2018 growing season, and many reservoirs became dry by late summer. Sparse rain events provided some moisture during the fall months, but the 2018-2019 winter has been mild to average in the herd unit. Thus far, the region has received average snowfall combined with many windy days. Snow has melted or drifted to open habitats for pronghorn to move freely on winter ranges and access forage. For detailed weather data see http://www.ncdc.noaa.gov/gac/time-series/us.

Habitat

This herd unit has no established habitat transects to measure production and/or utilization on shrub species that are preferred browse for pronghorn. Anecdotal observations and discussions with landowners in the region indicate growth and moisture during the spring of 2018 were average, but the summer of 2018 was dry. Pronghorn became more concentrated in areas where moisture and green forage persisted during this time period, and may have overbrowsed preferred plant species in some cases. Fall precipitation resulted in a mild fall green-up of forage that likely benefitted pronghorn nutritionally prior to the winter of 2018-2019. However, spring storms could still cause localized mortalities should they occur in the region.

Field Data

Fawn ratios for the Rattlesnake herd were historically low for the herd unit in 2012 and 2013, following a harsh winter in 2011 and severe drought conditions in 2012. Habitat conditions improved in 2013 & 2014 and fawn ratios recovered, but were still not as high as those recorded in adjacent herds. This suggests the carrying capacity for the herd unit was still suppressed despite improved precipitation. Native habitats were likely still recovering from the very high pronghorn numbers of 2004-2010 and prolonged drought conditions. Fawn ratios finally improved from 2015-2017 to levels of production which had not been observed within the herd unit since 2005. Overwinter survival was good during the same time period, and low harvest pressure allowed the herd to grow to its objective. In 2018, fawn ratios seemed to dip again, with 66 fawns per 100 does observed during preseason classification surveys. At the same time, recruitment of yearlings was high (20 yearling bucks per 100 does). Consequently, a higher proportion of yearling does without fawns may have suppressed the observed fawn ratio in the herd.

Buck ratios for the Rattlesnake herd have varied widely from year to year, from the mid 40s to mid 70s per 100 does. Overall buck ratios for the herd unit can appear low due to variation in management strategies and access in Area 70 versus Areas 71 & 72. Buck ratios are most commonly in the upper 50s for the herd unit, just below the lower limit for special management. Still, hunters have developed high expectations for buck numbers and quality within this herd. In more recent years, buck ratios dropped to the mid-40s as a result of low fawn recruitment and moderate harvest pressure on a slowly recovering population. In 2013, the buck ratio for the Rattlesnake Pronghorn Herd reached a 22-year low of 39:100 does. Since then buck ratios have gradually improved with reduced harvest pressure and improved overwinter survival, with 58 bucks per 100 does observed in 2018. Higher fawn survival/recruitment over the past three years and increased doe harvest should further improve the buck ratio in 2019, while maintaining the population near objective.

The 2018 post-season population estimate was approximately 12,200, which is slightly lower than the 2017 population estimate following increased harvest pressure. Line transect surveys conducted in 1998, 2000, 2003, 2007, and 2014 provide end-of-year population estimates and serve to align the population model. The 2014 survey yielded good results, with a reasonable standard error that aligns well with the population model. The current population model is considered to be of fair quality, as personnel believe there is significant interchange with the adjacent Beaver Rim Herd Unit that is not accounted for in the model. However, a merged dataset of the Rattlesnake and Beaver Rim Herds tested in 2015 did not show adequate improvements in predicting population size or trend to merit combining the two herds.

Harvest Data

License success in this herd unit is typically in the 90th percentile. Despite drastic reductions in license issuance, success declined from 2012-2014 to near the 80th percentile. In 2014, active license success reached a 12–year low of 78% with 588 antelope harvested, and reported hunter satisfaction for the Rattlesnake Herd Unit was the lowest in the state. Following further reductions in license issuance, harvest success for active licenses improved, but harvest was only 328 animals in 2015. As the herd began to grow and recover license issuance was increased, and harvest success has improved steadily. By 2018, the population estimate was near objective, with a harvest of 821 animals and overall harvest success of 99%. Hunter satisfaction improved steadily since 2015 as well, and was 95% in 2018. After six years of conservative management, this herd has grown steadily and has been near its objective of 12,000 for the past two years. Managers will strive to maintain the herd at this level utilizing increased doe harvest, with additional goals of sustaining high hunter satisfaction and harvest success while improving buck ratios.

Population

The “Semi-Constant Juvenile Survival – Semi-Constant Adult Survival” (SCJ,SCA) spreadsheet model was chosen for the post-season population estimate of this herd. This model seemed most representative of the herd, as it selects a moderate juvenile and adult survival rate across years other than 2011, when both juvenile and adult survival were constrained to reflect severe winter mortality. The CJ,CA model is similar, but does not adequately account for the severe winter and associated mortality observed in 2010-2011. While the TSJ,CA model accounts for low overwinter survival in 2010-2011, it does not track with improved fawn production/survival and observed population growth from 2016-present. None of the models track very well with the three early line transect estimates, but all three models align very well with the 2014 line transect estimate. While the AIC for the SJC,SCA model is the lowest of the three, all models are still well within one level of power of one another. The SCJ,SCA model appears to be the best representation

relative to the perceptions of managers on the ground and follows trends with license issuance and harvest success. Overall the current model is considered fair in quality as a representation of herd dynamics.

Management Summary

Traditional season dates in this herd unit run from September 15th through October 31st for all hunt areas. License increases are prescribed for Area 70 and Area 72 in the herd unit for 2019. Because Area 71 has difficult access and had lower harvest success, licenses will be maintained but not increased for 2019. Area 70 and Area 72 Type 1 licenses will be increased to allow for increased opportunity in a growing herd, while still striving to achieve special management buck ratios in Area 72. Doe/fawn licenses will be liberalized in Area 70 to maintain a low density of antelope in agricultural areas, and in Area 72 to curb population growth and maintain the herd near its objective. The 2018 season includes a total of 700 any-antelope and 700 doe/fawn licenses. Goals for 2018 are to increase doe harvest to curb population growth, improve buck ratios consistent with special management strategy, and maintain hunter success.

If the projected harvest of 1,215 pronghorn is achieved and fawn production/survival is moderate in 2019, this herd should remain near its objective. If fawn survival is above average, this herd should increase slightly. The predicted 2019 post-season population estimate for the Rattlesnake Pronghorn Herd assuming moderate fawn survival is approximately 10,200 animals, which is 7% below objective.

2018 - JCR Evaluation Form

SPECIES: Pronghorn

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

HERD: PR746 - NORTH NATRONA

HUNT AREAS: 73

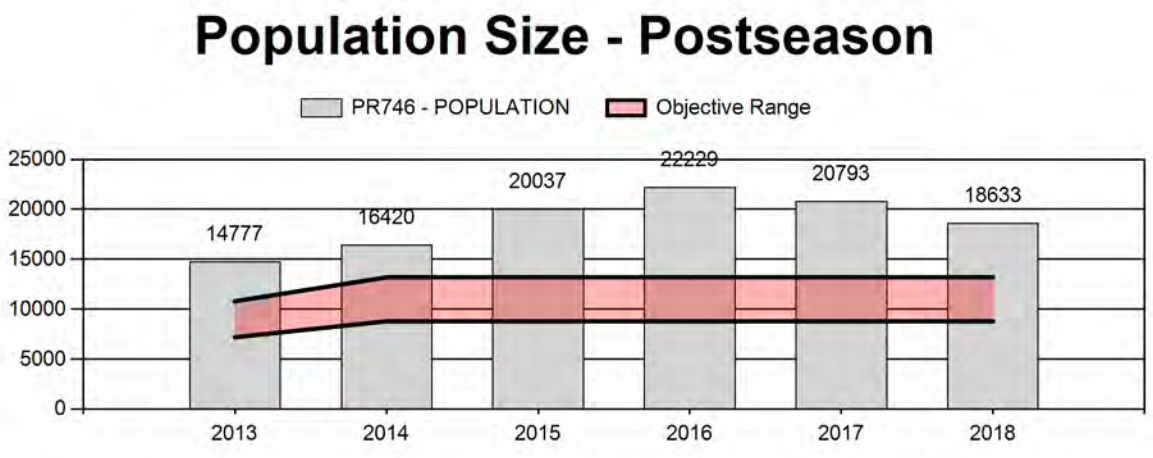
PREPARED BY: HEATHER O'BRIEN

	2013 - 2017 Average	2018	2019 Proposed
Population:	18,851	18,633	17,091
Harvest:	1,018	2,145	2,170
Hunters:	1,080	2,241	2,300
Hunter Success:	94%	96%	94%
Active Licenses:	1,133	2,267	2,300
Active License Success:	90%	95%	94%
Recreation Days:	3,768	4,922	6,500
Days Per Animal:	3.7	2.3	3.0
Males per 100 Females	55	54	
Juveniles per 100 Females	81	66	

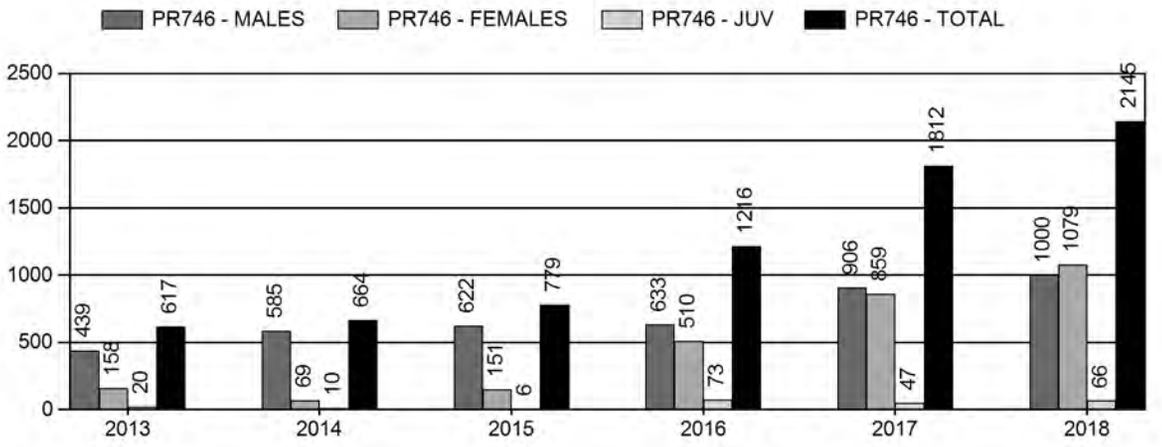
Population Objective (± 20%) :	11000 (8800 - 13200)
Management Strategy:	Recreational
Percent population is above (+) or below (-) objective:	69%
Number of years population has been + or - objective in recent trend:	6
Model Date:	2/27/2019

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

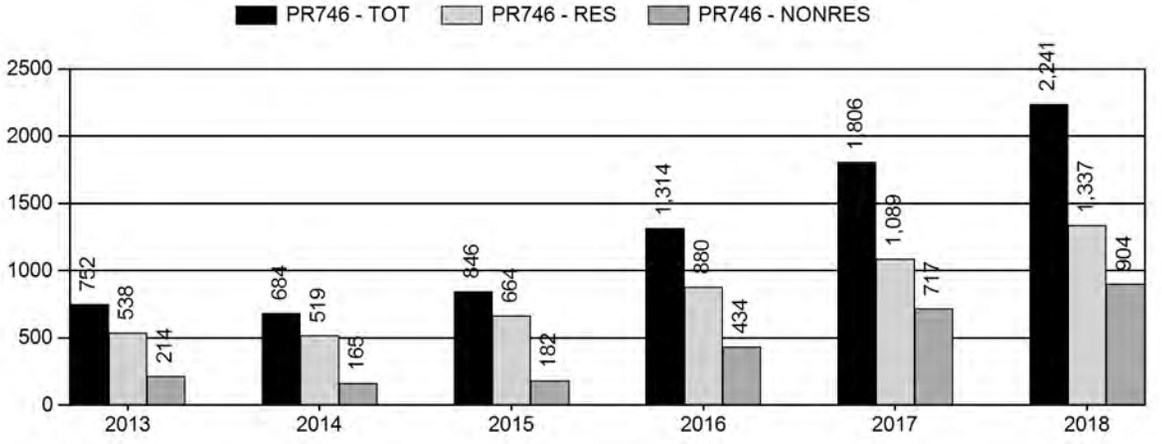
	JCR Year	Proposed
Females ≥ 1 year old:	13.3%	14.7%
Males ≥ 1 year old:	19.4%	20.5%
Total:	10.2%	11.1%
Proposed change in post-season population:	-10.4%	-8.3%



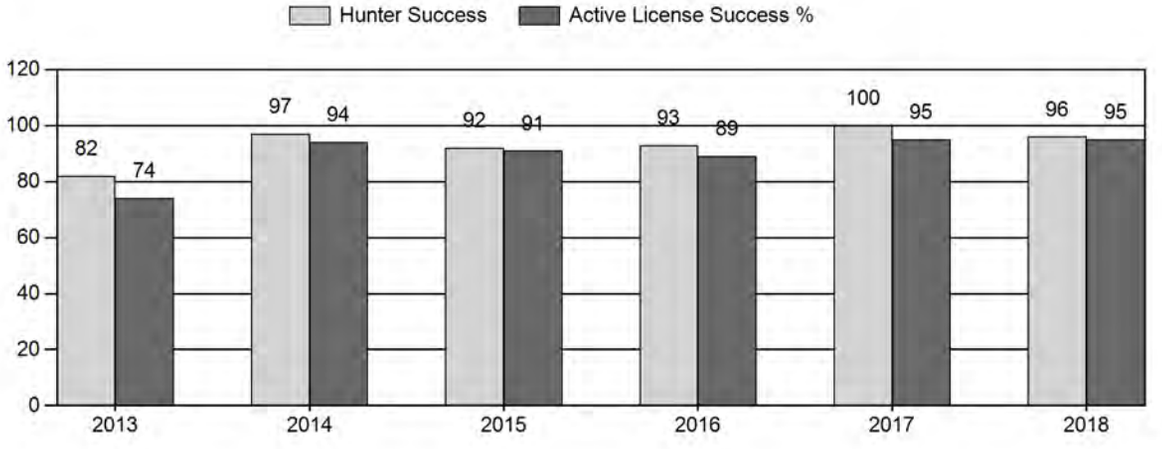
Harvest



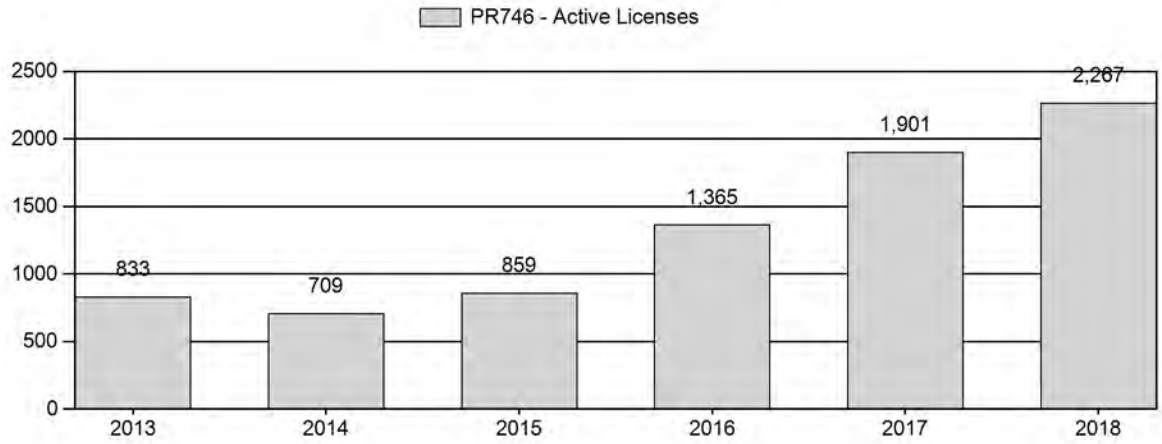
Number of Active Licenses



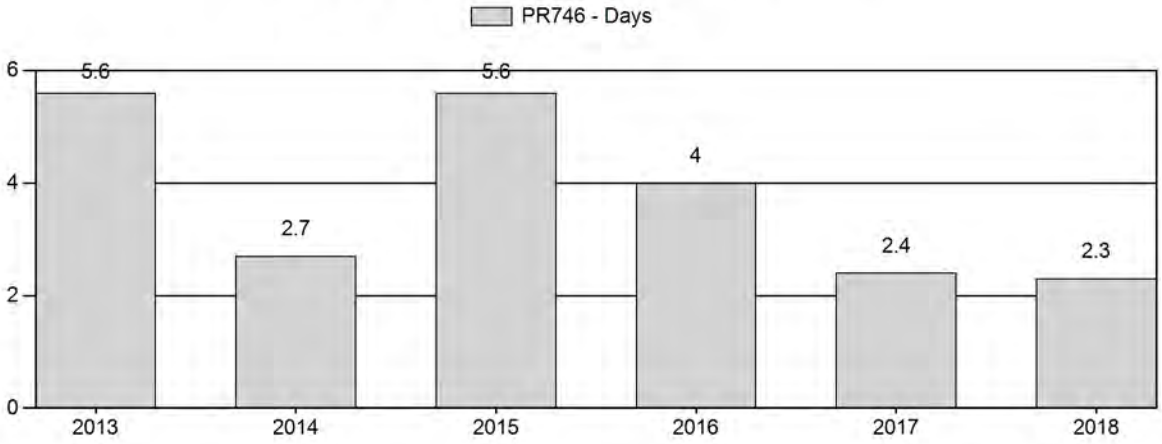
Harvest Success



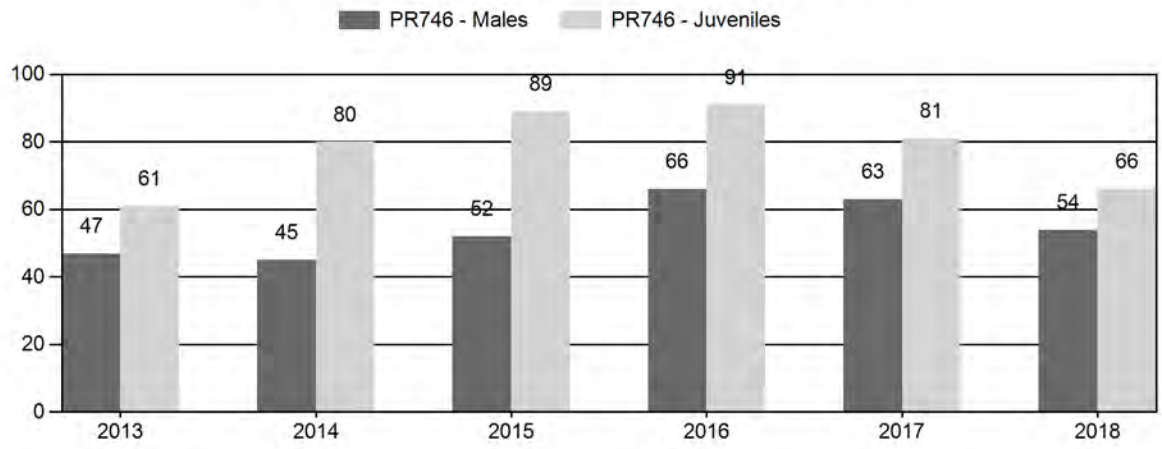
Active Licenses



Days Per Animal Harvested



Preseason Animals per 100 Females



2013 - 2018 Preseason Classification Summary

for Pronghorn Herd PR746 - NORTH NATRONA

		MALES				FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Pre Pop	Ylg	Adult	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Yling	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2013	15,455	69	318	387	23%	817	48%	497	29%	1,701	1,832	8	39	47	± 5	61	± 5	41
2014	17,151	85	210	295	20%	650	44%	520	35%	1,465	1,915	13	32	45	± 5	80	± 7	55
2015	20,894	215	268	483	21%	936	42%	835	37%	2,254	2,729	23	29	52	± 4	89	± 7	59
2016	23,567	319	281	600	26%	905	39%	820	35%	2,325	2,409	35	31	66	± 5	91	± 7	54
2017	22,787	221	375	596	26%	953	41%	768	33%	2,317	3,371	23	39	63	± 5	81	± 6	50
2018	20,993	183	396	579	24%	1,080	45%	716	30%	2,375	2,947	17	37	54	± 4	66	± 5	43

2019 HUNTING SEASONS
NORTH NATRONA PRONGHORN HERD (PR746)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
73	1	Sep. 15	Oct. 31	1,200	Limited quota	Any antelope
	6	Sep. 15	Oct. 31	1,200	Limited quota	Doe or fawn antelope
	7	Sep. 15	Oct. 31	50	Limited quota	Doe or fawn antelope valid on or within one (1) mile of irrigated land
Archery		Aug. 15	Sep. 14			Refer to license type and limitations in Section 2

Hunt Area	Type	Quota change from 2018
73	1	No Change
	6	No Change
	7	No Change

Management Evaluation
Current Postseason Population Management Objective: 11,000
Management Strategy: Recreational
2018 Postseason Population Estimate: ~18,600
2019 Proposed Postseason Population Estimate: ~17,100
2018 Hunter Satisfaction: 98% Satisfied, 2% Neutral, 1% Dissatisfied

The North Natrona Pronghorn Herd Unit has a post-season population management objective of 11,000 pronghorn. The herd is managed using the recreational management strategy, with a goal of maintaining preseason buck ratios between 30-59 bucks per 100 does.

Herd Unit Issues

Hunting access within the herd unit is very good, with large tracts of public land as well as Walk-In Areas available for hunting. The southeastern corner of the herd unit is the only area dominated by private lands. In this area, specific doe/fawn licenses are added to address damage issues on irrigated agricultural fields in years when landowners agree to allow hunting access. The main land use within the herd unit is traditional ranching and grazing of livestock. Industrial scale developments, including oil and gas development, are limited and isolated within this herd

unit. Periodic disease outbreaks (i.e. hemorrhagic diseases, *Clostridium spp*. infections) can impact this herd and contribute to population declines when environmental conditions are suitable, though there were no reported or confirmed cases of disease outbreak within the North Natrona Herd in 2018.

The population objective and management strategy for the herd were formerly reviewed in 2014. At that time, the population objective was revised from to 9,000 to 11,000. For the 2019 review, we are maintaining the current objective and management strategy based on internal discussions and conversations with constituents. Population status and habitat data included in this document were evaluated, and a change is not warranted at this time. The herd objective will be reviewed again in 2024. If the situation arises in the interim and a change is warranted, a review and proposal will be submitted as needed.

Weather

From 2013 to the present, weather trends have been generally favorable, and pronghorn have fared well within the herd. Range conditions were particularly good from 2013 to 2015, when spring and summer moisture improved and winters were mild. The winter of 2015 was fairly average, though some areas experienced prolonged periods of persistent snow. The spring of 2016 had above average precipitation but summer was extremely dry, causing rangeland habitats to cure early. Fortunately, precipitation in October resulted in a late surge of plant growth, which may have provided pronghorn with a boost in nutrition going into the winter months. While there were several notable snow storms and cold snaps during the winter of 2016-2017, there were also periods of warm weather and high winds that melted and drifted snow to expose forage. The 2017 growing season was very similar to the previous year, with ample spring moisture followed by a dry summer with little precipitation. Moisture improved during the fall, though there was little snow to speak of over the winter of 2017-2018. Precipitation was below average for the 2018 growing season, and many reservoirs became dry by late summer. Sparse rain events provided some moisture during the fall months, but the 2018-2019 winter has been mild to average in the herd unit. Thus far, the region has received average snowfall combined with many windy days. Snow has melted or drifted in at low elevation, opening habitats for pronghorn to move freely on winter ranges and access forage. For detailed weather data see http://www.ncdc.noaa.gov/gac/time-series/us.

Habitat

Eight sagebrush utilization transects were established within this herd in 2014 as part of the population objective review. These transects were measured for utilization in spring 2014-2016,

and in 2018 (see Table 1). Utilization was light to moderate on all eight transects in 2018. Anecdotal observations and discussions with landowners in the region confirm summer and winter forage availability for pronghorn was relatively average in 2018. Additionally, pronghorn appeared to be widely distributed across suitable habitat. This suggests current pronghorn population size and the revised objective are sustainable given available habitat.

Year	Average Utilization
2014	15.38%
2015	9.50%
2016	6.38%
2018	13.9%

Table 1. Average utilization of big sagebrush (*Artemisia tridentata* Nutt. Subsp. *wyomingensis*) for eight transects within the North Natrona Pronghorn Herd unit, 2014-2016 & 2018.

Field Data

Fawn ratios were below average in 2013 as the herd was recovering from the harsh winter and drought conditions of 2011-2012. Overall precipitation and forage quality were much improved from 2013-2017, and the population grew during this time period. Fawn ratios improved greatly from 2014-2017 and averaged 85 per 100 does. Overwinter survival was very high during this time frame as well, as evidenced by very high yearling buck ratios. License issuance did not keep pace with population growth, and the herd grew well above objective by 2016. License numbers were increased significantly from 2016-2018, with a considerable increase in doe/fawn licenses. The preseason fawn ratio was 71 per 100 does in 2018, which was a drop from previous years. The yearling buck ratio was lower as well at 18 per 100 does. These more typical ratios coincided with average winter conditions and spring moisture. Managers continued to observe high densities of pronghorn during ground classifications in 2018, and the winter of 2018-2019 has been average so far. Managers expect normal overwinter mortality and recruitment in a population that is over objective, and thus recommend continued liberal harvest pressure to manage towards objective.

Buck ratios for the North Natrona Herd historically average in the mid-50s:100 does. Buck ratios were below average in 2013 and 2014, but improved steadily every year from 2012-2016. The yearling buck ratio in 2013 was extremely low following severe drought conditions in 2012. Yearling buck ratios were very high from 2014-2017, indicating consecutive years of excellent overwinter fawn survival. Typically buck ratios for the herd unit are easily maintained within the target range for recreational management, but have exceeded that range in 2016 and 2017. Following a significant increase in license issuance, the buck ratio dropped back within recreational management parameters in 2018, with 57 bucks per 100 does observed. Ultimate

management goals for 2019 are to maintain harvest opportunity on available bucks and sustain high hunter satisfaction, while continuing to offer exceptional opportunity and good drawing odds via recreational management.

Harvest Data

License success in this herd unit is typically in the 80-90th percentile. Harvest success was lower from 2012-2013 as population size was also low. Total harvest dropped to only 617 in 2013 as total license issuance was reduced. In 2014, license issuance reached a 10-year low, but pronghorn numbers also began to recover. Thus, hunters enjoyed much improved harvest success in the 90th percentile, but overall antelope harvest was still under 700 total. From 2014-2016, hunter satisfaction remained high as buck availability increased. By 2017, high yearling recruitment from the previous three years created a high adult buck ratio, and opportunity to harvest mature bucks was exceptional. Harvest success for Type 1 licenses was its highest since 2007, and hunter satisfaction was the highest on record for the herd, and the highest in the state. At the same time, doe/fawn licenses were increased to address a population growing over objective, and overall harvest rose to over 1,800 animals. License issuance was increased again in 2018 to further address population growth. Success on Type 1 and Type 6 licenses has remained in the 90th percentile the past two years, despite an increase to 2,450 total licenses in 2018. License success on Type 7 licenses was lower at 85%, possibly due to access limitations and/or lower hunter effort. In total, hunters harvested 1,000 bucks and over 1,100 does and fawns in 2018 and overall satisfaction was 95%.

Population

The "Time-Specific Juvenile Survival - Constant Adult Survival" (TSJ,CA) spreadsheet model was chosen for the post-season population estimate of this herd. This model seemed the most representative of the herd, as it selects for higher juvenile survival during the years when field personnel observed mild winter conditions, particularly from 2003-2008 when drought conditions persisted and overwinter precipitation was minimal. The simpler models (CJ,CA and SCJ,CA) select for very low juvenile survival rates and very high adult survival rates across years, which does not seem feasible for this herd. All three models follow a trend that seems representative for the herd unit. However, the CJ,CA and SCJ,CA models estimate population peaks in 2016 that are unrealistically high compared to the perceptions of field personnel and landowners. While the AIC for the TSJ,CA model is the highest of the three, it is only due to year-by-year penalties and is still well within one level of power in comparison to the AICs of the simpler models. One confounding issue with the TSJ,CA model is its selection of the lower constraint for juvenile survival for the last three years of simulation, which does not correspond

to high yearling ratios from classification surveys. Still, the model in general appears to be the best representation relative to the perceptions of managers on the ground for all other years, while following trends with license issuance and harvest success. Overall the model is considered to be good in representing dynamics of the herd.

The three models each align partially to four early line-transect estimates – each model aligning through some but not all line-transect estimate confidence intervals. The 2012 line transect had a wide standard error, and is considered to be an overestimate of population size for that year. However, its addition in the model only changes the current population estimate by about 100 animals. Thus, it was left in the model as it provides an additional estimation point for the model to utilize. The 2016 line transect resulted in an extremely high estimate with a wide standard error. This estimate was left out of the model, as managers have low confidence in its accuracy and impact to the model. An additional line transect survey was conducted in 2018 (Appendix A). While the resulting population estimate is also high, managers feel the estimate and standard error from this survey are more realistic. Adding this estimate to the model changes the population estimate by nearly 10,000 animals. The model increases but does not align exactly with the estimate, as it also must take into account classification and harvest data. Historically high license issuance, high harvest success, and high classification totals the past two years corroborate the survey and seem to confirm this herd is well above objective. Therefore managers feel comfortable including the 2018 line transect results in the model, though further review is being conducted to verify the accuracy of the survey.

Management Summary

Traditional season dates in this herd run from September 15th through October 31st. Season dates will remain the same for 2019, with no change in Type 1 and Type 6 license issuance. Licenses have been increased substantially the last two years to provide additional hunting opportunity and address rapid population growth above objective in the herd. This herd should continue to decrease in size given the same number of licenses as 2018. A small number of Type 7 licenses will be maintained this year as well, to address concentrations of antelope on irrigated agricultural lands in the southeastern part of the herd unit. The 2019 season includes 1,200 Type 1 licenses, 1,200 Type 6 licenses, and 50 Type 7 licenses. Goals for 2019 are to further reduce the pronghorn population toward objective, and to maintain current buck ratios, hunter success, and hunter satisfaction.

If we attain the projected harvest of 2,170 pronghorn with average fawn production, this herd will be reduced from 69% to 55% above the objective. The predicted 2019 post-season population size of the North Natrona Pronghorn Herd is approximately 17,100 animals.

APPENDIX A
North Natrona Pronghorn Herd Unit
Line Transect 2018 – Distance Analysis

```
Estimators:
-----------
Estimator  1
Key: Uniform
Adjustments - Function                 : Hermite poynomials
            - Term selection mode      : Sequential
            - Term selection criterion : Akaike Information Criterion (AIC)
            - Distances scaled by      : W (right truncation distance)

Estimator selection: Choose estimator with minimum  AIC
```

Cell i	Cut Points		Observed Values	Expected Values	Chi-square Values
1	0.000	21.8	120	72.25	31.563
2	21.8	49.0	103	87.90	2.593
3	49.0	87.2	75	113.04	12.801
4	87.2	147.	103	135.27	7.699
5	147.	206.	62	54.54	1.021

Total Chi-square value = 55.6779 Degrees of Freedom = 3.00

Probability of a greater chi-square value, P = 0.00000

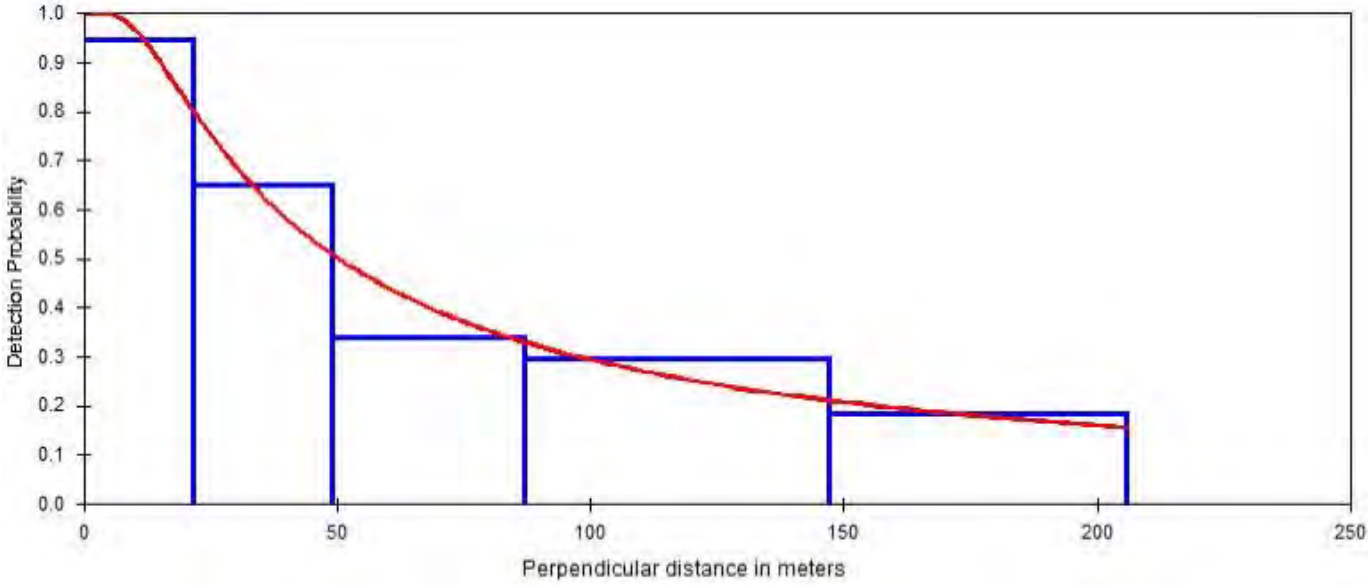
```
Effort        :    855.7406
# samples     :    39
Width         :    206.0000
Left          :       0.0000000
# observations:   463

Model  2
   Uniform key, k(y) = 1/W
   Hermite polynomial adjustments of order(s) :  2
```

Parameter	Point Estimate	Standard Error	Percent Coef. of Variation	95% Percent Confidence Interval	
DS	10.067	0.68636	6.82	8.7827	11.539
E(S)	1.6777	0.47822E-01	2.85	1.5864	1.7744
D	16.890	1.2481	7.39	14.581	19.564
N	21416.	1582.6	7.39	18489.	24807.

```
Measurement Units
---------------------------------
Density: Numbers/Sq. miles
    ESW: meters

Component Percentages of Var(D)
-------------------------------
Detection probability   :  14.5
Encounter rate          :  70.6
Cluster size            :  14.9
```


1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Detection Probability
0
50
100
150
200
250
Perpendicular distance in meters

2018 - JCR Evaluation Form

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

HERD: PR748 - NORTH CONVERSE

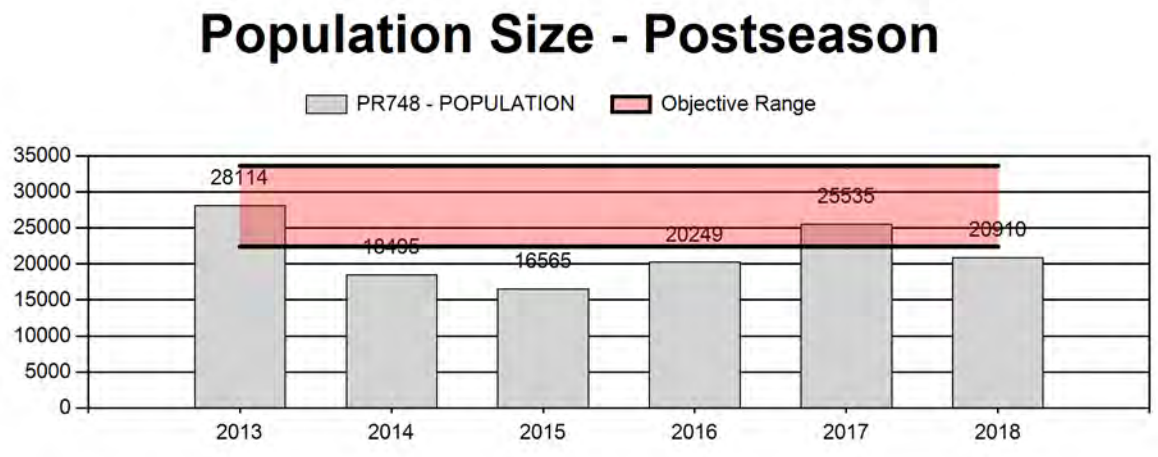
HUNT AREAS: 25-26
PREPARED BY: WILLOW BISH

	2013 - 2017 Average	2018	2019 Proposed
Population:	21,792	20,910	22,591
Harvest:	1,772	2,502	2,675
Hunters:	1,957	2,615	2,750
Hunter Success:	91%	96%	97%
Active Licenses:	2,078	2,763	2,900
Active License Success:	85%	91%	92%
Recreation Days:	6,055	7,188	7,300
Days Per Animal:	3.4	2.9	2.7
Males per 100 Females	57	54	
Juveniles per 100 Females	81	77	

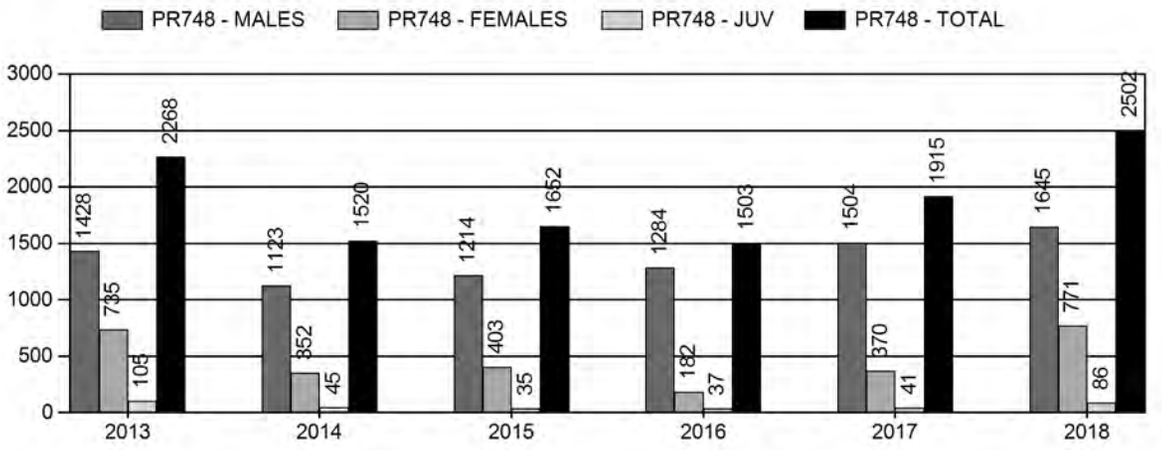
Population Objective (± 20%) :	28000 (22400 - 33600)
Management Strategy:	Recreational
Percent population is above (+) or below (-) objective:	-25.3%
Number of years population has been + or - objective in recent trend:	8
Model Date:	02/04/2019

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

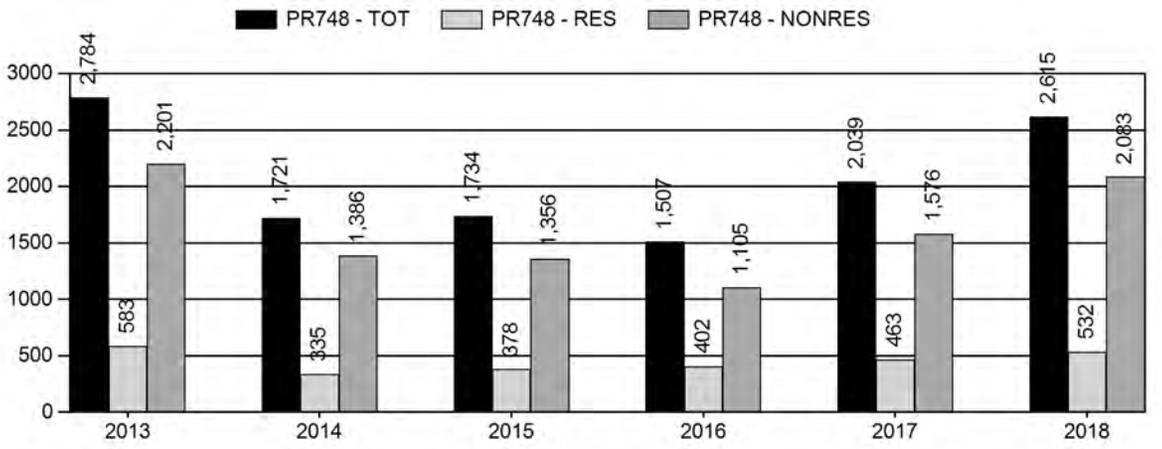
	JCR Year	Proposed
Females ≥ 1 year old:	8.3%	8.3%
Males ≥ 1 year old:	32.2%	32.6%
Total:	40.5%	40.9%
Proposed change in post-season population:	-11.6%	-11.6%



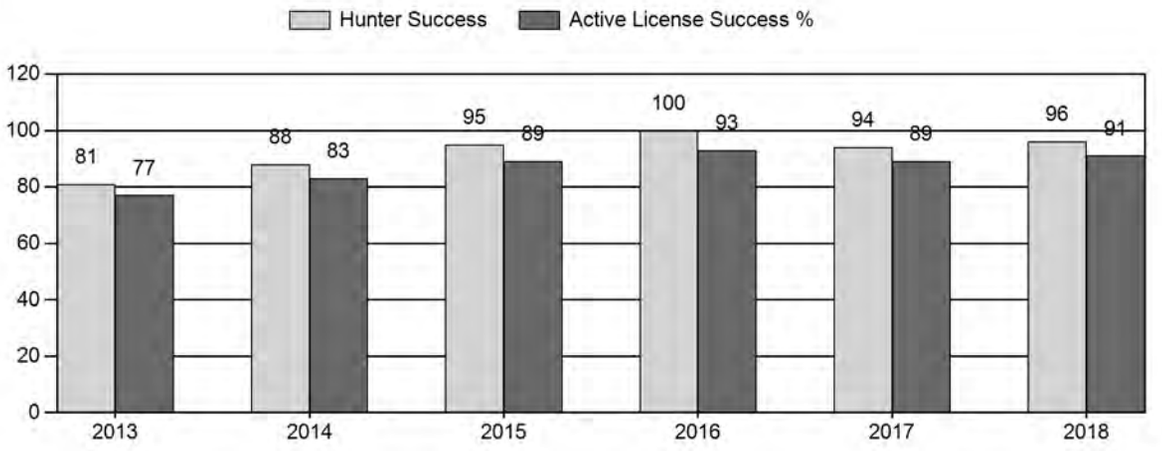
Harvest



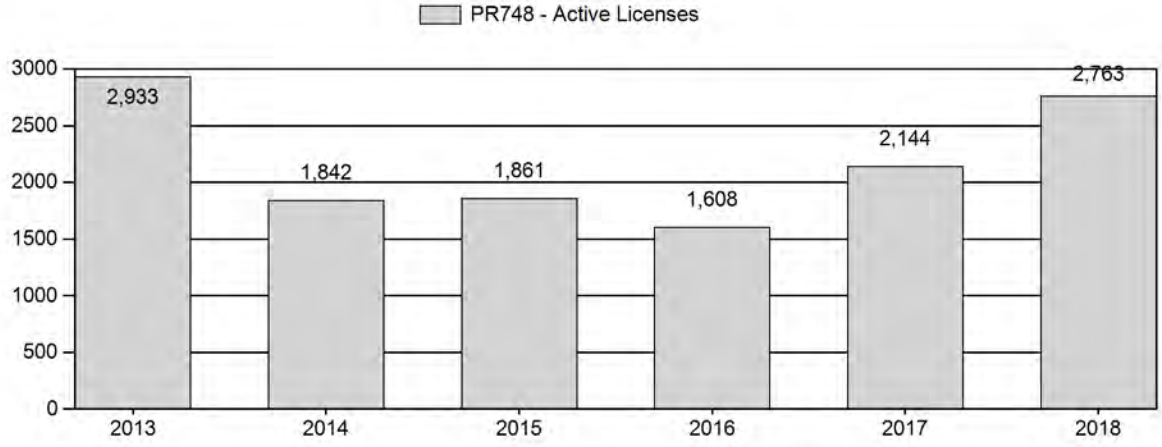
Number of Active Licenses



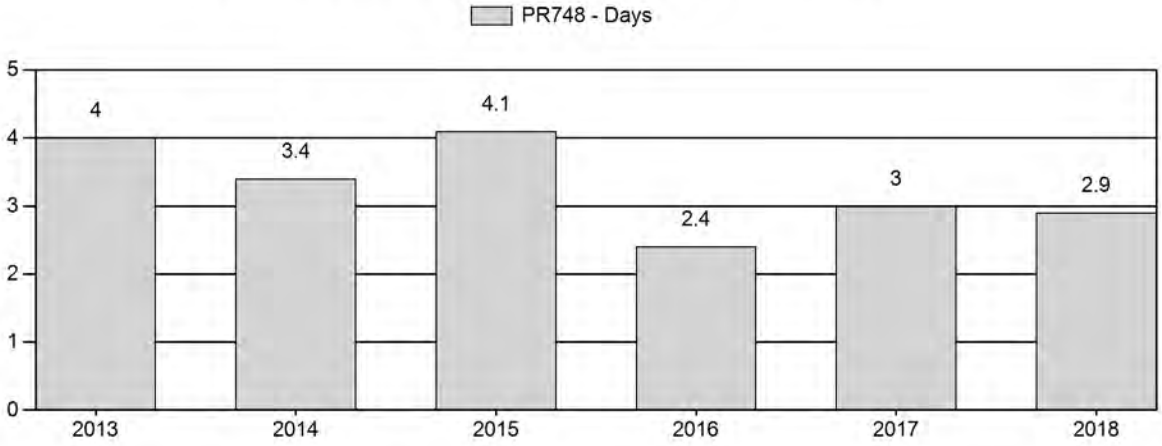
Harvest Success



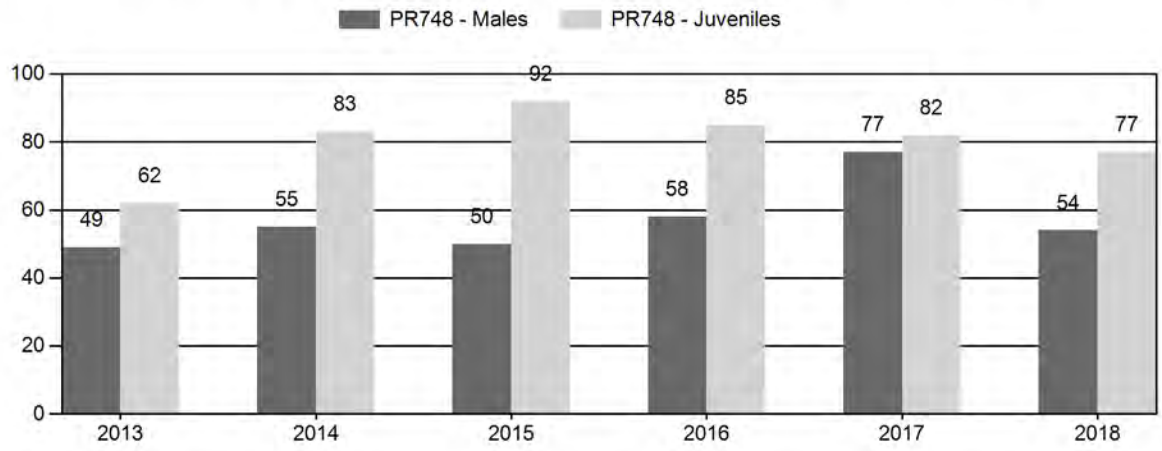
Active Licenses



Days Per Animal Harvested



Preseason Animals per 100 Females



2013 - 2018 Preseason Classification Summary

for Pronghorn Herd PR748 - NORTH CONVERSE

		MALES				FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Pre Pop	Ylg	Adult	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Yling	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2013	30,608	101	294	395	23%	803	47%	498	29%	1,696	2,059	13	37	49	± 5	62	± 6	42
2014	20,167	121	249	370	23%	669	42%	554	35%	1,593	3,415	18	37	55	± 6	83	± 8	53
2015	18,382	196	251	447	21%	896	41%	820	38%	2,163	3,717	22	28	50	± 4	92	± 7	61
2016	21,902	197	216	413	24%	716	41%	609	35%	1,738	3,480	28	30	58	± 6	85	± 7	54
2017	27,642	154	329	483	30%	624	39%	510	32%	1,617	3,643	25	53	77	± 7	82	± 8	46
2018	23,662	189	336	525	23%	968	43%	748	33%	2,241	2,980	20	35	54	± 5	77	± 6	50

2019 HUNTING SEASONS
NORTH CONVERSE PRONGHORN HERD (PR748)

Hunt Area	Type	Season Dates Opens	Closes	Quota	License	Limitations
25	1	Oct. 1	Oct. 14	900	Limited quota	Any antelope
	6	Oct. 1	Oct. 14	450	Limited quota	Doe or fawn
26	1	Sep. 24	Oct. 14	1,300	Limited quota	Any antelope
	6	Sep. 24	Oct. 14	500	Limited quota	Doe or fawn
Archery		Aug. 15	Sep. 30			Refer to license type and limitations in Section 2

Hunt Area	Type	Quota change from 2018
25	1	+100
25	6	+50
Herd Unit Totals	**1**	**+100**
	6	**+50**

Management Evaluation
Current Postseason Population Management Objective: 28,000
Management Strategy: Recreational
2018 Postseason Population Estimate: ~20,900
2019 Proposed Postseason Population Estimate: ~ 22,600
2018 Hunter Satisfaction: 92% Satisfied, 4% Neutral, 4% Dissatisfied

Herd Unit Issues

The North Converse Pronghorn Herd Unit has a post-season population objective of 28,000 pronghorn. This herd is managed under the recreational management strategy, with a goal of maintaining preseason buck ratios between 30-59 bucks per 100 does. The objective and management strategy were last revised in 2015.

Hunting access on public lands is poor within this herd unit, with only small tracts of accessible public land interspersed within predominantly private lands. However, there is enough accessible public land that many hunters enjoy this hunt area. Two Walk-In Areas provide some additional hunting opportunity, although they are relatively small in size. Primary land uses in this herd unit include extensive oil and gas production, large-scale industrial wind generation, In-Situ

uranium production, and traditional cattle and sheep grazing. In recent years, expansion of oil shale development has dramatically escalated anthropogenic disturbance throughout this herd unit. In addition to current development, two large-scale Environmental Impact Statements are currently being developed that are partially within this herd unit. The Converse County and Crossbow Oil and Gas EIS's combined propose to develop up to 6,500 wells on 1,600 pads over the next 10 years. The cumulative impacts on pronghorn in this herd from the present and planned natural resource development are potentially significant.

Weather

Total precipitation in 2018 was slightly above average which was similar to 2017. However, the bulk of the precipitation was received throughout the summer months (May-July) with less than average precipitation through spring and fall. Due to the relatively dry spring, forage production occurred later in the season than normal but precipitation throughout the summer months supported good forage growth for the year. The 2018-2019 winter has been relatively mild to date, however, there were some cold snaps and snow accumulation in November which may have influenced animal movements and foraging capabilities. Given the relative mildness of the rest of the winter and less than average snowfall received, pronghorn have likely experienced normal over-winter survival this year.

Habitat

There are no habitat transects in this herd unit due to the preponderance of private land. Habitat conditions are variable in this herd unit due to some past wildfires which have removed portions of sagebrush habitat. The past five years have produced above average to average precipitation, resulting in a general trend of good forage production. These conditions have been effective in allowing rangelands to recover from the extreme drought in 2012. Sagebrush plants are recruiting in some areas of this herd unit, which may lead to higher quality forage availability in the future.

Field Data

It has been difficult to meet classification sample sizes in this herd unit as aerial surveys have been abandoned for safety reasons and budgetary constraints. The total number of animals classified has markedly decreased since aerial surveys were eliminated in 2011. In 2018, the adequate sample size was about 3,000 animals, yet only about 2,200 pronghorn were classified despite intensive ground coverage. There is limited public road access throughout this herd unit. Given this, field personnel requested access to classify antelope on private land two-tracks in addition to public roads in order to increase coverage.

Fawn production in 2018 was similar to the previous 5-year average (81 per 100 does) with a ratio of 77 fawns per 100 does. From 2008-2013 there was an average of 69 fawns per 100 does. From 2014-2018, the average was 84 fawns per 100 does, demonstrating the marked improvement in fawn production in recent years. Correspondingly, recruitment has increased. Yearling buck ratios averaged 17 per 100 does from 2008-2013 versus 22 yearling bucks per 100 does from 2014-2018. The population increase realized in recent years is attributed to increased fawn production and recruitment.

Preseason buck ratios in 2018 (54 per 100 does) were similar to the previous 5-year average of 58, and are within the upper limits of management strategy criteria. Historically buck ratios often exceed the management strategy maximum due to limited hunter access and widespread outfitting. Therefore, managers are content with current buck ratios given past challenges with remaining within management criteria. However, with buck ratios very near the upper limits of management criteria, some increased opportunity is warranted for the 2019 season.

Harvest

Hunt Area 25 had higher total success (101%) than Hunt Area 26 (92%), which can mostly be attributed to lower resident success in Hunt Area 26 (71%) over Hunt Area 25 (89%). This reduction in resident success may be due quota increases in 2018 as the resident success rate in 2017 in Hunt Area 26 was 100%. Field managers in Hunt Area 26 experienced a high volume of calls and inquiries from hunters in 2018 requesting information on hunting locations and access. Given the marked increase of inquiries in 2018 over recent years, field managers believe license issuance in Hunt Area 26 is near saturation and that increased license issuance would decrease hunting quality and potentially further decrease resident success.

Total harvest increased significantly in 2018 (2,502 pronghorn), and was well above that of 2017 (1,915). Total harvest success (95.7%) was similar to 2017 (93.9%) but the overall harvest increase can be attributed to quota increases last year. Given current trends, this population has regained the ability to accommodate harvest at higher levels. However, managers are sensitive to license issuance saturating public land availability. In addition, based on input from private lands that allow outfitted or trespass fee hunts, license issuance is nearing the saturation point on private lands as well. Based on past experience in this herd unit, increasing license issuance for these two areas far beyond current levels will result in further overcrowding of limited public lands as landowners become unwilling to accommodate more hunters, which could potentially decrease harvest rates despite higher license issuance while also leading to more hunter dissatisfaction. Regardless, recent high hunter satisfaction, excellent harvest success and high buck ratios all indicate a modest increase in opportunity is warranted.

In 2018, 92% of hunters reported being either satisfied or very satisfied with their hunt, indicating a remarkably high level of satisfaction given the lack of public access. It should be noted that most hunters who speak to Game and Fish personnel are advised to secure access on private land before purchasing a license in areas that have limited public access, or at least be cognizant of the fact that public land availability is extremely limited.

Population

The 2018 post-season population estimate is approximately 20,900 pronghorn, which is 25% below objective. While this population was historically above objective, the population dropped below objective due to elevated mortality during the relatively severe 2010-2011 winter, and continued to decrease through 2013. Significant reductions in licenses were made in response to population decrease. Poor fawn production in 2012 and 2013 further suppressed this herd, but significant improvements began in 2014. License issuance remained conservative in 2015 because managers were concerned about unreported hemorrhagic disease and stagnation in population growth despite high fawn production. However, field data and observations from

2016-2018, as well as the current population trend, show this herd is rebounding. In years past, high fawn productivity coupled with limited access has allowed this herd to exceed the objective very readily. Therefore managers began to increase license issuance in 2016 to slow the growth of this population. Rather significant increases were made in 2018, with only slight increases proposed for 2019 given concerns with hunter saturation.

The "Time Specific Juvenile – Constant Adult" (TSJ-CA) spreadsheet model was chosen for the post-season population estimate of this herd. All three models had similar relative AIC values. The TSJ-CA model most accurately represented population trend based on field personnel and landowner perceptions. This model is considered to be of fair quality and tracks well with observed preseason buck ratios. However, this model has not been anchored to past end-of-year abundance estimates as multiple Line Transect surveys have yielded unusable results with widely fluctuating point estimates and high coefficients of variation.

Management Strategy

The traditional season dates in this herd unit are from October 1 to October 14 in Hunt Area 25 and from September 24 to October 14 in Hunt Area 26. These season dates have typically been adequate to meet landowner desires while accommodating a reasonable harvest. For 2019, herd unit-wide Type 1 license issuance will be 2,200 licenses, and Type 6 license issuance will be 950 licenses. This is an overall increase of 100 Type 1 licenses and 50 Type 6 licenses from 2018.

In 2013, the post-hunt population estimate was 53% below objective. From 2013 to 2017, the population increased by 40%, and is now 25% below objective, showing this population's potential for rapid growth. Due to the high percentage of private land within this herd unit and limited hunter access, this population can easily increase above the objective. Therefore, relatively high license issuance is warranted, however the population has not yet met the objective and mangers have concerns with public land saturation. Given trends in recent years, managers intend to slow the growth of this population to prevent it from going over objective too quickly, which would then necessitate even higher license issuance to achieve objective. If we attain the projected harvest of ~2,675 pronghorn and realize normal fawn recruitment, this population is projected to increase to about 22,500 pronghorn, which is 20% below objective.

2018 - JCR Evaluation Form

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

HERD: PR750 - BLACK THUNDER

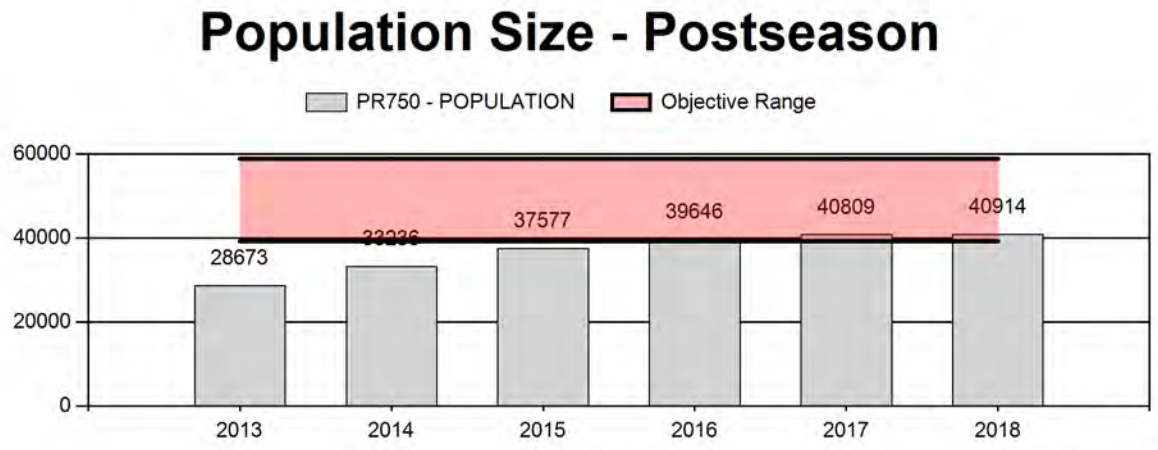
HUNT AREAS: 4-9, 24, 27, 29
PREPARED BY: JOE SANDRINI

	2013 - 2017 Average	2018	2019 Proposed
Population:	35,988	40,914	45,543
Harvest:	3,694	4,520	4,580
Hunters:	4,315	4,896	4,980
Hunter Success:	86%	92%	92%
Active Licenses:	4,666	5,365	5,400
Active License Success:	79%	84%	85%
Recreation Days:	14,024	14,322	14,500
Days Per Animal:	3.8	3.2	3.2
Males per 100 Females	47	48	
Juveniles per 100 Females	79	58	

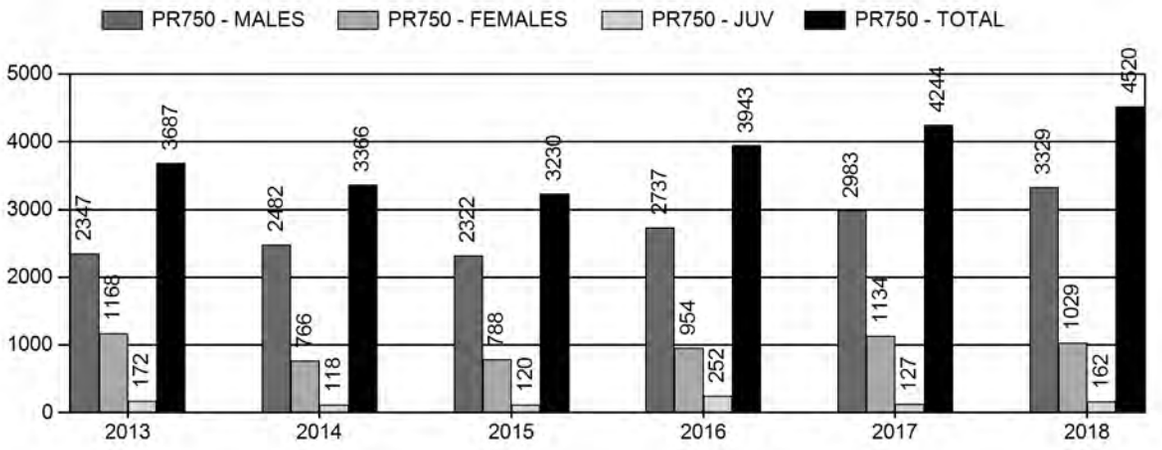
Population Objective (± 20%) :	49000 (39200 - 58800)
Management Strategy:	Recreational
Percent population is above (+) or below (-) objective:	-16.5%
Number of years population has been + or - objective in recent trend:	10
Model Date:	01/24/2019

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

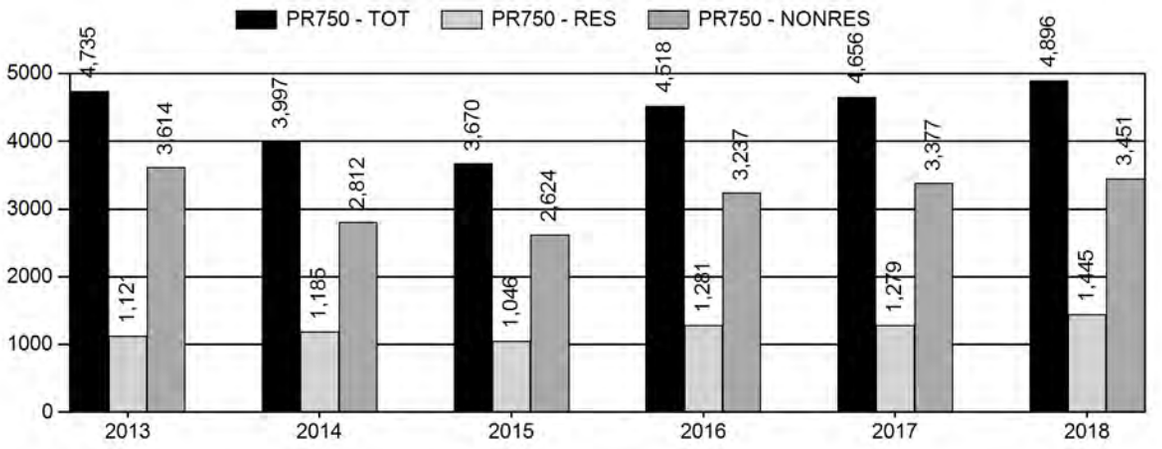
	JCR Year	Proposed
Females ≥ 1 year old:	5.1%	5.2%
Males ≥ 1 year old:	34.2%	35.5%
Total:	10.8%	10.0%
Proposed change in post-season population:	-1.1%	+10.0%



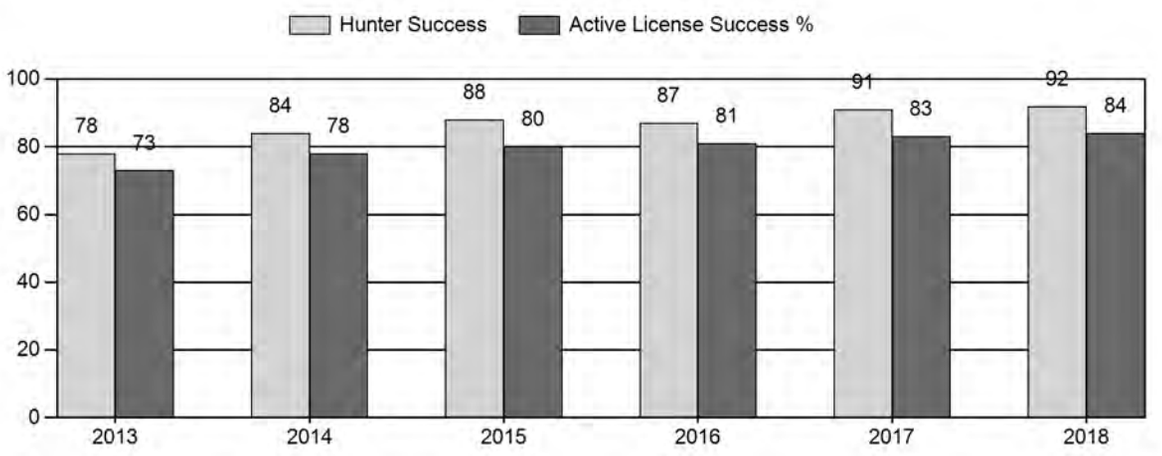
Harvest



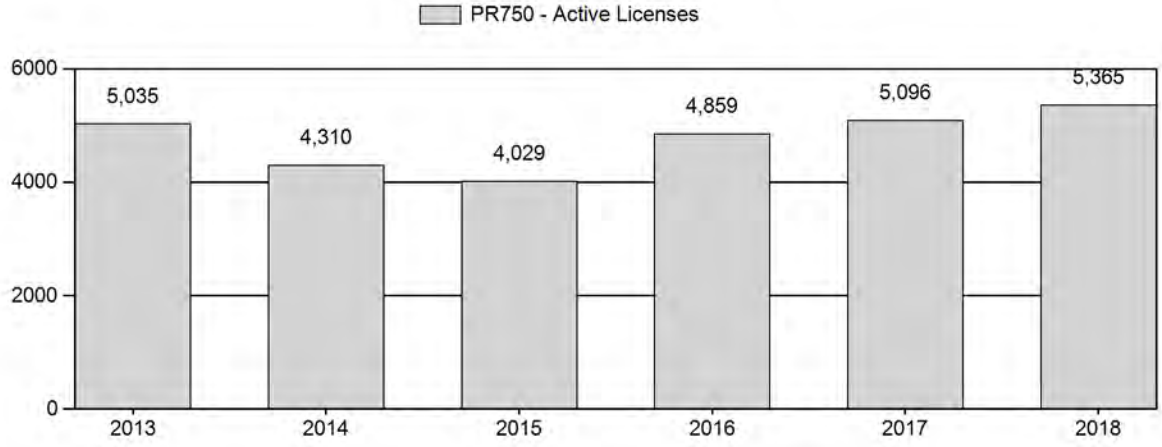
Number of Active Licenses



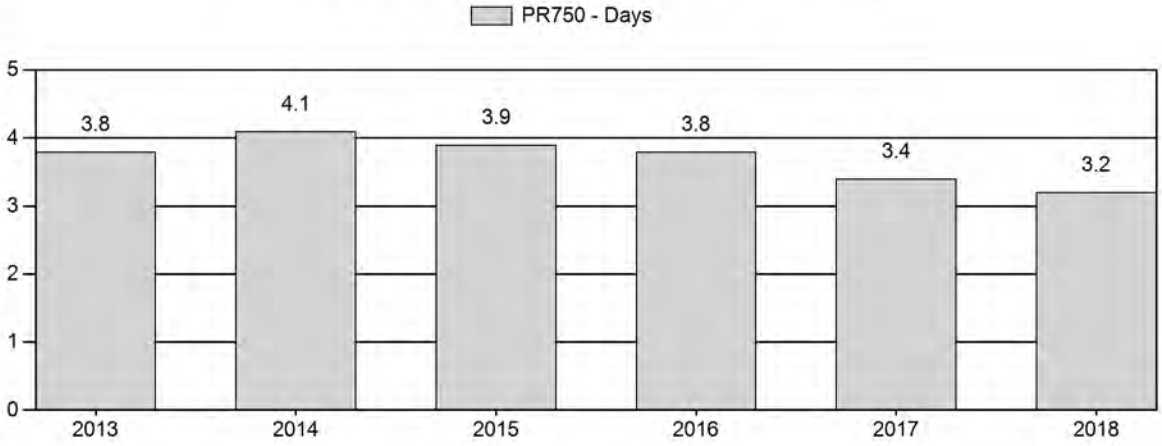
Harvest Success



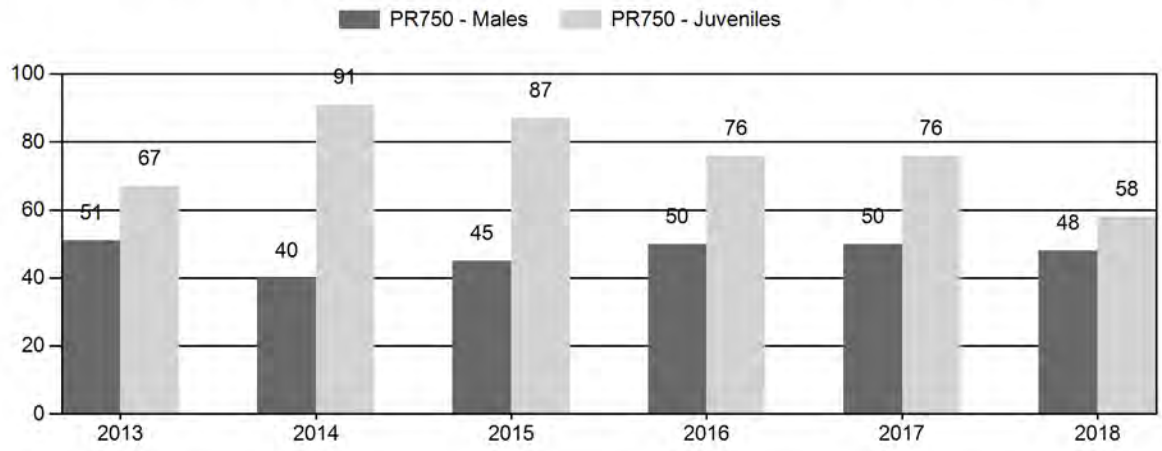
Active Licenses



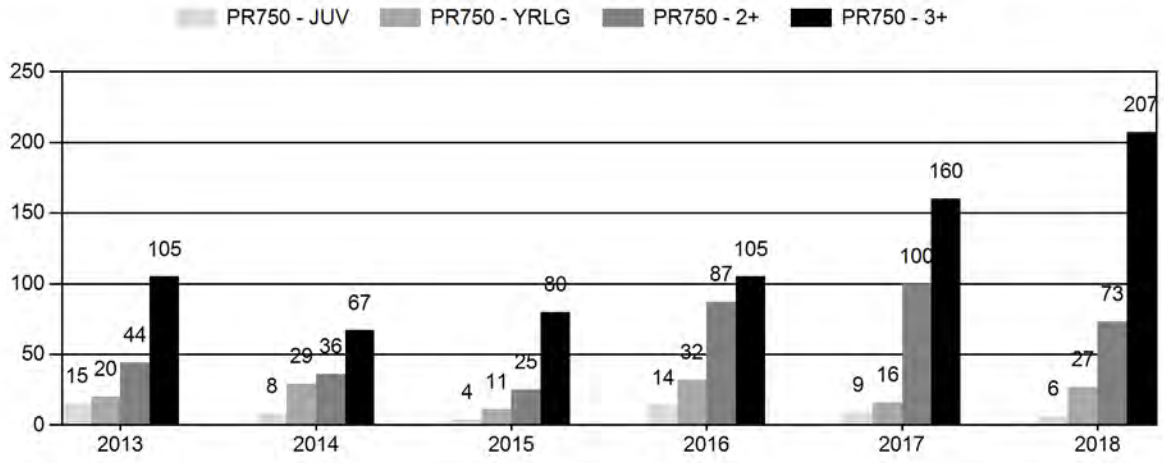
Days Per Animal Harvested



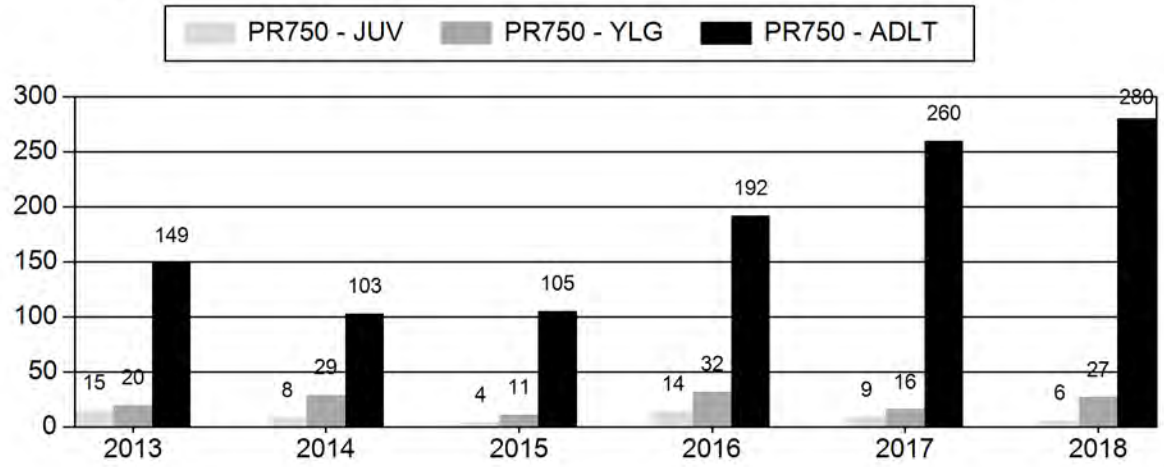
Preseason Animals per 100 Females



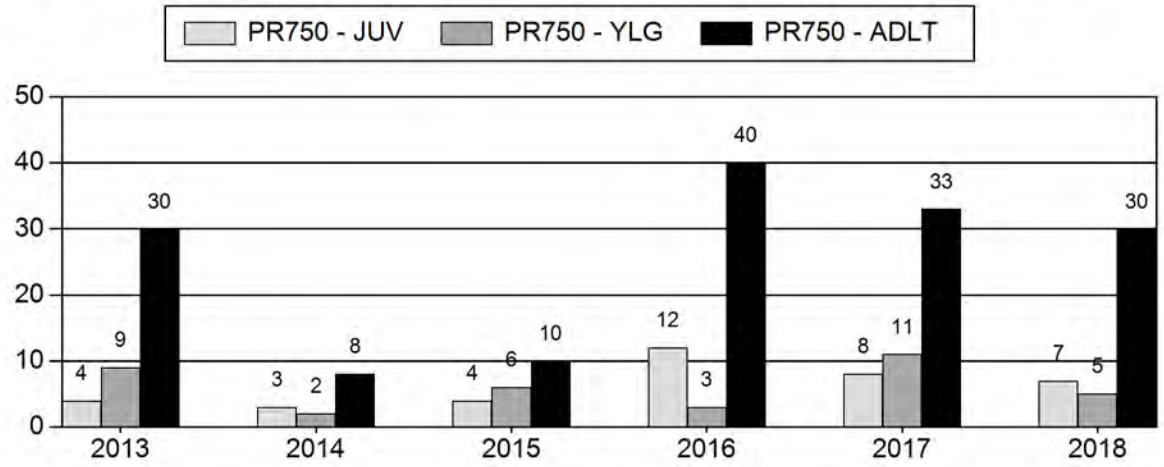
Age Structure of Field Checked Males



Age Structure Data (Field and Laboratory) - Male



Age Structure Data (Field and Laboratory) - Female



2013 - 2018 Preseason Classification Summary

for Pronghorn Herd PR750 - BLACK THUNDER

		MALES				FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Pre Pop	Ylg	Adult	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Yling	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2013	32,729	315	733	1,048	23%	2,067	46%	1,380	31%	4,495	2,444	15	35	51	± 3	67	± 4	44
2014	36,939	288	582	870	17%	2,197	43%	2,008	40%	5,075	3,888	13	26	40	± 2	91	± 4	65
2015	41,130	482	659	1,141	19%	2,558	43%	2,235	38%	5,934	3,717	19	26	45	± 2	87	± 4	60
2016	43,983	617	763	1,380	22%	2,770	44%	2,096	34%	6,246	3,046	22	28	50	± 3	76	± 3	51
2017	45,477	631	1,033	1,664	22%	3,343	44%	2,526	34%	7,533	3,069	19	31	50	± 2	76	± 3	50
2018	45,886	413	908	1,321	23%	2,766	49%	1,613	28%	5,700	1,957	15	33	48	± 2	58	± 3	39

2019 HUNTING SEASONS
BLACK THUNDER PRONGHORN HERD (PR750)

Hunt Area	Type	Dates of Seasons Opens	Dates of Seasons Closes	Quota	License	Limitations
4	1	Oct. 1	Nov. 20	225	Limited quota	Any antelope
	6	Oct. 1	Nov. 20	200	Limited quota	Doe or fawn
5	1	Oct. 1	Nov. 20	125	Limited quota	Any antelope
	7	Oct. 1	Nov. 20	100	Limited quota	Doe or fawn valid on private land
6	1	Oct. 1	Oct. 15	350	Limited quota	Any antelope; also valid on private land in that portion of Area 8 in Weston County
	6	Oct. 1	Oct. 15	50	Limited quota	Doe of fawn; also valid on private land in that portion of Area 8 in Weston County
7	1	Oct. 1	Oct. 15	700	Limited quota	Any antelope
	6	Oct. 1	Oct. 15	150	Limited quota	Doe or fawn
8	1	Oct. 1	Oct. 15	375	Limited quota	Any antelope
	7	Oct. 1	Oct. 15	75	Limited quota	Doe or fawn valid on private land
9	1	Oct. 1	Oct. 31	650	Limited quota	Any antelope; also valid in that portion of Area 11 in Converse or Niobrara counties
	6	Oct. 1	Oct. 31	500	Limited quota	Doe or fawn; also valid in that portion of Area 11 in Converse or Niobrara counties
24	1	Oct. 1	Oct. 31	300	Limited quota	Any antelope
	2	Oct. 1	Oct. 31	500	Limited quota	Any antelope valid on private land
	6	Oct. 1	Oct. 31	100	Limited quota	Doe or fawn
	7	Oct. 1	Oct. 31	300	Limited quota	Doe or fawn valid on private land

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27	1	Oct. 1	Oct. 15	350	Limited quota	Any antelope
	7	Oct. 1	Oct. 15	75	Limited quota	Doe or fawn valid on private land
29	1	Oct. 1	Oct. 15	150	Limited quota	Any antelope
	2	Oct. 1	Oct. 31	600	Limited quota	Any antelope valid on private land
	7	Oct. 1	Oct. 31	350	Limited quota	Doe or fawn valid on private land
	8	Oct. 1	Nov. 15	100	Limited quota	Doe or fawn valid south and west of Interstate Highway 25

Hunt Special Archery Season Hunt Areas	**Opening Date**	**Limitations**
4, 5	Sep. 1	Refer to Section 2 of this Chapter
6 - 9, 24, 27, 29	Aug. 15	Refer to Section 2 of this Chapter

SUMMARY OF CHANGES IN LICENSE NUMBER

Hunt Area	License Type	Quota change from 2018
5	6	-100
5	7	+100
8	7	+ 75
29	6	- 350
29	7	+ 250
29	8	+ 100
Herd Unit Total	**1**	**0**
	2	**0**
	6	**- 450**
	7	**+ 425**
	8	**+ 100**

Management Evaluation

Current Postseason Population Management Objective: 49,000
Management Strategy: Recreational
2018 Postseason Population Estimate: ~ 40,900
2019 Postseason Population Estimate: ~ 45,500
2018 Hunter Satisfaction: 89% Satisfied**,** 7% Neutral**,** 4% Dissatisfied

HERD UNIT ISSUES: The management objective of the Black Thunder Pronghorn Herd Unit is for an estimated, post-season population of 49,000 pronghorn. This herd is managed under the recreational management strategy. The population objective and management strategy were reviewed and adopted in 2014 when this herd was created by combining the Cheyenne River (PR740) and Highlight (PR316) pronghorn herd units. The post-season population objectives of the parent herds were combined to create the current objective for the Black Thunder herd.

The Black Thunder Pronghorn herd unit encompasses much of northeastern Wyoming and accounts for about 10% of the annual, statewide harvest of antelope. Because of the disparity of habitats across the herd unit and the preponderance of private land, this herd unit is managed for recreational hunting. The herd unit encompasses approximately 8,315 mi^2, of which slightly more than 7,100 mi^2 are delineated as occupied pronghorn habitat. This figure was revised in 2016 to better quantify unsuitable and unoccupied habitat (2016 PR750 JCR). The largest blocks of unoccupied habitat are found in Hunt Areas (HA's) 4 and 5 and generally include a portion of the Black Hills having topographical and vegetative features unsuitable for pronghorn.

Approximately 77% of this herd unit is private land. The remaining 23% includes lands managed by the United States Forest Service (USFS), the Bureau of Land Management (BLM), and the State of Wyoming. Most occupied USFS lands publically accessible to hunters are part of the Thunder Basin National Grassland (TBNG) and located in HA's 5, 6, 7, 27, and 29. HA 27 contains the largest contiguous amount followed by HA's 7 and 29. The State of Wyoming owns a large parcel of land in HA 9. Remaining public lands are scattered throughout the herd unit, and many are not legally accessible by the general public. Access fees for hunting are common on private land, and many landowners have leased their property to outfitters. Therefore, accessible public lands are subjected to disproportionately heavy hunting pressure.

Major land uses in this herd unit include livestock grazing, oil and gas production, farming, and timber harvest. There are several oil and gas fields, primarily in HA's 6, 7, 8, 24 and 29, and development pressure has increased in recent years in HA's 8 and 29. Several large surface coal mines represent a substantial land use within HA's 24 and 27 and limit legal access to public lands. Farming occurs in the southern most portion of the herd unit; but there are a number of wheat, oat, and alfalfa fields near Sundance, Upton, and Gillette. When pronghorn numbers are high, damage to growing alfalfa can become an issue, especially near Sundance and Lusk.

We are maintaining this herd at the current objective and management strategy based on internal discussions and conversations with our constituents. We evaluated and considered population status and habitat data included in this document and a change is not warranted at this time. We

will review this herd objective again in 2024. However, if the situation arises that a change is required, we will review and submit a proposal as needed.

WEATHER: The winters of bio-year 2010 and 2011 were tough to severe in most of the Cheyenne and Niobrara River drainages, and resulted in above average over-winter mortality. These winters were followed by severe drought in 2012. The combination of which led to continued reductions in fawn productivity and survival. Bio-year 2013 was a transition year when drought moderated yielding good forage growing conditions followed by a relatively normal winter. Weather conditions between 2014 and 2016 fostered increased productivity and survival, resulting in a rebounding population of pronghorn. In 2014 & 2015, spring and summer temperatures were near long-term averages, while growing season precipitation was above average. Consequently, forage production during this period was excellent. Overall, winter conditions in 2014 and 2015 were not detrimental to pronghorn. During the spring and summer of both 2016 & 2017, drought hit most of the herd unit, and was fairly intense in some areas. In many locations, cool season forage production was nominal both years and warm season production limited. Overall, range conditions were generally fair to poor going into both the 2016-17 and 2017-18 winters. The 2016-17 winter saw a return of more normal winter weather with temperatures generally close to average and precipitation slightly above normal. The 2017-18 winter was notably cooler than that of the previous year, but average monthly precipitation a bit reduced. Over-winter mortality in both the 2016 and 2017 biological years is thought to have been about average to slightly elevated, with greater mortality realized during the 2018 biological year, as temperatures were below average and precipitation above normal. The combination of summer drought in 2016 & 2017 coupled to average to severe winter weather since 2016 has acted in concert with harvest to temper herd growth. Weather summary details are available at http://www.ncdc.noaa.gov/cag/.

HABITAT: This wide ranging herd unit is largely characterized by stands of Wyoming big sagebrush (*Artemesia tridentata wyomingensis*) and silver sagebrush (*Artemesia cana*) interspersed with mid-prairie grasses such as wheatgrasses (*Agropyron* spp.), grama grasses (*Bouteloua* spp.), and needle grasses (*Stipa* spp.). Other areas are dominated by grasslands with less sage influence and more agricultural production, notably near the towns of Douglas, Lusk, Gillette, Newcastle, Upton, and Sundance. In addition, there are several major drainages throughout the herd unit dominated by plains cottonwood (*Populus deltoides*) and greasewood (*Sarcobatus vermiculatus*). These drainages include the head waters of the Belle Fourche River in the north and those of the Niobrara River in the south; while the Cheyenne River drainage (including Beaver Creek, Black Thunder Creek, Antelope Creek, Old Woman Creek, Hat Creek, Lance Creek, and Lightning Creek) make up the bulk of the herd unit. Steep canyons in the southern and central Black Hills are found in the northeast corner of the herd unit, where vegetation consists generally of ponderosa pine (*Pinus ponderosa*) forest and its associated savannah.

Habitat suitability for pronghorn varies greatly throughout the herd unit. Much of the habitat in the northeast portion of the herd unit is marginal, consisting of topography and vegetation not particularly favorable for pronghorn. The west-central portions of the herd unit represent the largest block of contiguous sagebrush habitat. While the eastern and southern sections of the herd unit are dominated more by mid-grass prairie and agricultural lands, but locally support good numbers of pronghorn.

Habitat disturbance throughout the herd unit is generally high. There are a number of developed oil fields and areas impacted by surface coal mining, and to a lesser extent bentonite mining. In areas dominated by irrigated and dry land farming, historic sagebrush control projects have decreased the amount of sagebrush available for wintering pronghorn. In addition to sagebrush control, livestock grazing practices and wildfires have converted areas once thought to be dominated by Wyoming big sagebrush to more grass, prickly pear and silver sage dominated communities. Yet, pronghorn still winter in some of these locations. Habitat loss and fragmentation is expected to continue and negatively impact this herd. Based upon current exploration and leasing trends, the amount of disturbance caused by mining, and oil & gas activities will continue to increase in HA's 8, 24, 27 and 29. In addition, a large wind farm is planned in HA 29.

After about a decade of collecting annual Wyoming big sagebrush leader growth and utilization data in this herd unit, the Department suspended these efforts. This was because it had been demonstrated annual leader production was generally proportional to the amount of spring and early summer moisture received; while over-winter browsing of shrubs could be fairly well gauged through causal observation. During 2014 and 2015 wet spring and summer conditions combined with low numbers of pronghorn and mule deer to yield excellent leader growth and low levels of winter use. Observations in 2016 and 2017 indicated little in the way of cool season grass and forb production and reduced leader growth on shrubs, which likely compromised the reproductive potential of the herd. The summer of 2018 saw a return to good growing season moisture and forage production. Given the responses observed in fawn production and survival the past several years, it appears this population is still below carrying capacity when range conditions are good, and about at carrying capacity in poor weather years. As such, it can likely be permitted to continue to grow towards objective.

FIELD DATA: This population last peaked in 2007 and declined through 2012. That decline was accentuated by the winter of 2010-2011 and subsequent drought of 2012. During this time, low fawn:doe ratios persisted and where accentuated by Epizootic Hemorrhagic Disease (EHDV) in 2013. In 2014, fawn production and survival increased substantially with a preseason fawn:doe ratio of 91:100 being observed, a value not seen in a decade. This was followed by a second year of great fawn production and survival, even with significant numbers of yearling does in the population. Fawn production and survival in 2016 & 2017 dropped to slightly above average levels with 76 fawns per 100 does being observed each year. In 2018, the observed fawn:doe ratio plummeted to 58:100. This was the third lowest value observed since 1991, and it was not the result of bias created by significant numbers of yearling does. It is speculated low fawn production was the result of drought conditions during the 2016 and 2017 growing seasons that preceded colder and wetter than normal winter and early spring conditions each year. As a result, the reproductive potential of does and survival of fawns declined. Consequently, the post season population of this herd dropped slightly in 2018 after experiencing an average annual increase of about 11% between 2014 and 2017.

Over the last 25^{+} years, annual productivity of this herd, as measured by preseason fawn:doe ratios, while experiencing cyclic fluctuations, appears to have trended lower (Figure 1). Transient declines in annual, and perhaps long-term fawn:doe ratios are thought to be the result of weather

conditions coupled with a gradual reduction in habitat quantity and quality through succession, aging of sagebrush, and over-browsing at times by both domestic livestock and wildlife.

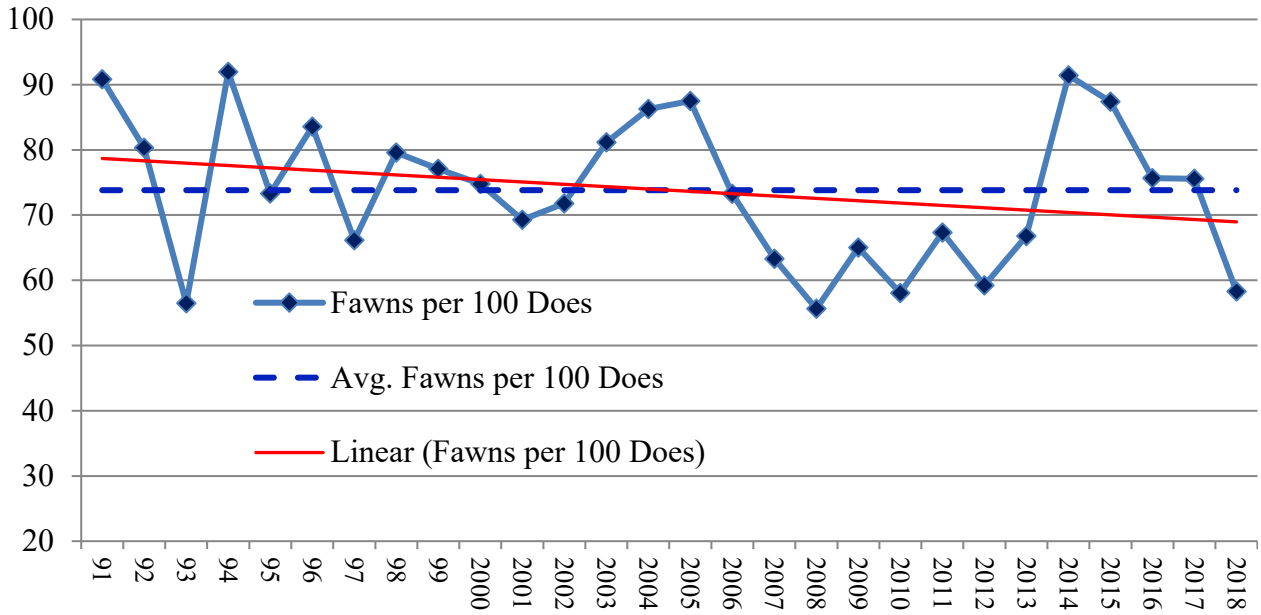


Figure 1: Observed Annual and Average Preseason Fawn:Doe Ratios in the Black Thunder Pronghorn Herd Unit (1991 – 2018) with Trend Line.

As this population grew during the early and mid 2000's, preseason buck:doe ratios generally rose. Then, as this population dropped and the percentage of bucks harvested from the population increased each year, preseason buck:doe ratios declined - dropping to a low of about 40:100 in 2014. With generally conservative buck hunting in place and enhanced fawn production and survival, the observed preseason buck:doe ratio increased to 45:100 in 2015 and 50:100 in both 2016 and 2017. With the recruitment declining after 2014 and liberalization of harvest the past three years, the preseason buck:doe ratio dropped slightly in 2018 to 48:100. In 2019, on the heels of poor fawn recruitment, the preseason buck:doe ratio is expected to decline to 45:100, which is the mid-point of management criteria.

HARVEST DATA: Hunter success dropped while effort remained fairly consistent between 2010 and 2013 as this population declined. In both 2014 and 2015, with conservative hunting seasons in place and a growing pronghorn population, hunter success improved each year while hunter effort fluctuated around 4 days per animal harvested. These harvest statistics remained essentially unchanged in 2016, as seasons were liberalized to moderate population growth. With the continued increase in the preseason population and only moderate increases in license issuance, hunter success increased and effort declined in 2017 and 2018. The number of harvested pronghorn field checked was also significantly greater in 2017 (N=285) and increased again in 2018 (N=313), although this in part may have been due to the use of a new automated field check application all personnel deployed from their smart phones.

After several years of hunter success below that normally observed and desired for pronghorn hunting in Wyoming, most hunt areas in the herd unit have witnessed a return to historic success levels since 2015. However, there have been some notable exceptions. In 2018, hunter success on doe/fawn licenses ranged from a low of 54% in HA 29 (on Type 7 licenses) to a high of 94% in HA 6, with the mean success rate for doe/fawn hunters being 79%, which was identical to last year. These figures do not include the reported 0% success reported for HA 6 Type 6 tags used in that portion of HA 8 where they were valid, which suggests bias or undetected errors in the harvest survey data. Hunter success on Type 1 and 2 licenses ranged from 69% in HA 5 to 97% in HA 6 (with a mean of 87%). Except for HA 5, hunter success on any antelope tags was above 80% in all other hunt areas. Continued low hunter success on both license types in HA 5 is likely due to persistent low buck:doe and fawn:doe ratios, which have averaged 37:100 and 70:100 since 2000, respectively.

Hunter success dropped steadily between 2010 and 2013, and remained low until 2015 when pronghorn numbers noticeably increased while license issuance remained conservative. Since then, total hunter success has trended upwards peaking at 92% in 2018. In 2015, hunter satisfaction rose about 8 percentage points with 81% of the hunters reporting they were very satisfied or satisfied. Hunter satisfaction then rose slightly in 2016 and improved more substantially in 2017 as 89% of the hunters reported they were very satisfied or satisfied. This level of overall satisfaction continued in 2018. In 2018, total satisfaction was lowest in HA's 5 & 9 at 79% and 80%, respectively. However, resident participation can bias satisfaction numbers for a couple of reasons. First of all, there are relatively greater expectations and demands exhibited by resident hunters compared to their non-resident counterparts, which results in residents expecting more from a quality antelope hunt and generally reporting lower satisfaction. Secondly, resident hunter participation in most of the hunt areas where private land predominates is significantly lower than that of non-residents, and very few residents are surveyed, which can impact reported values. For example, HA 5 had the highest proportion of residents surveyed (51%), while only four resident hunters were surveyed in HA 8 (5%) and eight in HA 9 (7%). So, while HA 5 had the lowest overall satisfaction, non-resident satisfaction there was 92%. As such, a case can be argued that the lowest overall satisfaction is strongly present in HA 9 where 93% of the respondents were non-residents who voiced an overall satisfaction rating about equal to HA 5.

POPULATION: Following the creation of this herd, an official population model was constructed in February, 2015 (see 2015 PR750 JCR for details). As has been the case since, the "Semi Constant Juvenile & Semi Constant Adult" (SCJ SCA) spreadsheet model was again chosen this year to estimate the herd's population. All three competing models generally simulate a population rise between 2000 and 2006 or 2007, followed by a decline through 2012 or 2013 and then an increase through 2017, with a small decline in 2018. All three models also produce post-season population estimates for 2014 within 2% of each other and within about 10% in 2015 and 2016. However, the SCJ SCA model begins to diverge from the competing models and produces a 2018 post-season population estimate about 18% above the CA CJ and 11% above the TSJ CA. However, the SCJ SCA model exhibits an AICc value about 25% lower than the competing models and a lack of fit value midway between the competing models without appearing to over parameterize modeled buck:doe ratios. Finally, the magnitude of population trends produced by

SCJ SCA model dovetail better with general trends in harvest statistics and perceptions of local game managers, landowners, and hunters.

The competing models all fit line transect (LT) estimates well enough, although the chosen model does give the highest estimate above the LT figure for end of bio-year 2016. It should be noted that corrections were made to the end of bio-year 2014 LT due to an error that was detected in calculations combined with use of revised occupied habitat figures. As a result, all of the models now track LT estimates better than previously reported, without substantially changing population estimates generated by the models.

The current model seems to function well because it allows for modeling the significantly increased mortality observed during the severe winter of 2010-2011; and (although it lacks herd-specific survival data) estimated juvenile and adult survival rates are very reasonable. Consequently, the model is considered fair to good overall because it has over twenty years of data; ratio data available for all years in the model; at least one sample-based population estimate with standard error; aligns fairly well with observed data; and is biologically defensible.

The Black Thunder pronghorn population is projected to have increased steadily from the late 1990's through 2006-07, when it reached a plateau and peaked about 30% above objective. During this timeframe, above average fawn:doe ratios were observed, while doe/fawn harvest was limited by our inability to sell all available licenses. After this peak, the postseason population declined through 2012 and remained essentially unchanged in 2013 at 45% below objective. Some of this decline was due to increased harvest following regulatory and license issuance changes that increased doe/fawn licenses sales. But more ostensibly, the drop resulted from reduced fawn recruitment due to drought, significant mortality during and following the 2010-11 winter; and increased summer mortality of all age classes due to EHD. Fairly conservative hunting seasons, excellent fawn production and favorable weather allowed this population to increase substantially between 2014 and 2017. Increased harvest and low productivity then caused this population to drop slightly post-harvest 2018 to 20% below objective.

MANAGEMENT SUMMARY: Hunting seasons between 2012 and 2015 were quite conservative. Beginning in 2016, harvest was liberalized each year through 2018 to slow population growth in response to very good productivity. However, doe/fawn harvest remained significantly reduced from historic levels. This year, in response to poor fawn production in a population below objective, license issuance has not been significantly adjusted, except for the addition of 75 type 7 tags in HA 8. This being done to initiate some limited doe/fawn harvest at the behest of landowners in an area that has not had doe/fawn tags issued the last six years.

In HA 29, as a response to complaints from landowners and hunters about low pronghorn numbers and hunter success on public land, the bulk of any-antelope licenses will continue to be issued as Type 2 (valid on private land only). Additionally, the season length for this tag along with the Type 7 licenses is being extended to October 31 at the request of several landowners. Changes made in this hunt area over the past several years have been well received by many landowners and have significantly reduced harvest pressure on public land in the northern part of HA 29. Another modification being made in this hunt area (and in HA 5) is changing Type 6 licenses to Type 7 to standardize doe/fawn tags valid on private land only as Type 7. As such the former

Type 7 licenses in HA 29 (portion of the area) are now designated as Type 8. Similarly, in HA 24 Type 2 and Type 7 licenses are continuing to be issued.

In 2019, total harvest should be close to, or slightly exceed, 2018 levels. Given average preseason age and sex ratios observed over the past 5 years, normal survival rates, and the predicted harvest of ~ 4,580 pronghorn, the 2019 hunting season suggests the post-season population of this herd will grow 10% to about 45,500 pronghorn, which is 7% below objective. However, given the winter losses observed in this herd this year, it is more likely herd numbers will stabilize or drop slightly.

2018 - JCR Evaluation Form

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

HERD: MD740 - CHEYENNE RIVER

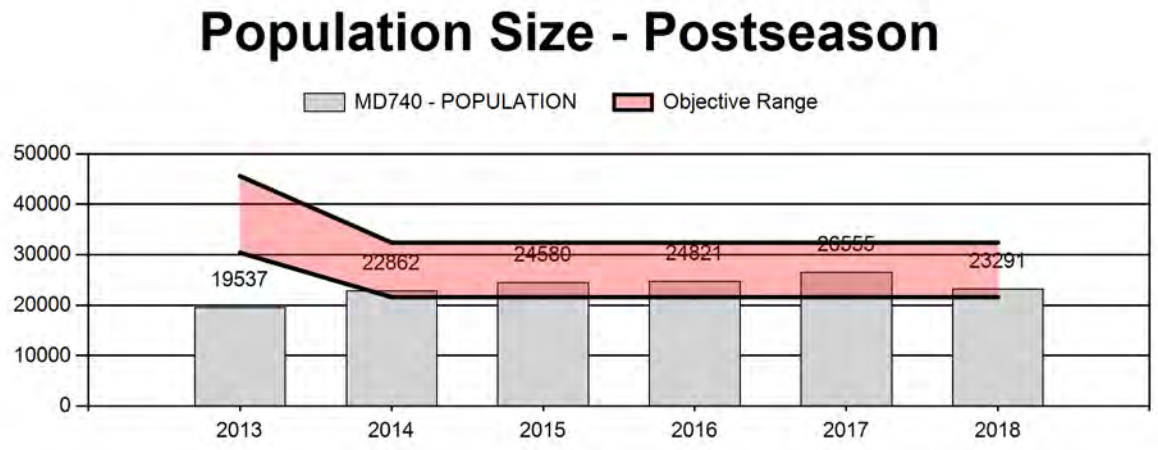
HUNT AREAS: 7-14, 21
PREPARED BY: JOE SANDRINI

	2013 - 2017 Average	2018	2019 Proposed
Population:	23,671	23,291	24,391
Harvest:	1,081	1,384	1,535
Hunters:	1,912	2,247	2,425
Hunter Success:	57%	62%	63%
Active Licenses:	1,938	2,273	2,500
Active License Success:	56%	61%	61%
Recreation Days:	7,549	8,404	9,300
Days Per Animal:	7.0	6.1	6.1
Males per 100 Females	43	39	
Juveniles per 100 Females	70	58	

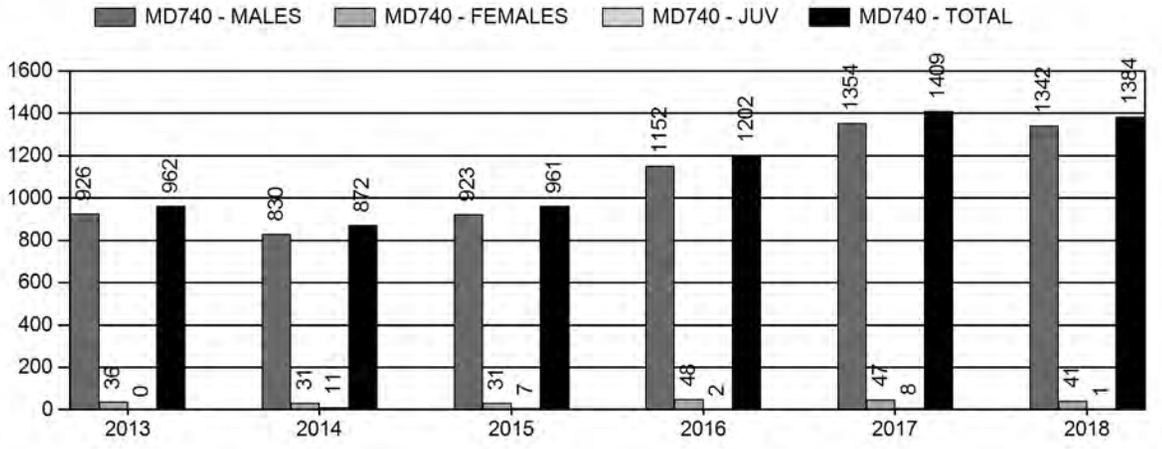
Population Objective (± 20%) :	27000 (21600 - 32400)
Management Strategy:	Private Land
Percent population is above (+) or below (-) objective:	-13.7%
Number of years population has been + or - objective in recent trend:	9
Model Date:	02/15/2019

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

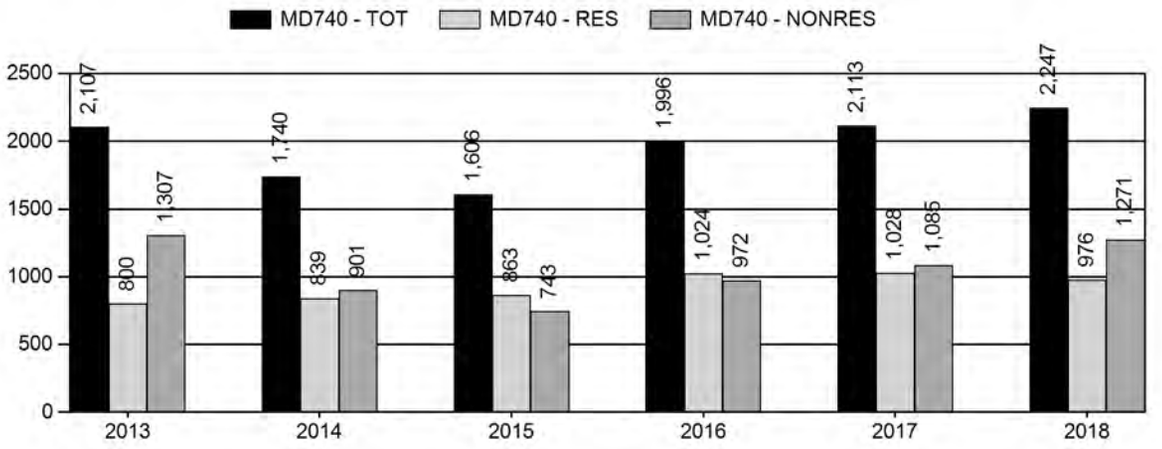
	JCR Year	Proposed
Females ≥ 1 year old:	0.4%	0.4%
Males ≥ 1 year old:	23.4%	26.4%
Total:	6.1%	6.3%
Proposed change in post-season population:	+0.3%	+4.7%



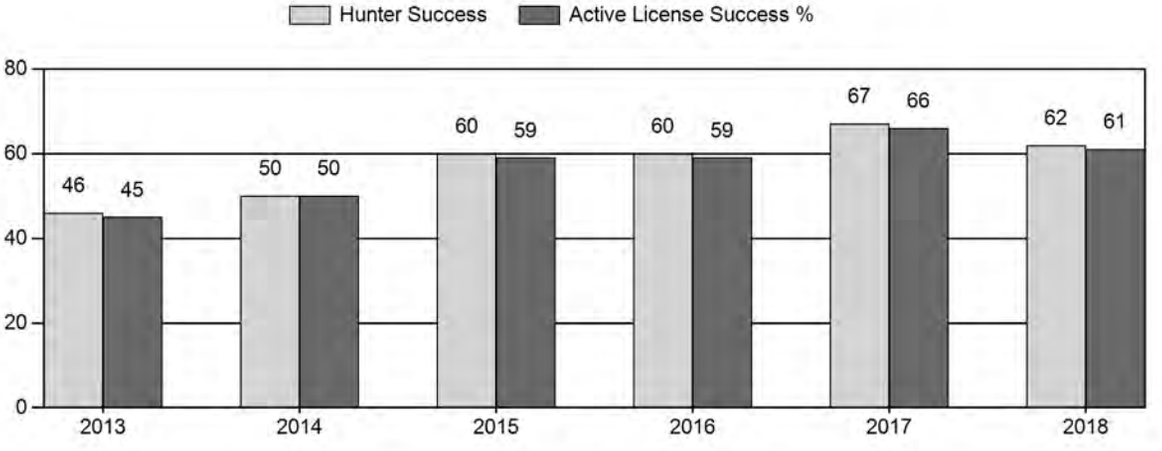
Harvest



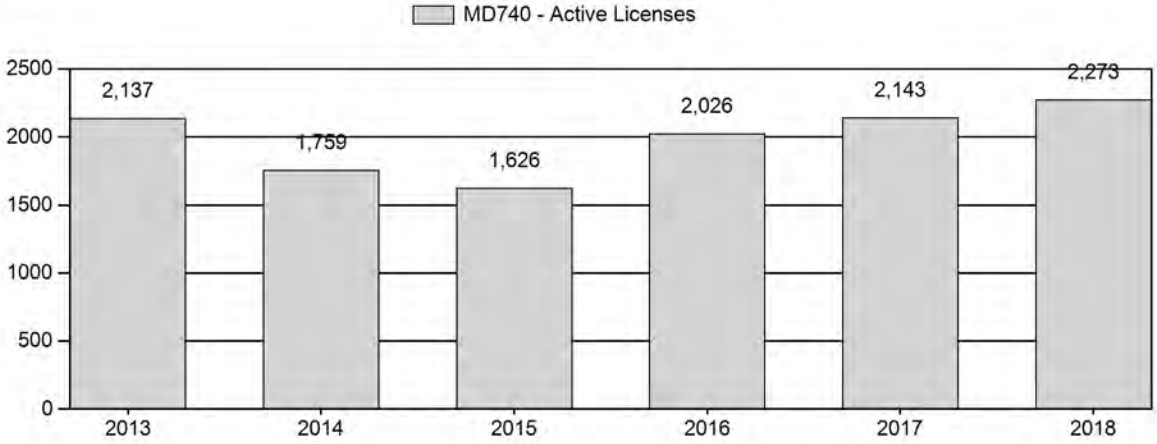
Number of Active Licenses



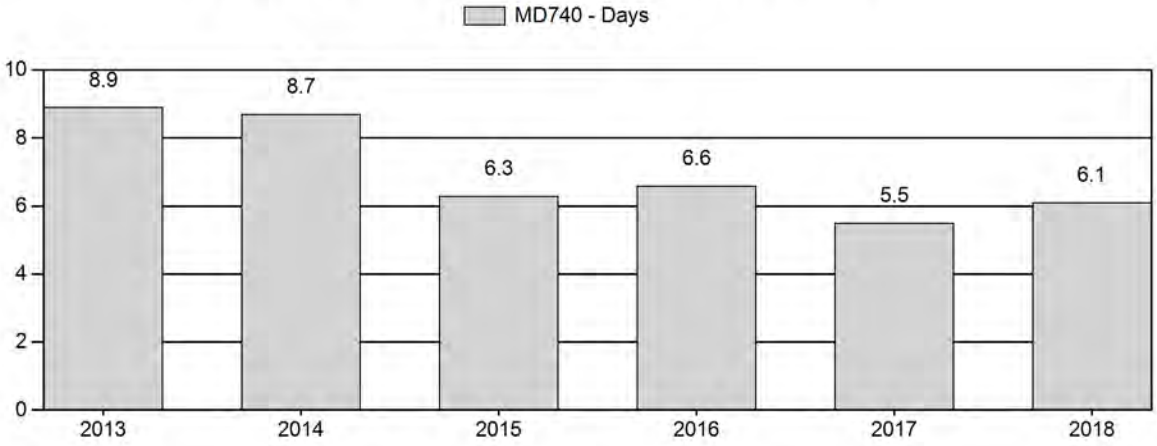
Harvest Success



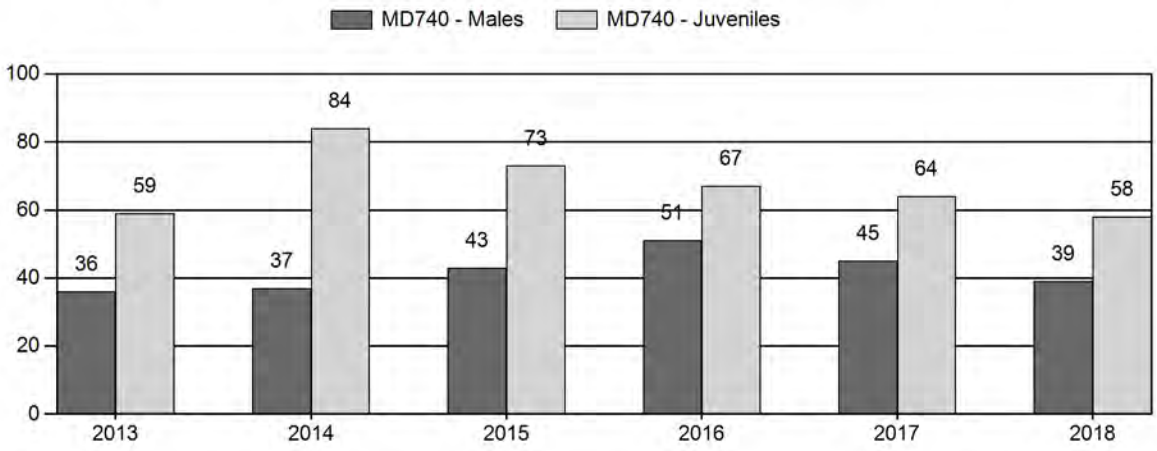
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2013 - 2018 Postseason Classification Summary

for Mule Deer Herd MD740 - CHEYENNE RIVER

		MALES							FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Post Pop	Ylg	2+ Cls 1	2+ Cls 2	2+ Cls 3	2+ UnCls	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Ylng	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2013	19,537	114	0	0	0	302	416	19%	1,142	51%	669	30%	2,227	1,137	10	26	36	± 3	59	± 3	43
2014	22,862	186	0	0	0	336	522	17%	1,426	45%	1,198	38%	3,146	2,044	13	24	37	± 2	84	± 4	61
2015	24,580	268	193	76	15	43	595	20%	1,373	46%	1,009	34%	2,977	1,672	20	24	43	± 3	73	± 4	51
2016	24,821	298	297	90	8	0	693	23%	1,371	46%	916	31%	2,980	1,506	22	29	51	± 3	67	± 3	44
2017	26,555	264	413	109	12	0	798	21%	1,777	48%	1,143	31%	3,718	1,371	15	30	45	± 2	64	± 3	44
2018	23,291	132	399	114	8	0	653	20%	1,669	51%	970	29%	3,292	1,133	8	31	39	± 2	58	± 3	42

2019 HUNTING SEASONS
CHEYENNE RIVER MULE DEER HERD (MD740)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
7		Oct. 1	Oct. 15		General	Antlered mule deer or any white-tailed deer
8		Oct. 1	Oct. 15		General	Antlered mule deer or any white-tailed deer
9		Oct. 1	Oct. 15		General	Antlered mule deer or any white-tailed deer
10	1	Oct. 1	Oct. 15	125	Limited quota	Antlered deer
11		Oct. 1	Oct. 15		General	Antlered mule deer or any white-tailed deer
11		Oct. 16	Nov. 30		General	Any white-tailed deer
12		Oct. 1	Oct. 15		General	Antlered mule deer or any white-tailed deer
12		Oct. 16	Nov. 30		General	Any white-tailed deer
12	6	Oct. 1	Nov. 30	50	Limited quota	Doe or fawn
13		Oct. 1	Oct. 15		General	Antlered mule deer or any white-tailed deer
13		Oct. 16	Nov. 30		General	Any white-tailed deer
14		Oct. 1	Oct. 15		General	Antlered mule deer or any white-tailed deer
14		Oct. 16	Nov. 30		General	Any white-tailed deer
21		Oct. 1	Oct. 15		General	Antlered mule deer or any white-tailed deer
21	7	Oct. 1	Oct. 31	50	Limited quota	Doe or fawn valid on private land

Special Archery Season Hunt Areas	Season Dates	
	Opens	Closes
1-14, 21	Sep. 1	Sep. 30

Region B Nonresident Quota: 1,500

SUMMARY OF CHANGES IN LICENSE NUMBER

Hunt Area	License Type	Quota change from 2018
Herd Unit Totals	**Region B**	**+150**

Management Evaluation
Current Management Objective: 27,000
Management Strategy: Private Land Management
2018 Postseason Population Estimate: ~ 23,300
2019 Proposed Postseason Population Estimate: ~ 24,400
2018 Hunter Satisfaction: 74% Satisfied 17% Neutral 9% Dissatisfied

HERD UNIT ISSUES: The Cheyenne River mule deer herd was created in 2009 by combining the Thunder Basin and Lance Creek herds. In 2014, following an internal review and public input process, the postseason population objective was revised downward to 27,000 from 38,000 and the management strategy changed from recreational to private land. This was done to better align the post-season population objective with historic herd performance, habitat capacity, and address the consequences of limited access to private land for mule deer hunting. To date this objective seems very reasonable.

There are about 6,350 mi^2 in this herd unit, and 5,485 mi^2 (86%) are considered occupied habitat. Approximately 75% of the land within the herd unit is private. The United States Forest Service, Bureau of Land Management, or the State of Wyoming administers the remaining lands. Hunter access is largely controlled by private landowners, and access fees along with outfitted hunting are common. Consequently, hunting pressure can be heavy on lands legally accessible to the public. Historically, two-thirds or more of the hunters pursuing mule deer in this herd unit have been non-residents. In recent years, due to reductions in the Region B quota, nonresident hunter numbers have more closely approximated that of residents. Compared to residents, non-residents typically are more willing to pay trespass or access fees for hunting privileges, or hire an outfitter. Many resident hunters, but also an increasing percentage of non-residents, pursue mule deer with general licenses on accessible on public land, which significantly concentrates hunting pressure.

Primary land uses within the herd unit include livestock grazing, oil and gas production, and some crop production. By far, the dominant land use is livestock grazing. Cultivation of alfalfa, grass hay, oats, and wheat occur mostly in the southern and eastern portions of the herd unit. The majority of oil and gas development occurs in the western and north central portions of the herd unit. However, substantial new oil and gas development is occurring in northern Niobrara County (HA's 9 & 11) and near Douglas (HA 14). Horizontal oil well development over a large portion of hunt areas 10, 11, 14 and 21 has begun to increase disturbance. There are also several large surface coalmines in HA 10 and HA 21, which create a high level of disturbance and limit access to public lands for hunting.

We are maintaining this herd at the current objective and management strategy based on internal discussions and conversations with our constituents. We evaluated and considered population status and habitat data included in this document and a change is not warranted at this time. We will review this herd objective again in 2024. However, if the situation arises that a change is required, we will review and submit a proposal as needed.

WEATHER: Winters during bio-years 2010 and 2011 were tough to severe. They resulted in above average over-winter mortality. This is evident from observed fawn:doe and yearling buck:doe ratios (Figures 1, 2 & 3). Following these winters was severe drought in 2012. The combination of these climatic conditions led to reductions in fawn productivity and survival even though the 2012-13 winter was mild. Bio-year 2013 was a transition year when drought moderated yielding good forage conditions followed by a relatively normal winter. Favorable weather for mule deer was then experienced through 2015, with spring and summer weather conditions leading to outstanding forage production followed by mild winters. Consequently, fawn production and survival were excellent in bio-years 2014 and 2015, and resulted in substantial herd growth. During the spring and summer of 2016 and 2017 drought hit most of the herd unit. In many locations, cool season forage production was nominal and warm season production limited. Overall, range conditions were generally fair to poor going into both the 2016-17 and 2017-18 winters. The 2016-17 winter saw a return to more normal winter weather and survival, with temperatures generally close to average and precipitation slightly above normal. The 2017-18 winter was notably colder than that of the previous year, and several ranchers in the herd unit said they fed more hay to their cattle than normal and had lower than expected yearling cattle weights in the spring. It appears now that over-winter mortality of buck mule deer six to eighteen months old increased substantially in bio-year 2017 (Figure 1), while anecdotal information suggests survival of adults was closer to average. Decreased survival and fawn productivity the past two years led to reduced herd growth in 2017 followed by a slight drop in 2018. Weather summary details available are at http://www.ncdc.noaa.gov/cag/ .

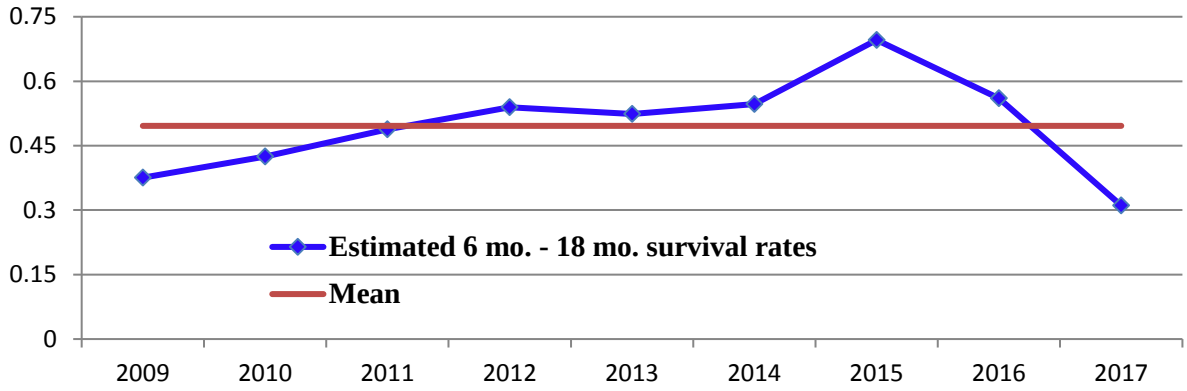


FIGURE 1. Estimated survival rate[1] of buck mule deer in the Cheyenne River herd Unit from 6 mo. to 18 mo. of age with mean (bio-years 2009 - 2017)

[1] $[(\text{Yearling Buck:Doe})_{\text{Bio-Year}+1} / 0.85] / \frac{1}{2}(\text{Fawn:Doe})_{\text{Bio-Year}}$ Note - This assumes constant doe survival rate of 0.85.

HABITAT: Mixed sagebrush (*Artemisia ssp*.) grasslands with scattered hills dominated by ponderosa pine (*Pinus ponderosa*) comprise most of the western, central, and northern segments of the herd unit. The easternmost lands in the herd unit are dominated more by short grass prairie punctuated with pine breaks, and there is a small area (about 30 mi^2) of southern Black Hills habitat along the Stateline near Newcastle. Rolling ponderosa pine and limber pine (*Pinus flexilis*) hills and ridges dominate the southern portions of the herd unit. Major agricultural crops include grass and alfalfa hay and winter wheat. Croplands are localized and found primarily near Gillette, Moorcroft, Upton, Newcastle, Manville, and Lusk. These variations in habitat types and limited riparian areas affect deer densities and distribution. The majority of mule deer are typically found utilizing broken topography characterized by sagebrush, conifer covered hills, or cottonwood and sagebrush dominated riparian communities. Scattered mule deer are found in the open sagebrush-grassland areas.

Several major cottonwood drainages traverse the herd unit including the headwaters of the Belle Fourche River in the north and those of the Niobrara River to the south. The Cheyenne River and many of its tributaries such as Beaver Creek, Lightning Creek, Twenty-Mile Creek, Lance Creek, and Old Woman Creek make up the bulk of the herd unit. Overstory canopy along these drainages is dominated by decadent stands of plains cottonwood (*Populus deltoides*). These riparian cottonwood groves comprise one of the most important habitat types for mule deer in this herd unit. Unfortunately, many are in poor condition and lack recruitment of new cottonwoods along with the general lack of woody understory species. The health and vigor of riparian cottonwood communities and shrub stands need to be enhanced across the herd unit if mule deer are going to thrive in this part of Wyoming.

After about a decade of annually collecting Wyoming big sagebrush leader growth and utilization data in this herd unit, the Department suspended these efforts. This was done because it had been demonstrated annual leader production was proportional to the amount of spring and early summer moisture received; while over-winter browsing of shrubs could be fairly well gauged through causal observation. During 2014 and 2015, wet spring and summer conditions combined with low numbers of pronghorn and mule deer yield excellent leader growth and low levels of winter use. Observations in 2016 and 2017 indicated little in the way of cool season grass and forb production together with reduced leader growth on shrubs; and fawn production and survival dropped to levels near or slightly below long-term averages. On the heels of the 2017-18 winter and drought conditions the previous summer, fawn production dropped more significantly in 2018. This herd was thought to be near objective as habitat conditions deteriorated and deer numbers leveled off in the face of consistent harvest. This would seem to indicate the population was below carrying capacity when forage conditions were good (2014 & 2015) and was near it when they were substantially poorer (2016 - 2018). As such, the current population objective seems reasonable.

FIELD DATA: Postseason fawn:doe ratios have undergone cyclic fluctuations, but generally trended downward (Figure 2). In 2018, the observed, post-season fawn:doe ratio was 58:100, which was significantly below the previous 20-year average of 65:100, and represented a drop of 31% from the recent high of 84:100 observed in 2014. The latest decline in late fall fawn numbers is thought to be the result of drought two summers in a row and normal to more severe winter weather impacting the reproductive potential of does and survival of fawns. As such, this herd is likely heading into a cyclical population decline, since fawn:doe ratios have declined the past four

years, and in 2018 were equal to those observed during this herd's last decline (2006 – 2012), when an average of 58 fawns per 100 does was observed.

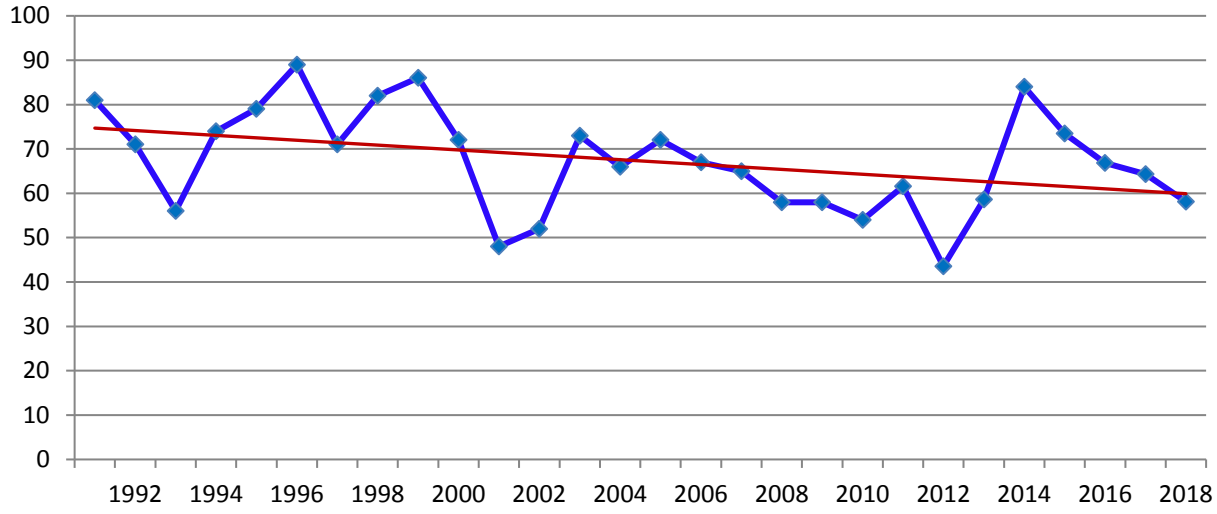


Figure 2. Post-Season Fawn:Doe Ratios (1991 – 2017) in the Cheyenne River Mule Deer Herd with linear trendline.

Post-season buck:doe ratios in this herd have fluctuated cyclically while generally trending upward (Figure 3). Prior to 2008, moderate productivity coupled with limited access for hunters to private land yielded an increasing buck:doe ratio despite enhanced license issuance. Then, as fawn production and survival dropped, buck:doe ratios declined. Region B license issuance was lowered during this time and buck:doe ratios stabilized. Excellent fawn production and over-winter survival in 2014 and 2015 caused buck:doe ratio to jump to 43:100 in 2015 and 51:100 in 2016. As recruitment and survival declined the past two years, the observed buck:doe ratio dropped to 45:100 last year and 39:100 this year. Despite cyclical variations in productivity and survival over the past couple of decades, conservative harvest of bucks has resulted in increasing buck:doe ratios, despite generally declining fawn:doe ratios.

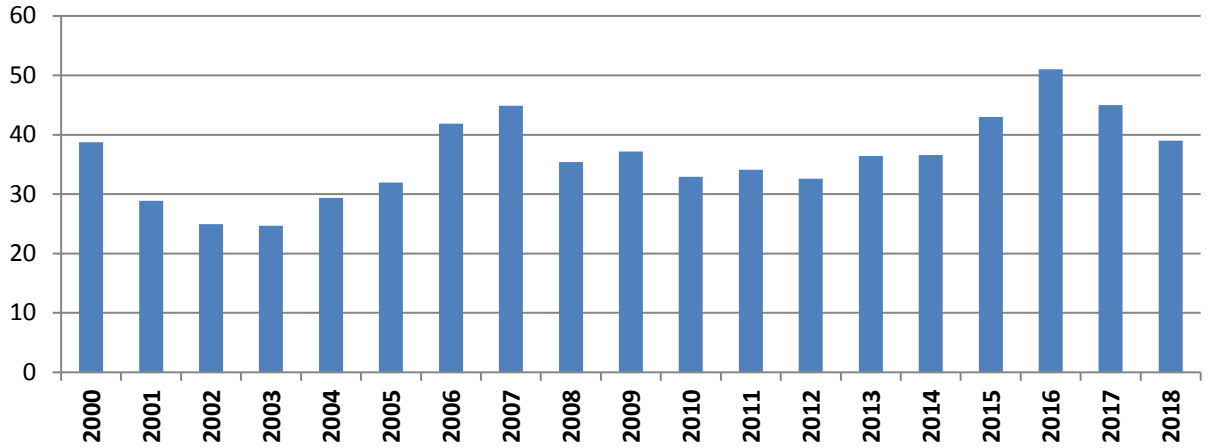


Figure 3. Post-Season Buck:Doe Ratios in the Cheyenne River Mule Deer Herd (2000 - 2018).

HARVEST DATA: In this herd unit, most mule deer are harvested on private land because it provides the majority of mule deer habitat. The Department is currently attempting to balance desires of many landowners and hunters to maintain or increase deer numbers, but still keep the population at levels that will reduce the chance of a large-scale die-off. This was part of the reason for reducing the post-season population objective in 2014. We are now at a point where a few landowners are expressing the desire to host more hunters and even entertain some limited doe/fawn hunting, while others are limiting harvest as they have lower than desired deer numbers. Considering the biological data and landowner sentiments, we seem to be near a number of deer where this mule deer population should be actively managed.

Between 2006 and 2014, hunter participation and harvest declined, while harvest effort increased. The trend in effort was reversed in 2014, as the population began to increase and hunter participation continued to drop. Non-resident hunter numbers fell steadily between 2006 and 2015 as the Region B quota was successively lowered most years. In addition, likely responding to declining deer numbers, resident hunter participation dropped through 2013 to about 835 active licenses before increasing in 2016 and stabilizing at about 1,000 hunters since. With proportionately greater increases in buck numbers relative to hunter participation, complaints about the low number of deer seen and harvested have diminished significantly over the past four years.

Harvest statistics have generally reflected well changes in the population estimate. However, these statistics indicate this population dropped to its low point in 2013, versus 2012 as projected by the model. This was likely attributable to winter storm Atlas in October 2013 hindering harvest success. Additionally, with the vast majority of the harvest being adult bucks, it is likely harvest statistics reflect changes in mature buck numbers more than gross population changes. As such, we might expect an offset between harvest statistics and population estimates of a year or two as recruitment into older age classes fluctuates. In 2014, harvest statistics reversed their course from declining hunter success and increasing effort to improved success and reduced effort. This same scenario continued in 2015, with substantial increases in hunter success and reductions in effort. Hunter success and effort values then continued to improve steadily through 2017. In 2017, with very little change in license issuance, total hunter success climbed to 67% from 60% and effort decreased from 6.6 to 5.5 days per harvest from the year before. Then in 2018, as this population appeared to level off or decline, hunter success dropped to 62% and effort increased to 6.1 days per harvest. These 2018 changes suggest more of a drop in the population than indicated by the current population model.

As harvest increased the past few years, the number of field check mule deer has increased as well. In 2017, with the advent and use of the smartphone mediated check station application, field check numbers increased substantially. This trend continued in 2018 as the number of field check deer was augmented by increased Chronic Wasting Disease (CWD) testing efforts. However, the exact number of mule deer field checked in 2018 is difficult to know, as an unknown number of lab aged, CWD sampled deer were recorded using the check station application resulting in the JCR program generating duplicate counts of lab and field aged deer. At minimum, a total of 124 mule deer harvested were field checked and/or lab aged in 2018. The bulk of these, 108, were bucks age two-years or greater. Of the 113 mule deer tested for CWD, 10 were positive, yielding a prevalence rate of 9.9%. All of the infected deer coming from the 101 adult bucks tested. The

2018 detection prevalence was substantially higher than the approximately 2.2% that had been observed from this herd prior to 2018, during which time 38 of 1,740 tested positive.

POPULATION: After recent model revisions, this herd's 2018 post-season population estimate of about 23,300 puts it 14% below objective. Model projections suggest this herd increased almost 40% between 2012 and 2017 before essentially leveling off in 2018. The substantial rebound was a result of excellent reproduction and survival between 2014 and 2016, while hunting seasons remained extremely conservative. This population increase was also a considerable course reversal considering this herd declined appreciably between 2007 and 2012, when it fell 45%. However, placing great confidence in the accuracy of population estimates in recent years very tenuous, since the inherent constraints in the spreadsheet models used make population estimates at the extremes of the years modeled the most questionable, and harvest statistics and field observations suggest deer numbers declined more than indicated this year.

The Semi-Constant Juvenile / Semi-Constant Adult (SCJ SCA) model was again chosen to estimate this herd's population. It was selected over competing models because it had the lowest AICc and fit observed buck ratios well without being overly parameterized. Preseason population estimates of the selected model are also 86% correlated with changes in hunter success, and inversely correlated 72% with changes in hunter effort between 2006 and 2018. The competing models are not as well correlated. However, modeled changes in population size do not seem to be of the magnitude field personnel and many landowners report. There seemed to be more of a peak in deer numbers about 2006 or 2007 with a steeper increase preceding this and more abrupt decline following. More recently, in some locations it does not appear that the increase in deer numbers has been as great as the model suggests and numbers may have dropped more than indicated this year. Model projections for the coming year are based upon long-term (1995-2018) classification sample means instead of the past 5-year's average. This was done to more accurately capture herd performance, as average, observed fawn:doe and buck:doe ratios the past-five years are well above what this herd is capable of next year given demographics and weather patterns. Overall, the chosen model is considered to be of fair quality because it has 15-20 years of data; ratio data available for all years in model; the juvenile and adult survival estimates are very reasonable; it exhibits modest fit; and results are generally defensible. But, we do not have any specific survival rates or independent population estimates for this herd; and the population changes indicated are not completely congruent with field personnel's sentiments.

MANAGEMENT SUMMARY: The traditional hunting season dates in this herd unit are Oct. 1-15. In order to facilitate population growth commensurate with landowner and hunter desires, we are proposing to continue with very little doe/fawn harvest and antlered-only general license seasons for mule deer. Limited doe/fawn harvest will continue in HA 12, where a couple landowners are experiencing some damage and want to reduce mule deer numbers. Fifty Type 7 licenses valid on private land will again be issued in HA 21 to address localized concentrations of mule deer around cultivated and landscaped areas.

Due to heavy hunting pressure on accessible public land, there is a discrepancy in deer numbers and densities between these areas and surrounding private lands. Historically, this was most exemplified in HA 10, which contains the highest proportion of public land in the herd unit. To address low buck numbers and hunter crowding here, the season length there and Region B quota where steadily decreased for a number of years, and finally a 3-point restriction implemented in

2012. These strategies helped improve the HA 10 buck:doe ratio to the herd-wide average in 2009 and 2010, but deer densities remained depressed. With the 3-point restriction in place during 2012, the post-season buck:doe ratio improved to 42:100. Similar classification efforts in 2013 and 2014 revealed a buck:doe ratio that remained near 36:100.

Following the 2015 inaugural limited quota season in HA 10, comparable classification efforts found buck:doe ratios of 51:100 in 2015 and 57:100 in 2016. However, 30% of the bucks observed were yearlings in 2015 and 43% in 2016. In 2017, nearly 700 deer were classified in this hunt area (most from the ground) yielding a buck:doe ratio of 41:100. 2018 aerial classification efforts here obviously experienced some type of bias, as 134 bucks per 100 does were recorded. At any rate, buck numbers in HA 10 are strong and we should consider increased license issuance as cohorts of younger deer reach mature age classes. Along these lines, it is suggested the license quota for HA 10 be set at 10% of the Region B quota. This is because the average proportion of deer classified in Region B from HA 10 since 1992 has been about 10%. Harvested buck quality has also been good recently in the HA. Tooth boxes were mailed to Type 1 license holders in 2017 and 2018, and based upon harvest survey data, a return rate of 28% and 23% was garnered each year, respectively. These data revealed the median buck harvested in 2017 was a 3.5 year old deer with 4X4 antlers a bit under 20 inches in outside beam width. In 2018, the median buck harvested was a 4.5 year old deer with 4X4 antlers and an in outside beam width of about 21 inches. Since a limited quota season was established in HA 10, mean hunter success has been 77% each year without much variance (std dev = 5.5%). Finally, limited quota hunting in this hunt area has been very well received by those hunting here, with 91% of hunters reported being satisfied or very satisfied with their hunt in 2017, and 80% in 2018, but no hunters reported any measure of dissatisfaction either year. Since hunting on limited quota basis was instituted in HA 10, mean hunter satisfaction has been 83%.

Throughout Region B, some landowners continue to state they are not willing to host increased numbers of deer hunters, while others want to take more hunters. Overall, local game managers remain reluctant to significantly increase Region B license issuance due to concerns over non-resident hunters purchasing licenses without securing permission on private lands, resulting in phone calls looking for places to hunt, hunter complaints about access, and dissatisfaction from those hunters relegated to hunting isolated parcels of public land with low buck numbers. However, now that HA 10 has been limited quota for four years, Region B license demand still exceeds issuance, and the buck:doe ratio strong the past four years, a slight increase in the Region B quota is undoubtedly warranted. Therefore, Region B licenses will increase 11% to 1,500 in 2018. A number that, when this herd is near objective, should be the number of non-resident tags issued annually.

Assuming resident hunter participation remains constant, the 2019 hunting season should result in harvest of about 1,450 bucks and 50 antlerless deer. Given long-term postseason classification values and modeled survival rates, this harvest should allow the postseason population to increase about 5% to 24,400. This would put it 12% below its objective of 27,000. However, winter weather was normal to somewhat severe, at least in the northern portion of the herd unit, and considering 2016 & 2017 drought and recent declines in fawn:doe ratios, this population will more likely level off or drop in 2019.

2018 - JCR Evaluation Form

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

HERD: MD751 - BLACK HILLS

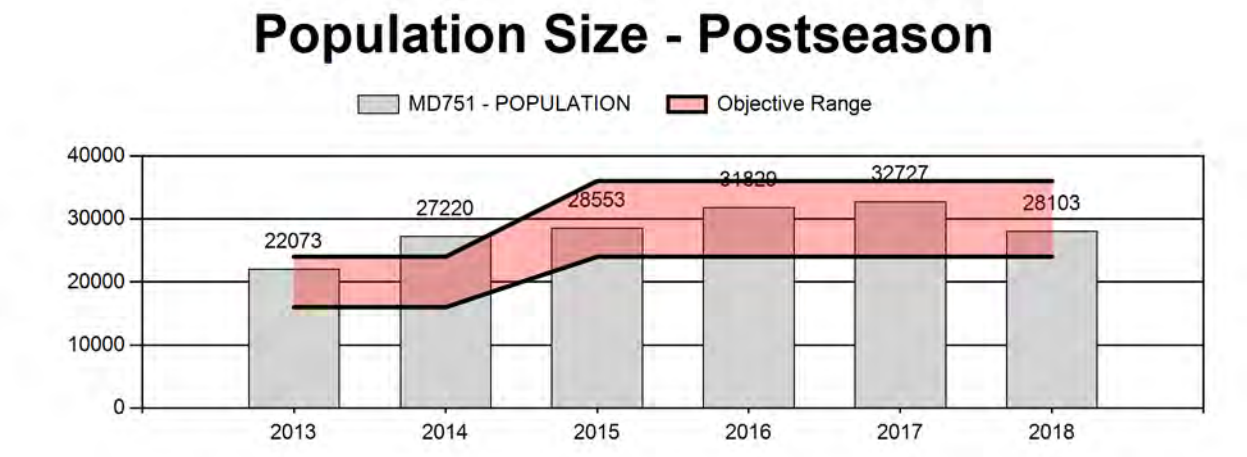
HUNT AREAS: 1-6
PREPARED BY: JOE SANDRINI

	2013 - 2017 Average	2018	2019 Proposed
Population:	28,480	28,103	29,581
Harvest:	2,251	2,217	2,500
Hunters:	4,728	5,325	5,400
Hunter Success:	48%	42%	46 %
Active Licenses:	4,877	5,437	5,525
Active License Success:	46%	41%	45 %
Recreation Days:	14,077	16,332	17,000
Days Per Animal:	6.3	7.4	6.8
Males per 100 Females	29	22	
Juveniles per 100 Females	77	66	

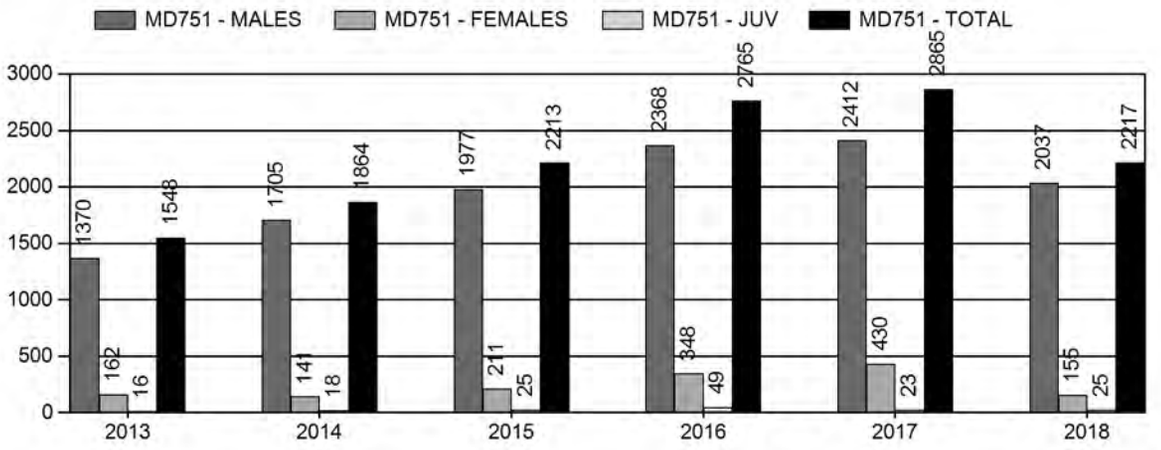
Population Objective (± 20%) :	30000 (24000 - 36000)
Management Strategy:	Recreational
Percent population is above (+) or below (-) objective:	-6.3%
Number of years population has been + or - objective in recent trend:	3
Model Date:	02/15/2019

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

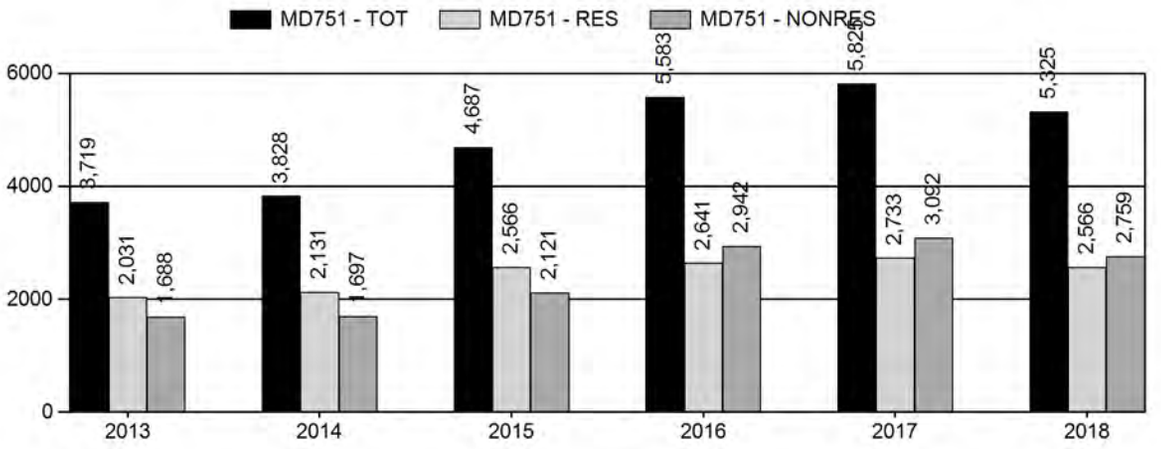
	JCR Year	Proposed
Females ≥ 1 year old:	1.1%	1.8%
Males ≥ 1 year old:	38.4%	41.2%
Total:	8.0%	8.5%
Proposed change in post-season population:	- 6.2%	+ 5.3%



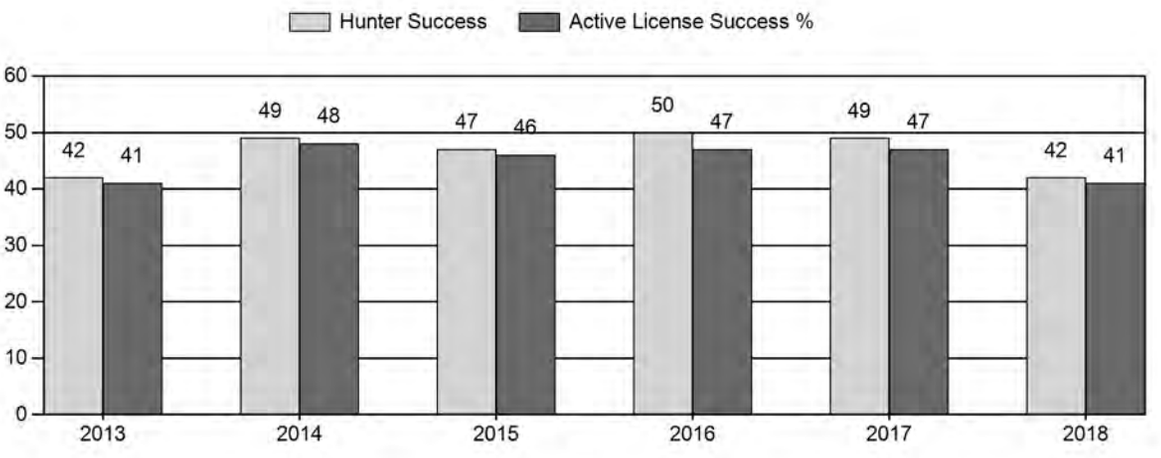
Harvest



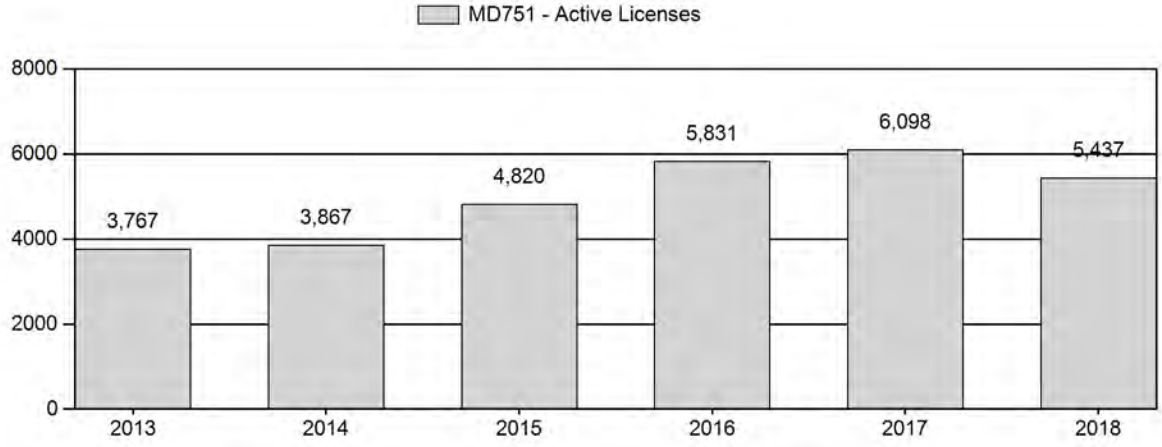
Number of Active Licenses



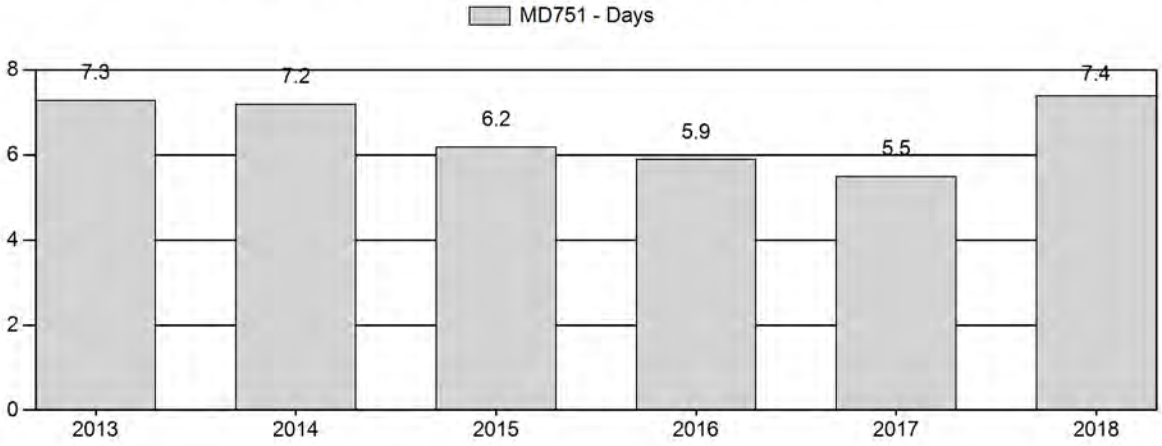
Harvest Success



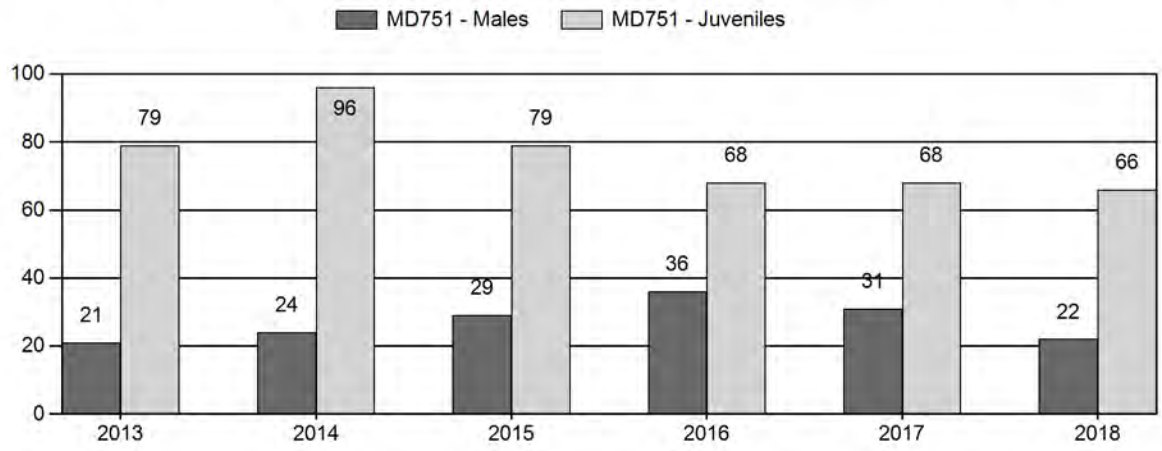
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2013 - 2018 Postseason Classification Summary

for Mule Deer Herd MD751 - BLACK HILLS

		MALES							FEMALES		JUVENILES				Males to 100 Females				Young to		
Year	Post Pop	Ylg	2+ Cls 1	2+ Cls 2	2+ Cls 3	2+ UnCls	Total	%	Total	%	Total	%	Tot Cls	Cls Obj	Ylng	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2013	22,073	71	0	0	0	62	133	11%	634	50%	499	39%	1,266	1,714	11	10	21	± 2	79	± 6	65
2014	27,220	98	0	0	0	113	211	11%	880	45%	847	44%	1,938	2,466	11	13	24	± 2	96	± 6	78
2015	28,553	158	90	16	0	9	273	14%	939	48%	746	38%	1,958	1,812	17	12	29	± 2	79	± 5	62
2016	31,829	182	183	32	0	0	397	17%	1,113	49%	762	34%	2,272	1,467	16	19	36	± 3	68	± 4	50
2017	32,727	146	216	57	2	0	421	16%	1,343	50%	917	34%	2,681	1,429	11	20	31	± 2	68	± 4	52
2018	28,103	71	109	15	2	0	197	12%	884	53%	582	35%	1,663	1,297	8	14	22	± 2	66	± 4	54

2013 - 2018 Trend Count Summary

for Mule Deer Herd MD751 - BLACK HILLS

Year	Count Dates	Number Counted
2014	OCTOBER 2014	1,093
2015	OCTOBER 2015	1,098
2016	OCTOBER 2016	1,410
2017	OCTOBER 2017	1,426
2018	OCTOBER 2018	1,453

2019 HUNTING SEASONS
BLACK HILLS MULE DEER HERD (MD751)

Hunt Area	Type	Dates of Seasons Opens	Closes	Quota	License	Limitations
1		Nov. 1	Nov. 20		General	Antlered deer off private land; any deer on private land
1, 2, 3	7	Nov. 1	Nov. 30	4,200	Limited quota	Doe or fawn valid on private land
2		Nov. 1	Nov. 30		General	Antlered deer off private land; any deer on private land
3		Nov. 1	Nov. 30		General	Antlered deer off private land; any deer on private land
4		Nov. 1	Nov. 20		General	Antlered deer off private land; any deer on private land except the lands of the State of Wyoming's Ranch A property shall be closed
4	7	Nov. 1	Nov. 20	300	Limited quota	Doe or fawn valid on private land
5		Nov. 1	Nov. 20		General	Antlered deer off private land; any deer on private land
5	6	Nov. 1	Nov. 20	200	Limited quota	Doe or fawn
6		Nov. 1	Nov. 20		General	Antlered deer off private land; any deer on private land
Archery		Sep. 1	Sep. 30			Refer to license type and limitations in Section 2

Region A Nonresident Quota: 4,500

SUMMARY OF CHANGES IN LICENSE NUMBER

Hunt Area	License Type	Quota change from 2018
4	6	- 300
4	7	+300
Herd Unit Total	**6**	**- 300**
	7	**+ 300**
	Region A	**None**

Management Evaluation
Current Postseason Population Management Objective: 30,000
Management Strategy: Recreational
2018 Postseason Population Estimate: ~ 28,100
2019 Proposed Postseason Population Estimate: ~ 29,600
2018 Hunter Satisfaction: 79% Satisfied 12% Neutral 9% Dissatisfied

HERD UNIT ISSUES: In 2015, the management objective of the Black Hills Mule Deer Herd Unit was revised to a post-season population of 30,000 mule deer. Prior to this revision, an objective of 20,000 had been in place since 1986. The herd is managed under the Department's "Recreational Management Strategy," which calls for 20 to 29 bucks per 100 does post-season.

The Black Hills mule deer herd unit encompasses 3,181 mi^2 of occupied habitat**.** Approximately 76% of the land in the herd unit is private. Significant blocks of accessible public land are found on the Black Hills National Forest in Hunt Area (HA) 2 and HA 4, and on the Thunder Basin National Grassland in HA 6. A block of BLM land with a couple of access points is also present in HA 1. Because the majority of private landowners lease to outfitters or charge access fees for hunting, and given the timing of the Black Hills deer season, accessible parcels of public land receive much greater hunting pressure than private lands and are probably the most heavily hunted in the State.

Historically, management of this mule deer herd has been a derivative of managing the Black Hills White-Tailed Deer Herd, with hunting seasons primarily structured to address the white-tailed deer population. Although, this has changed to some degree in recent years. As with many of the herd units in the eastern half of Wyoming, the Game & Fish Department has tried to maintain deer numbers at levels acceptable to landowners. In the case of these two sympatric herds, landowners typically feel saturated with whitetails before mule deer become a problem.

White-tailed deer are the more numerous deer species in HA's 2 and 4, whereas more equal proportions of mule deer occupy HA's 1 and 3, and greater proportions of mule deer inhabit HA's 5 and 6. The vast majority of mule deer in the herd unit reside on private land. This results in management strongly influenced by landowner sentiments. Field personnel report mule deer numbers are near tolerance levels in most locations; but some landowners, especially those near Newcastle, desire to see more mule deer.

WEATHER: After a peak in 2006, this herd declined steadily through 2011, something that was exacerbated by a severe winter during bio-year 2010. Increasingly conservative harvest regimes were put in place and this herd began to rebound, but recovery was hampered by severe drought in 2012. In 2013, there was a transition with the advent of good growing season weather and an average winter. Then, in both 2014 and 2015, warm and wet growing seasons followed by mild winters set the stage for excellent fawn productivity and survival. Based upon weather, habitat conditions and deer numbers, it is likely mule deer entered the 2014-15 and 2015-16 winters in good to excellent condition. In addition, weather those years resulted in outstanding over-winter survival, as indicated by very robust post-season yearling buck ratios. More recently, drought plagued the Black Hills during the primary growing seasons of 2016 and 2017. These drought years resulted in poor forage production and led to several large wildfires. Fall weather over this same timeframe was characterized by normal to slightly above average temperatures and below

average precipitation. However, in 2016 and 2017 more normal to severe winter weather was experienced, as temperatures were close to average or below, and total precipitation received normal or above normal most months. Forage growth in 2018 was very good with above average moisture and close to normal temperatures during the growing season. However, the 2018-19 winter has been characterized by well below normal temperatures and above average snowfall. Given the previous two-year's drought and more severe winter weather, improvements in this herd's performance have come to a temporary end. As such, contrary to model predictions, the population will probably stabilize or continue to drop, as will the number of bucks available for harvest. See http://www.ncdc.noaa.gov/cag/ for weather information.

HABITAT: Ponderosa pine (*Pinus ponderosa*) is the dominant overstory species on forested lands. Quaking aspen (*Populus tremuloides*), paper birch (*Betula papyrifera*), and bur oak (*Quercus macrocarpa*) stands are also present. Important shrubs include big sagebrush and silver sage (*Artemesia spp.*), Saskatoon serviceberry (*Amelanchier alnifolia*), Oregon grape (*Berberis repens*), common chokecherry (*Prunus virginiana*), wild spiraea (*Spiraea betulifolia*), and true mountain mahogany (*Cercocarpus montanus*) in the southern portion of the herd unit. Non-timbered lands are dominated by sagebrush, or are used to produce agricultural crops such as winter wheat (*Triticum aestivum*), alfalfa hay (*Medicago sativa*), and grass hay.

Currently, quantification of mule deer habitat quality or quantity are not conducted within this herd unit. A single true mountain mahogany and two bur oak production and utilization transects were monitored in the past. The true mountain mahogany transect was located on mule deer transitional and winter range typical of the southern Black Hills, and the bur oak transects were in winter range more typical of white-tailed deer habitat in the northern hills. While little habitat data have been collected, it appears past drought conditions negatively affected shrub production, and peak mule deer numbers several years ago may have exceeded what the forage conditions could sustain given the lack of precipitation at the time. Bio-years 2013 through 2015 resulted in excellent forage production, and browse availability on winter and transitional ranges appeared to be generally good to excellent. However, during bio-years 2016 & 2017, forage production appeared to be fair or poor in most locations, and winter use elevated. 2018 was again wetter with good forage production. However, the 2018-19 winter to date has been colder and snowier than normal, and browsing more extensive.

FIELD DATA: Between 2009 and 2011, fawn productivity and survival were suppressed, with the mean observed, post-season fawn:doe ratio being 65:100 (Figure 1). In 2012, this situation reversed itself as the fawn:doe ratio improved to 76:100. Then between 2013 and 2015 it averaged 85:100, peaking at 96:100 in 2014 before falling to 68:100 in both 2016 and 2017, and then dropping to 66:100 in 2018. After 2015, annual survival of six to 18 month old deer appears to have fallen as well (Figure 2). Consequently, this population increased considerably between 2012 and 2016, and then is projected to have declined some into 2018. However, this recent decline has not been apparent in pre-season trend counts, which have remained fairly stable (Figure 3). This may be due to the fact that a single trend route in HA 5 accounts for a large percentage of the mule deer observed each fall, and numbers on this route have been consistent since 2016.

Because a post-season ratio of 66 fawns per 100 does is generally thought to be the level necessary to sustain hunted mule deer populations, the population decline experienced between 2006 and 2011 was likely due initially to increased harvest rates and a drop in over-winter survival, while increased non-hunting mortality augmented the decline after 2008 (2017 MD751 JCR). This same

period witnessed a 75% decline in preseason trend counts (Figure 3). With better fawn production and survival between 2012 and 2015, this population grew steadily until 2016, before declining in the wake of decreased recruitment and survival.

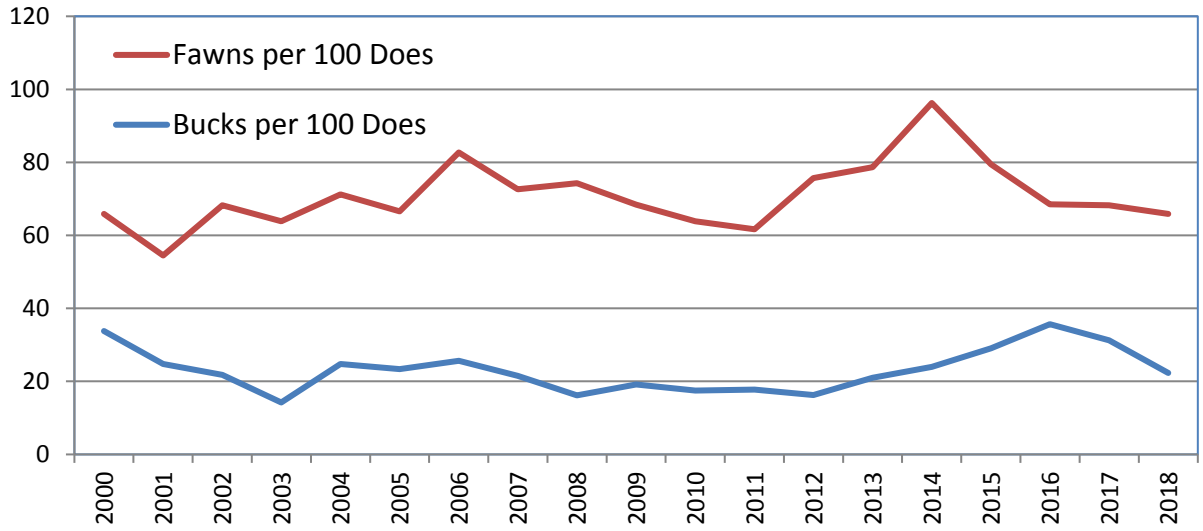


FIGURE 1. Post-season fawn:doe and total buck:doe ratios (per 100 does) in the Black Hills Mule Deer Herd (2000-2018).

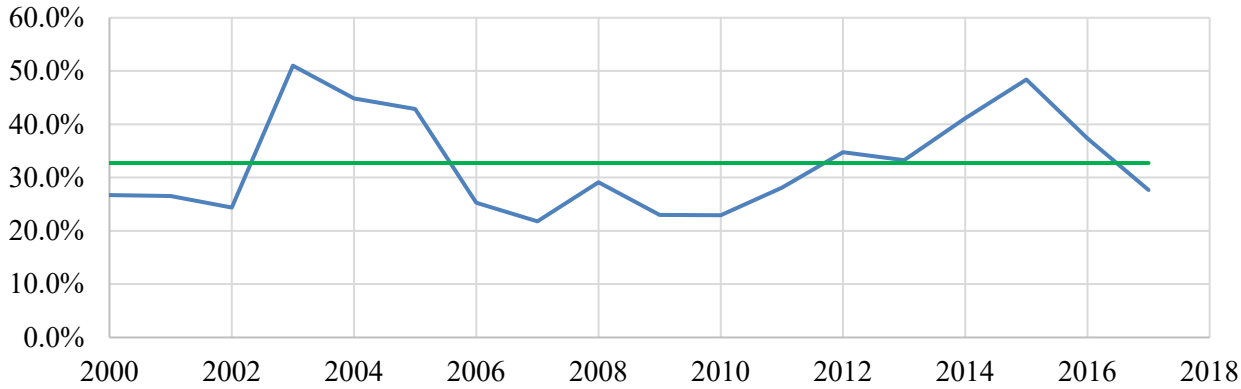


FIGURE 2. Estimated annual survival rate* of buck mule deer from 6 mo. to 18 mo. of age with mean in the Black Hills Mule Deer Herd (Bio-Years 2000-2017).

*Based upon observed fawn:doe ratios for a given bio-year and the subsequent year's observed yearling buck:doe ratio. Calculated as [(Yearling Buck:Doe) $_{\text{Bio-Year +1}}$ / 0.85] / ½ (Fawn:Doe) $_{\text{Bio-Year}}$

As this population declined between 2008 and 2012, so did post-season buck:doe ratios (Figure 1). With better fawn production and survival between 2012 and 2015, yearling buck numbers improved, driving an increase in the total observed buck:doe ratio from 16:100 in 2012 to 36:100 in 2016, before falling back to 31:100 in 2017 and 22:100 in 2018 (Figure 1). The recent decline

being a result of reduced fawn recruitment and survival as hunting pressure increased. However, post-season, adult buck:doe ratios observed in this herd over the last decade, and over the long-term have remained fairly consistent around 13:100, but did jump to about 20:100 in both 2016 and 2017 thanks to a strong class of two-year old bucks each year. As such, this herd improved from exhibiting buck:doe ratios below the Department's minimum management criteria for recreational hunting to exceeding its upper end. However, as expected, increases in mortality and reductions in fawn production and survival the past two years has led to declining buck:doe ratios, and this herd is again near the bottom of management criteria for buck:doe ratios at 22;100. Given past herd performance, it is anticipated the post-season buck:doe ratio will hold steady or return to near the midrange of the Department's recreational management criteria in 2019 if overwinter survival of deer is not overly compromised, rather than the higher value predicted by the population model.

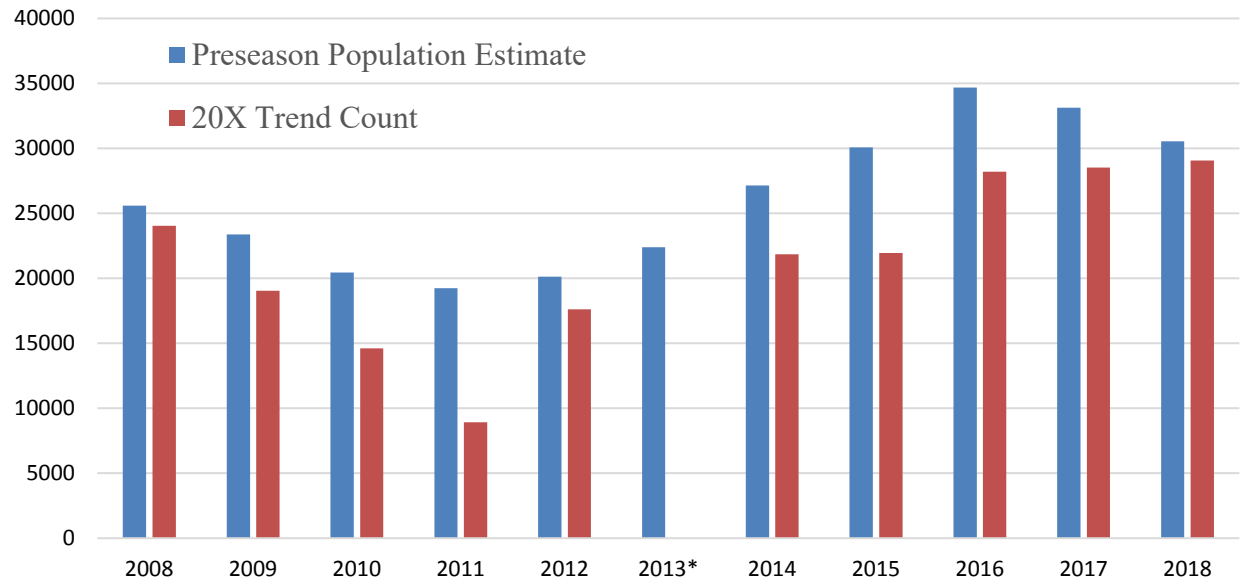


Figure 3. Pre-season population estimates produced by the current TSJ CA model, and mule deer observed preseason along trend count routes (increased by a factor of 20) 2008 – 2018.
* *Trend counts not conducted in 2013 due to winter storm Atlas.*

HARVEST DATA: Deer hunting seasons in the Black Hills have been traditionally structured to address white-tailed deer management. Consequently, harvest of mule deer bucks is managed by balancing white-tailed deer seasons and landowner tolerance for deer (both species) with recreational opportunity. Antlerless harvest is regulated primarily through doe/fawn license issuance. An analysis of historic general license harvest information shows the number of hunters in the field pursuing bucks has the greatest impact on total harvest. As such, buck harvest is regulated by altering non-resident hunter numbers via changes in the Region A quota, while resident buck hunter participation can only be limited by shortening the season. Department surveys and contacts with non-resident hunters indicate most non-residents want to harvest mule deer. This fact, combined with a hunting season that targets bucks during the rut, results in very heavy hunting pressure on buck mule deer.

With conservative hunting season structures in place between 2010 and 2014, mule deer harvest dropped about 40% from the level experienced when the population previously peaked, although reported harvest increased substantially in 2014 without concomitant increases in license issuance.[1] In 2015, Region A license issuance was liberalized, doe/fawn license issuance more than doubled, and HA's 2 and 3 returned to 30-day seasons. As a result, reported harvest climbed 19%. License issuance was again liberalized in 2016, and total harvest increased another 25%. During the 2017 hunting season, with an increase of 100 doe/fawn tags being the only change, about 50 more bucks and 50 more antlerless deer were taken. In contrast, 2018 saw a drop in harvest as antlerless take fell 65% and buck harvest dropped 16% even though Region A license issuance remained unchanged and d/f tag numbers increased slightly. Also in 2018, active license numbers for mule deer dropped about 10%, while hunter success fell ~15% and effort increased ~35%. These changes in harvest statistics all support a trend towards decreasing deer numbers, which is projected by the population model, but was not apparent in trend counts.

As harvest increased the between 2013 and 2017, the number of field-checked mule deer generally increased as well. In 2017, with the advent and use of the smartphone check station application, field check numbers increased proportionately more than harvest. This trend continued in 2018 as the number of field-checked deer was augmented by Chronic Wasting Disease (CWD) testing efforts while reported harvest dropped. However, the exact number of mule deer field checked in 2018 is difficult to know, as an unknown number of lab-aged CWD-sampled deer were also recorded using the check station application, resulting in the JCR program generating duplicate counts of some lab and field-aged deer. At minimum, 208 mule deer harvested were field checked and/or lab aged in 2018. The bulk of these, 184, were bucks age two-years or greater. Of the 157 mule deer tested for CWD, 9 were positive, yielding a prevalence of 5.7%. All of the infected deer came from the 131 adult bucks tested. The 2018 detection prevalence was substantially higher than the approximately 0.2% that had been observed in this herd prior to 2018 (N = 2 of 1,074). Noteworthy, in 2018, almost all of the CWD positive deer came from HA's 1 & 3 (7 of 9), and may have resulted from sampling local "hotspots."

Overall, hunting seasons between 2010 and 2014 reduced harvest of mule deer bucks about 37% from the level experienced during the immediately preceding 5-year period with the traditional 30-day November season north of I-90. Comparing these same periods, resident harvest of mule deer bucks dropped a bit more than 20%, while non-resident harvest of mule deer bucks dropped closer to 50%. During the period of conservative season structures, harvest of whitetail bucks declined less (see 2015, WD706). As a result, post-season mule deer buck:doe ratios held fairly stable and then began to improve. Meanwhile, hunter satisfaction remained basically unchanged between 2011 and 2013, with about 68% of hunters of both deer species reporting they were either satisfied or very satisfied with their Black Hills deer hunt. Satisfaction measures then improved in 2014 with 75% of both mule deer and white-tailed deer hunters reporting they were satisfied with their Black Hills deer hunt. Hunter satisfaction increased again in 2015, with just over 80% of both mule deer and white-tailed deer hunters reporting they were satisfied, and less than 7% reporting dissatisfaction. Between 2015 and 2017, hunter satisfaction climbed about a percentage point each year to a high of 83% before dropping to 79% in 2018. It can be inferred that steady increases in

[1] 2014 harvest survey statistics indicate mule deer buck harvest increased about 36% in 2014, something that appears very incongruent with no significant changes in hunter number or season structure given population trends and field observations.

deer hunter success and declines in the effort required to harvest a deer between 2013 and 2017 strongly influenced changes in hunter satisfaction and influenced their decline in 2018.

POPULATION: Population modeling of this herd has always been difficult. The population violates the closed population assumption due to significant interstate movement of deer combined with interchange between adjacent mule deer herds in Wyoming. In addition, changes in doe harvest rates, outbreaks of EHDV, possible adenovirus mortalities, substantial predation, a high level of vehicle-deer collisions, occasional severe weather events, and inadequate classification sample sizes at times have made constructing a reliable population model questionable at best. In 2014, the spreadsheet model for this herd was reconstructed and re-initiated after correcting errors detected in the previous model. Model choice for this herd has changed several times, and did so again in 2016, when the Time Sensitive Juvenile, Constant Adult (TSJ, CA) model was chosen over competing models. This same model has been chosen each year since.

The 2018 modeled, post-season population estimate of Black Hills mule deer herd is ~28,100. A value significantly below the 33,400 projected last year. In addition, updating the model resulted in the 2017 post-season estimate declining from ~ 32,700 reported last year, to ~30,000. However, all recent modeled values may be somewhat inflated due to significantly increased reported harvest in 2014 without commensurate changes in season structure or perceived population size. In addition, the effects of EDHV, which caused significant mortality in some locations during 2017, are just being recognized by the model, as changes to harvest and buck:doe ratios inform the model in "hindsight." Given the current model selection with updated data, the population is now projected to have peaked in 2006 at an estimated postseason population of around 28,500 mule deer (versus the 36,000 reported for that year in 2015). Following that peak, it declined to about 17,700 in 2011 (versus 16,500 reported in 2015). It is now estimated to have rebounded, growing 78% to about 31,600 post-season 2016, and then dropping 5% to ~ 30,000 in 2017. [2] Because the models we use to simulate populations produce the most unreliable estimates in the first and last few years of model construction, we question whether this population grew as much as indicated between 2013 and 2016. This is asserted because recent trend counts are below those found in years contained in the middle of the model at a time when this population is projected to have been at a similar level (Figure 1). At any rate, this herd definitely rebounded after a substantial decline, and then stabilized or declined a bit in 2017, before falling some in 2018.

As mentioned above, population modeling of this herd is difficult; and the Time Sensitive Juvenile / Constant Adult (TSJ CA) model was used again this year. This was done because it had the lowest AICc value and best fit. Both the SCA SCJ and TSJ CA models are well correlated with preseason trend counts since 2008 (SCJ SCA ~ 90% and TSJ CA ~ 85%), but the TSJ CA model fits observed buck:doe ratio data substantially better. Both models indicated a slight decline in the population since 2016, something not reflected in harvest statistics until 2018. However, the chosen model does not reach the upper constraint on adult survival (0.9) that the SCJ SCA model does in all years not constrained. Instead, the TSJ CA model produces a very reasonable adult survival rate of 85% and an average juvenile survival rate of 62%. Overall, we consider the selected model to be of poor quality due to the lack of herd specific survival data, violations of the closed population assumption, below adequate classification in some years, and aerial classifications in terrain that makes classifying yearling bucks difficult.

[2] All values reported in this paragraph reflect the current population model estimates and therefore do not match previous reports.

MANAGEMENT SUMMARY: The spreadsheet model suggests this herd was at its management objective of 30,000 mule deer in 2017, and was 6% below post-season 2018. If the herd actually numbers close to 30,000 mule deer post-season, then the current objective is near what most landowners desire north of I-90, but may be below some landowners' and hunters' wishes south of I-90. Based upon habitat conditions, the desires of hunters, and landowner sentiments, a season designed to allow this herd to stabilize or grow slightly is warranted at this time. Therefore, the 2019 hunting season is designed to maintain buck-hunting opportunity at levels commensurate with the past three years, along with consistent levels of antlerless harvest. This prescription could result in a slight lowering of buck:doe ratios, although they should remain within the range of recreational management. This prescribed management should yield a stable or slightly decreasing population (contrary to model projections) given the forage conditions and winter weather experienced this year.

Buck mule deer numbers substantially improved in this herd unit between 2012 and 2016. Based upon classification data and population estimates, typical numbers of yearling and two-year old bucks, along with cohorts older bucks, should be available for hunters in 2019.

With this population close to objective and the sympatric white-tailed deer population above objective, no significant changes have been made to the structure of doe/fawn license issuance. The exception being a change in license type designation for reduced priced doe or fawn licenses in HA 4 from Type 6 to Type 7. This is being done to be consistent with other HA's where doe/fawn tags are valid on private land only. Long-term harvest data show if doe/fawn licenses are valid for either species of deer, consistently about one-third of the antlerless deer harvested will be mule deer. We believe a few more doe/fawn licenses will sell in 2019 and active license success will increase on these tags for mule deer as hunters realize they can be used for both species. This should result in a bit of an increase in antlerless harvest from HA's 1, 2, and 3. Further, because resident general license hunter numbers will likely not change significantly in 2019, and most non-residents don't harvest antlerless deer on their Region A licenses, doe/fawn harvest on general licenses will likely not change much. Consequently, it is estimated that the 2019 season will result in the take of 250 to 300 antlerless mule deer, a value close to the average harvest over the past five years. The low level of female mule deer harvest (less than 2%), coupled with consistent data on harvest percentages by species, does not warrant complicating the regulations by segregating mule deer and white-tailed deer harvest more than already occurs on general licenses.

The 2019 hunting season as modeled will yield a postseason population of about 29,600 mule deer, which represents 5% growth in the post-season population. If this happens, which we doubt given the current weather conditions and recruitment levels, such a change would put this population essentially at objective.

2018 - JCR Evaluation Form

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

HERD: MD755 - NORTH CONVERSE

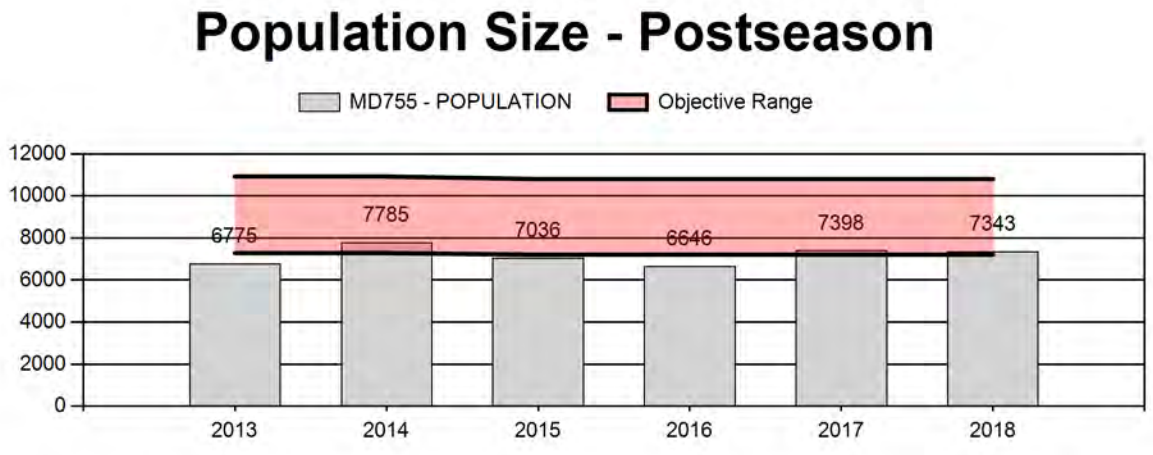
HUNT AREAS: 22
PREPARED BY: WILLOW BISH

	2013 - 2017 Average	2018	2019 Proposed
Population:	7,128	7,343	7,767
Harvest:	235	276	400
Hunters:	317	339	450
Hunter Success:	74%	81%	89 %
Active Licenses:	323	339	450
Active License Success:	73%	81%	89 %
Recreation Days:	1,206	1,266	1,400
Days Per Animal:	5.1	4.6	3.5
Males per 100 Females	38	0	
Juveniles per 100 Females	78	0	

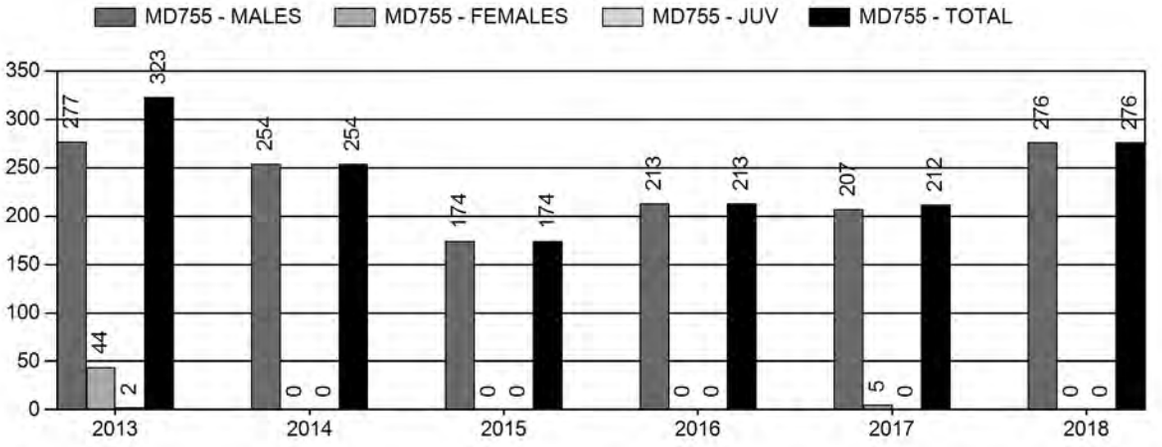
Population Objective (± 20%) :	9000 (7200 - 10800)
Management Strategy:	Special
Percent population is above (+) or below (-) objective:	-18.4%
Number of years population has been + or - objective in recent trend:	10
Model Date:	02/15/2019

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

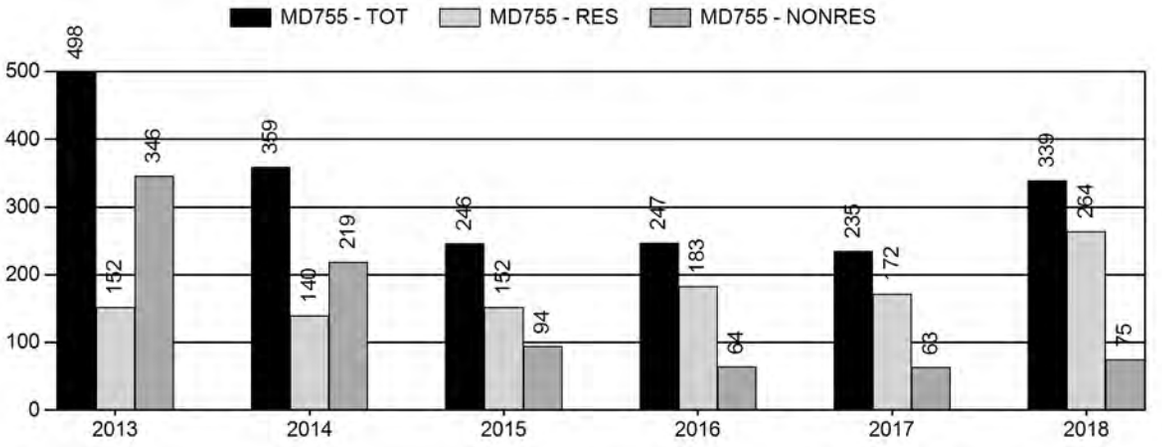
	JCR Year	Proposed
Females ≥ 1 year old:	0%	0%
Males ≥ 1 year old:	16.5%	22.5%
Total:	16.5%	22.5%
Proposed change in post-season population:	-4.0%	-5.4%



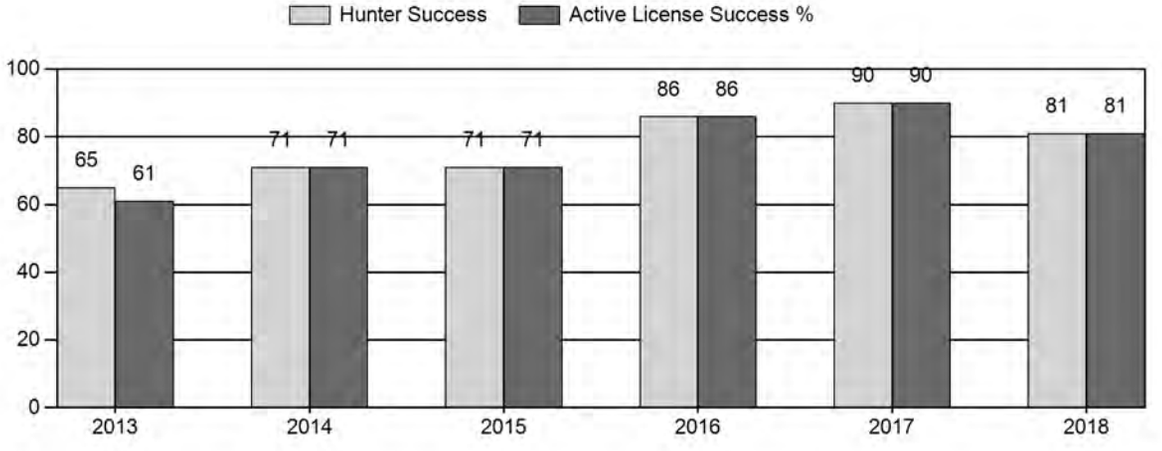
Harvest



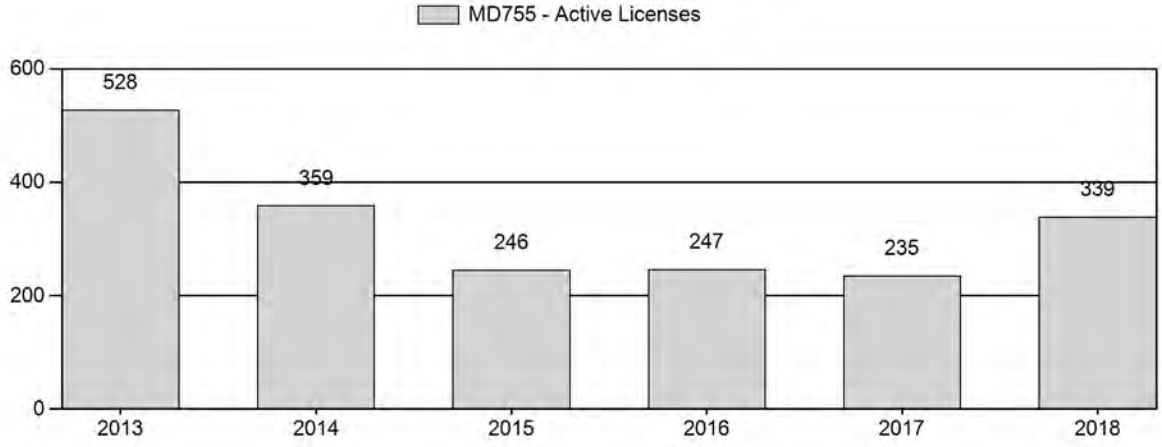
Number of Active Licenses



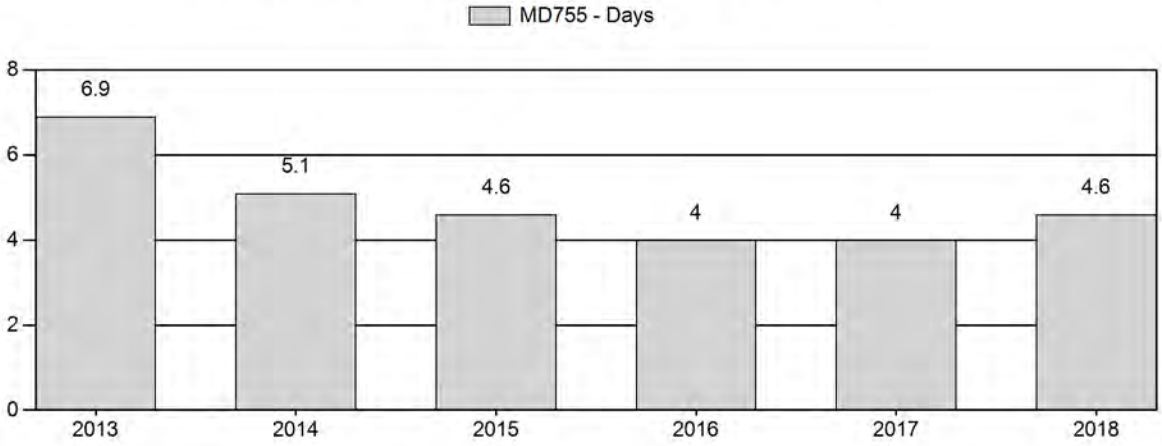
Harvest Success



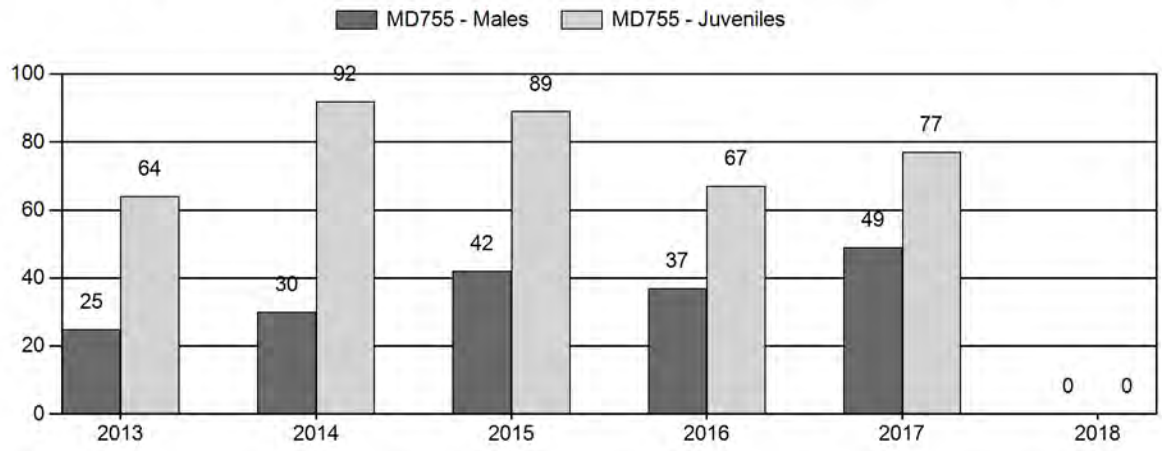
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2013 - 2018 Postseason Classification Summary

for Mule Deer Herd MD755 - NORTH CONVERSE

		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	6,775	30	0	0	0	39	69	13%	275	53%	176	34%	520	1,095	11	14	25	± 4	64	± 8	51
2014	7,785	23	26	14	3	0	66	14%	220	45%	202	41%	488	1,936	10	20	30	± 5	92	± 11	71
2015	7,036	65	54	35	10	0	164	18%	393	43%	351	39%	908	1,858	17	25	42	± 5	89	± 8	63
2016	6,646	37	42	24	2	14	119	18%	324	49%	217	33%	660	1,224	11	25	37	± 5	67	± 7	49
2017	7,398	41	98	42	7	0	188	22%	383	44%	295	34%	866	1,588	11	38	49	± 5	77	± 7	52
2018	7,343	36	75	16	0	0	127	31%	159	39%	123	30%	409	1,825	23	57	80	± 12	77	± 12	43

2019 HUNTING SEASONS
NORTH CONVERSE MULE DEER HERD (MD755)

Hunt Area	Type	Season Dates Opens	Closes	Quota	License	Limitations
22	1	Oct. 1	Oct. 14	500	Limited quota	Antlered mule deer or any white-tailed deer
Archery		Sep. 1	Sep. 30			Refer to license type and limitations in Section 2

Hunt Area	Type	Quota change from 2018
22	1	+100

Management Evaluation
Current Postseason Population Management Objective: 9,000
Management Strategy: Special
2018 Postseason Population Estimate: ~7,300
2019 Proposed Postseason Population Estimate: ~7,800
2018 Hunter Satisfaction: 86% Satisfied, 8% Neutral, 6% Dissatisfied

Herd Unit Issues

The North Converse Mule Deer herd has a postseason population objective of 9,000 mule deer and is managed under the special management strategy, with a goal of maintaining postseason buck ratios between 30-45 bucks per 100 does. The objective and management strategy were last revised in 2015.

Public hunting access within the herd unit is poor, with only small tracts of accessible public land interspersed with predominantly private lands. High trespass fees and outfitting for mule deer are common on most ranches within this herd unit. Primary land uses in this area include extensive oil and gas production, large-scale industrial wind generation, In-situ uranium production, and traditional cattle and sheep grazing. In recent years, expansion of oil shale development has dramatically escalated anthropogenic disturbance throughout this herd unit.

Weather

Total precipitation in 2018 was slightly above average which was similar to 2017. However, the bulk of the precipitation was received throughout the summer months (May-July) with less than average precipitation through spring and fall. Due to the relatively dry spring, forage production occurred later in the season than normal but precipitation throughout the summer months supported good forage growth for the year. The 2018-2019 winter has been relatively mild to date, however, there were some cold snaps and snow accumulation in November which may have influenced animal movements and foraging capabilities. Given the relative mildness of the

rest of the winter and less than average snowfall received, mule deer have likely experienced normal over-winter survival this year.

Habitat

There are no habitat transects in this herd unit due to the preponderance of private land. Habitat conditions are variable in this herd unit due to some past wildfires which have removed portions of sagebrush habitat. The past five years have produced above average to average precipitation, resulting in a general trend of good forage production. These conditions have been effective in allowing rangelands to recover from the extreme drought in 2012. Sagebrush plants are recruiting in some areas of this herd unit, which may lead to higher quality forage availability in the future.

Field Data

The total number of mule deer classified has steadily decreased in this herd unit as classification sample sizes have been difficult to meet since this herd has not been a budget priority. Given the potential level of oil and gas disturbance that may be forthcoming, managers prioritized this herd unit for aerial flights beginning in 2015 in order to collect more representative baseline pre-disturbance information. The bulk of aerial survey time was spent classifying mule deer along the Pine Ridge, Salt Creek, and in the sand hills where limited road densities and difficult access preclude ground classifications. Although classification survey effort was elevated beginning in 2015, only 409 mule deer were classified in 2018 as flight budgets were somewhat reduced and observers had a more difficult time finding deer despite recent population increase. The sample size goal for 90% confidence was 1,825 mule deer, which was far above the total number of deer classified. This sample size was much lower than in recent years, with the most recent 5-year average being 688 deer classified.

Fawn production in 2018 was 77 fawns per 100 does, which is the same as the previous 5-year average. This level of fawn production is contributing to this herd's general upward trend and, if the trend continues, will likely result in this herd meeting objective within the next few years.

The 2018 postseason buck ratio (80) is higher than the previous 5-year average of 37 bucks per 100 does and far exceeds management guidelines. Yearling buck ratios in 2018 (23) were also higher than the previous 5-year average of 12 bucks per 100 does. While buck ratios are likely increasing as a result of good fawn production and recruitment, along with conservative license issuance and limited private land hunting access, it is likely that such high buck ratios are a result of low sample size. The buck ratio in 2017 was 49, and it is unlikely that such a dramatic increase in buck ratios would occur in one year. However, the data do support field manager's observations that deer hunting opportunity has increased in recent years.

Harvest

Overall harvest has declined in this herd unit as license issuance has decreased to address population decline, although this trend reversed beginning in 2016. From 2011 to 2015, Type 1 quotas were reduced by 63%, buck harvest decreased by 60%, and average hunter success was 71%. The 2015 harvest of 174 bucks was by far the lowest total deer harvest ever obtained in this herd unit. License issuance between 2015 and 2017 was static, but hunting success averaged

82%. In 2018, the quota was increased by 100 licenses and hunter success was 81% resulting in a harvest of 276 bucks. Overall, 2018 harvest statistics suggest increased buck mule deer availability and improved hunting opportunity within this herd unit.

In 2018, 86% of hunters reported being either satisfied or very satisfied with their hunt, indicating a remarkably high level of satisfaction given the lack of public access and population decline. It should be noted that most hunters whom speak to Game and Fish personnel are advised to secure access on private land before purchasing a license in areas that have limited public access, or at least be aware of the limited availability of accessible public land.

Population

The 2018 postseason population estimate was about 7,300 mule deer. After population decline following substantial winter mortality in bio-year 2010, this herd is beginning to trend upward toward objective due to increased fawn production.

The "Semi-Constant Juvenile & Semi-Constant Adult Survival" (SCJ-SCA) spreadsheet model was chosen for the post-season population estimate of this herd. This model had a low relative AIC (78) and most accurately depicted population trend and size based on field personnel perceptions and landowner input. Adult survival was constrained lower than normal (between 0.5 and 0.7) for 2010 as a result of high winter mortality that year. This model is considered to be of fair quality based on model fit and simulated population trend.

Management Summary

The hunting season in this area has traditionally run from October 1st to October 14th. These season dates have generally been adequate to meet landowner desires while allowing a reasonable harvest. For 2019, the Department is increasing the Type 1 quota by 100 licenses, for a total of 500 licenses. The license reduction in previous years allowed buck ratios to increase back within special management criteria. Observed 2018 buck ratios far exceeded management criteria maximums, although sample sizes were far from being adequate. Doe/fawn license issuance was considerable in past years, but was eliminated in 2014 due to population concerns. Conservative hunting season structure, including relatively low Type 1 license issuance and no doe/fawn licenses, has been warranted to permit population growth while allowing for more mature bucks to become available for harvest. However, recent hunter success, buck ratios, and population trend suggest more hunting opportunity can now be provided.

In this herd unit, landowner input is given a lot of deference given the limited availability of accessible public land. The proposal to increase Type 1 licenses has proved rather contentious with landowners in recent years. A few landowners and outfitters would like even more licenses than proposed but many are not supportive of increases. The data supports an increase, but given the level of contention, only a modest increase has been proposed.

If we attain the projected harvest of 400 bucks and experience normal fawn productivity, the predicted 2019 postseason population will likely increase slightly to 7,800 mule deer, which is 13% below objective.

2018 - JCR Evaluation Form

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

HERD: MD756 - SOUTH CONVERSE

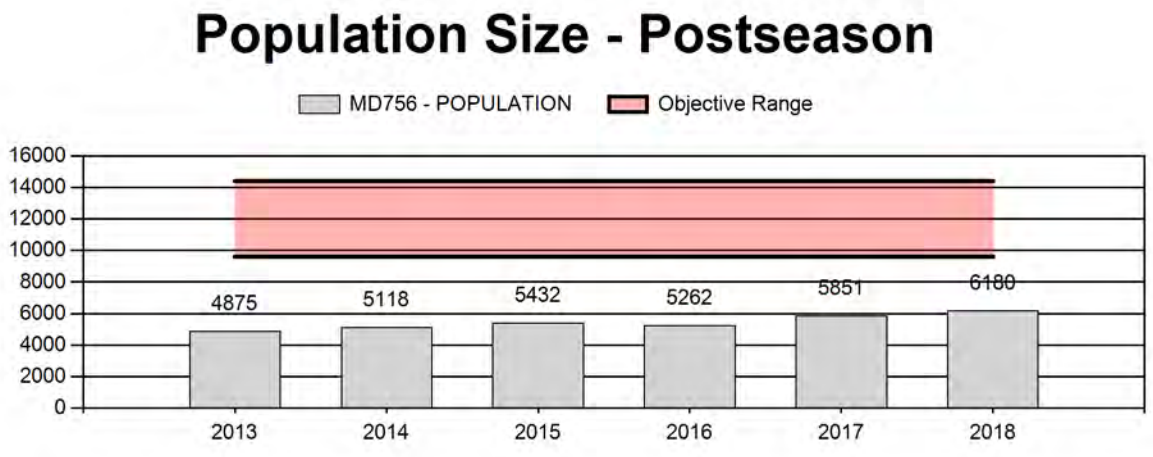
HUNT AREAS: 65
PREPARED BY: WILLOW BISH

	2013 - 2017 Average	2018	2019 Proposed
Population:	5,308	6,180	5,396
Harvest:	258	301	266
Hunters:	691	704	700
Hunter Success:	37%	43%	38%
Active Licenses:	691	704	700
Active License Success:	37%	43%	38%
Recreation Days:	2,523	2,881	2,600
Days Per Animal:	9.8	9.6	9.8
Males per 100 Females	38	51	
Juveniles per 100 Females	60	79	

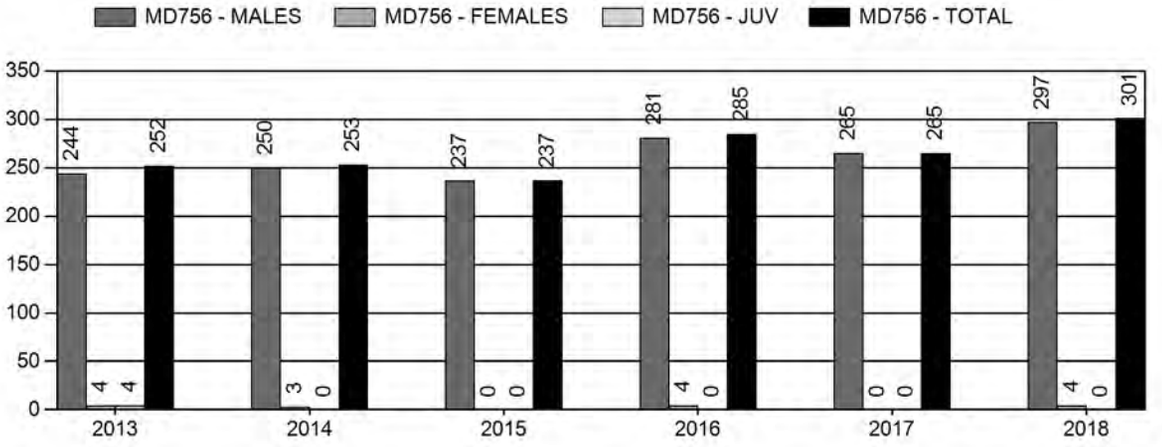
Population Objective (± 20%) :	12000 (9600 - 14400)
Management Strategy:	Private Land
Percent population is above (+) or below (-) objective:	-48.5%
Number of years population has been + or - objective in recent trend:	19
Model Date:	02/15/2019

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

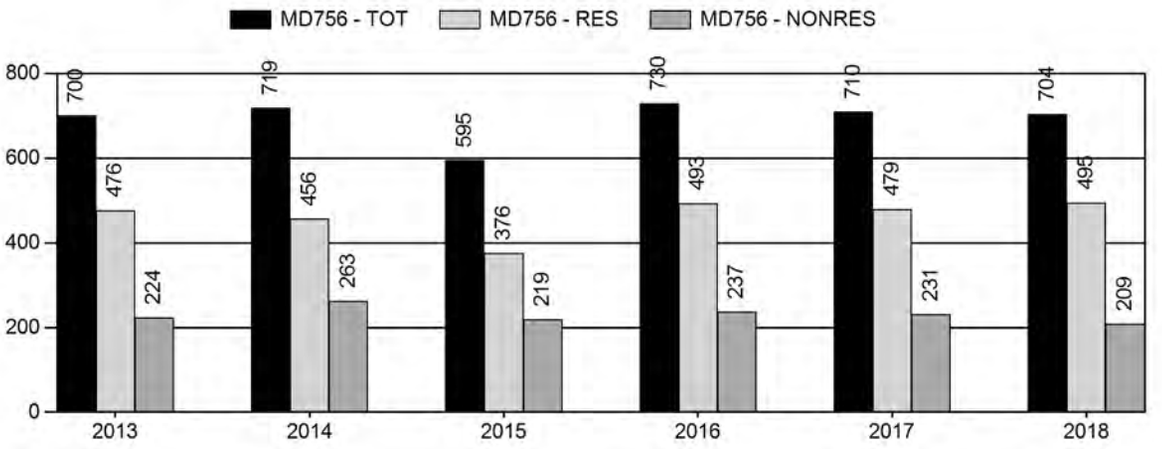
	JCR Year	Proposed
Females ≥ 1 year old:	0.2%	0%
Males ≥ 1 year old:	20.8%	20.7%
Total:	30%	20.7%
Proposed change in post-season population:	-5.1%	-5.2%



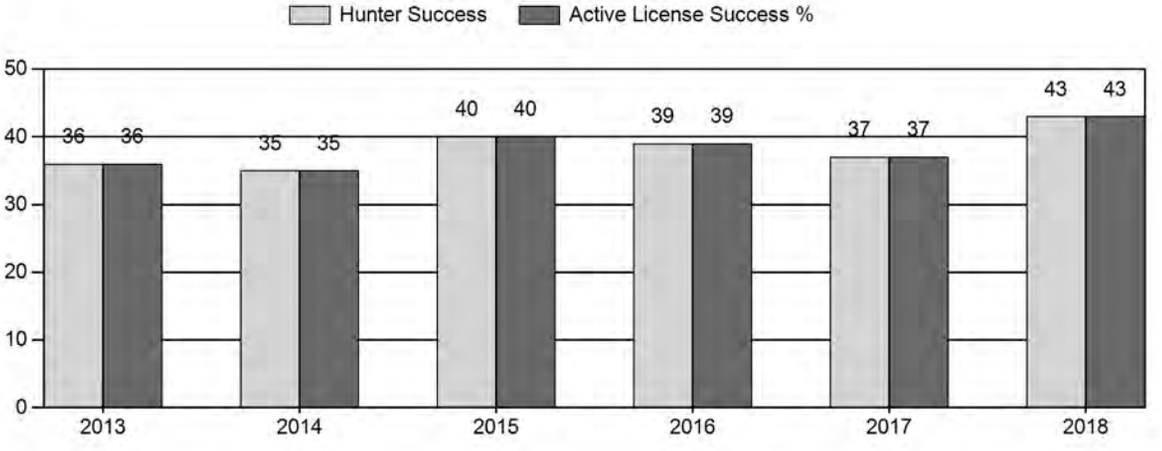
Harvest



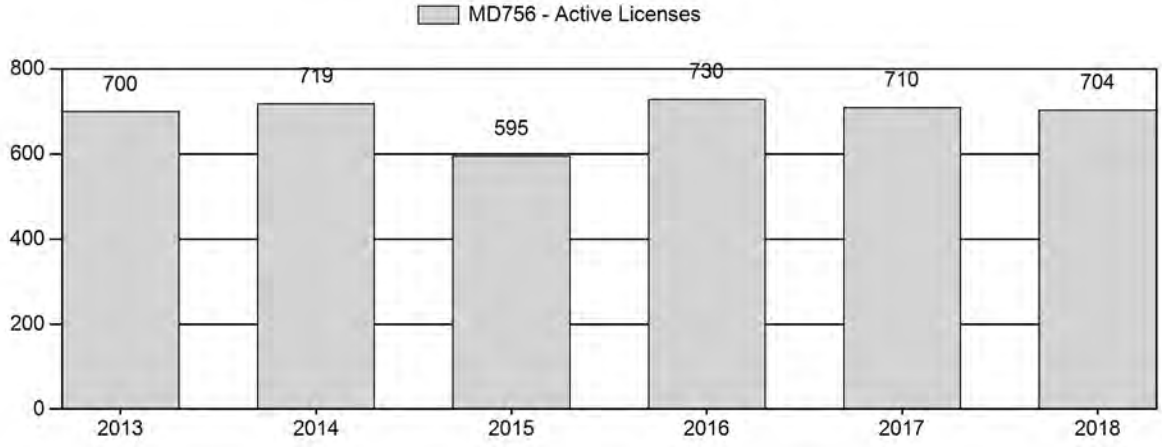
Number of Active Licenses



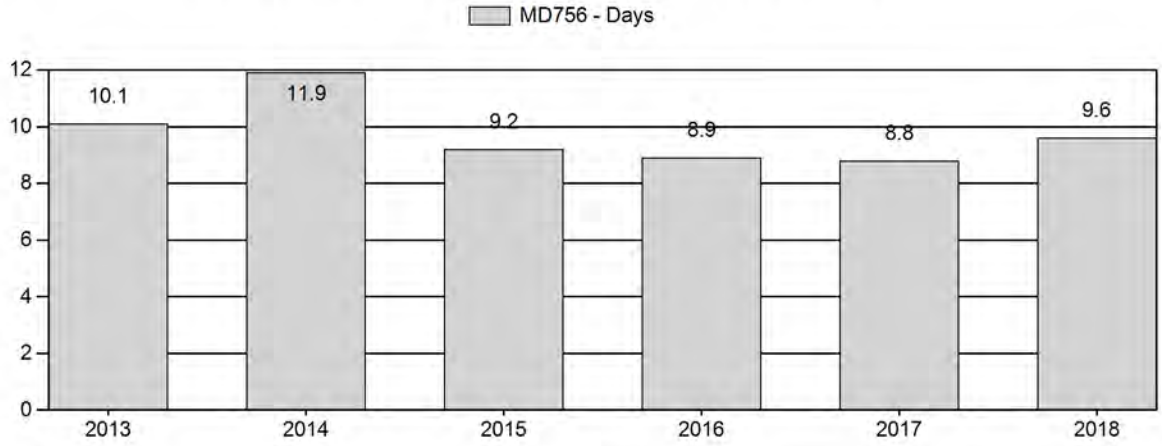
Harvest Success



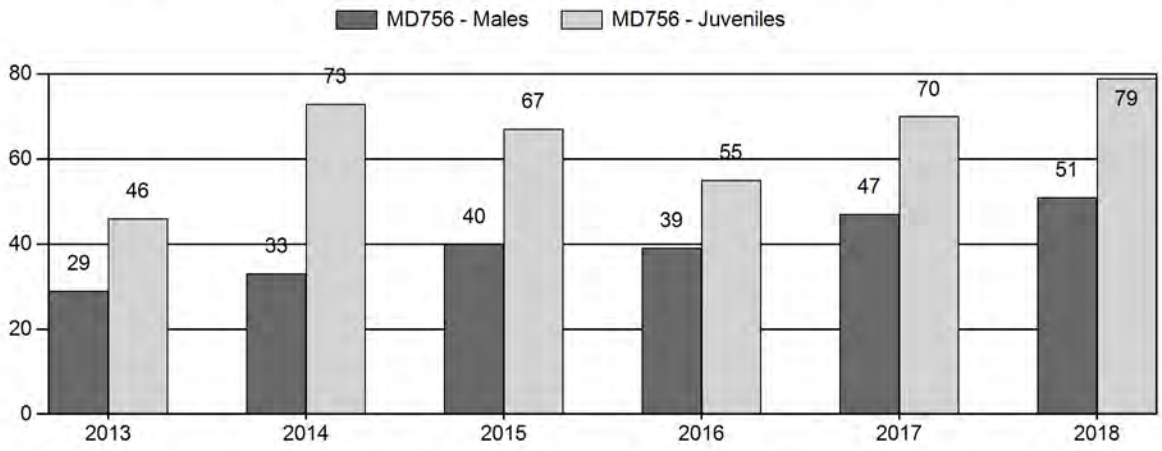
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2013 - 2018 Postseason Classification Summary

for Mule Deer Herd MD756 - SOUTH CONVERSE

		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	4,875	64	65	17	8	0	154	17%	528	57%	245	26%	927	719	12	17	29	± 3	46	± 4	36
2014	5,118	30	56	24	19	0	129	16%	393	49%	286	35%	808	1,281	8	25	33	± 4	73	± 7	55
2015	5,432	81	68	29	7	0	185	19%	458	48%	308	32%	951	1,164	18	23	40	± 4	67	± 6	48
2016	5,262	137	176	70	20	0	403	20%	1,030	51%	568	28%	2,001	900	13	26	39	± 2	55	± 3	40
2017	5,851	70	103	38	3	0	214	22%	453	46%	319	32%	986	1,315	15	32	47	± 5	70	± 6	48
2018	6,180	41	79	23	8	0	151	22%	299	44%	237	34%	687	1,571	14	37	51	± 6	79	± 8	53

2019 HUNTING SEASONS
SOUTH CONVERSE MULE DEER (MD756)

Hunt Area	Type	Season Dates Opens	Closes	Quota	License	Limitations
65		Oct. 15	Oct 31		General	Antlered mule deer three (3) points or more on either antler or any white-tailed deer
	Archery	Sep. 1	Sep. 30			Refer to license types and limitations in Section 2

Management Evaluation

Current Management Objective: 12,000

Management Strategy: Private Land

2018 Postseason Population Estimate: ~ 6,200

2019 Proposed Postseason Population Estimate: ~ 5,400

2018 Hunter Satisfaction: 65% Satisfied, 19% Neutral, 16% Dissatisfied

The South Converse Mule Deer Herd Unit has a postseason population management objective of 12,000 deer. The herd is managed using a private land management strategy, as buck ratios are difficult to influence with hunting seasons as the majority of mule deer in this herd unit occupy private lands. The objective and management strategy were last revised in 2013.

Herd Unit Issues

Hunting access within the herd unit is marginal, with tracts of public land and national forest interspersed with predominantly private lands. The main land use is traditional ranching and grazing of livestock, with agricultural fields that have the potential for damage issues when big game are abundant. Doe/fawn licenses have historically been issued to address damage, but are not currently necessary for mule deer. Disease issues are a concern within this herd unit in particular, as the prevalence of Chronic Wasting Disease (CWD) has been higher here than any other area in Wyoming or adjacent states in most years. Research investigating population-level effects of CWD was concluded in 2014, with a published dissertation and additional publications (Devivo, 2015). Please refer to Appendix A of this report for further information regarding CWD and recently completed research in the South Converse Herd Unit. The CWD prevalence estimate derived from hunter-harvested mule deer in 2015 and 2016 were calculated from low sample sizes. However, the Department increased CWD sampling efforts in 2017 and 2018 and was able to sample approximately 19% of harvested deer both years.

Weather

Total precipitation in 2018 was slightly above average which was similar to 2017. However, the bulk of the precipitation was received throughout the summer months (May-July) with less than average precipitation through spring and fall. Due to the relatively dry spring, forage production occurred later in the season than normal but precipitation throughout the summer months supported good forage growth for the year. The 2018-2019 winter has been relatively mild to date, however, there were some cold snaps and snow accumulation in November as well as January/February which may have influenced animal movements and foraging capabilities. Given the relative mildness of the rest of the winter and less than average snowfall received, mule deer have likely experienced normal over-winter survival this year.

Habitat

Given average precipitation and informal assessments of habitat conditions throughout this herd unit, forage production and quality were moderate in 2018. A significant portion of mule deer habitat in this herd unit is comprised of decadent shrubs with lower palatability and available nutrition. The poor condition of these decadent shrub stands throughout the herd unit may be one of the primary limiting factors on this deer herd. Aspen stand treatments, juniper removal from riparian areas, and mountain mahogany rejuvenation projects are currently being implemented in the herd unit to improve habitat for mule deer.

Field Data

Fawn production/survival was moderate in this herd through the mid-2000's, and the population fluctuated between approximately 8,000 and 12,000 deer during this time period. The general license season during this time period was 11 days (except in 2008 when it was extended to 17 days), and issuance of doe/fawn licenses ranged from 50 to 400 licenses. From 2008-2013, fawn production/survival was extremely poor, with fawn ratios averaging 50 per 100 does. The population has declined significantly since 2008 from approximately 8,000 to 5,000 deer. In accordance, the general license season was shortened to 7 days and doe/fawn licenses were diminished and subsequently eliminated from the 2011-2017 hunting seasons. In 2014 and 2015, fawn production improved (ratios of 73 and 67, respectively). The fawn ratio decreased to 55 in 2016. This could be due to the relatively lower amount of precipitation received in 2016, or the larger proportion of yearling does not reproducing in the population as a result of higher fawn recruitment from the previous two years. Fawn production improved again in 2017 and 2018 with 70 and 79 fawns per 100 does, respectively. Since 2013, the population has been trending slightly upward, and the current model estimates a 2018 post-season population of 6,200 mule deer. The 2018 classification conditions were not ideal, resulting in only 686 deer being classified, although the sample size goal was 1,600. In 2016, just over 2,000 deer were classified in this herd unit which is the highest sample size acquired since 1992 despite similar levels of effort in other years. The previous 10-year average classification sample size was 1,175 deer. Although conditions in 2016 were ideal with high visibility, good snow cover, and calm conditions, the sample size supported field managers' perception that deer numbers have been increasing slightly in recent years. Annual survival of mule deer has likely increased over the past three years due to improved habitat conditions, which is also contributing to population increase. Adult does entering into winters with good nutritional condition, coupled with mild

winters, has likely increased survival. Several more years of improved fawn production and survival will be needed for this herd to increase to objective.

While fawn production improved in this herd over the past two years, fawn ratios remain well below adjacent mule deer herds. From 2008 – 2018, postseason fawn ratios averaged 54 (per 100 does) in the South Converse Herd Unit. Over the same time frame, fawn ratios averaged 63 in the Bates Hole / Hat Six Herd (Hunt Area 66) as well as in the Laramie Mountains Herd (Hunt Areas 59, 60, & 64). Such relatively low fawn production/survival in the South Converse Herd was thought to be partially attributed to the extraordinarily high prevalence of CWD. However, recently concluded research within this herd unit suggests neither fawn production nor recruitment were significantly affected in CWD-positive radio-marked adult females (DeVivo, 2015). Regardless, the high prevalence of CWD in this herd has the potential to reduce overall fawn production and recruitment over the long term as infected deer exhibit far lower survival rates than uninfected deer due to deaths from clinical CWD as well as increased vulnerability to predation, winter loss, vehicular strikes, etc. Although climatic and habitat conditions have the largest influence on the nutritional condition of does, and therefore fawn production and survival, long-term fawn recruitment may be impacted in areas with high prevalence of CWD. Given diminished survival rates of marked CWD-positive deer in this study and model projections stemming from recent research, endemic CWD at current prevalence levels may contribute to substantial population decline over the long term, or at minimum, may constrain the potential for this herd to grow when environmental conditions are favorable.

Buck ratios within the South Converse Herd historically average in the 30s-40s. These ratios seem counterintuitive, as CWD research references higher prevalence in males than females (Farnsworth et al, 2005). Despite the general season structure, higher buck ratios in this unit are a function of limited access to hunting on private lands where minimal harvest pressure on bucks is typical. In 2013, the buck ratio dropped to a 15-year low of 29, with a correspondingly low yearling buck ratio of 8 the following year. The buck ratio has since increased to 50 bucks per 100 does in 2018 which is higher than the previous 5-year average of 37. The yearling buck ratio was 14 in 2018, which is similar to recent years and is a 44% increase from 2014 when yearling buck ratios were at an all time low. Increased yearling buck ratios indicate improved recruitment in recent years, which may continue to result in good availability of adult bucks in the population in the coming years despite endemic CWD.

Since 2008, bucks classified in the South Converse Mule Deer Herd Unit have been further categorized based on antler size. Classification efforts in 2018 resulted in antler classifications in line with the long-term average with 72% Class I (small), 21% Class II (medium), and 7% Class III (large) bucks. This is similar to the previous 5-year average (66% Class I, 25% Class II, and 9% Class III bucks).

Harvest Data

Harvest success was 43% in 2018, which was slightly improved over the previous 5-year average of 37%. Harvest success is not expected to improve much beyond the 30^{th}-40^{th} percentile in this herd unit until long-term fawn production/survival improves and enhances the growth rate of this herd, or access to private lands is greatly improved. In 2018, there were 704 active licenses and

297 harvested bucks, which is also comparable to the previous 5-year average of 691 active licenses and 255 harvested bucks. There were also 4 does reported in the harvest which likely came from general license youth hunters. Total harvest and hunter numbers declined dramatically from 2008 to 2013 by 64% and 44%, respectively, but have since generally stabilized. Hunters apparently began to self-regulate through the late 2000s and early 2010s. Private land access for mule deer hunting has dwindled as well. Despite improved deer numbers, hunter numbers have not increased in recent years due to restricted access.

In 2018, season length was extended to 17 days and an Antler Point Restriction (APR) was implemented. This resulted in a 2018 buck harvest that was slightly higher than the previous five-year average, but was still well below harvest levels prior to 2012. This slight increase in buck harvest is likely a function of extended season length, as buck harvest typically does not increase in conjunction with an antler point restriction. Field managers noted that hunters utilized the season extension, especially during the last weekend, and anticipate that the season extension will continue to result in slightly higher harvest in future years despite the APR.

Population

The 2018 postseason population estimate was approximately 6,200 mule deer. This population is beginning to recover from a long-term downward trend which began in the late 1990s. Population decline in this herd is thought to be a combination of multiple limiting factors including poor habitat condition, lower fawn productivity/survival, and high prevalence of CWD.

The "Time-Specific Juvenile & Constant Adult Survival" (TSJ,CA) spreadsheet model was chosen for the postseason population estimate of this herd. Adult female survival estimates from the aforementioned CWD research conducted from 2010 to 2013 were between 0.65 and 0.73, which were very low relative to most published mule deer survival rates. Therefore, survival values were included for those years. The overall adult survival was constrained between 0.65 and 0.84 given long-term survival estimates in Colorado and the low adult survival rate found during CWD research. Spreadsheet model conventions suggest adult survival constraints should remain between 0.7-0.95. However, the upper constraint of 0.95 may be unrealistic for this herd given the high prevalence of CWD. AIC values between all 3 models were very similar, but the TSJ,CA model produced the most plausible trend and population estimate. However, the model does estimate adult survival in years other than 2010-2013 to be higher than survival estimates from the research. Based on survival values observed during this research, and those observed during another research project in the adjacent Bates Hole / Hat Six Mule Deer Herd in 2017 (0.73), adult survival for the South Converse herd is likely lower than model estimates in many years. However, adult survival likely improved immediately following this research in 2014 as weather and habitat conditions were extremely favorable for fawn production and adult mule deer survival. This uptick in fawn production and survival enabled this population to modestly grow over the past five years. This cannot be simulated by the selected model as adult survival is ascribed a constant value over the course of the simulation. Overall, this model is considered to be of fair quality.

Management Summary

Opening day for hunting the South Converse Mule Deer Herd Unit has traditionally been October 15th, with closing dates that have changed to offer greater or lesser opportunity depending on the management direction desired. In recent years, general licenses have been valid for antlered mule deer only. Many local hunters have pushed for an even more conservative hunting season to protect younger age class bucks. However, given the high prevalence of CWD in mature bucks, more conservative seasons may exacerbate the disease issue by limiting harvest as a culling mechanism. A more liberal season aimed at drastically reducing buck numbers to decrease CWD would likely be unpopular given the public's concern with this herd. In order to target older age class deer which are more likely to have CWD, while limiting harvest pressure on the overall buck population, a 3-point or better APR was implemented in 2018. The APR was also designed to protect younger age class bucks on public land, which helped garner public support for the season length extension. The season was also extended in 2018 until October 31 (previously October 21) to allow more opportunity for hunters to harvest older age class bucks. The 2018 season seemed to be viewed favorably by the public, and managers intend to implement the APR for a minimum of three years. The Department will not issue doe/fawn licenses for the foreseeable future based on recent population performance.

If we attain the projected harvest of 266 bucks and fawn production remains average, this herd will likely remain relatively stable but well below objective. The predicted 2019 postseason population size of the South Converse Herd is approximately 5,400 mule deer. This reduction in population projected by the model is likely due to using relatively low average fawn ratios from the previous 5-years to predict the future productivity despite improved fawn production over the past two years. Given that habitat conditions and high CWD prevalence may be limiting population growth, management goals for 2019 include continued emphasis on harvesting older age class bucks which are more likely to be CWD-positive while restricting harvest on younger bucks. In addition, managers are implementing prescriptive treatments in key habitats to benefit mule deer in this herd unit.

Citations

DeVivo, Melia. Chronic Wasting Disease Ecology and Epidemiology of Mule Deer in Wyoming. Diss. University of Wyoming, 2015.

Farnsworth, M.L., L.L. Wolfe, N.T. Hobbs, K.P. Burnham, E.S. Williams, D.M. Theobald, M.M. Conner, & M.W. Miller. Human Land Use Influences Chronic Wasting Disease Prevalence in Mule Deer. Ecological Applications, 15(1): 119-126.

APPENDIX A

Chronic Wasting Disease in the South Converse Mule Deer Herd Unit: Prevalence and Management Concerns

High prevalence of CWD in mule deer is of particular concern to local wildlife managers, as mule deer herds statewide have declined due to a number of environmental factors. The South Converse Mule Deer Herd Unit (Deer Hunt Area 65) has traditionally had the highest prevalence of Chronic Wasting Disease (CWD) in Wyoming over the long term, although measured CWD prevalence in a few other Wyoming mule deer herds has surpassed it in recent years. Managers are concerned that CWD may be an additive factor influencing mortality rates in the South Converse Herd, as it may be degrading the health of breeding-age females, suppressing average life-span of mature bucks, and affecting overall mule deer survival. CWD adversely affects deer survival due to direct fatality in addition to altered behavior which may render infected deer more vulnerable to natural causes of mortality such as predation or exposure.

Hunter-harvested deer have been tested in this herd unit since 2001. It should be noted that hunter-harvested samples do not represent a random sample of this population. Rather, samples are biased towards younger age-class males, as hunting seasons have focused on antlered deer, and hunters who harvest larger mature bucks often decline sampling to preserve their cape. Thus, reported prevalence in hunter-harvested deer may actually be biased low given CWD prevalence generally increases in older-age mule deer. However, CWD-positive deer are also more vulnerable to harvest, which may also be influencing reported prevalence. Regardless, CWD surveillance efforts have remained relatively consistent across years, and measured trends in prevalence likely mirror actual CWD dynamics in this herd.

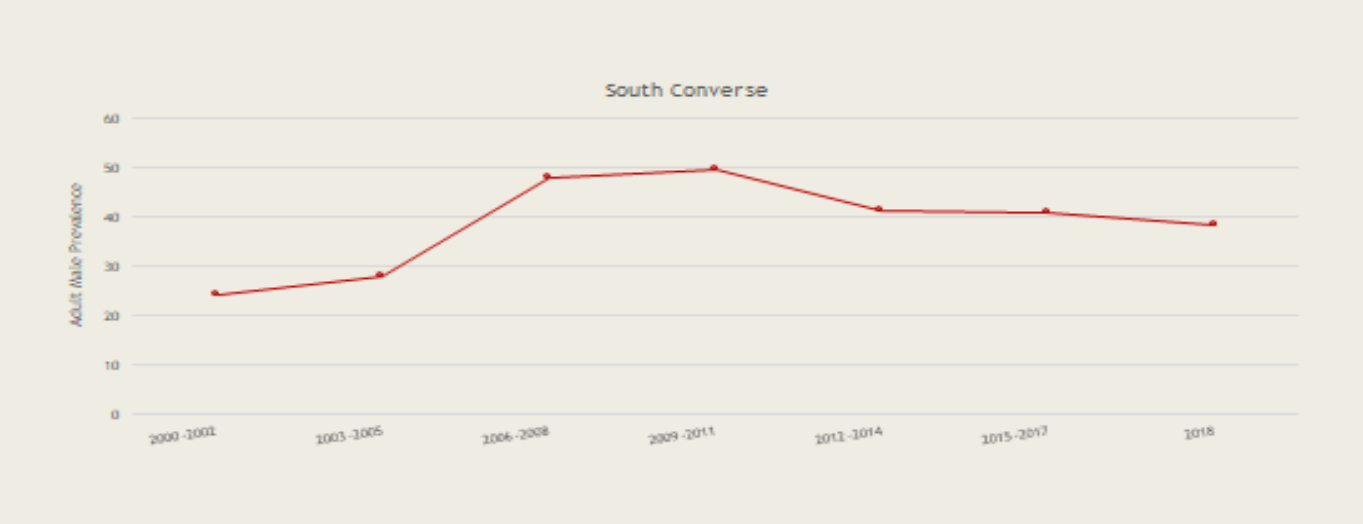
Since 2001, prevalence of CWD in hunter-harvested mule deer has increased significantly in the South Converse Mule Deer Herd (Table 1, Figure 1). Increasing CWD prevalence has coincided with concurrent overall population decrease for much of the past two decades. Considering CWD is ultimately fatal in cervids, higher prevalence is suspected of having more adverse and perhaps additive impacts at the population level - either directly or indirectly. However, it is difficult to discern or quantify the impacts of CWD on this population, and the extent to which CWD is limiting this population is speculative. Environmental conditions are still the most significant driver of this population, with annual variations in fawn recruitment and adult survival being primarily a function of weather, predation and the nutritional quality and availability of key mule deer habitats and preferred forage. Even in lieu of high CWD prevalence, this population is still capable of growth when environmental conditions are favorable, hence the modest population growth realized from 2014 – 2018. However, it is very likely that such high prevalence of CWD may be regulating this population from the standpoint that periods of population growth result in peaks that are lower than may have been

otherwise, while population nadirs may also lower. Essentially, overall population performance is likely being suppressed over the long term due to endemic CWD.

Table 1. CWD surveillance in hunter-harvested mule deer in the South Converse Herd Unit, 2001-2018.

Year	Total Harvest	N Tested	N Positive	**CWD Prevalence**
2001	885	81	12	**15%**
2002	825	98	23	**24%**
2003	733	155	46	**30%**
2004	533	52	14	**27%**
2005	461	88	29	**33%**
2006	555	81	32	**40%**
2007	729	74	30	**41%**
2008	708	44	19	**43%**
2009	425	48	20	**42%**
2010	365	42	20	**47%**
2011	303	35	20	**57%**
2012	345	30	14	**47%**
2013	252	41	18	**44%**
2014	253	38	12	**32%**
2015	237	4	3	**75%**
2016	285	14	6	**43%**
2017	265	51	18	**35%**
2018	297	57	21	**37%**

Figure 1. Adult buck CWD prevalence in the South Converse Herd Unit, 2000-2018.



A collaborative research project was initiated in 2010 to investigate the effects of CWD on the South Converse Mule Deer Herd. Using GPS-collared deer, a number of variables were explored to better understand the relationship between CWD and free-ranging mule deer population dynamics. This research was a cooperative effort of the United States Geological Survey, the University of Wyoming and the Wyoming Game and Fish Department, and was concluded in 2014. The research was published in a dissertation in 2015 titled "Chronic Wasting Disease Ecology and Epidemiology of Mule Deer in Wyoming". The goal of the study was to evaluate: 1) population growth estimation and effects of CWD status, sex, age, and CWD genetics on mule deer survival; 2) CWD effects on mule deer behavior; and 3) CWD Genetic Selection.

The research confirmed that CWD is a population limiting disease, with modeled estimates of population growth ($\lambda_{1)}$ = 0.81, corresponding to a 19% annual decline in the population. Further, males had a high prevalence of CWD (43%) compared to females (18%). They found that infected males showed higher activity levels, but noted that these males may have been more active prior to infection which placed them at a higher risk of encountering infected deer and contaminated environments. Further, infected deer were more likely to be predated upon by mountain lions or harvested by hunters due to their altered behavior. Lastly, the study found reduced incidence of CWD for deer of a certain genotype and documented genetic shift within the population as a result of higher fitness associated with that genotype. Despite selection towards deer with higher fitness, the study's population models still predicted severe decline in the next 50 years (DeVivo 2015). Some key findings of the research are listed below:

- For population growth estimation and effects of CWD status, sex, age, and genetics on mule deer survival:
  - Population lambda = 0.81, indicating an annual 19% decline of the population with extinction in 41 years (not accounting for genetic selection, female only model)
  - Age, winter body condition, and CWD status had no effect on pregnancy or fawn recruitment
  - Survival of males was lower than females regardless of CWD status
  - Survival of CWD-positive deer was markedly lower than CWD-negative deer
  - There was no difference in survival among age classes
  - Modeling suggested mortality levels of CWD-negative deer may influence lambda

- Management recommendations from this study were:
  - Eradication of CWD is unlikely without tools such as treatment, vaccination or environmental prion cleanup
  - Management efforts are best focused on improvement of overall mule deer health – habitat management and improvement are likely the best strategies to do this
  - Harvest prescriptions should continue to emphasize male harvest only

- CWD effects on mule deer behavior were:
  - Home ranges were larger for males than females, and were larger for CWD-negative females than for CWD-positive females
  - There was no significant difference in activity between CWD-positive and CWD-negative females
  - CWD-positive males had similar activity during the breeding season as CWD-negative males, suggesting they may still participate equally in the rut, although sample sizes of marked males were small
  - Males had larger home ranges and traveled larger distances, which may explain why they have higher CWD prevalence
  - Migration behavior did not appear to be affected by CWD status in females

- CWD Genetic Selection findings were:
  - Researchers developed a simulation model to determine effect of genetic-specific CWD incidence and mortality on the population growth rate looking at various scenarios
  - Even with genetic selection, the population model predicted a functional extirpation of mule deer with measured CWD prevalence and associated survival
  - Male only harvest did not appear to be a significant factor contributing to decline in this population
  - Continuing male-only harvest is reasonable and will also enable continued surveillance
  - Research suggests genetic shift may be occurring in this population
    - Genotyping during the course of routine CWD surveillance from 2001 – 2003 resulted in the F allele at Codon 225 being present in 1% of the population; during the course of this study it was present in 12% of the population
    - Genotypes from 2001 – 2003 were determined from hunter-harvested deer throughout the herd unit; genotypes from DeVivo's study from 2010 – 2014 were determined from radio-marked deer within the study area (LaPrele valley)

Citations

DeVivo, Melia. Chronic Wasting Disease Ecology and Epidemiology of Mule Deer in Wyoming. Diss. University of Wyoming, 2015.

2018 - JCR Evaluation Form

SPECIES: Mule Deer

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

HERD: MD757 - BATES HOLE/HAT SIX

HUNT AREAS: 66-67

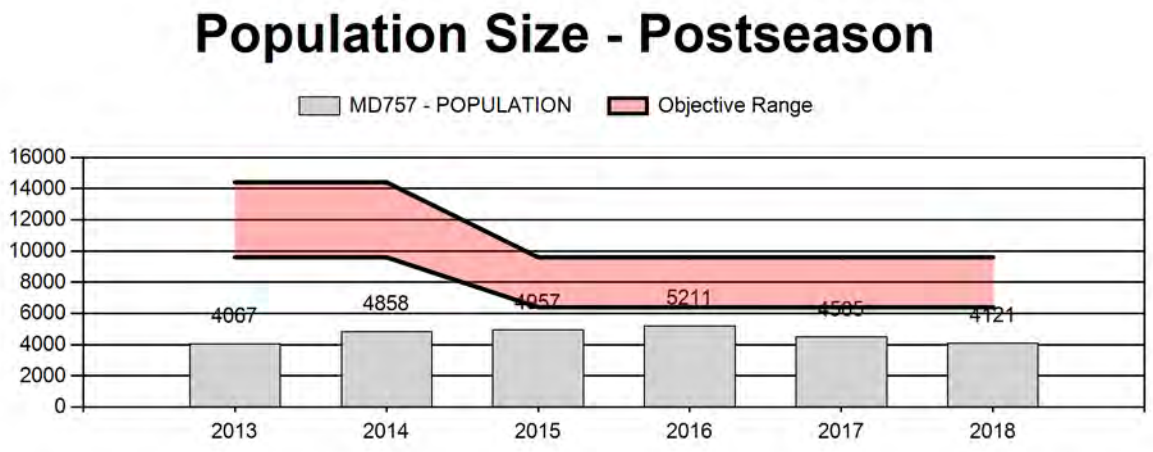
PREPARED BY: HEATHER O'BRIEN

	2013 - 2017 Average	2018	2019 Proposed
Population:	6,316	4,121	4,496
Harvest:	302	380	225
Hunters:	830	914	600
Hunter Success:	36%	42%	38 %
Active Licenses:	830	914	600
Active License Success:	36%	42%	38 %
Recreation Days:	3,221	3,437	2,200
Days Per Animal:	10.7	9.0	9.8
Males per 100 Females	30	26	
Juveniles per 100 Females	66	66	

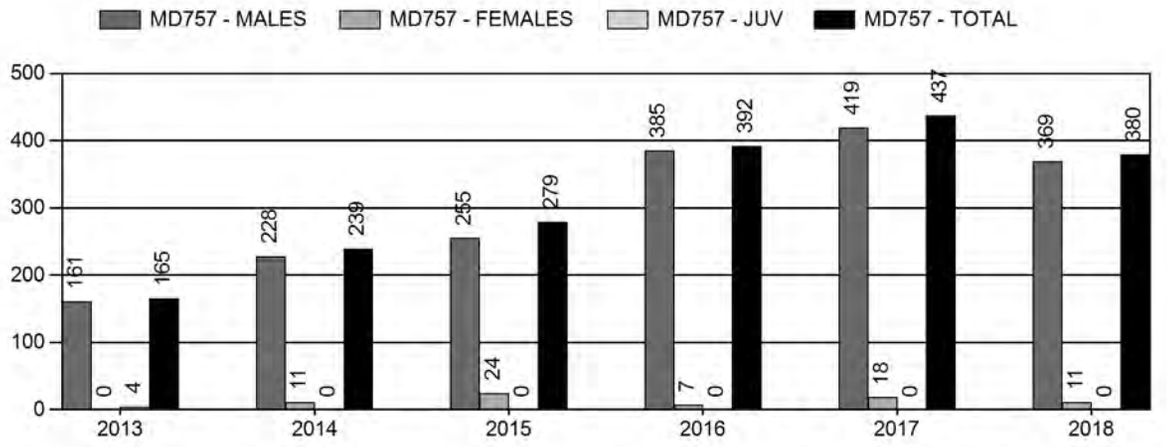
Population Objective (± 20%) :	8000 (6400 - 9600)
Management Strategy:	Special
Percent population is above (+) or below (-) objective:	-48.5%
Number of years population has been + or - objective in recent trend:	18
Model Date:	02/25/2019

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

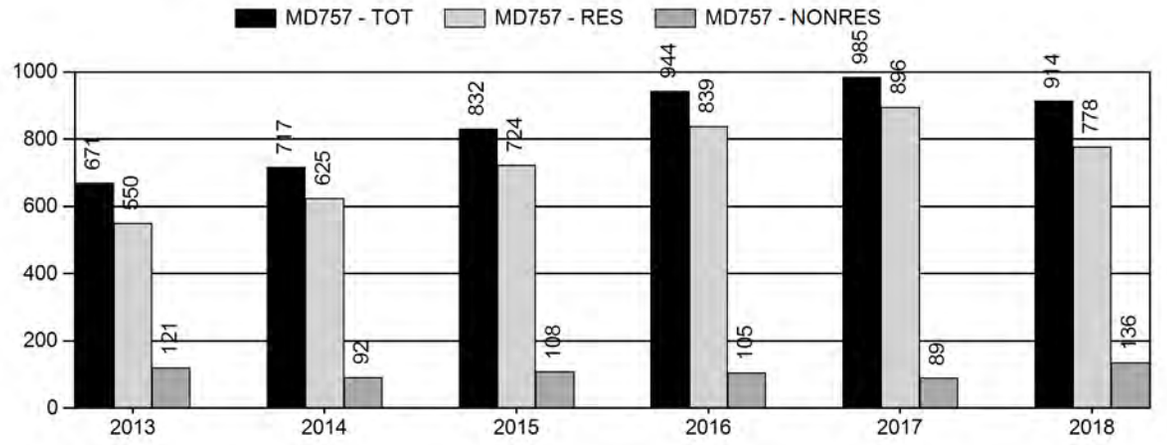
	JCR Year	Proposed
Females ≥ 1 year old:	.5%	.5%
Males ≥ 1 year old:	52.3%	27.6%
Total:	8.4%	4.7%
Proposed change in post-season population:	-8.5%	+9.1%



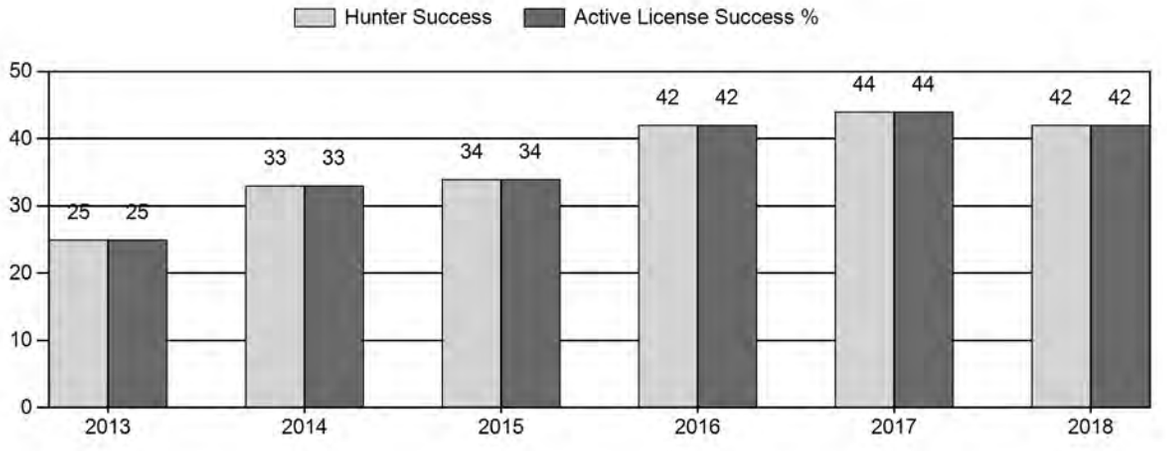
Harvest



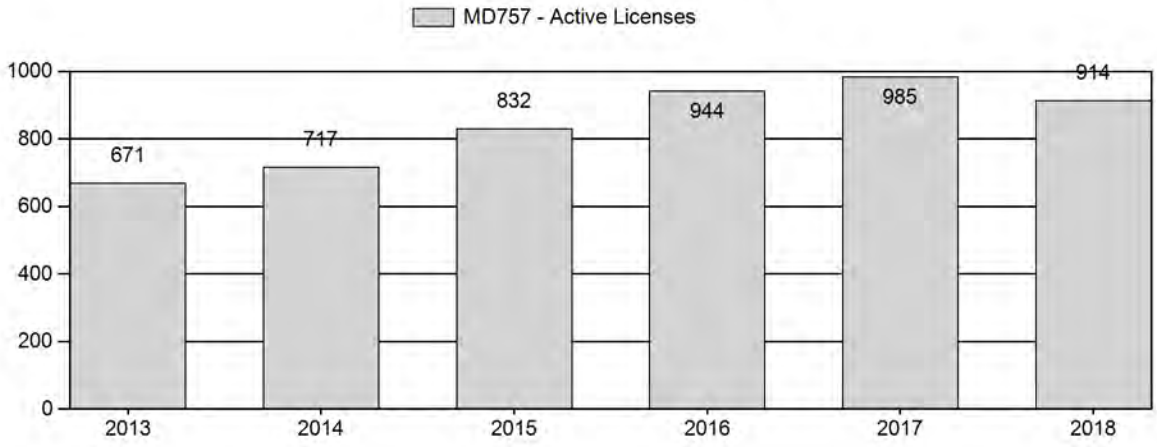
Number of Active Licenses



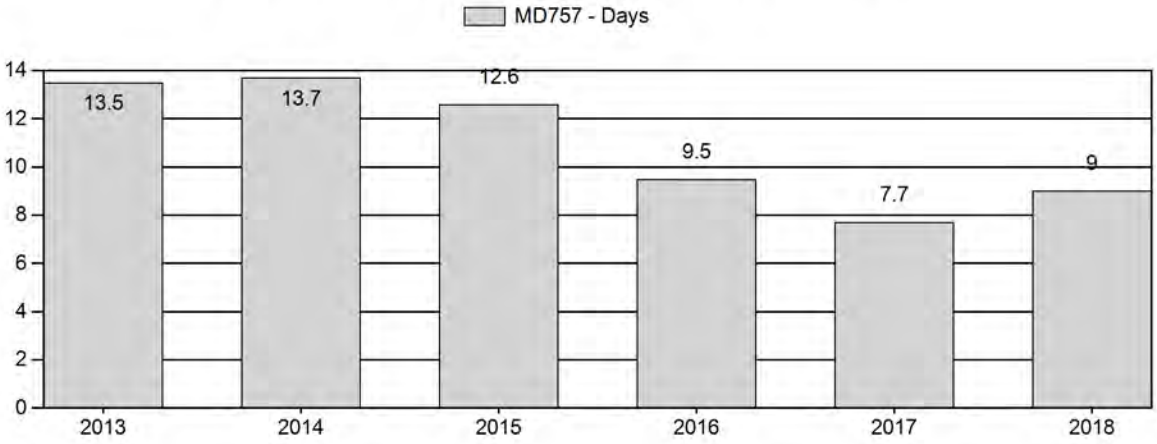
Harvest Success



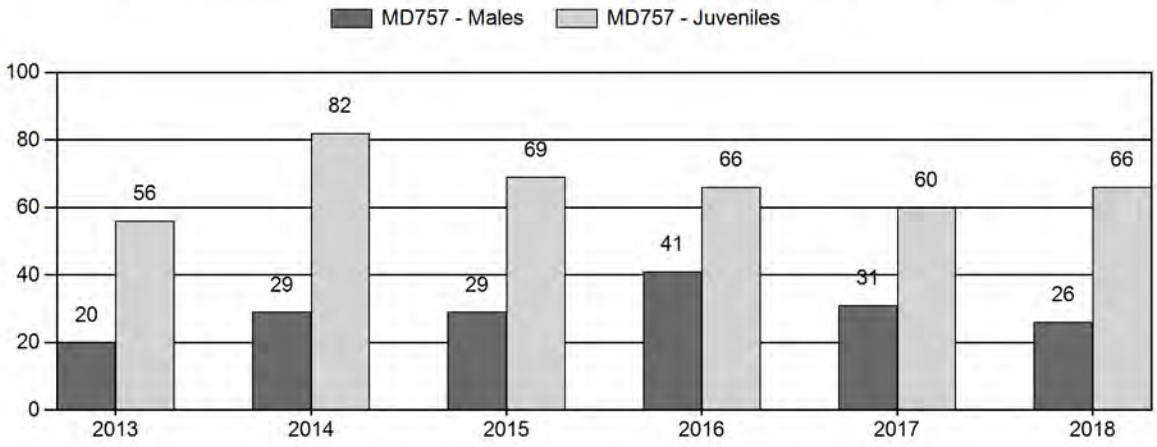
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2013 - 2018 Postseason Classification Summary

for Mule Deer Herd MD757 - BATES HOLE/HAT SIX

		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	5,135	86	50	25	7	0	168	11%	845	57%	470	32%	1,483	959	10	10	20	± 2	56	± 3	46
2014	5,578	83	79	26	7	0	195	14%	665	47%	543	39%	1,403	1,464	12	17	29	± 3	82	± 5	63
2015	5,890	164	97	29	13	0	303	15%	1,039	50%	719	35%	2,061	1,208	16	13	29	± 2	69	± 3	54
2016	7,190	132	198	31	4	0	365	20%	886	48%	585	32%	1,836	1,236	15	26	41	± 3	66	± 4	47
2017	7,789	54	108	23	4	0	189	16%	611	52%	365	31%	1,165	1,216	9	22	31	± 3	60	± 5	46
2018	4,121	32	59	7	0	0	98	13%	384	52%	252	34%	734	1,161	8	17	26	± 3	66	± 6	52

2019 HUNTING SEASONS
BATES HOLE / HAT SIX MULE DEER (MD757)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
66		Oct. 15	Oct. 21		General	Antlered mule deer three (3) points or more on either antler or any white-tailed deer
67						CLOSED
Archery		Sep. 1	Sep. 30			Refer to license type and limitations in Section 2

Management Evaluation

Current Postseason Population Management Objective: 8,000
Management Strategy: Special
2018 Postseason Population Estimate: 4,100
2019 Proposed Postseason Population Estimate: 4,500
2018 Hunter Satisfaction: 68% Satisfied, 17% Neutral, 15% Dissatisfied

The Bates Hole / Hat Six Mule Deer Herd Unit has a postseason management objective of 8,000 deer. The herd is managed using the special management strategy, with a goal of maintaining postseason buck ratios between 25-35 bucks per 100 does, as per the Mule Deer Initiative Management Plan. As part of the statewide Mule Deer Initiative, a citizen working group was formed in 2014 to discuss issues in the Bates Hole / Hat Six Mule Deer Herd Unit. The group developed a management plan and formal recommendations to Department managers in summer 2015 (MD757 2015 JCR, Appendix A). These recommendations, along with the objective and management strategy, were formally reviewed in 2015.

Herd Unit Issues

In Hunt Area 66, hunting access is good, with large tracts of public land as well as a sizeable Hunter Management Area providing access to key private lands. The main land use within the herd unit is traditional ranching and grazing of livestock. Very little industrial or energy development exists in this herd unit. Hunt Area 67, which includes the north-central portion of Casper Mountain, remains closed to hunting. Residents with small properties that dominate the hunt area are strongly opposed to hunting in their portion of the herd unit.

Weather

From 2013 to the present, weather trends have been generally favorable, and mule deer numbers have slowly increased. Range conditions were particularly good from 2013 to 2015, when spring and summer moisture improved and winters were mild. The winter of 2015 was fairly average, though some areas experienced prolonged periods of persistent snow. The spring of 2016 had above average precipitation but summer was extremely dry, causing rangeland habitats to cure early. Fortunately, precipitation in October resulted in a late surge of plant growth, which may have provided big game with a boost in nutrition going into the winter months. While there were several notable snow storms and cold snaps during the winter of 2016-2017, there were also periods of warm weather and high winds that melted and drifted snow to expose forage. The 2017 growing season was very similar to the previous year, with ample spring moisture followed by a dry summer with little precipitation. Moisture improved during the fall, though there was below average snowfall over the winter of 2017-2018. Precipitation was below average for the 2018 growing season as well, and although moisture was good in late spring, many reservoirs became dry by late summer. Sparse rain events provided some moisture during the fall months, but the 2018-2019 winter has been above average in severity, with good snow pack at higher elevations in the herd unit. While snow is deep in these areas, most low-elevation snows have melted or drifted over the course of the winter, opening habitats for mule deer to move freely on winter ranges and access forage. For detailed weather data see http://www.ncdc.noaa.gov/gac/time-series/us.

Habitat

This herd unit has eight established transects that measure production and utilization on True Mountain Mahogany (*Cercocarpus montanus*). Average leader growth on mahogany in 2018 was 2.81 inches (Figure 1). While this represents a decrease in production from the previous three years, average leader growth in 2018 was still higher than the long-term average. Above-average herbaceous plant production in recent years is attributed to good moisture during growing seasons. Average utilization on transects decreased compared to the past five years, and was 16.23% in 2018 (Table 1). While the herd generally grew from 2012-2016, observations by managers, landowners, and from surveys and harvest data indicate the herd declined in 2018. Habitat conditions were also poor by late summer 2018, as precipitation dropped below average and forage cured or was damaged by localized infestations of grasshoppers. Decreased average utilization on shrubs seems to correlate to a decreasing mule deer population in the past year.

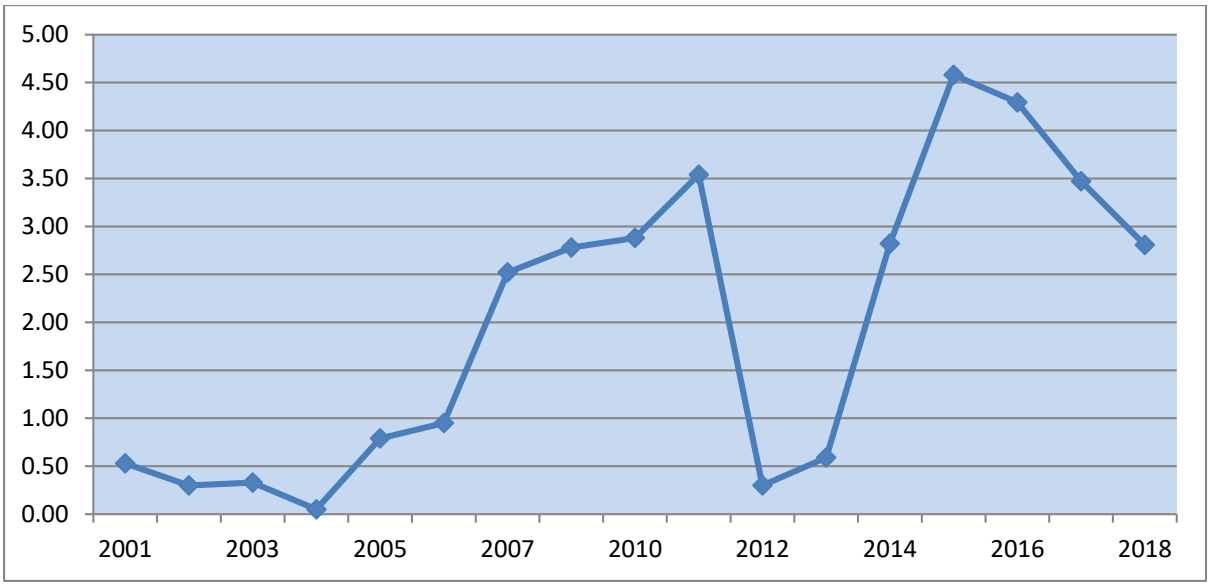


Figure 1. Mean annual growth of true mountain mahogany **(***Cercocarpus montanus*) in the Bates Hole / Hat Six Mule Deer Herd Unit, 2001-2018.

Year	02-03	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	15-16	16-17	17-18
Mean Utilization	30.65	23.75	12.27	26.73	15.33	23.33	28.00	13.67	20.29	25.90	26.40	16.23

Table 1. Mean utilization of true mountain mahogany **(***Cercocarpus montanus*) in the Bates Hole / Hat Six Mule Deer Herd Unit, 2001-2018. Note data were not collected or reported in some years.

Field Data

For much of the past 15 years, fawn ratios in this herd have been moderate to poor. Fawn ratios reached a 25-year low in 2010, with 45 fawns per 100 does postseason. Despite the elimination of doe/fawn hunting and restrictions placed on buck harvest, the population was still slow to recover from 2011-2013. Fawn ratios finally improved in 2014 to 82 per 100 does as a result of favorable weather and range conditions. Winter conditions from 2014-2016 were relatively mild, and spring weather and range conditions were favorable for pregnant and lactating does. As a result, overwinter survival of fawns improved. Fawn ratios were marginal from 2015-present, with 66 fawns per 100 does observed during 2018 postseason classification surveys. Yearling buck ratios have also been low the last two years, indicating poor overwinter survival of fawns. While low yearling ratios can in part be attributed to harvest during the last two hunting seasons, field checks did not indicate a disproportionate percentage of yearling bucks were

harvested. Prior to first implementing Antler Point Restrictions (APRs) in 2013, a high percentage of field-checked bucks were yearlings in some years.

Buck ratios for the Bates Hole / Hat Six Herd historically average in the mid-20s per 100 does, though they have occasionally exceeded recreational limits and risen into the low to mid 30's. In an attempt to improve yearling buck recruitment and a record-low buck ratio, an APR was added in 2013, requiring harvested bucks to have three (3) points or more on either antler. In 2015, the Area 66 Mule Deer Initiative (MDI) Management Plan recommended maintaining an APR in this herd unit if the buck ratio dropped below 25 per 100 does. This recommendation stemmed from a public desire to improve hunting quality and overall buck numbers while maintaining a general license season structure. In 2016, the observed postseason buck ratio was 41 as a result of high fawn production and survival in 2014 and 2015, but also owing to the protection of yearling bucks under the antler point restriction. In 2017 and 2018 the point restriction was removed to provide more liberal hunting opportunity, as buck ratios remained above MDI Management Plan and recreational management thresholds. Following the 2018 hunting season, the observed buck ratio declined to 26 per 100 does, and a sightability survey indicated this herd had a much lower population size than previously modeled. Consequently, the limitation of three (3) points or more on either antler will be reinstated for the 2019 hunting season.

Since 2008, bucks classified in Area 66 have been categorized based on antler size (see Table 2). The best distribution of mature buck classes was observed in 2008, with 50% Class I (small), 36% Class II (medium), and 14% Class III (large) bucks. Bucks classified from 2010-2016 showed a decrease in antler size, as the percentage of Class I bucks increased and percentage of Class II bucks decreased. It should come as no surprise that the percentage of Class I bucks increased from 2012 to 2016 with improved fawn production and the addition of antler-point restrictions, as more young bucks were present in the population. The proportion of Class III bucks has consistently remained under 10% in all years. A very high proportion of Class I bucks were observed in 2018, with a low number of Class II bucks observed. No Class III bucks were observed during 2018 postseason classifications. It should be noted however that survey effort was very light and overall sample sizes were low, as budgetary focus shifted to the year's sightability survey. Improved distribution of Class II bucks may be due in part to more even harvest pressure across antler classes with the removal of antler point restrictions. Still, the trend towards smaller antlered, younger bucks observed in the herd is concerning. Disease prevalence, low productivity, and harvest pressure may all be contributing factors if these results cannot be attributed to low sample size.

Bio-Year	Total Class N for HA	# Bucks Classified					Buck Ratios per 100 Females					
		Ylng	Class I	Class II	Class III	Total	Ylng	Class I	Class II	Class III	All Adult	Total
2008	1,254	75	57 (50%)	41 (36%)	16 (14%)	189	12	9	6	2	18	29
2009	1,320	59	61 (54%)	41 (37%)	10 (9%)	171	8	8	6	1	15	23
2010	1,479	82	49 (49%)	42 (42%)	9 (9%)	182	9	5	5	1	11	20
2011	1,248	47	52 (56%)	33 (36%)	7 (8%)	139	7	8	5	1	14	21
2012	1,272	28	55 (59%)	30 (32%)	9 (9%)	122	4	8	4	1	13	17
2013	1,483	86	50 (61%)	25 (30%)	7 (9%)	168	10	6	3	1	10	20
2014	1,403	83	79 (71%)	26 (23%)	7 (6%)	195	12	12	4	1	17	29
2015	2,061	164	97 (70%)	29 (21%)	13 (9%)	303	16	9	3	1	13	29
2016	1,836	132	198 (85%)	31 (13%)	4 (2%)	365	15	22	3	1	26	41
2017	1,165	54	108 (80%)	23 (17%)	4 (3%)	189	9	18	4	1	22	31
2018	734	32	59 (89%)	7 (11%)	0 (0%)	98	8	15	2	0	17	26

Table 2. Antler classification analysis for **Area 66** within the Bates Hole/Hat Six Mule Deer Herd Unit, 2008 – 2018.

During the 2018 hunting season, tooth age data were collected from harvested bucks in the herd unit in conjunction with Chronic Wasting Disease (CWD) samples (Table 3). While there are no data sets from previous years for comparison, these results can still provide valuable information to managers. While most hunters that harvested yearlings did not submit teeth for aging, two branch-antlered deer were tooth-aged as yearlings. Managers have long suspected this is somewhat common, and have discussed ways to research frequency across herd units for comparison. Many hunters that had their mule deer CWD-tested were able to find and harvest deer in mature age classes, with an average age of 3.88 for all CWD-sampled harvested bucks. Tooth ages from harvested deer ranged from 1.5 to 6.5, with a median age of 3.5. These data help illustrate the type of bucks that are most available for harvest in a general license hunt area, while also indicating the presence of older age class bucks, though they may be less common.

	2018
Average Age	3.88
Median Age	3.5
Average Antler Spread	18.4
Sample Size (N) =	47

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Table 3. Lab tooth age and antler spread data from Hunt Area 66 harvested mule deer, 2018.

Harvest Data

Hunter success in this herd fluctuates as a function of population size, season length, and season limitations. From 2013-2016, an antler point restriction was prescribed to the 7-day hunting season. At the same time, Region D non-resident license issuance was reduced significantly to only 400 licenses in 2014. Overall hunter participation and success were low in the first year of the antler point restriction, but gradually both participation and harvest success increased as the herd began to recover and grow. Harvest success improved further to 44% with the removal of the antler point restriction in 2017, but declined slightly to 41% in 2018. Hunter participation and buck harvest remained relatively static from 2016-2018, despite liberalized seasons in 2017 and 2018.

Hunter field checks were significantly increased in the Bates Hole / Hat Six Herd Unit during the 2017 and 2018 hunting seasons. Field personnel increased hunter contacts to better gauge the prevalence of Chronic Wasting Disease (CWD) in the herd unit. A total of 85 harvested mule deer were field checked and sampled during the 2018 season. The resulting prevalence of CWD for the herd unit was 27%, which was unchanged from the previous year. Managers will continue disease testing in 2019, as CWD remains a human health concern for hunters, and a management concern for the population overall.

Population

In February 2017, 45 doe mule deer were captured within the herd unit and fitted with satellite GPS radio collars. A second collaring effort took place in November 2017 to re-deploy collars from previous deer mortalities. Location, disease, and mortality data are being collected and analyzed from these deer, in a collaborative effort with the Bureau of Land Management. Information gleaned from this study will be used to update seasonal range delineation, identify important habitats, identify causes and rates of mortality, and monitor disease prevalence within the herd. Data collection from collared deer was completed in December 2018 due to

widespread collar failure as a result of mis-programming by the manufacturer. Data are currently being analyzed, and final reports will be submitted by Fall 2019.

In January 2019 a sightability survey was conducted for the herd unit, with the intent of adding an abundance estimate to align the current population model (Appendix A). A total of 2,789 deer were recorded during intensive flights of the hunt area, with an additional 45 deer counted from the ground (Figure 2). Analysis of survey counts as well as vegetation, snow cover, and behavioral data yielded an abundance estimate of 3,512 deer with a confidence interval of ±275 for the entire herd. These results modified the population model drastically, as it previously estimated herd size at approximately 7,500 deer. Such a drastic change in population estimates illustrates the importance of abundance surveys and other external data to align and improve the population model. With the newly adjusted model, managers plan to reconvene meetings with the Mule Deer Initiative group and the public to discuss the future management of this herd.

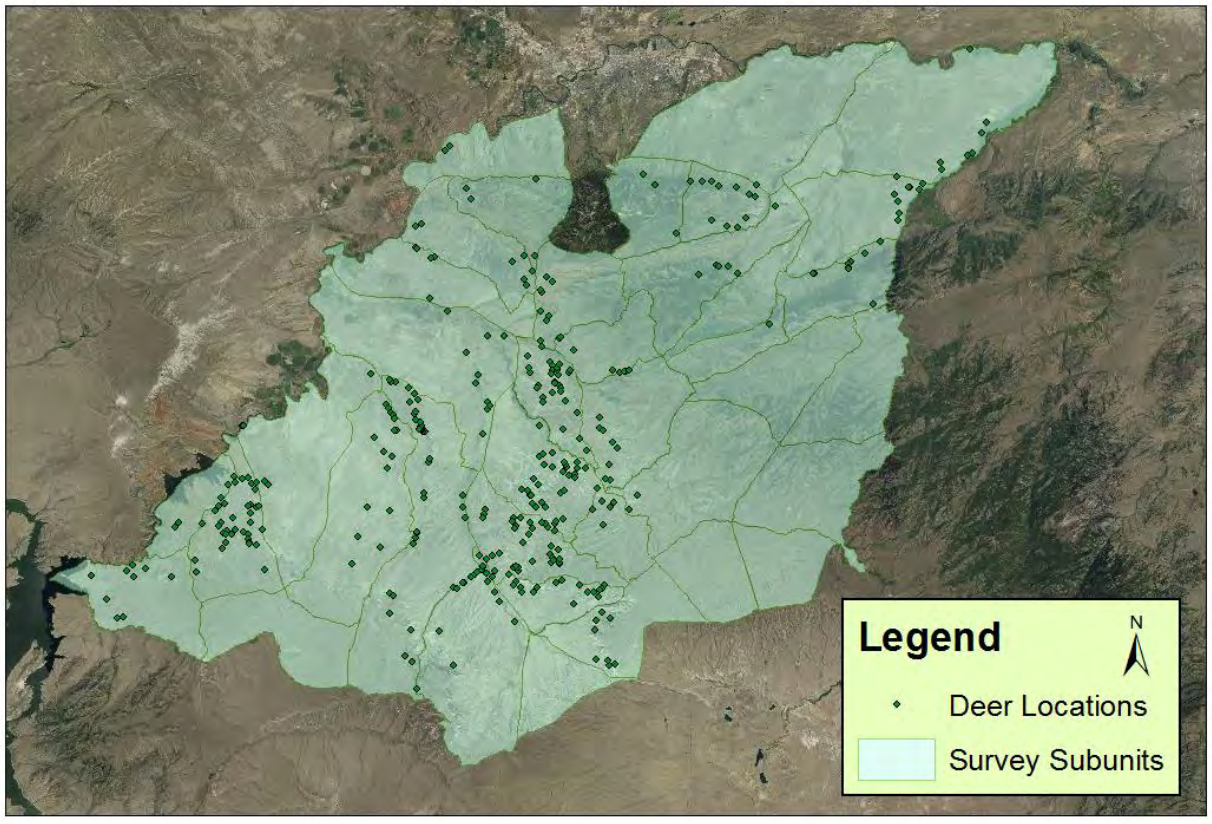

Figure 2. Deer locations and survey subunits from the sightability survey of the Bates Hole / Hat Six Mule Deer Herd Unit, January 2019.

The 2018 postseason population estimate for the Bates Hole / Hat Six Herd Unit was 4,100. This estimate changed drastically following adjustment of the model utilizing an abundance estimate from the aforementioned sightability survey. It should be noted that previous, higher estimates derived from the model were likely incorrect and did not accurately represent the herd. Trends of population growth and decline were likely accurate over time, although overall population totals were inflated. A separate estimate of adult survival derived from GPS-collared adult does in 2017 is also included to further align the model.

The "Time-Specific Juvenile, Semi-Constant Adult" (TSJ,CA) spreadsheet model was chosen for the postseason population estimate of this herd. All three models assume harvest is proportional across age and sex classes, and rely heavily on observed male ratios and harvest. Thus, harvest regimes that are specific to one sex or age class (as they have been in Area 66) make it difficult for the model to simulate true population dynamics. Managers are more confident in the current model, given the addition of survival data in 2017 and the abundance estimate for 2018. The model estimates a herd size above that of the abundance estimate, as it still incorporates long-term classification and harvest data and attempts to align closely to observed buck ratios. The TSJ, CA model seems the most representative of the herd in terms of recent and historic trends and aligns well to survival and abundance data, although simulated adult survival rates may be inflated based on the value measured in 2017 from collared mule deer. The CJ,CA model was rejected, as it does not align as well with survival and abundance estimates. The SCJ,SCA model predicts a similar population size and trend as the TSJ,CA model for the more recent years, but earlier years in the model are not consistent with historic estimates from those eras. The TSJ,CA model ultimately appears to be the best representation relative to the perceptions of managers and field personnel, is of good quality, and follows trends with harvest success.

Management Summary

Opening day for hunting in Area 66 has traditionally been October 15th, with closing dates that have changed to offer greater or lesser opportunity depending on the management direction desired. General licenses have been valid only for antlered mule deer since 2000. Doe/fawn licenses have been offered in years when winter range shrub utilization has been excessive, although no meaningful doe harvest has been prescribed since 2007. A short, seven-day season with no doe/fawn licenses will be maintained for 2019. The 2019 season will reinstate an antler point restriction of three (3) or better on one antler, as buck ratios are currently near the threshold defined by the Mule Deer Initiative Management Plan and the abundance estimate obtained from the sightability survey indicate this population is far smaller than previously estimated. In future years, if the observed buck ratio improves beyond 25 bucks per 100 does, the antler point restriction may be removed.

If we attain the projected harvest of 225 deer with fawn ratios similar to the last five years, this herd will grow slightly. If fawn production and adult survival improve in 2019, the herd should show more rapid growth. The predicted 2019 postseason estimate for the Bates Hole / Hat Six Herd is approximately 4,500 animals, which is 48% below objective.

APPENDIX A

Bates Hole Hat Six Mule Deer
Sightability Survey 2019 Summary

Heather O'Brien – Casper Wildlife Biologist

INTRODUCTION

The Bates Hole / Hat Six Mule Deer Herd Unit (MD 757) contains hunt areas 66 and 67 and is located in Central Wyoming (Figure 1). The herd unit encompasses approximately 1,396 square miles from the City of Casper, east to Deer Creek, south to the Shirley Rim, west to Pathfinder Reservoir, and northeast along the North Platte River back to the City of Casper. The main land use is traditional ranching and grazing of livestock, with very little other development. Area 67 within the herd unit consists of the City of Casper, adjoining suburban communities, and cabin sites on Casper Mountain. This area has remained closed to deer hunting due to the desire of property owners to maintain human safety and preserve deer around their homes and cabin sites (Wyoming Game and Fish Department, 1992). Land status within the herd is a mosaic of public (Bureau of Land Management, United States Forest Service, and State of Wyoming lands) and private lands, with about 44% public lands accessible to the hunting public. The Muddy Mountain Hunter Management Area was established in 2000 and provides additional access to large blocks of interspersed public and private lands.

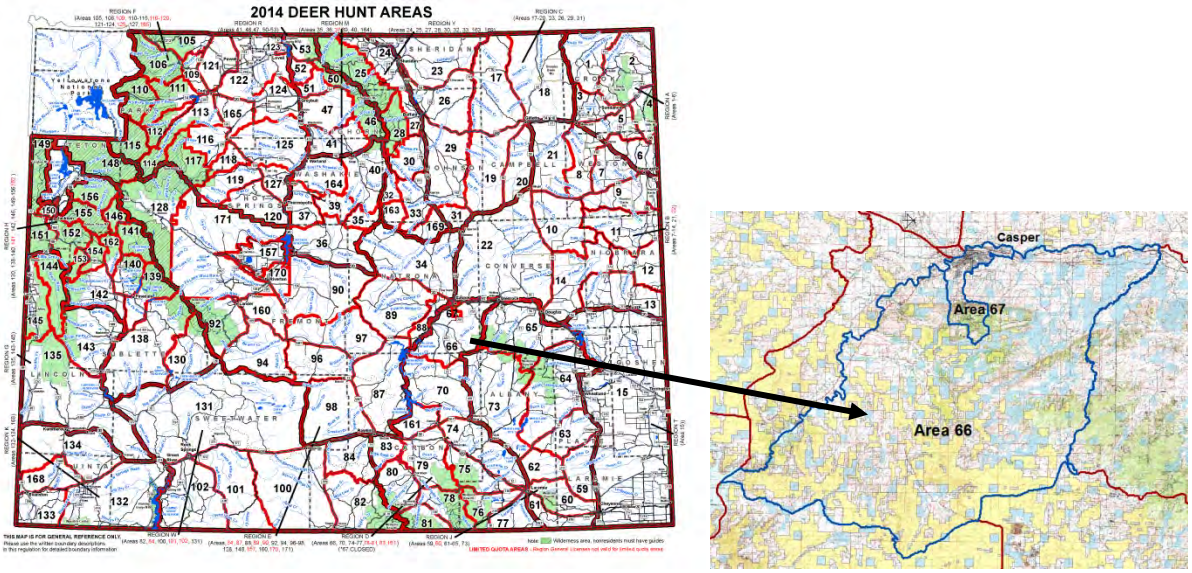

Figure 1. Map of mule deer hunt areas in Wyoming, with the Bates Hole – Hat Six Herd Unit (Hunt Areas 66 & 67) enlarged.

Due to its general license season structure and popularity with resident hunters, the Bates Hole Hat Six Herd Unit was selected as part of the statewide Mule Deer Initiative (MDI) in 2014. As a result, the herd has a public working group and has received supplementary funding for habitat improvements and population research. A GPS-collar study tracking forty-five doe mule deer was initiated in 2017. Goals of this study included attaining a better understanding of mule deer habitat use and seasonal distribution, gauging annual rates and causes of mortality, and documenting effects of Chronic Wasting Disease (CWD).

Population modeling of the Bates Hole Hat Six Mule Deer Herd has been persistently difficult using only classification and harvest data. In typical years, classification surveys are conducted on a limited budget. Thus, directed surveys are cover a limited portion of the herd unit with the goal of maximizing sample size. Specialized season structures allowing antlered-only harvest or those that also include antler point restrictions create variations in harvest data that violate spreadsheet model assumptions of even harvest distribution. Mortality rates from GPS collar data helped further refine the population model for this herd in 2018. However, managers still were not confident that model estimates were accurate in representing the herd. Landowners and members of the public also conveyed skepticism in the population estimate from the model, having anecdotally observed declining mule deer numbers over the past 1-2 years. With increased interest from the MDI, growing concern regarding effects of Chronic Wasting Disease (CWD) on this population, and emerging information from collar data, managers received additional funding for a more intensive abundance survey.

METHODS

In 2018 & 2019, a sightability survey was designed and conducted within the Bates Hole Hat Six Mule Deer Herd Unit. Defined management goals were to analyze survey data as a stand-alone abundance estimate, and to combine results with recent mortality estimates to further improve the population model.

To initiate study design, a mapping exercise was conducted among field managers to divide the herd unit into manageable subunits. Objectives for each subunit were to use boundaries that were visible from the helicopter when possible such as roads, drainages, and divides. Each subunit was drawn with the target of being flown in approximately one hour, following flight speed and line spacing guidelines for sightability surveys (Unsworth et. al, 1994). Local field managers collaborated to discuss and draw subunit boundaries on a large aerial photo map of the herd unit prior to digitizing using ArcMap (ESRI, 2011) (Figure 2). Subunits in the central portion of the herd unit were already delineated for stratified random surveys of elk in the Laramie Peak Muddy Mountain Herd; in these areas elk subunits were maintained to survey mule deer as well. Each subunit was assigned a unique number for the purpose of recording and tracking data during aerial surveys, and for comparison between this and future surveys.

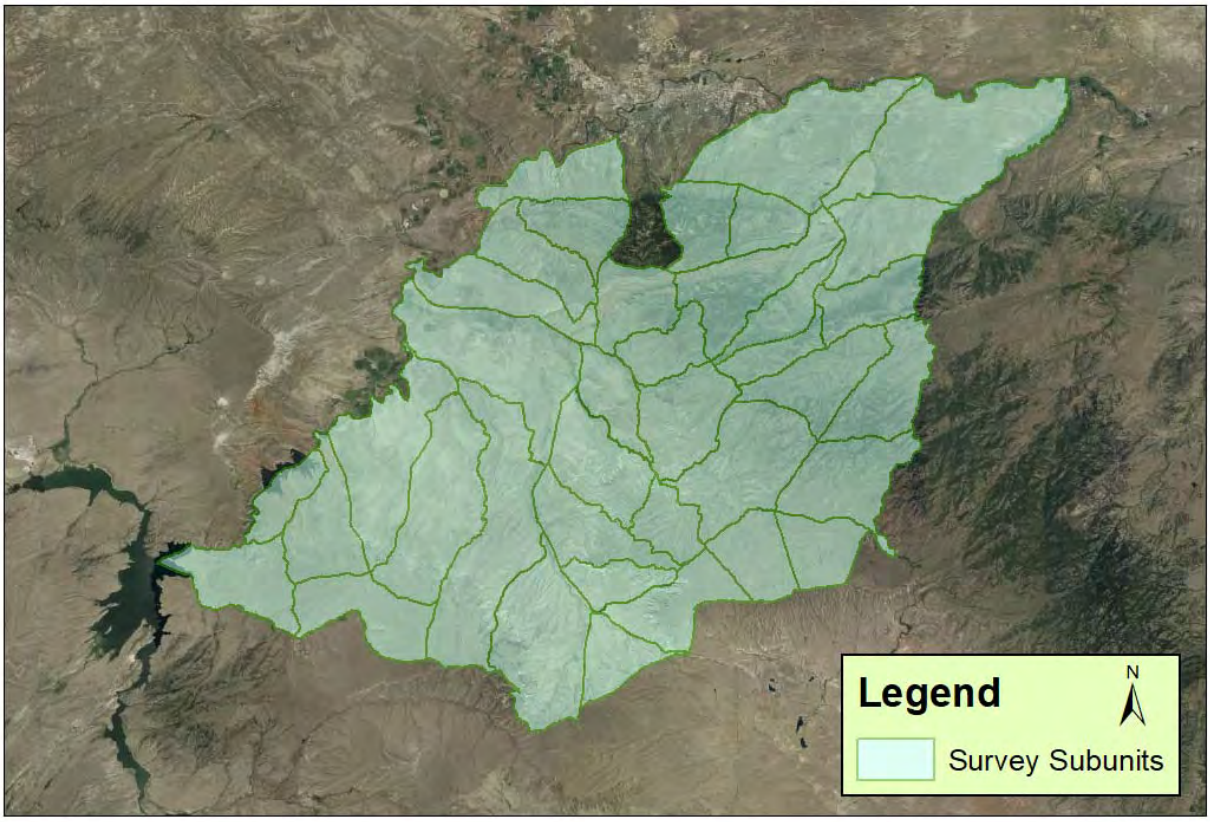

Figure 2. Survey subunits for the Bates Hole Hat Six Mule Deer Herd Unit sightability survey, winter 2019.

Prior to initiating flights, all potential observers were trained in proper data collection following the protocol for WGFD sightability surveys and safety standards outlined by WGFD flight policy (Wyoming Game and Fish Department 2017, Wyoming Game and Fish Commission, 2011). PowerPoint training presentations are available within the Department for both sightability surveys and approved flight policy. Flights were conducted from 29 January through 7 February 2019 on days when weather conditions were suitable for flights. All surveys were flown in a Bell Jet Ranger piloted by Kent Potter of Helicopter Solutions MT, Inc. from Laurel, Montana. Two observers were aboard every survey flight, and pilot observations were also included during data collection. The back-seat observer was positioned to view out the opposite side of the helicopter compared to the front-seat observer to visually survey the greatest area per transect line. Observers were replaced mid-day whenever possible to avoid eye fatigue and maximize survey performance. However, this was not always feasible due to scheduling conflicts for some observers. In these instances, 30-45 minute breaks were taken approximately every three hours during helicopter refueling to provide some rest for all-day observers.

Winter habitat conditions during 2019 flights were considered average to above average in terms of snow accumulation and daily temperatures. Higher elevation portions of the herd unit had deep and persistent snow cover, with little to no sagebrush or other vegetation visible. Lower elevation

portions of the herd unit were more open or broken in terms of snow cover. Snow in these areas was not as deep, with exposed shrubs and ground in most areas and deeper drifted snow along drainages and hillsides. Wind conditions were severe enough on several days within the survey period to cancel flights. Conversely, there were low-wind days during the survey where fog persisted in low-lying areas. Managers either cancelled flights on days when high winds or poor visibility compromised survey conditions and safety, or surveyed subunits in the herd unit where conditions were favorable and scheduled the remaining subunits later.

Data collection was performed by the back-seat observer in most instances using a hand-held GPS and standardized data sheet for sightability surveys (Appendix A). Location, number of individual deer in a group, activity of animals upon first sighting, percent snow cover, percent vegetative cover, and vegetative type were recorded for every survey observation. Mule deer were not classified by age or sex; though elk observed concurrently were classified as part of a separate survey. Other notable species (coyotes, winter sage-grouse flocks, congregations of pronghorn, etc.) were also recorded during flights as a means to maximize survey time and collect other useful wildlife data. Flight time to complete each subunit was recorded for evaluation purposes, so managers could modify subunit sizes for future surveys as needed.

Following the completion of all survey flights, data were compiled into a Microsoft Excel spreadsheet and standardized for import into the software program Aerial Survey for Windows (Unsworth et. al 1999). The pilot and all observers were debriefed and offered the opportunity to provide feedback on survey methods to consider for improvement of future surveys.

RESULTS

A total of 2,789 mule deer were surveyed within 349 recorded observations. Out of 38 total subunits, 36 were flown completely. Two subunits (SU46 and SU57) contained deep persistent snow and were not flown completely. Instead, the perimeter of these subunits were flown looking for deer or elk tracks. With no sign found and to complete the survey efficiently, the remainder of these two units were not flown. To be less disruptive in developed areas closer to the City of Casper, deer were surveyed from the ground rather than from the air.

Distribution of mule deer across the herd unit was uneven, with higher densities of deer at lower elevations, along drainages, and habitats containing shrubs that are utilized for both forage and cover (Figure 3). Deer were also found in some higher-elevation habitats, where snow did not persist and where winter forage was readily available. Some low-elevation habitats were seemingly devoid of deer. These areas tended to be more open habitats with less cover and presumably less palatable or available winter forage.

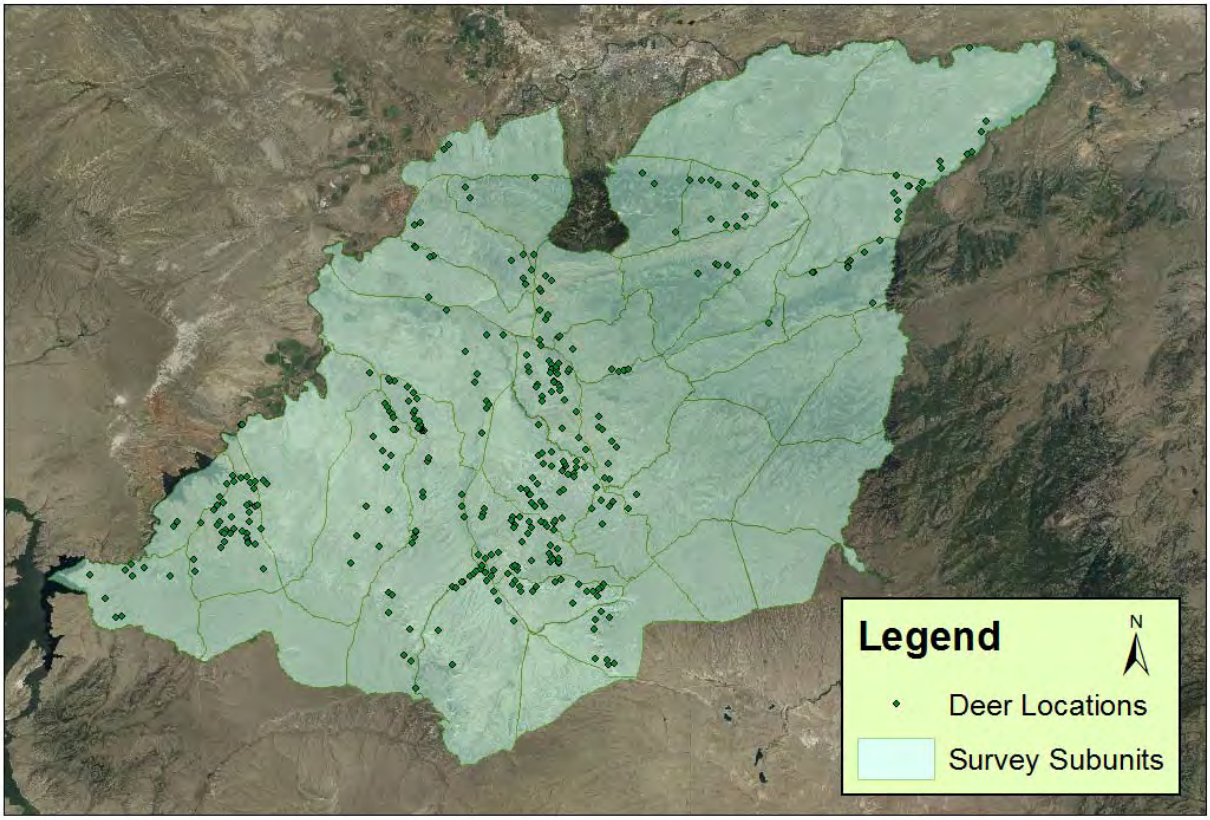

Figure 3. Mule deer group locations and subunits for the Bates Hole Hat Six sightability survey, 28 January - 1 February 2019.

Sightability data analysis using Aerial Survey for Windows yielded a population estimate of 3,512 mule deer ±275 using a 95% confidence interval, with a resulting standard error of 140 around the correction (Appendix B). The increase of 723 deer compared to the total observed accounts for deer presumably missed by observers due to variations in vegetation and snow cover. Observers agreed that this was a reasonable number to have missed, given many of the habitats surveyed contained dense juniper stands, tall mature sagebrush, or conifers. Observers also frequently noted that deer that remained bedded during surveys were difficult to see, as they did not move as they were flown over. Bedded deer were observed on several survey days, particularly when the temperature was low and/or winds were strong.

The abundance estimate and standard error from the sightability survey were incorporated into the spreadsheet model for the Bates Hole Hat Six Mule Deer Herd. This combined with the previous year's adult survival estimate served as data points beyond harvest and classification surveys to better anchor the model. Incorporating the abundance estimate from this sightability survey resulted in a lower population estimate for the herd unit. Without the sightability estimate, the spreadsheet model predicted a post-season population of 6,607 deer in 2018. Including the sightability estimate in the spreadsheet model yielded a post-season population estimate of 4,121 deer.

DISCUSSION

Sightability surveys seek to estimate absolute animal abundance, and provide some of the strongest data available to wildlife managers (Steinhorst and Samual 1989). Sightability models may have their own limitations in terms of cost, and can be biased if groups of animals are undercounted. Despite these limitations, sightability surveys are a powerful source of information for managers compared to traditional classification surveys. Currently, classification surveys do not incorporate a pre-defined survey route or a sampling design. Such directed surveys introduce bias and are not conducted with consistency from one management district to the next, or from one year to the next. Directed surveys also lack true variance estimates (e.g. confidence intervals or standard error), and can still be inefficient and expensive in terms of survey effort.

The abundance estimate and resulting adjustment to the spreadsheet model for the Bates Hole Hat Six Mule Deer Herd Unit are strikingly low compared to previous population estimates. The difference of over 2,000 deer illustrates a need to incorporate abundance and survival data to help inform the Department's deer population models and resulting managment. Without these anchor points, the spreadsheet model relies on harvest and classification data and assumptions regarding evenly distributed harvest pressure. These assumptions are violated in the Bates Hole Hat Six Herd Unit, as antlered-only and antler point restricted seasons allow for male-only harvest. An alternative model may be necessary to accurately represent this herd; one which does not rely on these harvest assumptions and may not rely as heavily on annual classification data.

Distribution of mule deer during the survey dates in late January and early February were different than those observed during the typical classification survey period of late November and early December. Some areas had relatively high densities of deer during both survey periods, such as along the larger drainages of Bolton Creek, Stinking Creek, and Bates Creek. Other areas had a shift of deer from low to high density (i.e. Flat Top) or from high to low density (Lone Tree Creek area). Some of this shift may have been attributed to an above-average amount of snow accumulation by late January 2019, or this shift may happen seasonally and with more frequency than was realized by managers.

Though an abundance estimate for Bates Hole Hat Six Mule Deer Herd was the main objective for this sightability survey, the resulting data can be used in other ways to improve and inform wildlife management. Mule deer location data have been used in combination with GPS collar data to recommend updates to seasonal habitats within this herd. Location data collected for observed sage-grouse flocks has been added to the Wildlife Observation System to improve knowledge of winter habitat use and distribution. Observations of large pronghorn herds can be used to demonstrate migration of pronghorn from adjacent hunt areas, and help justify further research regarding suspected migration routes.

Overall, managers felt very good about the design and implementation of this sightability survey. Minor improvements could be made to the current design to enhance future surveys in this herd

unit. Subunits that were too large or too small can be redrawn to so they can each be completed in about an hour. This would help divide effort equitably for future surveys, should subunits require random sampling for a partial survey. Location data could also be used to stratify subunits based on deer density, so that the survey can be stratified in years when funding does not allow for complete coverage. Methods that were refined designing the survey for this herd unit can now be applied to design sightability surveys in other herd units. The continued application of abundance surveys should help managers improve their knowledge of population dynamics and trend, and inform better management decisions in this and other big game herds.

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APPENDIX A:
Sightability Survey Data Collection Form for the Bates Hole Hat Six Mule Deer Herd Unit, Winter 2019.

Sightability

Date:		PRIMARY SPP: Mule Deer			Page:		of		
Tach Time	Start:		End:		*Weather:*				
Time Spent Flying Unit					Temperature		Cloud cover		
Start					Wind		Precipitation		
End					Primary Observer				
Area		Sub area			Secondary Observer				
			Males					Sightability	

Way Point	Spp.	UN-CLASS	Female	Juv.	Yrlg	Class I	Class II	Class III	Activity	% Snow Cover	% Veg Cover	Veg Class

Activity	1 = Bedded, 2 = Standing, 3 = Moving
Vegetation Classes	1 = Grassland, Ag. Field, Open, 2 = Sagebrush, 3 = Juniper, Mtn. Mahogany, 4 = Aspen, Riparian Brush, Mtn. Brush, 5 = Conifer
male class:	Elk males: **Class I** - raghorn < 270", **Class II** - Mature adult > 270" **Class III** - BIG > 320"
Spp.	**E** - elk, **M** - moose, **D** - mule deer, **Wt** - whitetail, **A** - antelope, **SG** - sage grouse, **C** -coyote, **F** - fox, **GE** - golden eagle, **BE** - bald eagle, **BC**- bobcat, **ML** - mtn. lion, **GH** - gosshawk

APPENDIX B
Sightability Data Analysis from Aerial Survey for Windows
Bates Hole Hat Six Mule Deer Herd Unit, Winter 2019

Aerial Survey for Windows, Version 1.00 Beta 6.1.4 (12-Feb-2000)

Wednesday, February 20, 2019 07:13 AM

Model: Mule Deer, Hiller 12-E, Idaho (Spring)

2018_MD757_v1

Section 1: Summary of Raw Counts

Stratum	Units Sampled	Total
1	36	2789
Total	36	2789

Section 2: Summary of Raw Counts for Perfect Visibility Model

This table projects the number of animals that would have been counted if every unit had been flown and visibility had been perfect (no animals obscured
by vegetation, etc.)

Strat	No of Units Popn	Sample	Total
1	36	36	2789
Total	36	36	2789

Section 3: Estimates for Total Number

Total

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Variance Sightability	Variance Model	Bound 95%
1	36	36	3512	0	17910	1758	275
Total	36	36	**3512**	0	17910	1758	**275**

2018 - JCR Evaluation Form

SPECIES: Mule Deer

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

HERD: MD758 - RATTLESNAKE

HUNT AREAS: 88-89

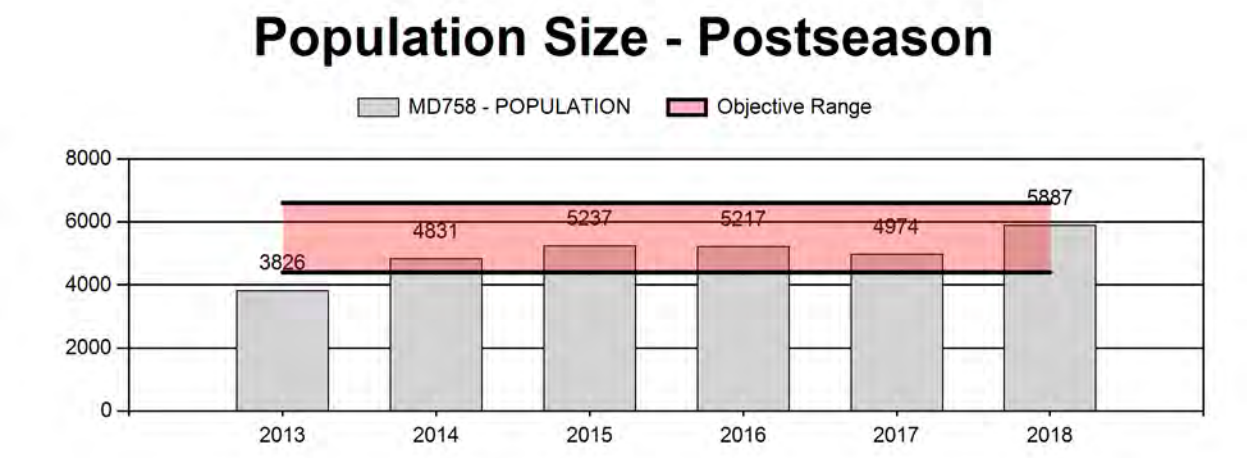
PREPARED BY: HEATHER O'BRIEN

	2013 - 2017 Average	2018	2019 Proposed
Population:	4,817	5,887	6,092
Harvest:	146	301	330
Hunters:	311	480	600
Hunter Success:	47%	63%	55 %
Active Licenses:	314	480	600
Active License Success:	46%	63%	55 %
Recreation Days:	1,205	1,631	1,900
Days Per Animal:	8.3	5.4	5.8
Males per 100 Females	42	53	
Juveniles per 100 Females	73	70	

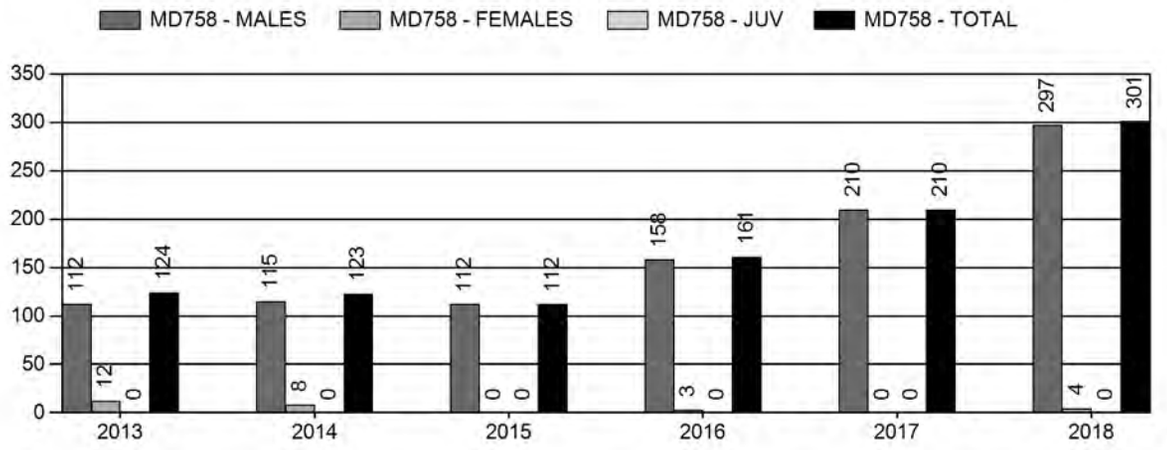
Population Objective (± 20%) :	5500 (4400 - 6600)
Management Strategy:	Special
Percent population is above (+) or below (-) objective:	7%
Number of years population has been + or - objective in recent trend:	1
Model Date:	02/25/2019

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

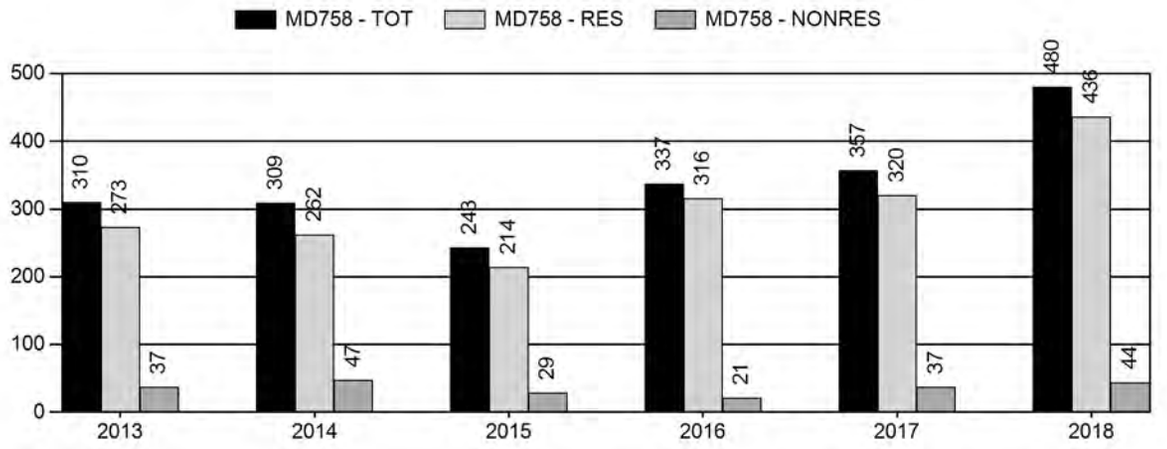
	JCR Year	Proposed
Females ≥ 1 year old:	0.2%	0.0%
Males ≥ 1 year old:	19.1%	21.6%
Total:	4.8%	5.1%
Proposed change in post-season population:	+16.6%	+3.5%



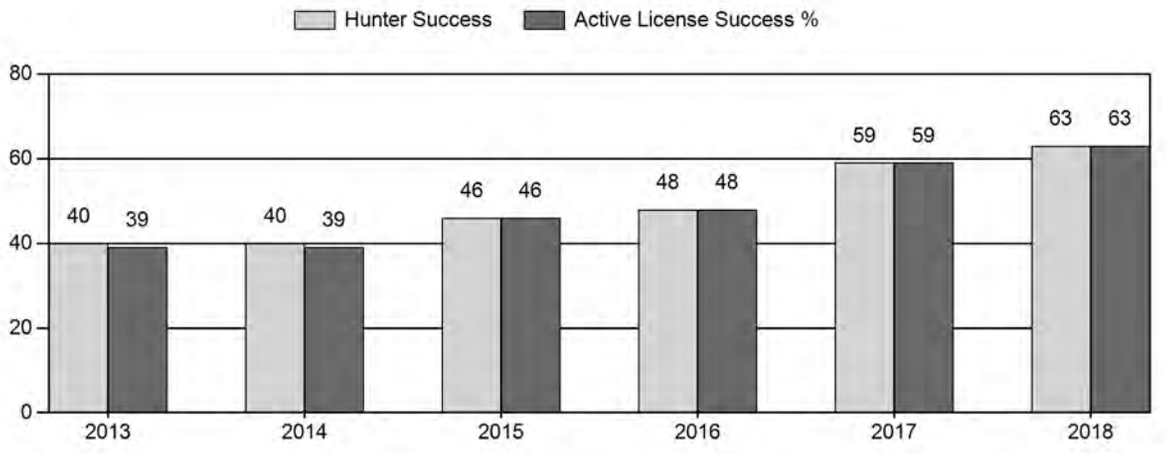
Harvest



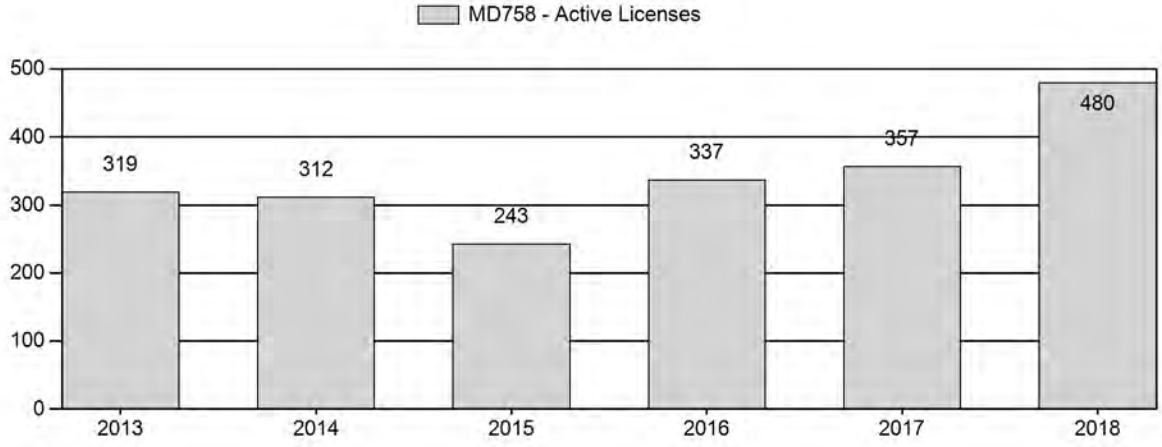
Number of Active Licenses



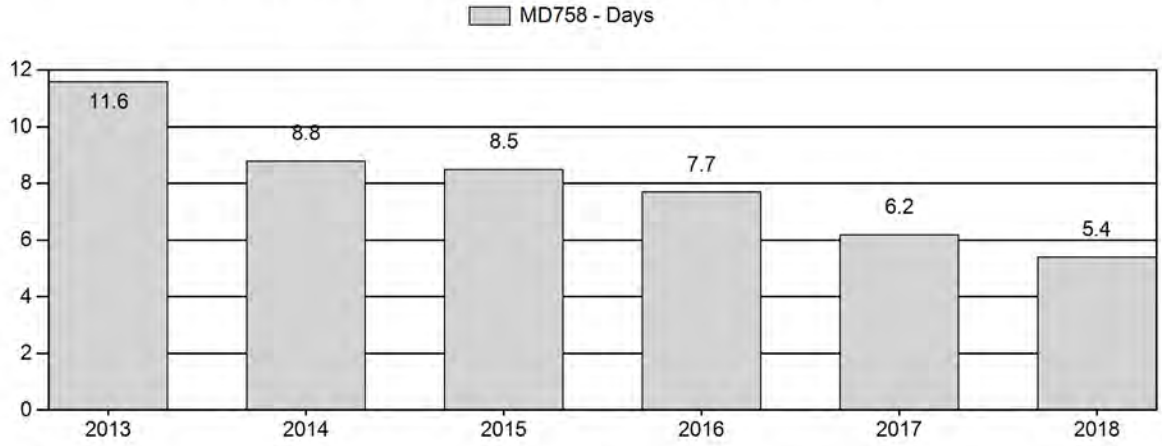
Harvest Success



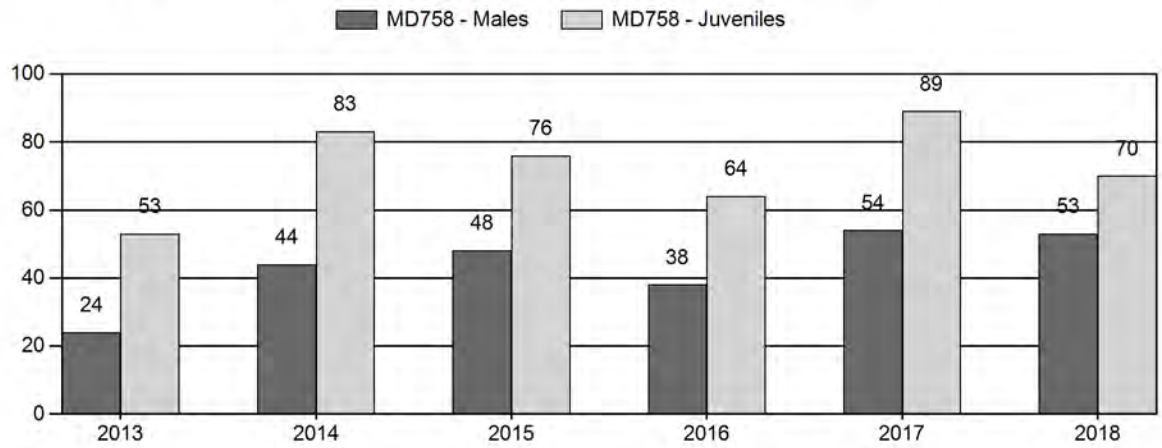
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2013 - 2018 Postseason Classification Summary

for Mule Deer Herd MD758 - RATTLESNAKE

		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	3,826	14	61	20	1	0	91	14%	376	57%	198	30%	665	671	4	20	24	± 3	53	± 5	42
2014	4,831	47	84	36	6	0	161	19%	368	44%	304	36%	833	1,446	13	31	44	± 5	83	± 7	57
2015	5,237	96	97	41	3	0	237	22%	491	45%	371	34%	1,099	1,209	20	29	48	± 4	76	± 6	51
2016	5,217	58	96	30	3	0	187	19%	487	49%	314	32%	988	1,288	12	26	38	± 4	64	± 5	47
2017	4,974	50	89	95	5	0	239	22%	442	41%	392	37%	1,073	1,132	11	43	54	± 5	89	± 7	58
2018	5,887	79	109	27	2	0	217	24%	407	45%	286	31%	910	1,270	19	34	53	± 5	70	± 6	46

2019 HUNTING SEASONS
RATTLESNAKE MULE DEER (MD758)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
88		Oct. 15	Oct. 21		General	Antlered mule deer or any white-tailed deer
89	1	Oct. 15	Oct. 31	200	Limited quota	Antlered deer
Archery		Sep. 1	Sep. 30			Refer to license type and limitations in Section 2

Hunt Area	Type	Quota change from 2018
88		No Change
89	1	+25
Total	1	+25

Management Evaluation

Current Postseason Population Management Objective: 5,500
Management Strategy: Special
2018 Postseason Population Estimate: 5,900
2019 Proposed Postseason Population Estimate: 6,100
2019 Hunter Satisfaction: 72% Satisfied, 17% Neutral, 11% Dissatisfied

The Rattlesnake Mule Deer Herd Unit has a postseason population objective of 5,500 deer. The herd is managed using the special management strategy, with the goal of maintaining postseason buck ratios between 30-45 bucks per 100 does. Management of this herd unit and interpretation of harvest data can be perplexing, with different management strategies for Hunt Area 88 versus Hunt Area 89. The objective and management strategy were last revised in 2015.

Herd Unit Issues

Hunting access within the herd unit is moderate. While there are large tracts of public lands and several large Walk-In Areas, there are also many parcels of private land with restricted access. Hunt Area 88 is dominated by private lands with several small public land parcels. Harvest pressure on females was previously maintained in Area 88 to address potential damage issues on

irrigated agricultural fields, but has not been necessary in recent years. General license hunting pressure can be disproportionately high on public lands within Area 88, and harvest success in the hunt area is typically low as a result. Traditional ranching and grazing are the primary land use over the whole unit, with scattered areas of oil and gas development and bentonite mining. Periodic disease outbreaks (i.e. hemorrhagic diseases) are possible in this herd and can contribute to population declines when environmental conditions are suitable.

Weather

From 2013 to the present, weather trends have been generally favorable, and mule deer have fared well within the herd. Range conditions were particularly good from 2013 to 2015, when spring and summer moisture improved and winters were mild. The winter of 2015 was fairly average, though some areas experienced prolonged periods of persistent snow. The spring of 2016 had above average precipitation but summer was extremely dry, causing rangeland habitats to cure early. Fortunately, precipitation in October resulted in a late surge of plant growth, which may have provided big game with a boost in nutrition going into the winter months. While there were several notable snow storms and cold snaps during the winter of 2016-2017, there were also periods of warm weather and high winds that melted and drifted snow to expose forage. The 2017 growing season was very similar to the previous year, with ample spring moisture followed by a dry summer with little precipitation. Moisture improved during the fall, though there was little snow to speak of over the winter of 2017-2018. Precipitation was below average for the 2018 growing season, and many reservoirs became dry by late summer. Sparse rain events provided some moisture during the fall months, but the 2018-2019 winter has been mild to average in the herd unit. Thus far, the region has received average snowfall combined with many windy days. Snow has melted or drifted, opening habitats for mule deer to move freely on winter ranges and access forage. For detailed weather data see http://www.ncdc.noaa.gov/gac/time-series/us.

Habitat

This herd unit has no established habitat transects to measure production and/or utilization on shrub species that are preferred browse for mule deer. Anecdotal observations and discussions with landowners in the region indicate growth and moisture during the spring of 2018 were average, but summer and early fall of 2018 were dry. Fall precipitation resulted in a mild fall green-up of forage that likely benefitted mule deer nutritionally prior to the winter of 2018-2019.

Field Data

The Rattlesnake Mule Deer Herd typically has moderate fawn production, with a long-term average of 66 fawns per 100 does. Harsh winter conditions in 2011 followed by severe drought in 2012 produced the lowest fawn ratios (in the mid-40s) in over 15 years for the herd unit. Doe/fawn licenses in Area 88 were reduced in the years to follow before being eliminated in 2015. Fawn recruitment recovered significantly in 2014-2015 with improved overwinter survival. Fawn ratios were lower in 2016, with 64 fawns per 100 does, but improved to 89 fawns per 100 does in 2017. Observed fawn ratios were close to the long-term average (68) in 2018, with 70 fawns per 100 does. While the population may be slightly above objective at this time, doe/fawn licenses for Area 88 are not yet warranted as there are no complaints of damage to agriculture from any landowners within the herd unit.

Buck ratios for the Rattlesnake Mule Deer Herd have been maintained consistently within special management parameters since 1999. As a result, hunters have developed high expectations for buck numbers and trophy quality within this herd unit. It can be difficult to maintain buck ratios over the entire herd unit, as Area 88 is managed for a low number of deer and Area 89 is managed for high mature buck ratios. Even in years when the population is below objective, higher buck ratios have been maintained by adjusting Area 89 license issuance accordingly. Postseason classification surveys yielded a buck ratio of 54 per 100 does in 2017, and consequently license issuance was increased. During 2018 surveys the buck ratio was still very high, with 53 bucks per 100 does observed. Given the continued high proportion of mature bucks surveyed in a growing population, an increase in Area 89 licenses is again warranted. An increase of 25 licenses will provide additional hunting opportunity while reducing the buck ratio within special management parameters.

Since 2008, bucks classified in Area 89 have been categorized based on antler size (Table 1). The distribution of bucks in larger antler classes (Class II & III) was very good from 2009-2011. Following the severe winter of 2010-2011, the proportion of bucks in larger antler classes dropped significantly. Since then, distribution of bucks across antler classes has fluctuated, dependent upon fawn survival and harvest pressure. In 2016, there was a higher proportion of Class I bucks. This was likely due to higher fawn survival and recruitment of a large number of young males the previous two years. Despite a buck ratio on the upper end of special management criteria, overall distribution of bucks was weighted toward smaller antler classes. In 2017, a large cohort was recruited into mature age classes, and the distribution shifted towards Class II bucks. At the same time, population size increased, the overall buck ratio exceeded special management thresholds, and accordingly license numbers were increased. In 2018 there was a higher proportion of Class I bucks observed again, similar to 2016. This shift may have been influenced more by increased harvest pressure, as the ratio of yearlings recruited from 2017 should not have been particularly high. Still, the availability of prime-age bucks should be good

over the next two to three years, and a modest increase in Type 1 licenses for the 2019 hunting season is warranted. The increase in harvest pressure should reduce buck ratios within special management criteria, provide additional hunting opportunity, and maintain a high proportion of mature bucks over the next few years.

Bio-Year	Total Class N for HA	# Bucks Classified					Buck Ratios per 100 Females					
		Ylng	Class I	Class II	Class III	Total	Ylng	Class I	Class II	Class III	All Adult	Total
2008	1,220	71	126 (74%)	40 (23%)	5 (3%)	242	11	20	6	1	27	38
2009	848	31	74 (53%)	54 (39%)	12 (9%)	171	7	17	13	3	33	40
2010	778	38	59 (54%)	45 (41%)	6 (5%)	148	9	14	11	1	26	35
2011	1,009	48	114 (62%)	61 (33%)	9 (5%)	232	9	21	11	2	34	43
2012	503	17	61 (84%)	10 (14%)	2 (3%)	90	6	22	4	1	26	32
2013	548	11	53 (74%)	18 (25%)	1 (1%)	83	4	17	6	0	24	27
2014	684	37	66 (65%)	30 (29%)	6 (6%)	139	12	22	10	2	34	46
2015	896	80	90 (69%)	38 (29%)	3 (2%)	211	20	22	9	1	28	48
2016	717	45	78 (74%)	25 (24%)	3 (2%)	151	13	22	7	1	30	42
2017	762	31	53 (39%)	78 (58%)	4 (3%)	166	10	16	24	1	42	51
2018	620	46	64 (73%)	22 (25%)	2 (2%)	134	21	29	10	1	40	61

Table 1. Antler classification analysis for Area 89 within the Rattlesnake Mule Deer Herd Unit, 2008-2018.

Harvest Data

License success in this herd unit is confusing to consider at the herd unit level given the season structure and access differences between Areas 88 & 89. Harvest success in Area 88 was 47% in 2018, with 139 bucks harvested. While better than the 5-year average, this success rate is low but considered typical for a general license area with little public land access. Harvest success in Area 89 was 89% in 2018 with 158 bucks harvested, and represents the highest success rate for the hunt area since 2009. Total deer harvested also increased in both hunt areas compared to 2017, indicating availability of deer was improved in both hunt areas. This increase in harvest success and higher total deer harvested coincides with an increasing population trend. Hunter days also decreased in Area 89 from 8.5 days in 2017 to 5.8 in 2018. However, it can be difficult

to use days per animal as a reference to population trends as hunters tend to be more selective of bucks and take more time to harvest a deer. It can also be difficult to interpret hunter satisfaction at the herd unit level, as hunters in Area 89 are typically more satisfied due to low hunter crowding and better access, while Area 88 hunters are less satisfied due to higher crowding and less hunting access. Hunter satisfaction at the herd unit level did increase slightly to 72% in 2018, compared to 71% in 2017 and 66% in 2016. Despite increased license issuance, good hunter satisfaction was maintained - coinciding with an increase in population size and a high buck ratio. Managers feel this further justifies an increase in license issuance to provide additional hunting opportunity while reducing high buck ratios in the herd unit.

Tooth boxes were mailed to all hunters who successfully drew an Area 89 license in 2009, 2012, and from 2014-2018 with the goal of collecting additional demographic information from harvested deer (Table 2). Hunter participation and submission of samples was poor from 2014-2016, but improved in 2017 and 2018. Despite low participation in some years, average tooth age within the hunt area appears to be fairly steady across years, with no major declines in average or median tooth age. Average measurements for antler spread have also remained fairly constant across years, indicating consistent availability of mature bucks. Slight declines in tooth age and antler spread for 2018 indicate a larger proportion of younger bucks present in the herd. These data are corroborated by postseason classification results, which also indicated a higher proportion of Class I bucks.

	2009	2012	2014	2015	2016	2017	2018
Average Tooth Age	5.6	5.07	5.83	5.88	5.67	5.4	5.09
Median Tooth Age	5.5	4.5	6.5	5.5	5.5	5.5	4.5
Average Antler Spread	22	20	23	23	23	23	20
Total Sample Size (N)	59	37	13	8	12	20	54

Table 2. Hunter-submitted tooth age and antler measurement data from Area 89 deer, 2009-2018.

Population

The 2018 postseason population estimate was approximately 5,900 mule deer and trending upward from an estimated low of 3,000 deer in 2013. The "Time-Specific Juvenile, Constant Adult Survival (TSJ,CA) spreadsheet model was selected for the postseason population estimate of this herd. Both the CJ,CA and SCJ,CA models are believed to overestimate population size. Lower constraints on juvenile survival were applied to the SCJ,CA model from 2010-2012 to match observed trends of low fawn production/survival. While the resulting population trend is more plausible than the CJ,CA model, the SCJ,CA still predicts a population that is well above objective. It is suspected the (TSJ,CA) model may also be overestimating herd size. A recent sightability survey in an adjacent mule deer herd indicates current population models have been

overestimating mule deer numbers. Managers recommend a similar abundance survey be conducted in this herd to align the model and better estimate herd size. In the mean time, managers believe the trends depicted in the TSJ,CA model are the most accurate, and harvest is conservative enough to maintain good mule deer numbers. While the AIC for the TSJ,CA model is the higher than the CJ,CA model, it is still well within one level of power compared to the both remaining models. The TSJ,CA model appears to be the best representation relative to the perceptions of managers on the ground and follows trends with license issuance and harvest success. However, because there are no additional survival or abundance data to augment the model, it is only considered to be fair in quality.

Management Summary

Traditional season dates in this herd run from October 15 through October 31 for limited quota licenses in Area 89, and October 15 through October 21 for general licenses in Area 88. The same season dates will be applied to the 2019 hunting season. There will be an addition of 25 Type 1 licenses to Area 89 to provide additional hunting opportunity, as a high proportion of bucks are present in the herd. Area 88-Type 6 licenses remain unnecessary, as there are currently no concerns regarding damage and few access opportunities on private lands. The 2019 season thus includes a total of 200 Type 1 licenses in Area 89, and a general season in Area 88 for antlered mule deer or any white-tailed deer. Goals for 2019 are to manage buck ratios within special management, and increase hunter opportunity, success, and satisfaction.

If we attain the projected harvest of 330 deer with fawn production similar to the five-year average, this herd will increase slightly. The predicted 2019 postseason population size for the Rattlesnake Mule Deer Herd Unit is approximately 6,100 deer, which is 7 percent above objective.

2018 - JCR Evaluation Form

SPECIES: Mule Deer

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

HERD: MD759 - NORTH NATRONA

HUNT AREAS: 34

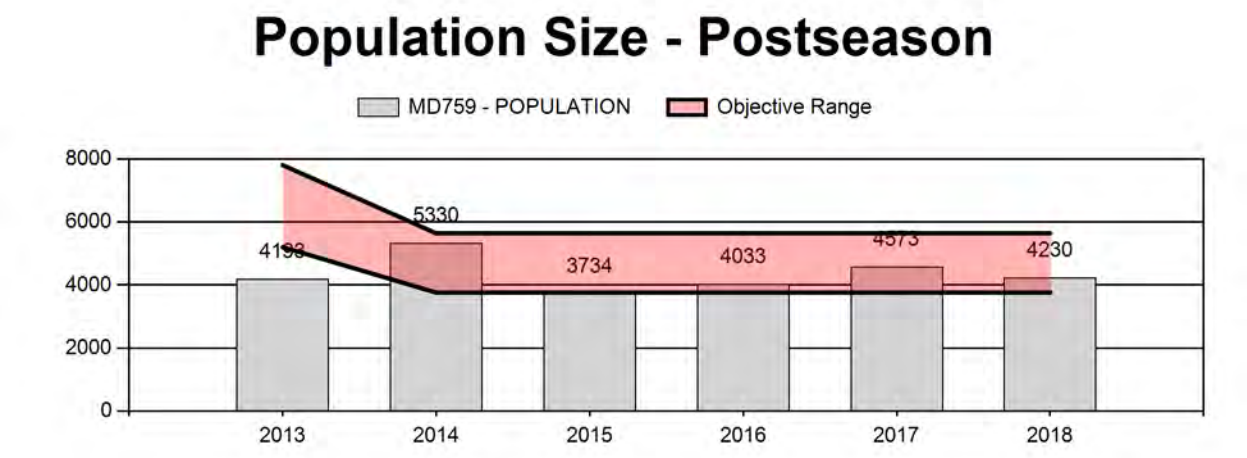
PREPARED BY: HEATHER O'BRIEN

	2013 - 2017 Average	2018	2019 Proposed
Population:	4,373	4,230	4,492
Harvest:	149	244	275
Hunters:	185	304	340
Hunter Success:	81%	80%	81%
Active Licenses:	188	313	350
Active License Success:	79%	78%	79%
Recreation Days:	914	1,504	1,700
Days Per Animal:	6.1	6.2	6.2
Males per 100 Females	41	53	
Juveniles per 100 Females	80	54	

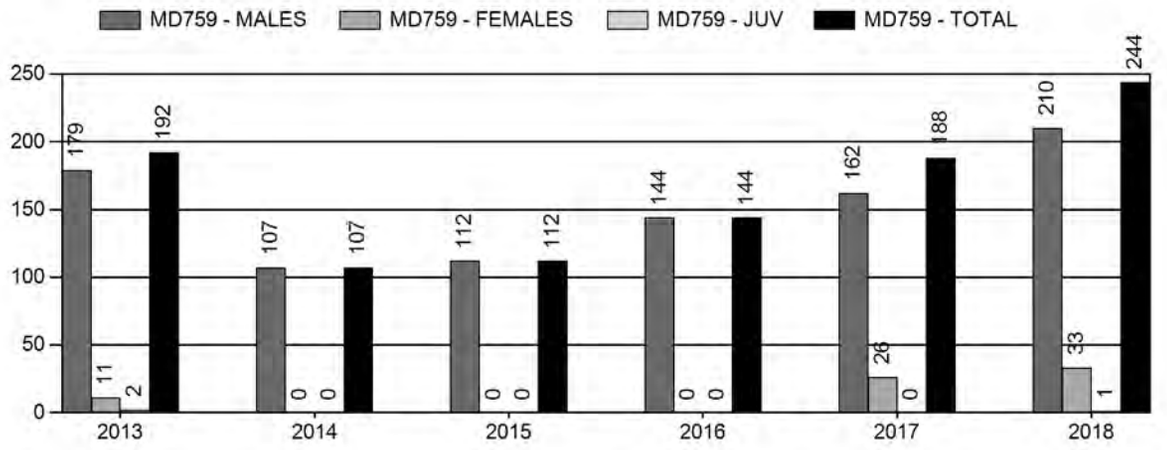
Population Objective (± 20%) :	4700 (3760 - 5640)
Management Strategy:	Special
Percent population is above (+) or below (-) objective:	-10%
Number of years population has been + or - objective in recent trend:	4
Model Date:	02/25/2019

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

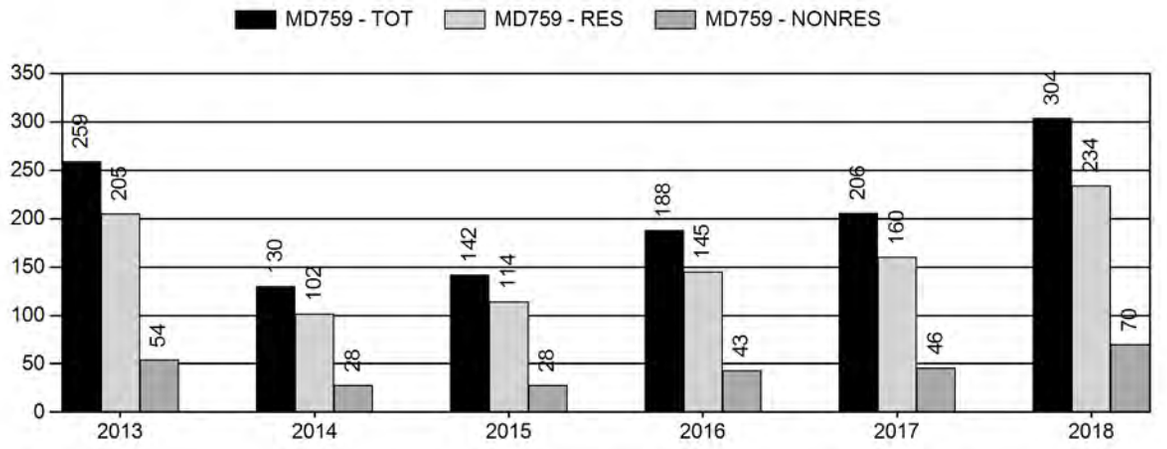
	JCR Year	Proposed
Females ≥ 1 year old:	1.7%	1.9%
Males ≥ 1 year old:	17.6%	20.7%
Total:	5.4%	6.1%
Proposed change in post-season population:	-7.7%	+6.2%



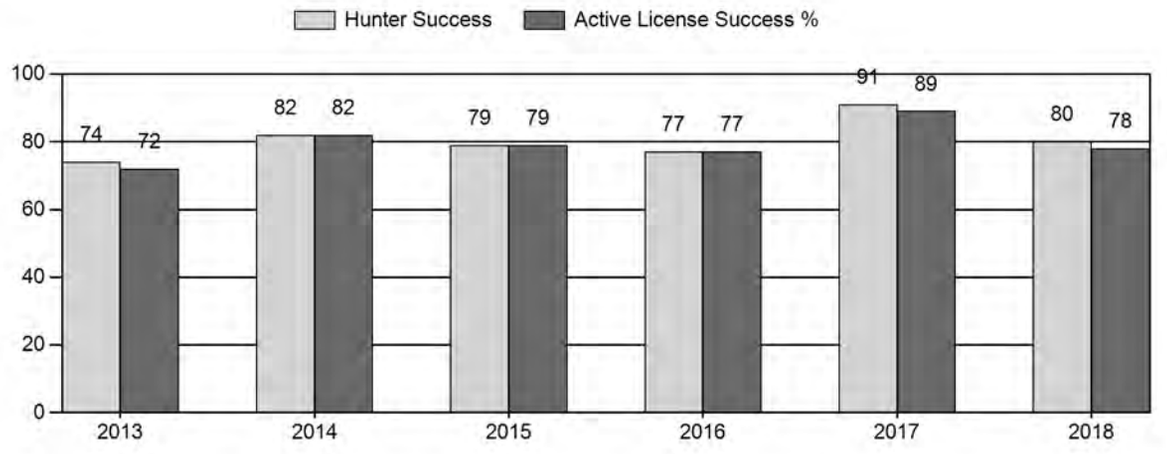
Harvest



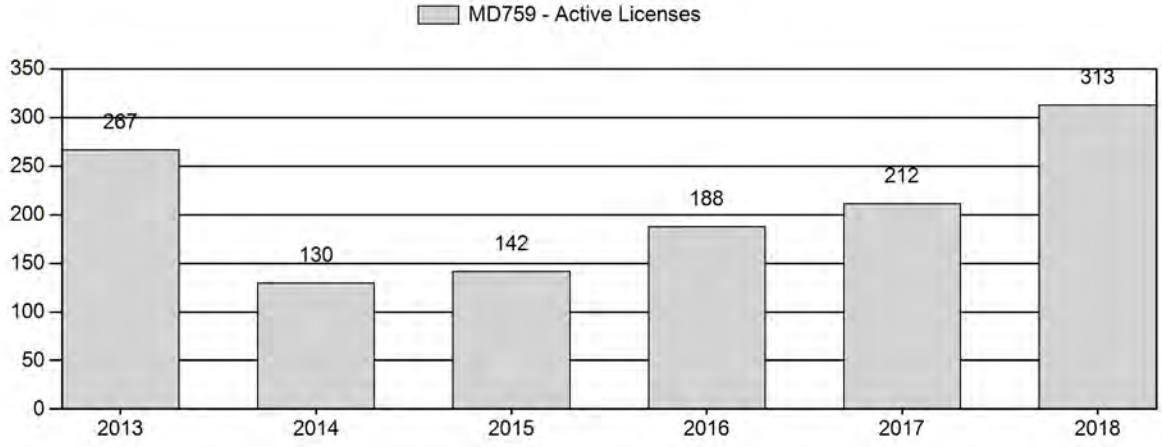
Number of Active Licenses



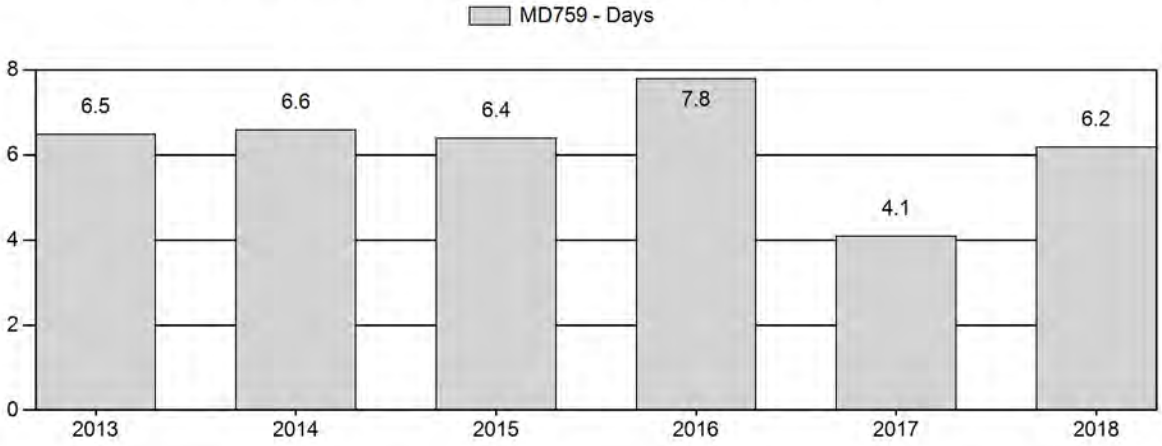
Harvest Success



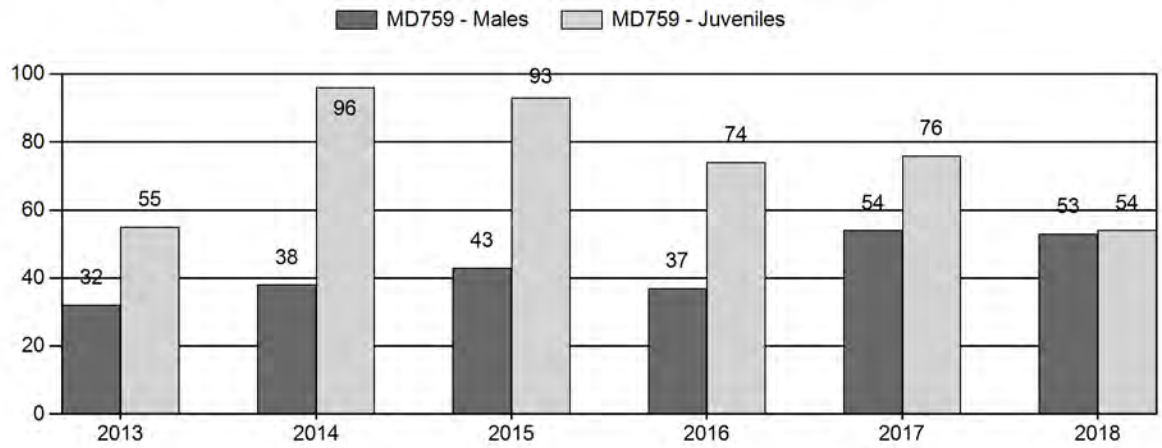
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2013 - 2018 Postseason Classification Summary

for Mule Deer Herd MD759 - NORTH NATRONA

		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	4,193	28	60	19	1	0	108	17%	342	54%	187	29%	637	580	8	23	32	± 4	55	± 6	42
2014	5,330	51	84	30	2	0	167	16%	441	43%	425	41%	1,033	1,713	12	26	38	± 4	96	± 8	70
2015	3,734	78	93	22	1	0	194	18%	452	42%	419	39%	1,065	1,236	17	26	43	± 4	93	± 7	65
2016	4,033	68	105	36	3	0	212	18%	571	47%	425	35%	1,208	1,336	12	25	37	± 3	74	± 5	54
2017	4,573	57	124	34	2	0	217	23%	402	44%	305	33%	924	1,113	14	40	54	± 5	76	± 7	49
2018	4,230	56	116	17	2	0	191	26%	360	48%	194	26%	745	1,223	16	38	53	± 6	54	± 6	35

2019 HUNTING SEASONS
NORTH NATRONA MULE DEER HERD (MD759)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
34	1	Oct. 15	Oct. 31	350	Limited quota	Antlered deer
	7	Oct. 15	Dec. 15	100	Limited quota	Doe or fawn deer valid on or within one (1) mile of irrigated land
Archery		Sep. 1	Sep. 30			Refer to license type and limitations in Section 2

Hunt Area	Type	Quota change from 2018
34	1	+50
	7	+25

Management Evaluation
Current Postseason Population Management Objective: 4,700
Management Strategy: Special
2018 Postseason Population Estimate: 4,200
2019 Proposed Postseason Population Estimate: 4,500
2018 Hunter Satisfaction: 74% Satisfied, 13% Neutral, 13% Dissatisfied

The North Natrona Mule Deer Herd Unit has a postseason population management objective of 4,700 mule deer. The herd is managed using the special management strategy, with the goal of maintaining postseason buck ratios between 30-45 bucks per 100 does.

Herd Unit Issues

Hunting access within the herd unit is very good, with large tracts of public land as well as Walk-In Areas available for hunting. The southeastern corner of the herd unit is the only area dominated by private lands. In this area, specific doe/fawn licenses are added to address damage issues on irrigated agricultural fields in years when landowners agree to allow hunting access. The main land use within the herd unit is traditional ranching and grazing of livestock.

Industrial-scale developments, including oil and gas development, are limited and isolated within this herd unit.

The objective and management strategy were formerly reviewed in 2014. At that time, the population objective was revised from 6,500 to 4,700. For the 2019 review, we are maintaining the herd at the current objective and management strategy based on internal discussions and conversations with constituents. Population status and limited habitat data included in this document were evaluated, and a change is not warranted at this time. The herd objective will be reviewed again in 2024. If the situation arises and a change is warranted a review and proposal will be submitted as needed.

Weather

From 2013 to the present, weather trends have been generally favorable, and mule deer have fared well within the herd. Range conditions were particularly good from 2013 to 2015, when spring and summer moisture improved and winters were mild. The winter of 2015 was fairly average, though some areas experienced prolonged periods of persistent snow. The spring of 2016 had above average precipitation but summer was extremely dry, causing rangeland habitats to cure early. Fortunately, precipitation in October resulted in a late surge of plant growth, which may have provided big game with a boost in nutrition going into the winter months. While there were several notable snow storms and cold snaps during the winter of 2016-2017, there were also periods of warm weather and high winds that melted and drifted snow to expose forage. The 2017 growing season was very similar to the previous year, with ample spring moisture followed by a dry summer with little precipitation. Moisture improved during the fall, though there was little snow to speak of over the winter of 2017-2018. Precipitation was below average for the 2018 growing season, and many reservoirs became dry by late summer. Sparse rain events provided some moisture during the fall months, but the 2018-2019 winter has been mild to average in the herd unit. Thus far, the region has received average snowfall combined with many windy days. Snow has melted or drifted in this region, opening habitats for mule deer to move freely on winter ranges and access forage. For detailed weather data see http://www.ncdc.noaa.gov/gac/time-series/us.

Habitat

This herd unit has no established habitat transects to measure production and/or utilization on shrub species that are preferred browse for mule deer. Anecdotal observations during the 2018 growing season suggest range conditions were average during the spring, but became very dry by mid to late summer. Herbaceous forage species were observed to be in good condition in spring and early summer, but had cured by mid to late summer. There were no major wild land fires in the herd unit during the 2018 summer. Several precipitation events in October created a mild

green-up that likely benefitted mule deer going into winter, and mule deer appeared to be in good body condition during aerial classification surveys during late November 2018.

Field Data

Following a harsh winter and severe drought in 2012, fawn survival was at a 15-year low for the herd unit. Fawn production reached a historic high of 96 per 100 does in 2014, and remained above average from 2015-2017. Fawn production was poor in 2018 by comparison, with 54 per 100 does observed during postseason surveys. Body condition of pregnant does emerging from the 2017-2018 winter may have been worse than originally thought, or summer range conditions may have been poor enough to impact lactating does and their fawns.

Buck ratios for the North Natrona Herd historically average in the mid 30s per 100 does. However, buck ratios declined in 2012-2013 to the lower cusp of special management. Yearling buck ratios were extremely poor during the same period, indicating poor recruitment and slowing the recovery of mature buck ratios. Buck ratios rebounded with a combination of reduced license issuance and improved fawn survival, and were near the upper threshold of special management by postseason 2015. From 2015-2018 the population increased and buck ratios held steady, even as license issuance was liberalized. Both harvest success and hunter satisfaction increased over the same period. By 2018 the observed buck ratio increased to 53 per 100 does, which is above special management thresholds. Although fawn ratios were poor in 2018, opportunity to harvest mature bucks is still ample. Management goals for 2019 are to reduce buck ratios within the range of special management by increasing current license opportunity.

Since 2008, classified bucks have been further categorized based on antler size (Table 1). The best distribution of mature buck classes was observed in 2010, with 46% Class I (small), 37% Class II (medium), and 18% Class III (large) bucks. Bucks classified from 2012-2018 showed a marked shift towards Class I bucks compared to previous years. It is unclear to managers why this trend has persisted, as harvest regimes have remained conservative compared to estimated herd size and buck ratios over this time period. Expectation for trophy-size bucks may be a contributing factor, as hunters apply more effort to find and harvest larger bucks while sparing smaller ones. A higher proportion of yearlings recruited to Class I may also be a contributor, though it would be more prominent in years following high observed yearling ratios. Regardless of antler class distribution, a large proportion of mature bucks are currently present in the population. With buck ratios that exceed special management parameters, managers feel an increase of Type 1 licenses is justified for the 2019 hunting season.

Bio-Year	Total Class N for HA	# Bucks Classified					Buck Ratios per 100 Females					
		Ylng	Class I	Class II	Class III	Total	Ylng	Class I	Class II	Class III	All Adult	Total
2008	1,023	59	111 (73%)	36 (24%)	5 (3%)	211	11	20	7	1	28	39
2009	1,009	51	87 (60%)	44 (31%)	13 (9%)	195	9	16	8	2	26	35
2010	905	47	55 (46%)	44 (37%)	21 (18%)	167	10	12	9	4	25	35
2011	760	52	64 (63%)	34 (33%)	4 (4%)	154	13	16	8	1	25	38
2012	868	36	91 (78%)	20 (17%)	6 (5%)	153	7	18	4	1	23	30
2013	637	28	60 (75%)	19 (24%)	1 (1%)	108	8	18	6	0	23	32
2014	1,033	51	84 (72%)	30 (26%)	2 (2%)	167	12	19	7	1	26	38
2015	1,065	78	93 (80%)	22 (19%)	1 (1%)	194	17	21	5	0	26	43
2016	1,208	68	105 (73%)	36 (25%)	3 (2%)	144	12	18	6	1	26	37
2017	924	57	124 (78%)	34 (21%)	2 (1%)	217	14	31	8	1	40	54
2018	745	56	116 (86%)	17 (13%)	2 (1%)	191	16	32	4	1	38	53

Table 1. Antler classification analysis for the North Natrona Mule Deer Herd Unit, 2008-2018.

Harvest Data

Hunter success in the North Natrona Mule Deer Herd Unit is typically in the 70-80th percentile, and was 78% in 2018. A total of 244 deer were harvested, which is the highest harvest since 2011. Harvest success on doe/fawn licenses on private land in 2018 was 77%, which is down from the previous year. This suggests access on private lands may have been difficult for some, or hunter effort may have been low. Hunter days (6.8) was similar to the ten-year average (6.1). Survey totals, comments from hunters and landowners, and population modeling all indicate growth in this herd has slowed or stabilized in the past few years. Managers suspect higher license issuance in 2017 & 2018 combined with lower fawn recruitment should maintain this herd near its objective. This herd has traditionally been fairly unproductive given most mule deer occupy low elevation desert habitats, and female harvest has not been necessary to manage this herd near its objective.

Tooth age data were collected from harvested bucks in the North Natrona Mule Deer Herd Unit in 2010 and 2013-2018 (Table 2). It should be noted that changes in overall sample size between years are in part due to reductions in license issuance between sample years. Comparing data between years shows a consistency of hunter selection for mature bucks, with the average and

median age remaining within prime age classes for mule deer. Average antler spread reported by hunters has also remained quite consistent across sample years. Relatively static results for average and median age of harvested bucks suggests availability of mature bucks has remained constant due to adjustments in license issuance. These tooth-age data indicate past and current management prescription has resulted in most hunters harvesting prime-age bucks, which is consistent with management strategy.

	2010	2013	2014	2015	2016	2017	2018
Average Age	4.44	5.4	5.27	5.27	4.85	4.6	4.7
Median Age	4.5	5.5	4.5	4.5	5.5	4.5	4.5
Average Antler Spread	21.2	21.2	20	20.9	21.5	20.7	19.9
Sample Size (N) =	68	52	44	32	40	51	49

Table 2. Lab tooth age and antler spread data from Hunt Area 34 harvested mule deer, 2010, 2013-2018.

Population

The 2018 postseason population estimate was approximately 4,200, which represents a decrease of approximately 300 deer since postseason 2017. No sightability or other abundance estimate data are currently available to further align the model in conjunction with postseason classification and harvest data. In the past, this herd has not typically exhibited abrupt changes in population size, as fawn production is usually moderate and habitat conditions are often fair. However, this herd appears to have grown steadily from 2012-2017, due mainly to improved fawn production and good overwinter survival. Despite significantly reduced survey effort due to time and budget constraints in 2016 -2018, managers classified high numbers of mule deer during postseason classifications. Higher densities of mule deer have also become a damage issue on irrigated farmlands in the southeast corner of the herd unit for the first time since 2011.

The "Time-Specific Juvenile – Constant Adult Survival" (TSJ,CA) spreadsheet model was chosen for the postseason population estimate of this herd. This model appears to be most representative of trends within the herd, especially during more recent years represented in the model. Modeling this herd can be difficult, as harvest regimes are biased toward bucks and the model assumes unbiased harvest across age and gender as well as consistent hunter effort. The CJ,CA and SCJ,SCA models appear to overestimate population growth the last six years, which coincides with years when doe harvest was eliminated in the herd. The TSJ,CA model selects an adult survival rate that is very reasonable for this herd, and selects low fawn survival rates in years known to have had severe winter conditions. All three models have AICs that are low and well within one magnitude of power of each other. Thus, AIC has little bearing on model

selection for this herd. The TSJ,CA model is considered to be of fair quality in representing observed population trends and estimates for this herd based on established model criteria.

Management Summary

Traditional season dates in this herd run for two weeks from October 15th through October 31st. The 2019 season will offer an increase from 300 to 350 Type 1 licenses as this population appears to be near objective and buck ratios, harvest success, and hunter satisfaction were all high in 2017. Type 7 licenses were made available in 2017 and 2018 to address growing numbers of mule deer on irrigated agricultural lands in the southeast portion of the herd unit. For 2019, managers will increase these licenses to provide further opportunity for hunters and landowners to manage deer numbers. These licenses will be valid within one mile of irrigated lands to help curb potential damage issues, while conserving doe mule deer on native habitats.

If we attain the projected harvest of 275 mule deer with fawn ratios similar to a 5-year average, this herd will remain just below objective. The predicted 2019 postseason population size of the North Natrona Mule Deer Herd is approximately 4,500 animals, or 4% below objective.

2018 - JCR Evaluation Form

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

HERD: WD706 - BLACK HILLS

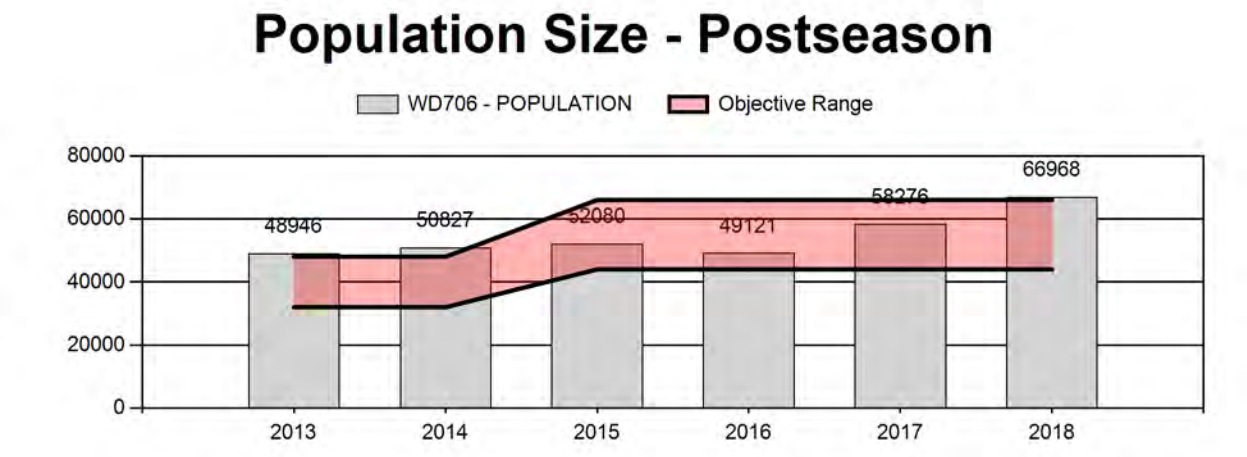
HUNT AREAS: 1-6
PREPARED BY: JOE SANDRINI

	2013 - 2017 Average	2018	2019 Proposed
Population:	51,850	66,968	56,215
Harvest:	5,400	7,092	7,050
Hunters:	8,182	10,486	10,500
Hunter Success:	66%	68%	67 %
Active Licenses:	8,758	10,940	10,950
Active License Success:	62%	65%	64 %
Recreation Days:	33,494	38,723	38,800
Days Per Animal:	6.2	5.5	5.5
Males per 100 Females	30	39	
Juveniles per 100 Females	73	71	

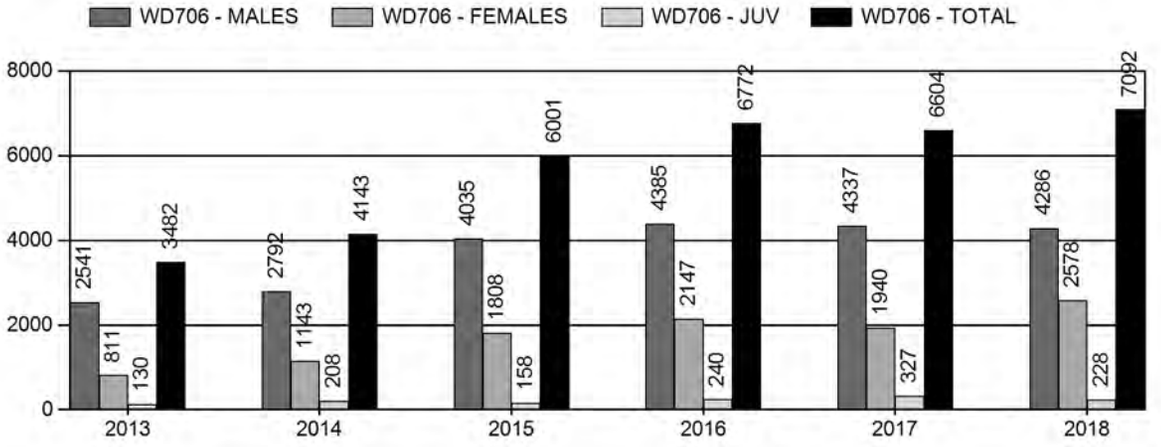
Population Objective (± 20%) :	55000 (44000 - 66000)
Management Strategy:	Recreational
Percent population is above (+) or below (-) objective:	22%
Number of years population has been + or - objective in recent trend:	3
Model Date:	02/15/2019

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

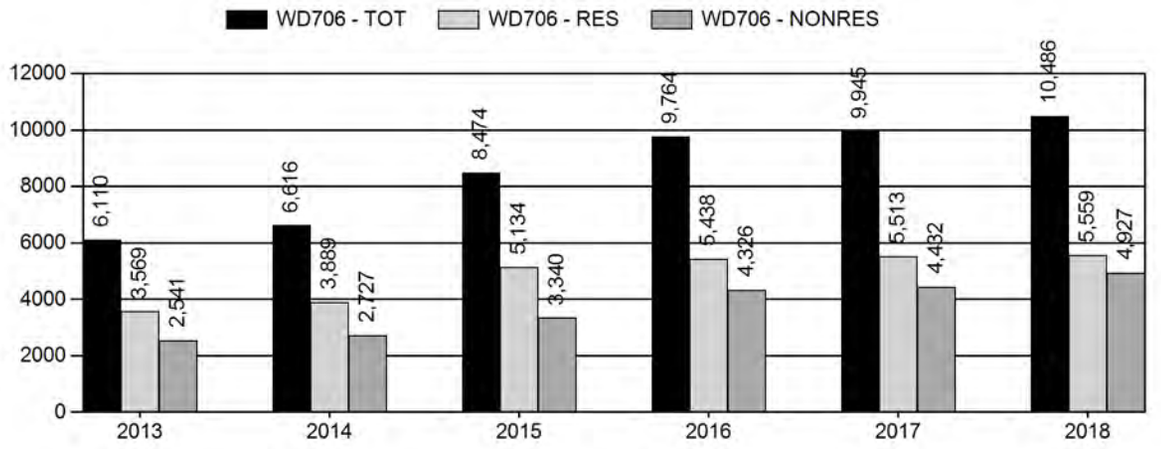
	JCR Year	Proposed
Females ≥ 1 year old:	8.3%	9.1%
Males ≥ 1 year old:	28.6%	34.3%
Total:	10.4%	12.1%
Proposed change in post-season population:	+ 8.4%	- 16.1%



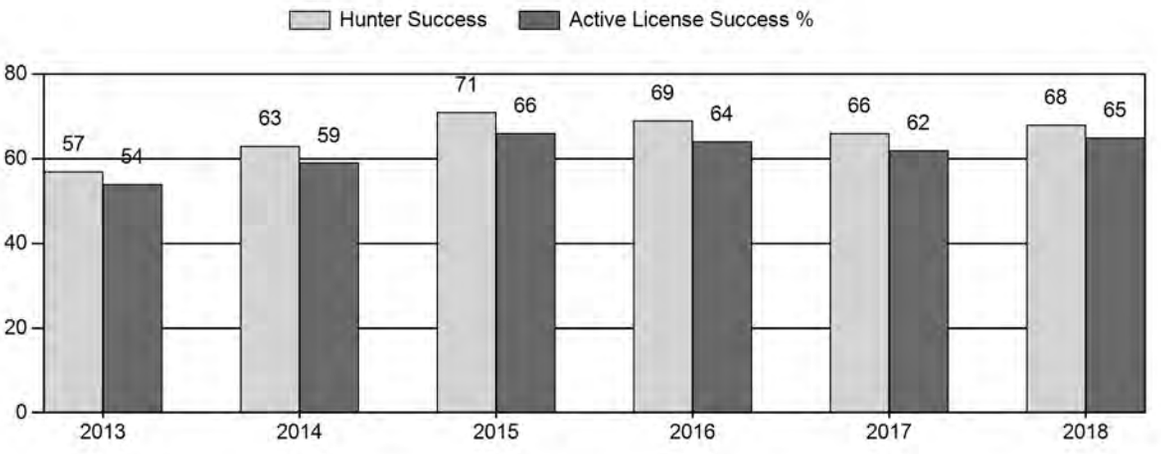
Harvest



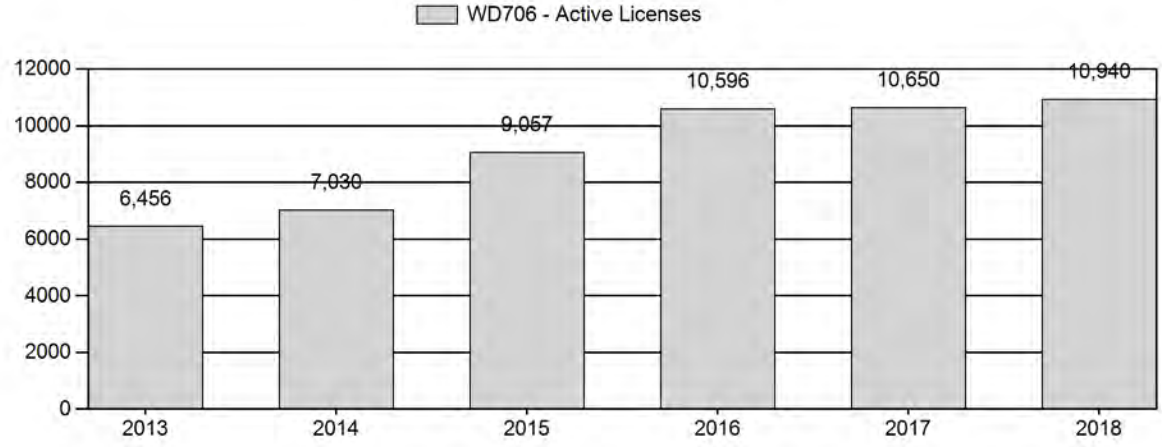
Number of Active Licenses



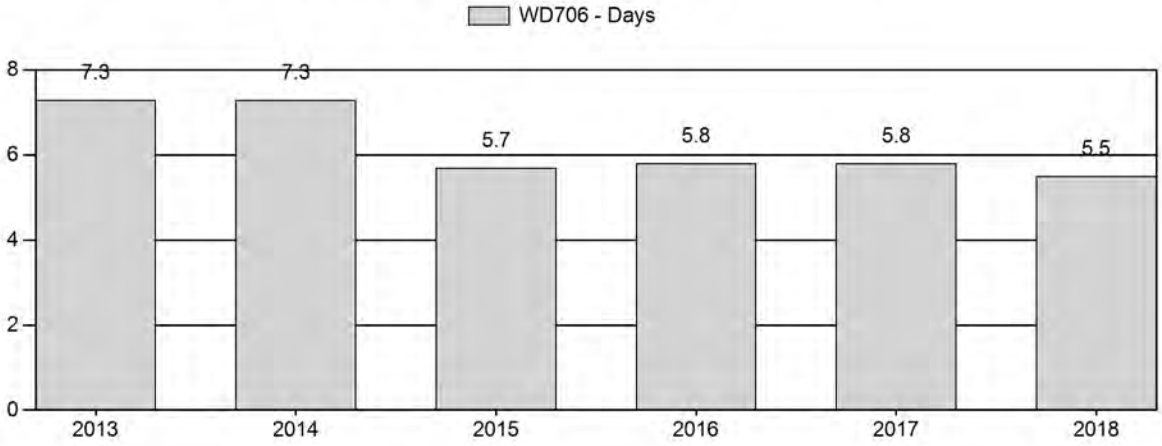
Harvest Success



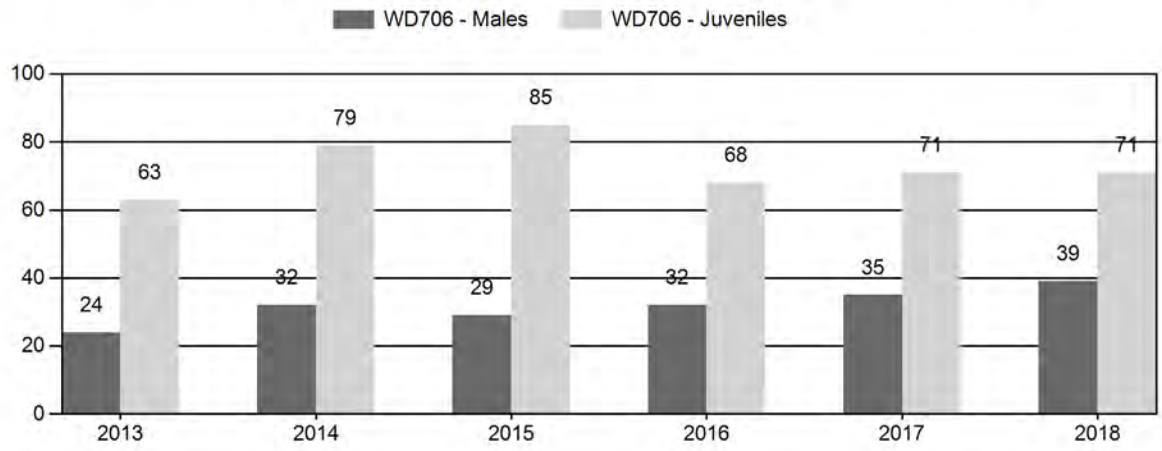
Active Licenses



Days Per Animal Harvested



Preseason Animals per 100 Females



2013 - 2018 Preseason Classification Summary

for White tailed Deer Herd WD706 - BLACK HILLS

		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	52,709	163	153	316	13%	1,303	53%	827	34%	2,446	1,232	13	12	24	± 0	63	± 0	51
2014	55,385	111	198	309	15%	980	47%	778	38%	2,067	1,888	11	20	32	± 0	79	± 0	60
2015	58,681	157	212	369	14%	1,276	47%	1,079	40%	2,724	2,132	12	17	29	± 0	85	± 0	66
2016	56,571	169	224	393	16%	1,216	50%	825	34%	2,434	1,464	14	18	32	± 0	68	± 0	51
2017	65,541	144	321	465	17%	1,331	49%	947	35%	2,743	1,605	11	24	35	± 0	71	± 0	53
2018	74,769	246	429	675	19%	1,721	47%	1,228	34%	3,624	1,641	14	25	39	± 0	71	± 0	51

2013 - 2018 Trend Count Summary

for White tailed Deer Herd WD706 - BLACK HILLS

Year	Count Dates	Number Counted
2014	OCTOBER 2014	3,932
2015	OCTOBER 2015	4,775
2016	OCTOBER 2016	5,978
2017	OCTOBER 2017	6,270
2018	OCTOBER 2018	6,360

2019 HUNTING SEASONS
BLACK HILLS WHITE-TAILED DEER HERD (WD706)

Hunt Area	Type	Dates of Seasons Opens	Closes	Quota	License	Limitations
1		Nov. 1	Nov. 20		General	Antlered deer off private land; any deer on private land
1		Nov. 21	Nov. 30		General	Antlered white-tailed deer off private land; any white-tailed deer on private land
1, 2, 3	7	Nov. 1	Nov. 30	4,200	Limited quota	Doe or fawn valid on private land
2		Nov. 1	Nov. 30		General	Antlered deer off private land; any deer on private land
3		Nov. 1	Nov. 30		General	Antlered deer off private land; any deer on private land
4		Nov. 1	Nov. 20		General	Antlered deer off private land; any deer on private land, except the lands of the State of Wyoming's Ranch A property shall be closed
4	7	Nov. 1	Nov. 20	300	Limited quota	Doe or fawn valid on private land
5		Nov. 1	Nov. 20		General	Antlered deer off private land; any deer on private land
5	6	Nov. 1	Nov. 20	200	Limited quota	Doe or fawn
6		Nov. 1	Nov. 20		General	Antlered deer off private land; any deer on private land
Archery		Sep. 1	Sep. 30			Refer to license type and limitations in Section 2

Region A Nonresident Quota: 4,500

SUMMARY OF CHANGES IN LICENSE NUMBER[1]

Hunt Area	License Type	Quota change from 2018
4	*6*	*see MD751*
4	*7*	*see MD751*
Herd Unit Totals	***Region A***	***None (see MD751)***

[1] Type 6 and 7 licenses and Region A quotas and changes for Hunt Areas 1-6 are captured in the MD751 JCR.

Management Evaluation
Current Management Objective: 55,000
Management Strategy: Recreational
2018 Postseason Population Estimate: ~ 67,000
2019 Proposed Postseason Population Estimate: ~ 56,200
2018 Hunter Satisfaction: 78% Satisfied, 14% Neutral, 8% Dissatisfied

HERD UNIT ISSUES: In 2015, the management objective of the Black Hills White-Tailed Deer Herd Unit was revised to a post-season population of 55,000. Prior to this revision, an objective of 40,000 had been in place since 1983. The herd continues to be managed under the Department's "Recreational Management Strategy," which calls for 24 to 44 bucks per 100 does observed pre-season.

Over the years, modeling this population has been difficult. This is due to substantial interstate movement of deer, wide fluctuations in observed fawn:doe ratios, large changes in doe harvest, a lack of survival data, regular outbreaks of epizootic hemorrhagic disease virus (EHDV), substantial mountain lion predation, a high level of vehicle-deer collisions, severe weather events, and low and irregular visibility of bucks during classifications. Consequently, the population model is thought to be of low quality and population estimates produced should be viewed very cautiously. However, the trends it produces are generally acceptable.

The Black Hills White-Tailed Deer Herd is located primarily within Crook and Weston Counties in northeastern Wyoming and encompasses about 3,140 mi^2 of occupied habitat. Seasonal range maps for this herd were updated in 2004, and currently 335 mi^2 are delineated as crucial winter range. However, there have been no research projects to quantify seasonal ranges. Instead, seasonal ranges were defined by local personnel based upon anecdotal field observations. Dominant land uses include livestock grazing and forage crop production. A large proportion of forested lands are actively managed for timber production. There is some extraction of minerals, primarily bentonite and oil. The majority of white-tailed deer are found in the eastern two-thirds of this herd unit and within the Belle Fourche River drainage where habitat is favorable.

Approximately 79% of the land within the herd unit is privately owned. The largest blocks of accessible public land are found on the Black Hills National Forest in Hunt Areas (HA) 2 and 4, Thunder Basin National Grasslands in HA 6, and BLM lands in HA 1. Due to the late timing of deer hunting season in the Black Hills relative to other areas in Wyoming and the potential to harvest a whitetail on public land, this herd unit is extremely popular with resident hunters (~5,500 annually since 2016). Its proximity to the upper Midwestern United States and availability of sympatric mule deer hunted concurrently make it very popular with non-residents as well, hosting about 4,300 non-resident hunters each year since 2016. Access fees for hunting are common on private land, and many holdings are leased to outfitters. Consequently, accessible public lands are subject to very heavy hunting pressure, probably the highest in the State. Due to limited access for hunters to private land, keeping the growth of this herd in check is difficult when habitat and weather conditions are favorable for deer productivity and survival.

Whitetails are the most numerous deer species in HA's 2 and 4, whereas more equal proportions of whitetails and mule deer are found in HA 1 and 3, and distribution favors mule deer in HA's 5 and 6. The vast majority of white-tailed deer reside on private land. Because of this, management

is heavily influenced by landowner tolerance of deer numbers. Field personnel report white-tailed deer numbers (primarily north of I-90) are now close to, or exceeding, local tolerance. A survey of approximately 450 Black Hills landowners at the end of 2014, when the estimated population was about 30% lower, revealed half of the respondents (52%) believed whitetail numbers to be "about right;" while just over a third (35%) reported their numbers to be "too low;" and only 13% felt whitetail numbers were "too high." More recently, as this population has rebounded, few landowners are asking to see more deer on the landscape, hunter satisfaction has increased, and more landowners would like to stabilize or reduce white-tailed deer numbers.

WEATHER: This white-tailed deer population peaked in 2007 following eight years of basically warmer and drier than normal weather. The herd then declined dramatically, something that was exacerbated by a harsh winter during bio-year 2010 and severe drought in 2012. 2013 saw a transition to good growing season weather and an average winter. Then, in 2014 and 2015 warm and wet growing seasons followed by mild winters set the stage for excellent fawn productivity and survival, leading to a rapid rebound in the population. More recently, drought plagued the Black Hills during the primary growing seasons of 2016 and 2017. These drought years resulted in reduced forage production and led to several large wildfires. Fall weather over this same timeframe was characterized by normal to slightly above average temperatures and below average precipitation. However, in 2016 and 2017 more normal to severe winter weather was experienced, as temperatures were close to average or below, and total precipitation received normal or above normal most months. Forage growth in 2018 was very good, with above average moisture and close to normal temperatures during the growing season. However, to date, the 2018-19 winter has had below normal temperatures and above average snowfall. Given the previous two-year's drought and more severe winter weather, improvements in this herd's performance have reversed themselves. As such, the population is projected to drop about 16% in 2019. See http://www.ncdc.noaa.gov/cag/ for weather information.

HABITAT: Ponderosa pine (*Pinus ponderosa*) is the dominant overstory species on forested lands. Quaking aspen (*Populus tremuloides*), paper birch (*Betula papyrifera*), and bur oak (*Quercus macrocarpa*) stands are also present. Many areas dominated by deciduous trees are in late successional stages. Important shrubs include Saskatoon serviceberry (*Amelanchier alnifolia*), Oregon grape (*Berberis repens*), common chokecherry (*Prunus virginiana*), and wild spiraea (*Spirea betulifolia*). Non-timbered lands in this portion of the herd unit are used to produce agricultural crops such as winter wheat (*Triticum aestivum*), alfalfa hay (*Medicago sativa*), or mixed-grass hay.

FIELD DATA: Preseason age and sex classifications are conducted in this herd unit during the second half of October along standardized drive routes. Many of these routes have been used for over 40 years. Since the 1980's, fawn production and survival has been generally below that observed in most white-tailed deer herds, and at times fluctuated dramatically (for example $mean_{1997\text{-}2018}$ = 62:100; std. dev. = 13). However, over the last decade (Figure 1) observed fawn:doe ratios have generally improved and fluctuations diminished ($mean_{2009\text{-}2018}$ = 71:100; std. dev. = 7.0). This is thought to be primarily a result of vegetative responses to fire enhancing forage quality and quantity.

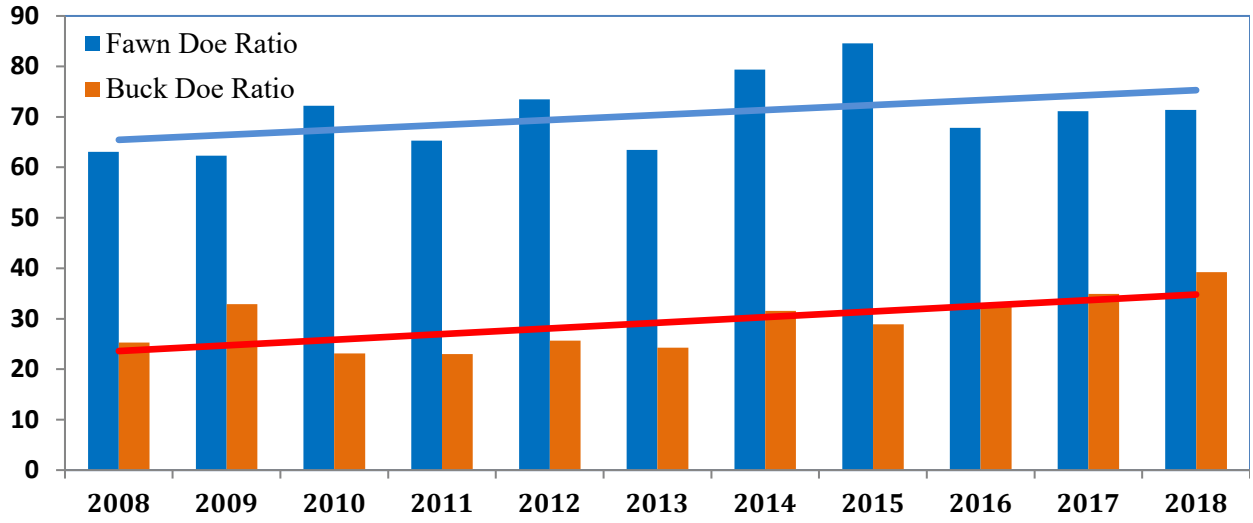


Figure 1. Observed, preseason fawn:doe and buck:doe ratios in the Black Hills White-Tailed Deer Herd (2008 - 2018), with linear trend lines.

This herd's observed, preseason buck:doe ratios have generally been at the lower end of the Department's recreational management criteria. However, it should be noted that classifications are made outside the rut, and because whitetails are secretive we have always modeled this herd's preseason buck:doe ratio about 30% above observed values. This corrective factor was determined from historical modeling efforts and the inflation in buck:doe ratios needed to get models to run given harvest levels of bucks. Additionally, there have been occasional years when observed buck ratios inexplicably jumped about 30% (something attributed to intermittently enhanced visibility of bucks during preseason spotlight surveys). Overall, preseason buck:doe ratios the past ten years have been relatively stable ($mean_{(09\text{-}18)}$ = 30:100; std. dev = 5.5), but have steadily increased since 2015. The recent increases in the preseason buck:doe ratio may have been due somewhat to enhanced visibility, but more ostensibly from significant improvements in fawn production and survival in 2014 and 2015 followed by near average productivity and survival the past three years.

HARVEST DATA: In the Black Hills, deer management entails regulating both mule deer and whitetail harvest under a general license season structure across a variety of habitats, with serious deference given to landowner desires. Historical analysis of harvest data indicates hunter number has the greatest impact on buck harvest. Therefore, buck harvest has been regulated by altering non-resident hunter participation via changes in the Region A quota, while resident buck hunter participation can only be limited by shortening the season - notably by inclusion or removal of the Thanksgiving Day weekend and the days following in hunt areas north of I-90. Alteration of season length affects resident hunter participation by encouraging or curtailing the late season influx of hunters during a period when buck deer are highly vulnerable to harvest. For example, when the 30-day white-tailed deer hunting season was most recently reinstated in HAs 1, 2 & 3, resident hunter numbers increased about 40% above the average number witnessed during the preceding years when shorter seasons were in place.

With conservative hunting seasons between 2010 and 2013, harvest of both antlered and antlerless whitetails dropped. After 2014, as this herd began to recover, doe/fawn license issuance increased and buck harvest climbed with increases in the Region A quota and resident hunter participation.

As a result, annual harvest has more than doubled since 2013. Additionally, both hunter success and active license success climbed significantly in 2014 and 2015, while effort declined substantially. These measures have since leveled off slightly at values near those experienced in 2015. Overall, harvest statistics support the projections that this population peaked in 2007, fell significantly through 2010, and then rebounded substantially.

Hunting seasons between 2010 and 2014 reduced annual harvest of whitetail bucks about 30% from that experienced during the traditional November season the preceding four years. Comparing these periods, resident harvest of white-tailed bucks dropped about 20%, while non-resident harvest of white-tailed bucks dropped closer to 40%. As mentioned above, resident hunter numbers have increased substantially since 2014 as the white-tailed deer hunting season was extended to the entire month of November in HA's 1, 2, & 3 and deer numbers improved. Likewise, increasing the Region A quota to 4,500 has put significantly more non-resident hunters on the ground. As a result, white-tailed buck harvest has risen about 60% above the 2014 level.

As harvest increased the between 2013 and 2018, the number of field-checked white-tailed deer generally increased as well. In 2017, with the advent and use of the smartphone check station application, field check numbers increased proportionately more than harvest. This trend continued in 2018 as the number of field checked-deer was augmented by increased Chronic Wasting Disease (CWD) testing. However, the exact number of whitetails field checked in 2018 is difficult to know, as an unknown number of lab-aged, CWD-sampled deer were recorded using the check station application, resulting in the JCR program generating duplicate counts of some lab and field-aged deer. At minimum, a total of just over 500 white-tailed deer harvested were field checked and/or lab aged in 2018. The bulk of these (340) were bucks age two-years or greater. Of the 146 whitetails tested for CWD, 8 were positive, yielding a prevalence of 5.5%. All but one of the infected deer came from the 111 adult bucks tested. The other positive being one of 35 adult females tested. The 2018 detection prevalence was substantially higher than the approximately 0.2% that had been observed in this herd prior to 2018, during which time 2,232 white-tailed deer were tested. However, in 2018, almost all of the CWD-positive deer came from HA 3 (5 of 8), and may have been a result of a single "hotspot" biasing a low sample number.

Despite the harvest trends, preseason whitetail buck:doe ratios held fairly stable and deer hunter satisfaction remained essentially unchanged between 2011 and 2013, with about 68% of white-tailed deer hunters reporting they were either satisfied or very satisfied with their Black Hills deer hunt. Satisfaction improved in 2014 as hunter success climbed and effort dropped, with 75% of the white-tailed deer hunters reporting they were satisfied. With continued good success and declines in the effort required to harvest a deer, hunter satisfaction has improved and remained near 80% since 2015.

POPULATION: As noted above, population modeling of this herd has always been very difficult. In 2014, the spreadsheet model for this herd was reconstructed and re-initiated after correcting errors detected in the previous model and experimenting with models of various construction. Of the final three competing spreadsheet models, the Semi-Constant Juvenile / Semi-Constant Adult survival (SCJ SCA) model has been selected each year to estimate the population. The present model is set to "solve" through the projected bio-year (2019) instead of only on years for which actual field data exist and uses long-term, average classification values. This change, allows for a standardized method of estimating next year's post-season population – one that is not affected by a couple recent high or low observation values. On the down side, it results in situations where

the model does not recognize proximate impacts, such as the effects of EDHV, because actual changes in harvest and age/sex ratios inform the model in "hindsight." Further adjustments made to the model this year to simplify it and reduce the model's parameterization, again increased previous year's population estimates, but resulted in a better correlation with trend counts (Fig. 2).

While the Constant Juvenile / Constant Adult survival (CJ CA) model will function with this herd's data set, it produces essentially a stable population of about 90,000 deer since 2014, which does not comport at all with field observations or harvest statistics. The AICc of this model is also over double that of the competing models and it most poorly fits observed data. On the other hand, the Time Sensitive Juvenile / Constant Adult survival model (TSJ CA) yields an AICc value about 7% lower than that of the SCJ SCA model and provides best fit of observed buck:doe ratio data. However, this model was rejected because in order to get it to function, juvenile survival rates had to be allowed to vary down to 25% in 7 out of 24 years, and it predicts very low (about 35%) survival in five other years. Additionally, this model is not as well correlated with preseason trend count data or harvest statistics. The SCJ SCA model is 86% correlated with preseason trend counts since 2008, while the TSJ CA model is 77% correlated (Figure 2). The preseason population estimates produced by the SCJ SCA model are also better correlated with hunter success (88% compared to 60% with the TSJ CA model). Similarly, preseason population estimates of the SCJ SCA model exhibit an 88% inverse correlation with hunter effort, while the TSJ CA model predictions are negatively correlated at 72%. Finally, the trends produced by the SCJ SCA model are much more congruent with field personnel and landowner perceptions. However, this model indicates a substantial decline in the population in 2009 that was not actually realized until after the 2010/11 winter; and it does not capture the apparent stabilization or drop of deer numbers into 2017 that resulted from EHDV, which is apparent from harvest statistics and field observations. Finally, the SCJ SCA model estimates a mean buck harvest rate of about 30% the past five years, which is something very reasonable. Therefore, due to the variety of factors identified, we consider the chosen model to be of poor quality, but better than the competing models.

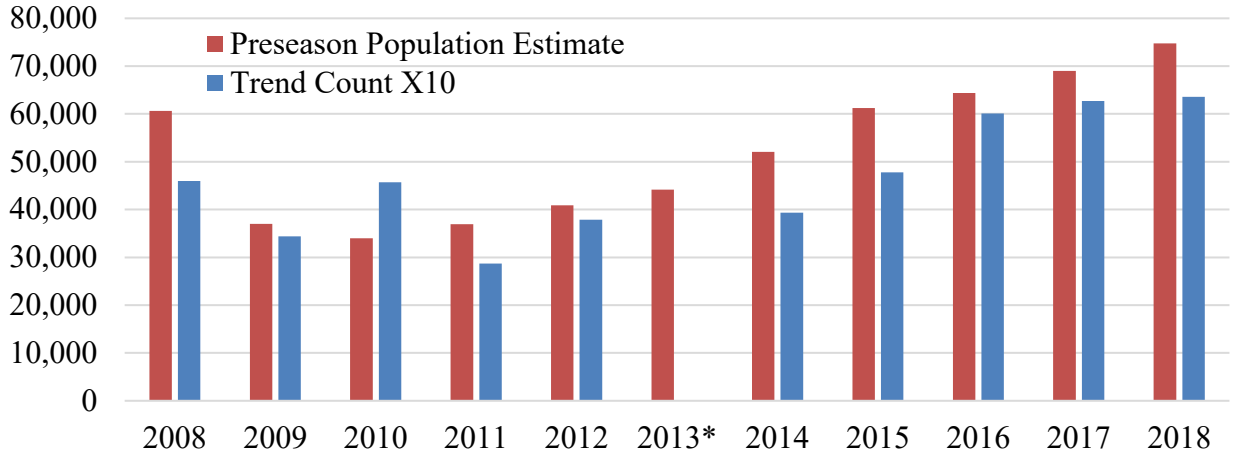


Figure 2. 2008 - 2018 white-tailed deer, estimated preseason population and trend count data, increased by a factor of 10. ***Note, trend count not completed 2013 due to weather.***

It should also be noted that the current year's post-season population estimate recorded in the JCR program and presented on page 1 are no longer updated in subsequent years, but rather remain fixed following JCR finalization. Because of this, and the fact that estimates produced by our models at the beginning and ending years of model construction are the most tenuous and subject

to change as more years of data are added, the estimates provided in Figure 3 reflect current, modeled trends in this herd's population size.

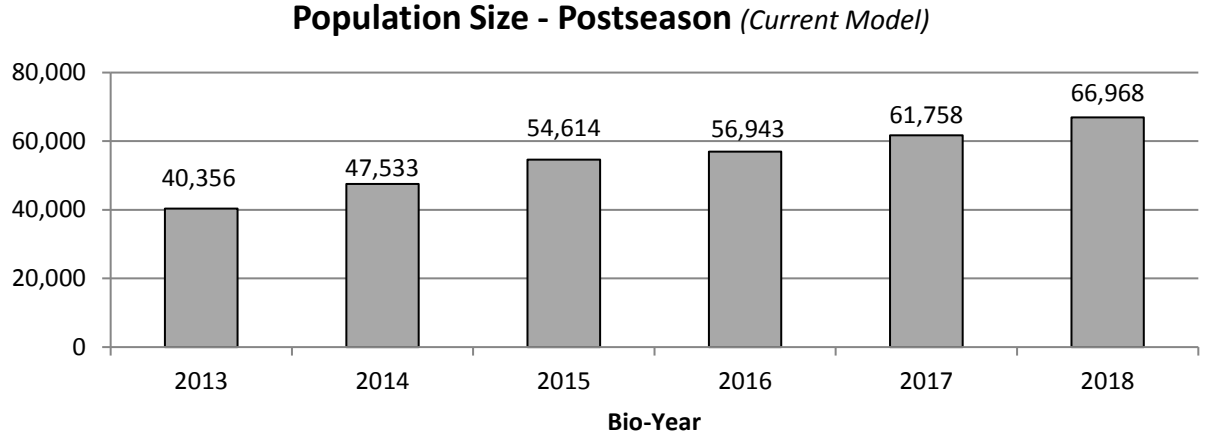


Figure 3. Post-season population estimates (2013 – 2018) produced by the 2018 SCJ SCA model

Based upon the current SCJ SCA model, this population grew 50% between 2001 and 2007. The population then dropped 57% to ~ 29,300 in 2010, before more than doubling through 2018. The 2007 peak (~ 63,000), subsequent decline and rebound in the population reflects overall field observations. However, as previously noted, by all accounts this population dropped steadily from 2007 through 2011 – a trend shown one year antecedent in the model's projections. It is also more likely this population has been stable or only increased slightly from last year. If population estimates produced by the spreadsheet model are close to accurate, then our current objective is near landowner tolerance and yields excellent hunter satisfaction.

MANAGEMENT SUMMARY: The modest changes to the 2018 white-tailed deer hunting season were designed to maintain buck harvest and increase take of antlerless white-tailed deer. It was successful in that buck harvest only fell 1%, while antlerless harvest increased about 25%. As such, this season structure is being carried into 2019. Likewise, the traditional November 30th closing date in Hunt Areas 1, 2, and 3, and that of November 20th in HA's 4, 5 & 6 are being maintained. This structure makes an abundant number of doe/fawn licenses available, which have failed to sell out the past couple of years. Whitetail buck numbers have remained strong in recent years, and there should again be good numbers of mature bucks available in 2019. Therefore, it seems prudent to maintain buck harvest even with the increased non-hunting mortality we have experienced recently. This will also help maintain total non-resident hunter numbers, which are important to affect doe harvest.

White-tailed doe harvest needs to be augmented to keep this population near objective, and landowners must be proactive in curbing increases in whitetail numbers. To help foster these goals and simplify the regulations, once again all of the doe/fawn tags valid north of I-90 will fall under a single license and type (HA 1, 2, 3 Type 7), which is valid for a doe or fawn of either deer species on private land only. Because these licenses have remained well under-subscribed the past couple of years, the total number of doe/fawn licenses valid in HA's 1, 2, and 3 remains unchanged. It is projected that a few more doe/fawn licenses will sell in 2019 and active license success will be about 85%. This should result in a harvest from HA's 1, 2, and 3 of about 2,300 antlerless whitetail

deer. South of I-90, doe/fawn license issuance also remains unchanged, but the HA 4 Type 6 license is being converted to a Type 7 to standardize license types where antlerless harvest is restricted to private land.

Because we believe resident general license hunter numbers will not change significantly in 2019 and most non-residents don't harvest antlerless deer on their Region A License, it is anticipated doe/fawn harvest on general licenses will not change. As a result, it is anticipated there will be a total harvest of about 2,800 antlerless white-tailed deer in 2019. This should provide a female harvest rate of around 9%. Given the consistent data on harvest percentages by species, complicating the regulations by segregating mule deer and white-tailed deer harvest more than we already have on general licenses is not warranted. A female harvest rate in excess of 10% is needed to control this population, but until there is better access for antlerless deer hunters to private land and all the available licenses sell, that will not happen.

The 2018 hunting season is projected to yield an estimated postseason population of about 56,200 white-tailed deer, which represents a 16% decrease in the current, estimated post-season population. However, this projection assumes observed fawn:doe and buck:doe ratios near long-term average driven by moderate over-winter mortality, average reproduction and recruitment, and summer losses to EHDV that are minimal. Provided the projected change in population is reached, this herd would be about 2% above objective. This should put it at a level most landowners would like to see, and is satisfying to hunters. Overall, the 2019 hunting season should at a minimum temper population growth, and hopefully reduce numbers, while resulting in a slight drop in the buck:doe ratio. In the end, the story written will depend upon doe/fawn license sales and the level of over-winter mortality we experience this year.

2018 - JCR Evaluation Form

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

HERD: WD707 - CENTRAL

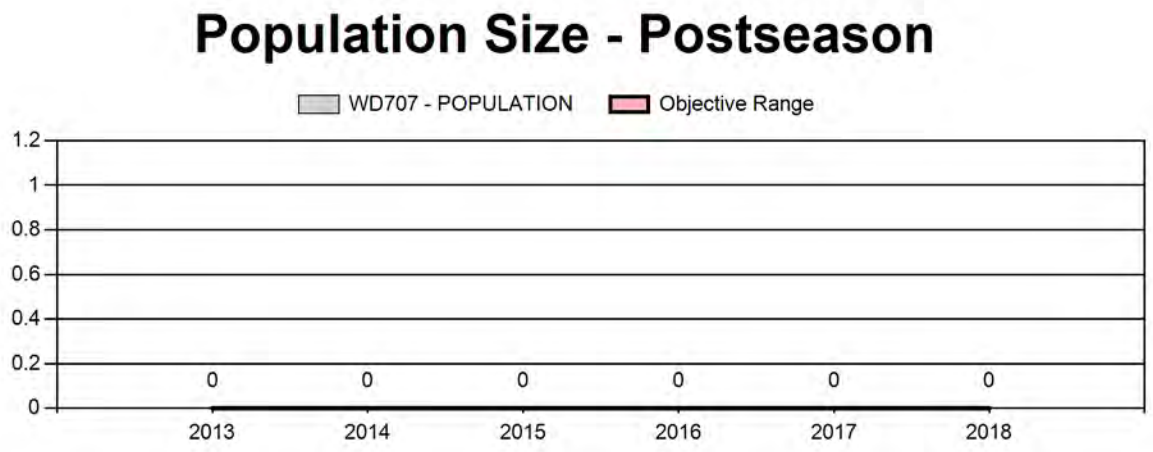
HUNT AREAS: 7-14, 21-22, 34, 65-67, 88-89
PREPARED BY: WILLOW BISH

	2013 - 2017 Average	2018	2019 Proposed
Population:	0	N/A	N/A
Harvest:	901	1,335	1,300
Hunters:	2,067	2,544	2,500
Hunter Success:	44%	52%	52 %
Active Licenses:	2,365	2,936	2,900
Active License Success:	38%	45%	45 %
Recreation Days:	9,602	10,825	10,800
Days Per Animal:	10.7	8.1	8.3
Males per 100 Females	39	43	
Juveniles per 100 Females	73	76	

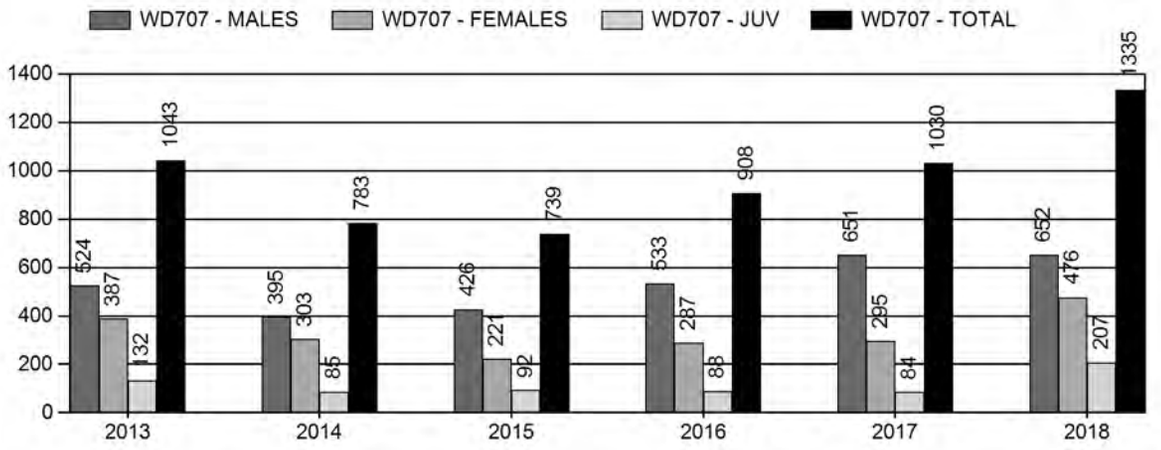
Population Objective (± 20%) :	0 (0 - 0)
Management Strategy:	Recreational
Percent population is above (+) or below (-) objective:	N/A%
Number of years population has been + or - objective in recent trend:	0
Model Date:	None

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

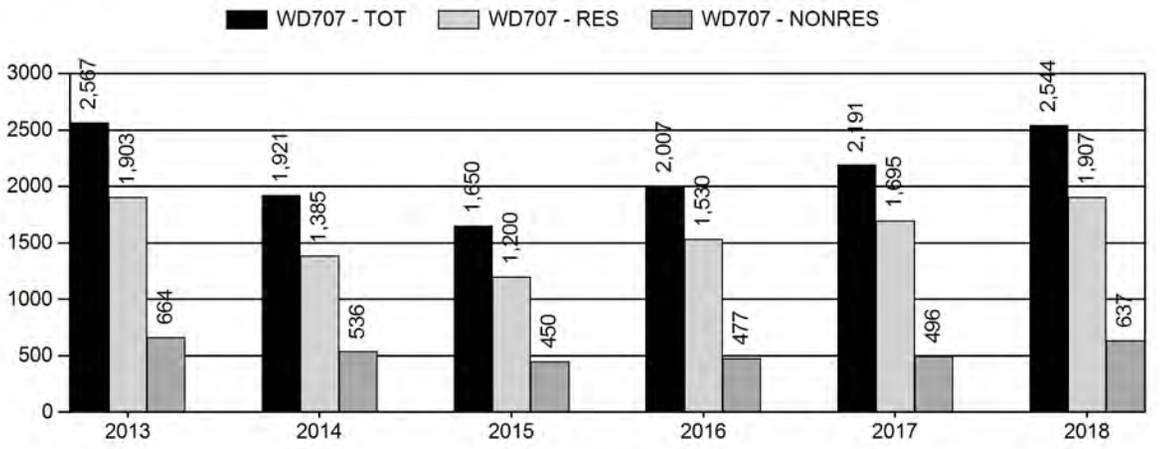
	JCR Year	Proposed
Females ≥ 1 year old:	0%	0%
Males ≥ 1 year old:	0%	0%
Total:	0%	0%
Proposed change in post-season population:	0%	0%



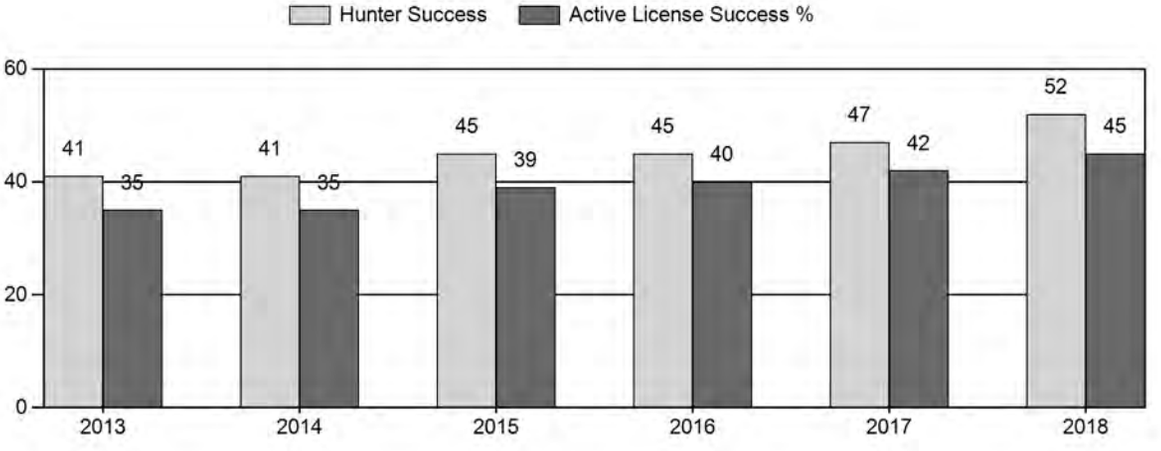
Harvest



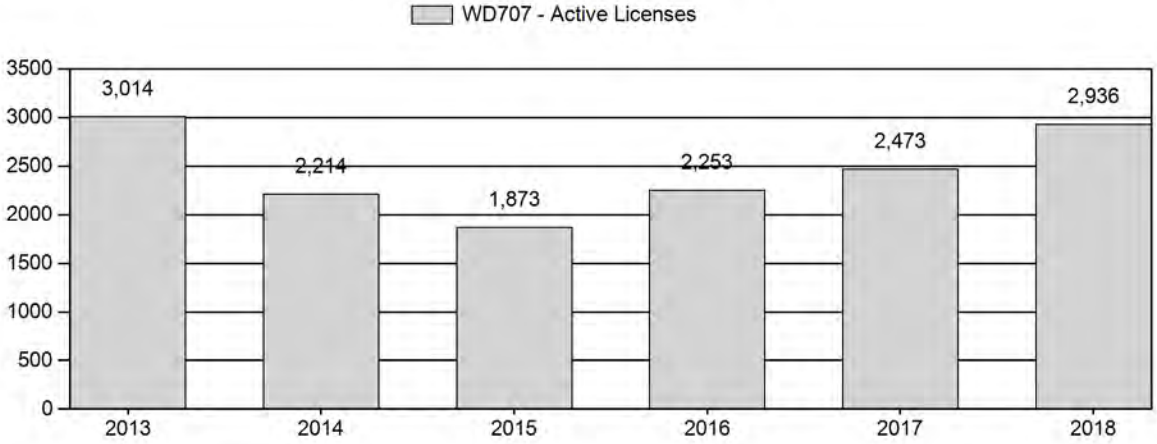
Number of Active Licenses



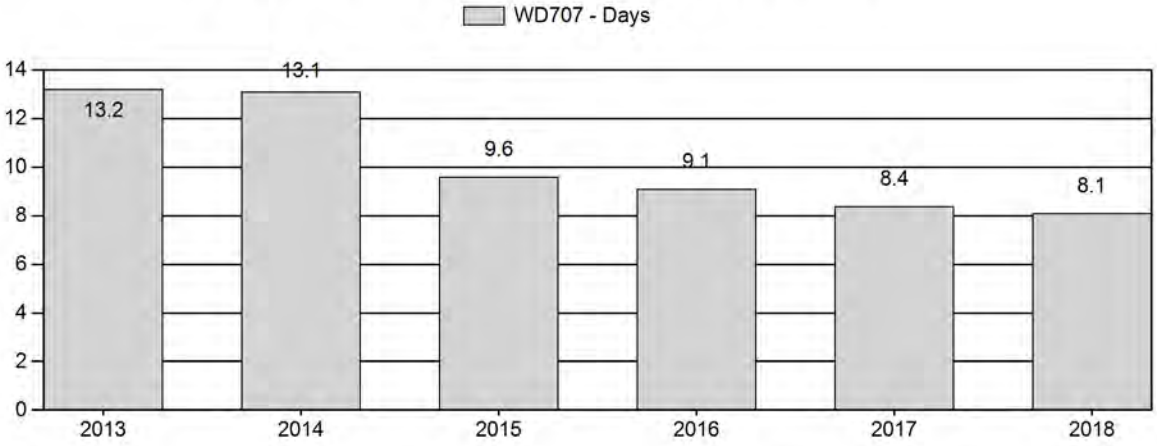
Harvest Success



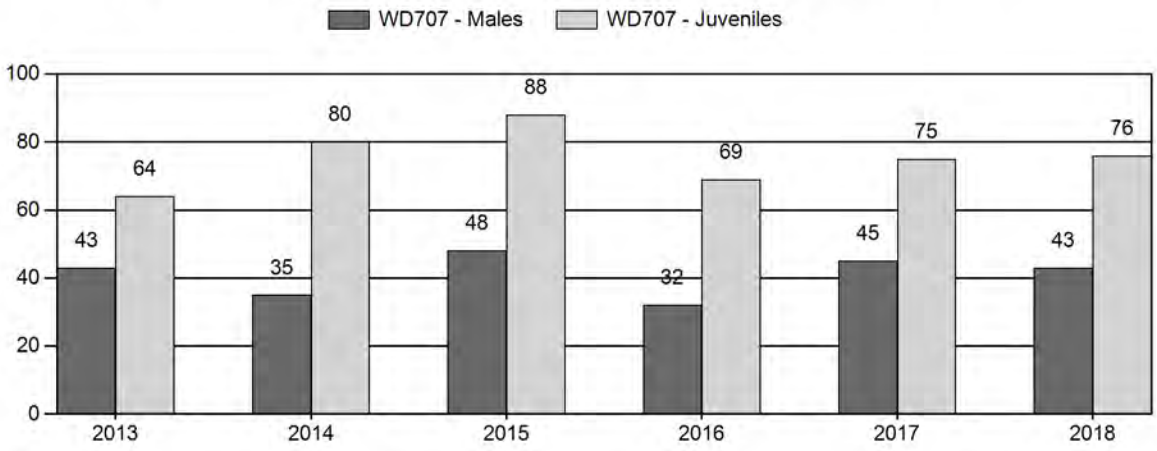
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2013 - 2018 Postseason Classification Summary

for White tailed Deer Herd WD707 - CENTRAL

		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	0	19	61	80	21%	188	48%	121	31%	389	0	10	32	43	± 0	64	± 0	45
2014	0	11	24	35	16%	100	47%	80	37%	215	0	11	24	35	± 0	80	± 0	59
2015	0	48	59	107	20%	223	42%	196	37%	526	0	22	26	48	± 0	88	± 0	59
2016	0	78	127	205	16%	635	50%	436	34%	1,276	0	12	20	32	± 0	69	± 0	52
2017	0	69	114	183	21%	404	45%	301	34%	888	0	17	28	45	± 0	75	± 0	51
2018	0	90	161	251	19%	601	46%	456	35%	1,308	0	15	27	42	± 0	76	± 0	54

2019 HUNTING SEASONS
CENTRAL WHITE-TAILED DEER (WD707)

Hunt Area	Type	Season Dates Opens	Closes	Quota	License	Limitations
10	3	Oct. 1	Nov. 30	35	Limited quota	Any white-tailed deer
10	8	Oct. 1	Nov. 30	35	Limited quota	Doe or fawn white-tailed deer
10,11,12 13,14	3	Oct. 1	Nov. 30	300	Limited quota	Any white-tailed deer
10,11,12 13,14	8	Oct. 1	Nov. 30	300	Limited quota	Doe or fawn white-tailed deer
11		Oct. 16	Nov. 30		General	Any white-tailed deer
12		Oct. 16	Nov. 30		General	Any white-tailed deer
13		Oct. 16	Nov. 30		General	Any white-tailed deer
14		Oct. 16	Nov. 30		General	Any white-tailed deer
21	7	Oct.1	Oct. 31	50	Limited quota	Doe or fawn valid on private land
21	8	Oct.1	Oct. 31	50	Limited quota	Doe or fawn white-tailed deer valid on private land
22	3	Oct. 1	Nov. 30	100	Limited quota	Any white-tailed deer
22	8	Oct. 1	Nov. 30	100	Limited quota	Doe or fawn white-tailed deer
34	3	Oct. 15	Nov. 30	50	Limited quota	Any white-tailed deer
65	3	Oct. 15	Nov. 30	400	Limited quota	Any white-tailed deer, also valid in that portion of Area 66 in Converse County
65	8	Oct. 15	Nov. 30	400	Limited quota	Doe or fawn white-tailed deer, also valid in that portion of Area 66 in Converse County
66,88,89	3	Oct. 15	Nov. 30	150	Limited quota	Any white-tailed deer
66,88,89	8	Oct. 15	Nov. 30	100	Limited quota	Doe or fawn white-tailed deer
Archery						Refer to license type and limitations in Section 2

Note: The above season limitations are restricted to only those lines in the Chapter 6 Regulation that directly affect white-tailed deer hunting. Additional general and limited quota seasons occur in hunt areas 7-14, 22, 34, 65-67, 88, and 89 but are not captured here.

Hunt Area	License Type	Quota Change from 2018
7, 8, 9	3	-50
	8	-50
88	8	+100
Herd Unit Totals	**3**	**-50**
	8	**+50**

Management Evaluation

Current Management Objective: ≥ 20 bucks:100 does postseason

Management Strategy: Recreational

2018 Postseason Population Estimate: NA

2019 Proposed Postseason Population Estimate: NA

2018 Hunter Satisfaction: 70% Satisfied, 18% Neutral, 12% Dissatisfied

The Central White-tailed Deer Herd Unit has a postseason management objective of ≥20 bucks per 100 does. No population model exists for this herd unit, as this is not a well-defined or closed population. Managers are unable to obtain adequate classifications over this large herd unit as it is not a budget priority for helicopter surveys and there is poor sightability of white-tailed deer in cottonwood riparian habitats. Access to perform ground surveys is inconsistent and highly variable from year to year as most white-tailed deer inhabit private lands.

Herd Unit Issues

White-tailed deer densities in this herd are highest along major cottonwood riparian communities of the Cheyenne River and North Platte River drainages and on irrigated hay fields in the La Prele Creek, La Bonte Creek, and Casper Creek drainages. Most white-tailed deer habitats in this herd unit are on private lands. Landowners typically have a low tolerance for white-tailed deer, and access to hunt them is generally good. Periodic disease outbreaks (i.e. hemorrhagic diseases, adenovirus, Asian louse, Chronic Wasting Disease) are known to occur within this herd, and can contribute to population declines in localized areas when environmental conditions are suitable. Female harvest in this herd is typically insufficient to curtail growth when the population is high since many Type 8 licenses typically remain unsold each year. Epizootic Hemorrhagic Disease (EHD) often regulates this population given the lack of female harvest.

Weather

Weather conditions from 2010-2012 coupled with EHD resulted in a significant reduction in this population. Beginning in 2013, conditions improved and the population responded accordingly. This more recent trend of favorable conditions has continued through 2018. Total precipitation in 2018 was slightly above average which was similar to 2017. However, the bulk of the precipitation was received throughout the summer months (May-July) with less than average precipitation through spring and fall. Due to the relatively dry spring, forage production occurred later in the season than normal but precipitation throughout the summer months supported good forage growth for the year. The 2018-2019 winter has been relatively mild to

date in lower elevation habitats where the bulk of the white-tailed deer occur. Given this, white-tailed deer are likely to have experienced normal over-winter survival.

Habitat

This herd unit has no established habitat transects that measure growth and/or utilization on shrub species that are preferred browse of white-tailed deer. However, browse quality and availability were relatively high along riparian corridors due to average or above average precipitation conditions since 2013. Anecdotal observations from field personnel noted good browse and herbaceous forb conditions throughout the herd unit. Many landowners also reported improved conditions for irrigation of hay fields in recent growing seasons.

Field Data

The fawn ratio in 2018 was 76, which is comparable to the previous 5 year average of 75. This herd appears to be rebounding from a low point following disease outbreak, harsh winters in 2010 and 2011, and the severe drought of 2012. This herd unit has had good fawn production for several years and is beginning to increase in size accordingly.

Buck ratios for the Central White-tailed Deer Herd historically average in the mid 30s per 100 does, but occasionally swell into the 40s or drop into the 20s. The 2018 total buck ratio of 43 per 100 does and 15 yearling bucks per 100 does are in line with the previous 5-year average of 41 total bucks per 100 does and 14 yearling bucks per 100 does. Observed ratios may vary from year to year due to differing levels of effort or success in sampling white-tailed deer during post-season classification surveys. Buck ratios vary widely across the large variety of habitats in this herd unit as well. Additionally, white-tailed deer can be difficult to classify on private lands and in riparian cover, particularly bucks that may be solitary and elusive. Still, observed buck ratios have always met management objectives for this herd by remaining at or above 20 bucks per 100 does. However, postseason classification ratios in this herd should be viewed with caution as sample sizes are typically small and are not well stratified throughout the herd unit. For example, in 2018, only 1,308 white-tailed deer were classified in this herd and about 56% of these deer were found in Area 65. This hunt area has the highest population of white-tailed deer within the herd unit. Over the past 4 years, significantly more white-tailed deer were classified in this herd unit, which is likely due to an increasing population as well as increased sampling effort.

Harvest Data

License success in this herd unit is typically in the 40-50th percentile, and was 45% in 2018. License issuance varies greatly between the many hunt areas contained within the herd unit. Hunters can take white-tailed deer on general licenses and also purchase additional limited quota licenses valid for any white-tailed deer or doe/fawn white-tailed deer. In recent years, reductions in limited quota white-tailed deer licenses have been made due to low deer densities, declining hunter success, and few complaints regarding damage on private lands. White-tailed deer hunting opportunity peaked in 2011 with over 3,100 hunters afield. Between 2011 and 2015, license issuance has been gradually reduced as the population and hunting access have decreased, resulting in a low of 1,650 hunters afield in 2015. From 2011-2014, hunter success declined 32% while hunter effort (days to harvest) increased 34%. This trend is now reversing as hunter

success and hunter effort were improved by 21% and 38%, respectively since 2014. Hunting opportunity for white-tailed deer has increased since 2016, and adjustments to license issuance have been made accordingly. In 2018, there were about 2,550 whitetail hunters in this herd unit and they harvested 1,335 white-tailed deer.

Population

Currently there is no population model that accurately represents this herd. Therefore, management is based on maintaining postseason buck ratios with a goal of ≥20 bucks per 100 does. Observed buck ratios continue to exceed this goal, and this population is continuing to recover from recent declines. The population reached a low point in 2013, following a harsh winter in 2010/2011, drought in 2012, and epizootic hemorrhagic disease in 2013. Fawn production and recruitment significantly improved beginning in 2014, and the population has been on an upward trajectory for the past 5 years.

Management Summary

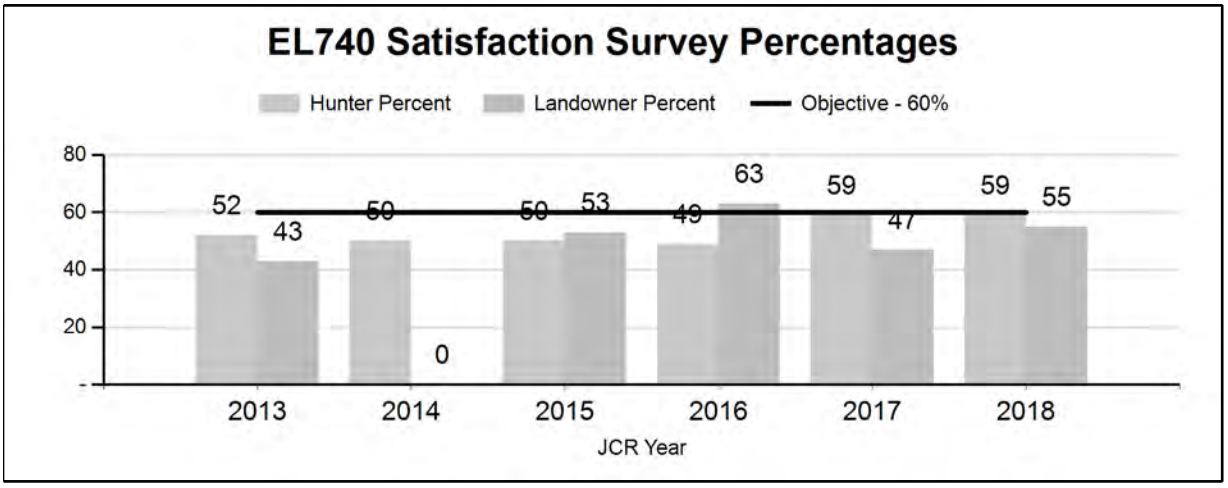
Traditional season dates in this herd vary from one hunt area to the next. Generally, white-tailed deer seasons run concurrently with October mule deer seasons, and are extended into November to maximize hunter opportunity and harvest. The 2019 season includes 1,035 Type 3 licenses, 985 Type 8 licenses, 50 Type 7 licenses, and additional opportunities to harvest white-tailed deer on General and Type 1 licenses. Type 3 and 8 licenses were removed for Areas 7, 8, and 9 given unsatisfied hunters and landowners and the ability to harvest white-tailed deer on general licenses. Goals for 2019 are to maintain buck ratios, improve hunter opportunity, afford landowners the opportunity to address agricultural damage on private lands if necessary, and maintain hunting opportunity as a result of population increase.

If we attain the projected harvest of 1,300 white-tailed deer with fawn production/survival similar to the five-year average, buck ratios should be maintained well above 20 per 100 does.

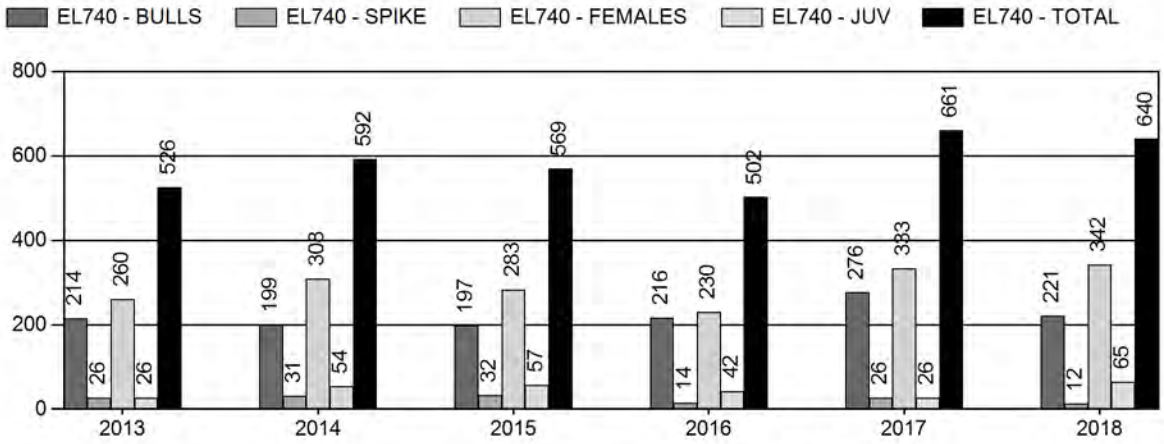
2018 - JCR Evaluation Form

SPECIES: Elk
PERIOD: 6/1/2018 - 5/31/2019
HERD: EL740 - BLACK HILLS
HUNT AREAS: 1, 116-117
PREPARED BY: JOE SANDRINI

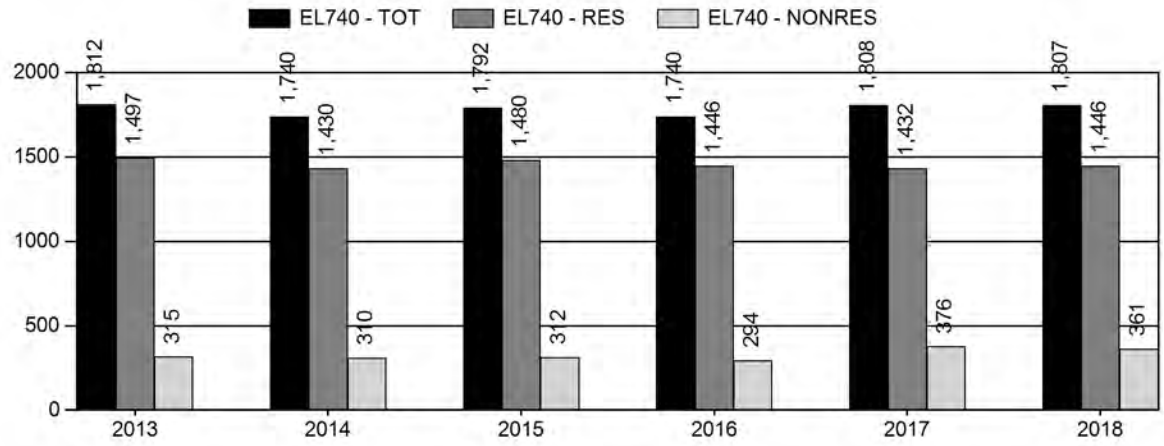
	2013 - 2017 Average	2018	2019 Proposed
Hunter Satisfaction Percent	52%	59%	60%
Landowner Satisfaction Percent	53%	55%	60%
Harvest:	570	640	750
Hunters:	1,778	1,807	1,875
Hunter Success:	32%	35%	40%
Active Licenses:	1,874	1,872	1,500
Active License Success:	30%	34%	50%
Recreation Days:	18,208	16,207	17,200
Days Per Animal:	31.9	25.3	22.9
Males per 100 Females:	32	47	
Juveniles per 100 Females	41	44	
Satisfaction Based Objective			60%
Management Strategy:			Private Land
Percent population is above (+) or (-) objective:			-3%
Number of years population has been + or - objective in recent trend:			5



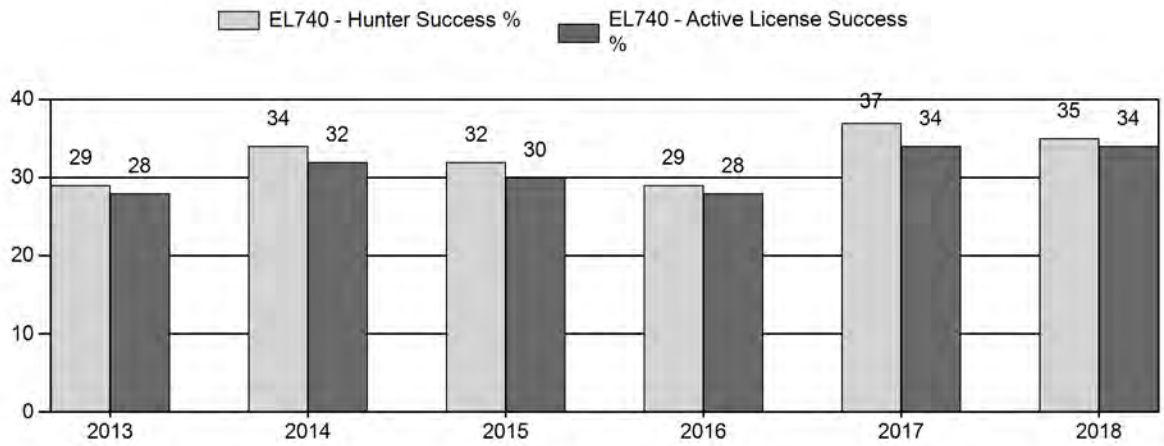
Harvest



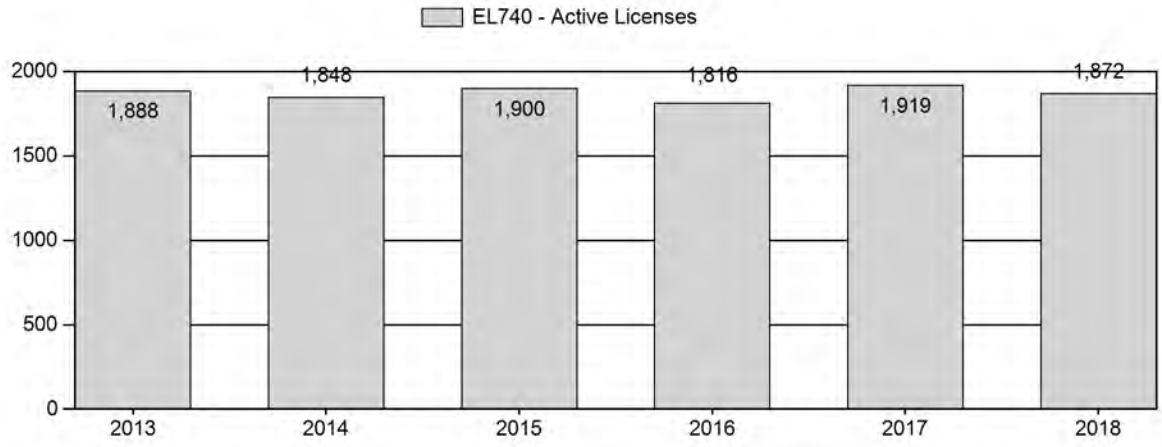
Number of Hunters



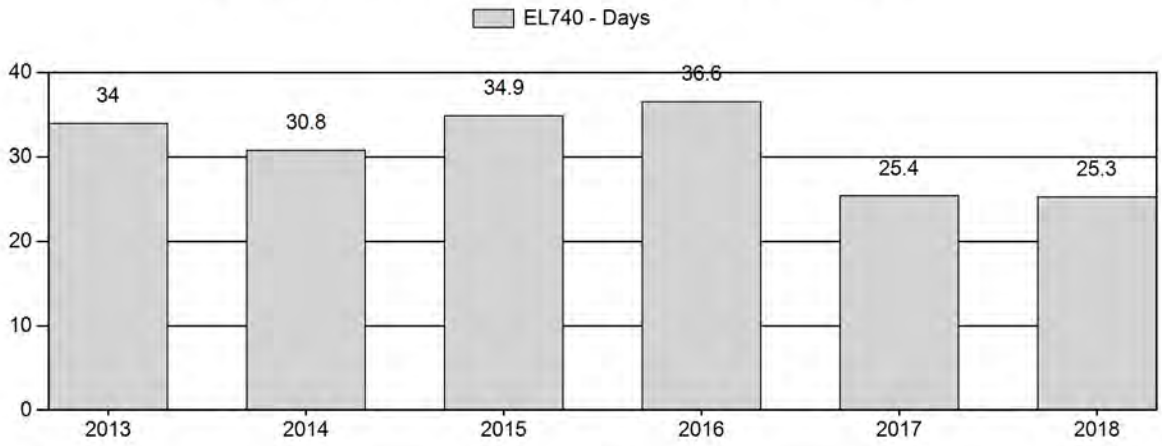
Harvest Success



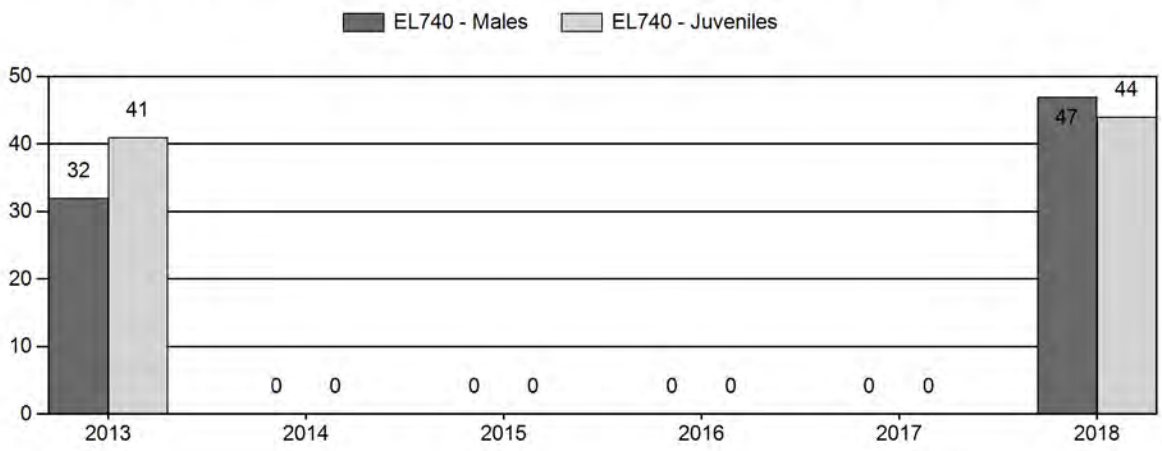
Active Licenses



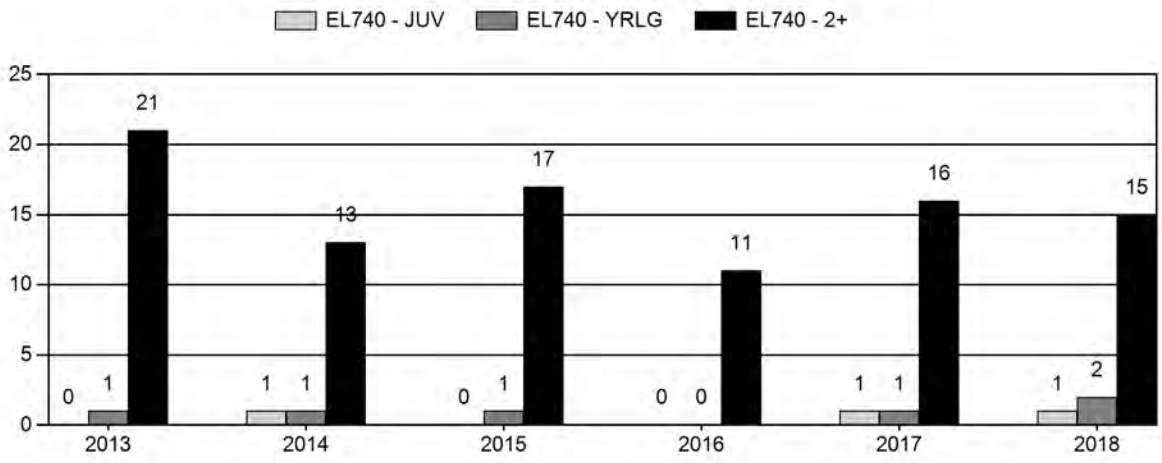
Days per Animal Harvested



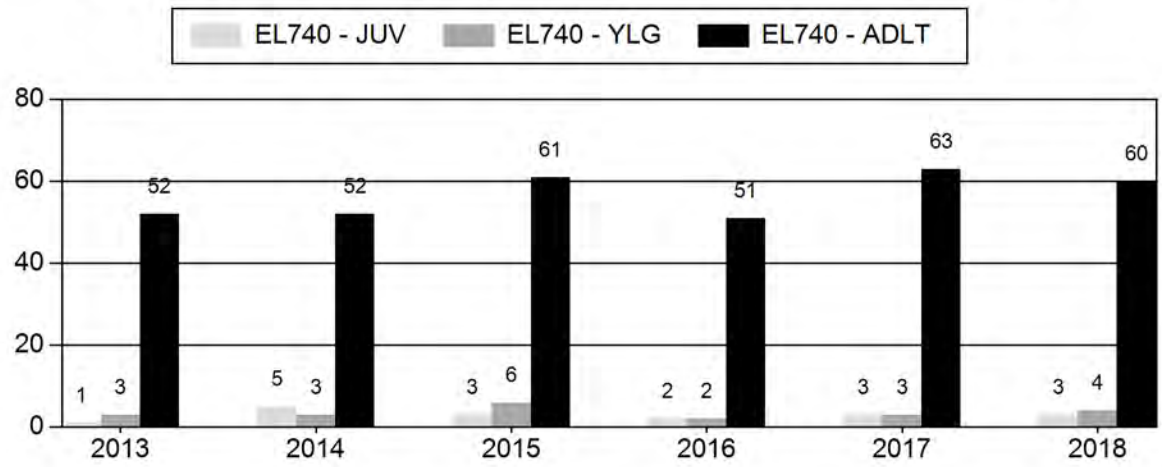
Postseason Animals per 100 Females



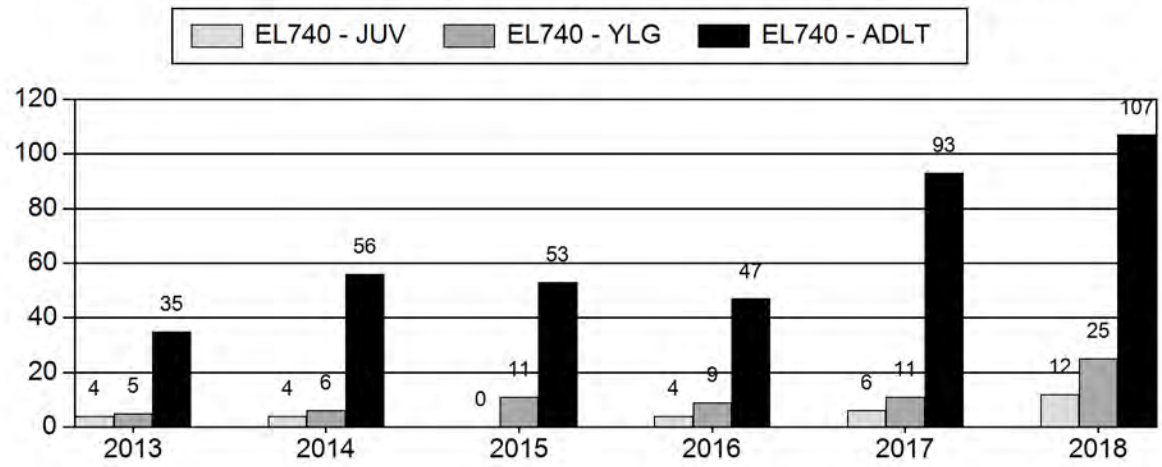
Age Structure of Field Checked Males



Age Structure Data (Field and Laboratory) - Male



Age Structure Data (Field and Laboratory) - Female



2013 - 2018 Postseason Classification Summary

for Elk Herd EL740 - BLACK HILLS

		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	0	19	24	43	19%	133	58%	54	23%	230	0	14	18	32	± 0	41	± 0	31
2014	0	0	0	0	0%	0	0%	0	0%	0	0	0	0	0	± 0	0	± 0	0
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%	0	0%	0	0%	0	0	0	0	0	± 0	0	± 0	0
2017	0	0	0	0	0%	0	0%	0	0%	0	0	0	0	0	± 0	0	± 0	0
2018	0	47	79	126	25%	266	52%	116	23%	508	0	18	30	47	± 0	44	± 0	30

2019 HUNTING SEASONS
BLACK HILLS ELK HERD (EL740)

Hunt Area	Type	Season Dates Opens	Closes	Quota	License	Limitations
1	1	Oct. 15	Nov. 30	100	Limited quota	Any elk
1	4	Oct. 15	Nov. 30	75	Limited quota	Antlerless elk
116		Oct. 15	Nov. 10		General	Any elk
116		Nov. 11	Nov. 30		General	Antlerless elk
116	7	Aug. 15	Jan. 31	300	Limited Quota	Cow or calf valid off national forest
117	1	Oct. 15	Nov. 30	350	Limited quota	Any elk
117	1	Dec. 1	Jan. 31			Antlerless elk
	2	Oct. 15	Jan. 31	50	Limited quota	Spike or antlerless elk
117	4	Oct. 15	Jan. 31	200	Limited quota	Antlerless elk
117	7	Aug. 15	Jan. 31	400	Limited quota	Cow or calf valid off national forest

SUMMARY OF CHANGES IN LICENSE NUMBER

Hunt Area	License Type	Quota change from 2018
116	6	- 250
	7	+ 300
	8	- 50
117	1	+ 50
	2	+ 50
	4	- 50
Herd Unit Totals	**1**	**+ 50**
	2	**+ 50**
	4	**- 50**
	6	**- 250**
	7	**+ 300**
	8	**- 50**

Management Evaluation

Current Hunter Satisfaction Management Objective: 60%
Current /Landowner Satisfaction Management Objective: 60%
Management Strategy: Private Land
Secondary Management Strategy: Age distribution of harvested bulls

2018 Hunter Satisfaction Estimate: 59%
2018 Landowner Satisfaction Estimate[1]: 55%

Most Recent 3-year Running Average Hunter Satisfaction Estimate: 56%
Most Recent 3-year Running Average Landowner Satisfaction Estimate[2]: 56%

2018 Postseason Population Estimate: *~ 2,500 (Anecdotal Field Estimate)*
2019 Proposed Postseason Population Estimate: *~ 2,500 (Anecdotal Field Estimate)*

HERD UNIT ISSUES: The Black Hills Elk Herd is managed for 60% or greater landowner and hunter satisfaction. The management strategy is private land, with a secondary management objective seeking an annual bull harvest (based upon tooth age data) comprised of 20% aged ≤ 2 years old; 60% aged 3 to 5 years old; and 20% aged 6 years old, or older *(± 5% in all categories).* These management objectives and strategies were adopted in 2013 and renewed in 2018. Based upon anecdotal observations, field personnel estimate Wyoming's Black Hills elk population to have numbered around 2,500 at the close of the 2018 hunting season (01/31/19). This estimate of wintering elk in Wyoming does not take into account the significant (but unknown) number of elk that move into South Dakota for the winter that are normally present in Wyoming from late spring through early January.

We can neither construct a population model, nor generate a population estimate for this herd as the Department has historically not been able to collect adequate classification data. Additionally, radio collar data show substantial numbers of elk regularly cross the Wyoming / South Dakota Stateline violating the closed population assumption of models. Consequently, no attempts have been made to model this population since 1996. As a result, the aforementioned non-numerical management objectives were adopted.

The Black Hills Elk Herd Unit is comprised of Hunt Areas (HA's) 1, 116, & 117. It is located in the northeast corner of Wyoming and encompasses approximately 3,270 mi^2, of which 1,920 mi^2 are considered occupied habitat. Elk are not ubiquitous across occupied habitat. Rather, they tend to move about depending upon range conditions, snow depth and human activity, with some areas seeing regular elk use and others very infrequent use. Approximately 73% of the occupied habitat is private land, with the single largest block of public land being found on the Black Hills National Forest (BHNF), which contributes 14% of the occupied habitat. HA 1 is 97% public land, and represents the largest contiguous block of public land extensively inhabited by elk. Elk do occur

[1] Percentage of landowner respondents to survey indicating elk numbers "at or about at desired level."
[2] Mean percentage of landowner respondents to survey indicating elk numbers "at or about at desired level" (bio-yrs. 2016-2018).

on other portions of the Black Hills National Forest and dispersed sections of State and other federally owned lands. However, elk use and hunter harvest in those areas are irregular.

The adopted management framework states all landowners receiving landowner elk licenses and other landowners whose property see regular elk use, or have expressed an interest in elk management will receive a mail survey with prepaid response envelopes every three years; and annual, documented one on one visits will be conducted on non-survey years (annual meeting with "key" landowners).[3] However, since 2015, we have been conducting the former in lieu of the latter based upon administration direction. Landowner satisfaction with elk numbers was first quantified in bio-year 2012 with the proposal to move to a non-numerical objective. At that time, slightly more than 60% noted they were satisfied, very satisfied, or neutral with respect to elk numbers.

The criteria used to gauge landowner satisfaction were formalized in bio-year 2014 by Wildlife Division Administration when it was deemed landowners reporting elk numbers to be "at, or about at" desired levels were to be considered satisfied, while those reporting numbers above or below desired levels categorized as unsatisfied. As such, survey results for bio-years 2012 and 2013 were reanalyzed using these criteria where they could be teased from the responses collected. Consequently, the recorded satisfaction values were changed to 59% and 43% for bio-years 2012 and 2013, respectively. Unfortunately, due to the timing of survey efforts and administrative direction regarding satisfaction measurement criteria, no landowner satisfaction survey data meeting the revised standards were collected during 2014.

Since 2016, each January a pre-paid return mail survey has been sent to about 160 Black Hills landowners who receive landowner elk licenses, whose property see regular elk use, or have expressed an interest in elk management. Subtracting for undelivered surveys, the response rate has declined steadily from 53% in 2016 to 49% this year. Responses are summarized in Figures 1, 2 & 3. Landowner satisfaction and the reasons for satisfaction are not strictly tied to perceptions of elk numbers. Therefore, they cannot be directly compared to hunter satisfaction measures, because quantifying criterion for each group are different. Consequently, using reports of "at," "above," and "below" desired levels as satisfaction measures is inappropriate. These statements are not measures of satisfaction per se, and while they may be associated to some degree with satisfaction, they are simply subjective indications of perceived elk numbers relative to personal desire. Therefore, to tease out true satisfaction and be consistent with harvest survey data, each year landowners are specifically asked to identify their satisfaction level with elk numbers as very dissatisfied, dissatisfied, neutral, satisfied, or very satisfied (Figure 2). We also ask a follow up question to quantify reasons for dissatisfaction (Figure 3). Each year the number of respondents indicating they are not specifically dissatisfied with elk numbers (satisfied + very satisfied + neutral) has been greater than those reporting elk numbers were "at or about at" desired levels.

[3] See "Final Black Hills Herd Unit and Population Review" adopted by the Dept. and Commission in 2013.

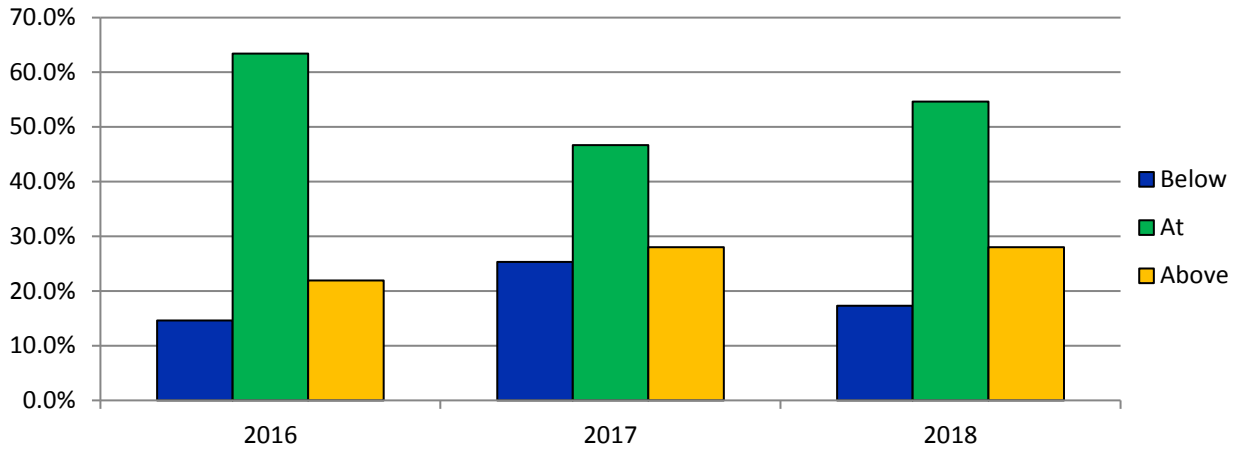


Figure 1. Proportions of Black Hills landowner reporting perceptions of elk numbers relative to "desired level."

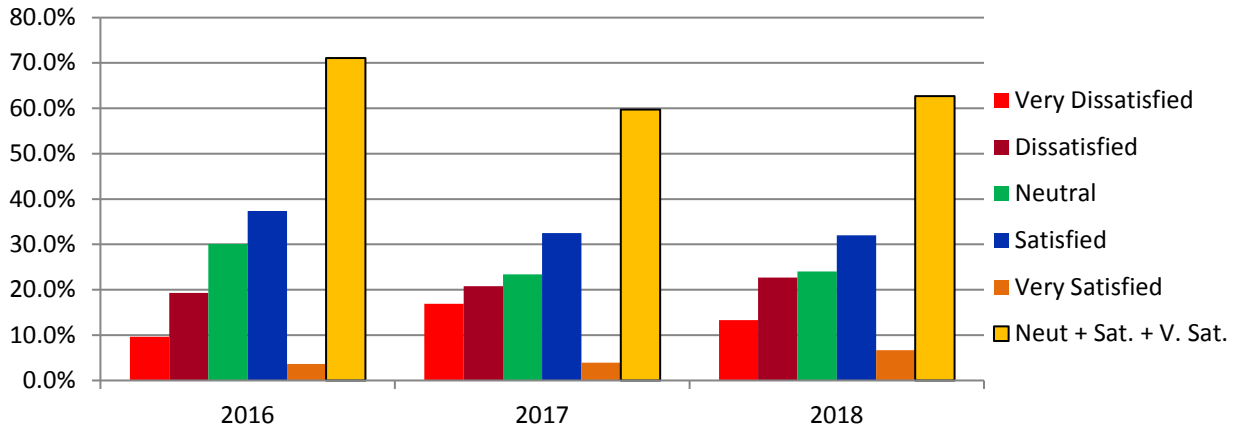


Figure 2. Percentages of landowners reporting various satisfaction levels with elk numbers in the Black Hills.

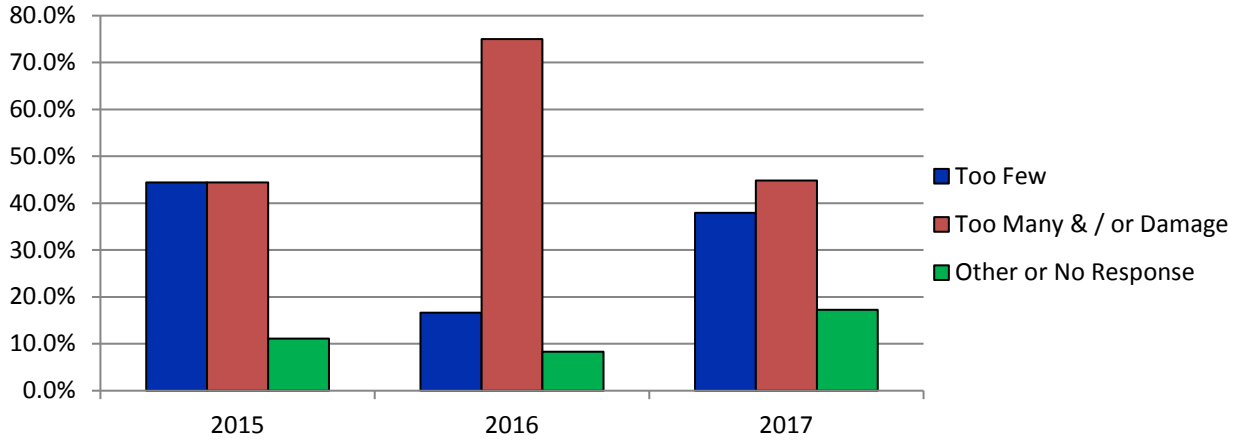


Figure 3. Reason(s) for dissatisfaction with elk numbers in the Black Hills.

These survey data demonstrate how difficult it is to broadly quantify landowner satisfaction. Most private land holdings in the Black Hills are relatively small by typical Wyoming ranch standards, and many are not dependent on agriculture for profit. A significant portion of these landowners enjoy having elk around and would like to see more, as would other non-traditional landowners who have purchased property for hunting. On the other hand, there are traditional ranching landowners negatively impacted by elk and frustrated with the damage they cause along with the lack of hunting on adjoining or nearby properties. As such, these two contingents are diametrically opposed in what they desire in the way of elk numbers. The result is conflict between the disparate positions, with both contributing to dissatisfaction with elk numbers. Overall, field personnel report wide-ranging ambivalence among landowners regarding elk management, with some noting conflicts and dissatisfaction and others expressing real satisfaction, or a desire for more elk.

In the normal course of duties, Department field personnel contact landowners on an almost daily basis. Complaints about elk numbers are recurrently received from the same cadre of landowners who endure regular pasture use by elk, damage to fences, and crop depredation. In FY18, there was a single elk damage claim from the Sundance game warden district and eight claims (stemming primarily from two landowners) in the Newcastle game warden district. The claims totaled $61,489.38 of which $38,011.37 was paid. Paid claims were for damage to growing cultivated crops, improvements, and extraordinary damage to grass. Given landowner attitudes, landownership patterns, and disparate access for public hunting, damage claims will persist no matter what hunting season structures are put in place.

WEATHER: For the most part, winter weather and growing season conditions over most of the past decade in the Black Hills have been neither specifically detrimental, nor abundantly beneficial for elk. However, fluctuations in weather patterns such as transient drought periods, a few significant snow events, and persistent deep snow at times have intermittently impacted herd demographics and exacerbated damage. Severe drought plagued the Black Hills in 2012, and drought again beset the majority of the herd unit during the primary growing seasons of 2016 and 2017. These ephemeral droughts resulted in poor to very poor forage production and led to several large wildfires. Consequently, over the past decade, elk have entered winter in good condition, except in 2012, and possibly again in 2016, and 2017.

During the 2013 to 2015 inter-drought period, above average temperatures and rainfall characterized growing seasons. This resulted in good to excellent forage production each year. Fall and winter weather over this same timeframe was dominated by normal to above average temperatures and average to below normal precipitation. Consequently, productivity and survival of elk was excellent. However, on the heels of drought ridden summers in 2016 and 2017, more normal to severe winter weather was experienced as temperatures were close to average or below, and total precipitation received was normal or above normal most months. These conditions may have lowered yearling recruitment in 2017, but did not appear to affect it in 2018 (Figure 4). In fact, forage growth in 2018 was very good with above average moisture and close to normal temperatures during the growing season. However, the 2018-19 winter presented below normal temperatures and above average snowfall. Given the drought in 2016 & 2017, more severe winter weather since, and increased antlerless harvest, transient improvements in this herd's performance may be beginning to reverse themselves. See http://www.ncdc.noaa.gov/cag/ for weather information.

HABITAT: The Black Hills is the western most extension of many eastern plant species. These species are often found mixed with more typical western plants providing a large variety of habitats used by elk. Ponderosa pine (*Pinus ponderosa*) is the predominant overstory species. There are scattered patches of quaking aspen (*Populus tremuloides*), paper birch (*Betula papyrifera*), bur oak (*Quercus macrocarpa*), and true mountain mahogany (*Cercocarpus montanus*). Many of these stands are in late successional stages. Important shrubs include Saskatoon serviceberry (*Amelanchier alnifolia*), Oregon grape (*Berberis repens*), common chokecherry (*Prunus virginiana*), and wild spiraea (*Spiraea betulifolia*). Since 2000, wildfires in both Wyoming and South Dakota have burned well over 10% of the BHNF and significant amounts of private land in this ecosystem. These fires have been beneficial for elk by creating early succession plant communities and increasing available forage. However, there are no habitat evaluation or vegetation surveys located within this herd unit related to elk forage or cover.

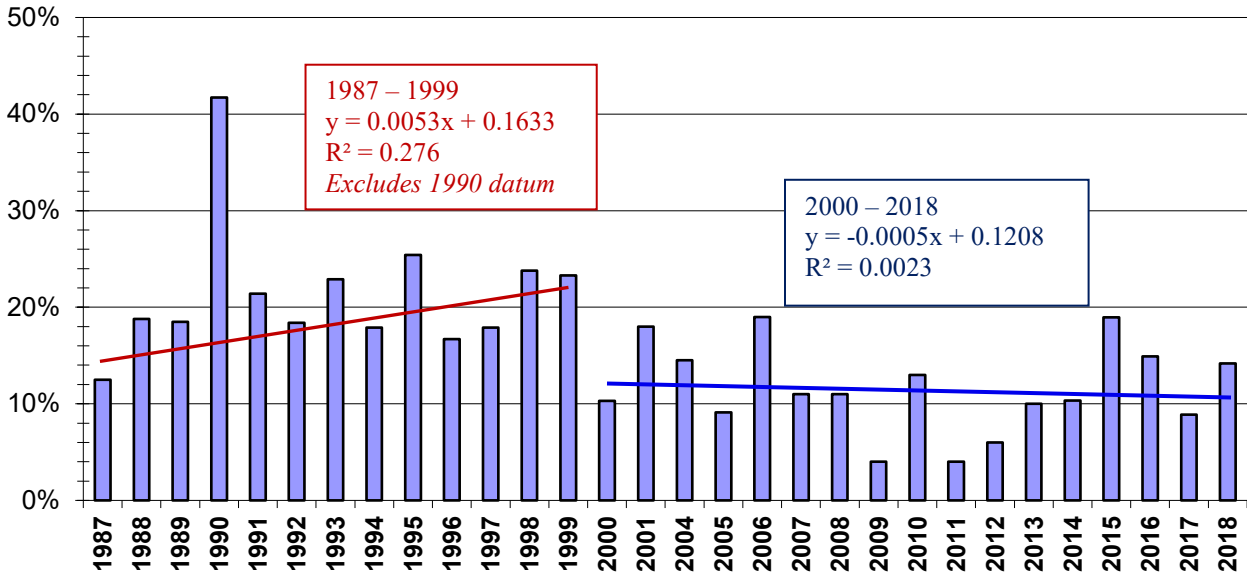
Elk habitat quantity and quality are thought to be good, but security areas may be impacted or lacking in areas due to high road densities. These road densities, along with vast tracts of commercially thinned ponderosa pine stands, do not provide what is usually considered classic, good elk habitat. Despite the lack of escape cover in areas, the elk population significantly expanded through the 1990's and into the early years of the next decade. Several factors benefited this population. First, herbaceous forage is abundant, and wildfires have increased annual forage production. Second, despite high road densities, much of the land inhabited by elk is privately owned. This private land has lower road densities and experiences limited human activity. Many of these same private land areas provide elk refuge from hunting pressure during the fall. Also benefiting the situation, the number of road closures increased on the Black Hills National Forest in 2010 when USFS adopted a new travel management plan.

FIELD DATA: Collection of regular classification data was suspended in 1996, and only occasionally are limited classification data garnered during other field activities. These limited data collected over the years have generally reflected larger samples collected in the Black Hills of South Dakota by SDGF&P. SDGF&P collects preseason classification data most years, and since 2003 these data have consistently yielded calf:cow ratios near 50:100, but more variable bull:cow ratios, which have averaged near 30:100. It is believed SDGF&P's observed bull:cow ratio is low due to classifications be conducted outside the rut and from the ground.

In 2015, WGFD partially funded SDGF&P's helicopter-based late winter elk survey. This funding was used to pay for SDGF&P's survey efforts in much of the occupied habitat south of Interstate Highway 90 (I-90) within HA 117. That effort detected a total of 923 wintering elk. Of the elk observed, SDGF&P personnel were able to classify 516 (262 cows, 52 calves, and 202 bulls). The 407 unclassified elk were primarily large groups of cows and calves. Assuming these unclassified elk were cow:calf groups and had a similar calf:cow ratio as those classified, the post-season bull:cow ratio would have been about 35:100 (which is a decent estimate, but probably low). Managers are considering standardizing this type of data collection in future years, at least in that portion of Wyoming south of I-90 harboring wintering elk. Should budgetary constraints allow, periodic winter trend / sightability surveys may possibly become the basis for a mid-winter trend count objective with good classification data.

In early March of 2019, the opportunity presented itself to aerially classify elk in a large portion of HA 117 north of Highway 16. That effort resulted in 508 elk being classified, and yielded an observed calf:cow ratio of 44:100. A total bull:cow ratio of 47:100 was found, with 37% of the bulls observed being spike elk. This resulted in a spike:cow ratio of 18:100 and a mature bull:cow ratio of 30:100. Of the mature bulls categorized by antler class, 83% were class II bulls and 17% class I. Snow cover and weather conditions during this survey were excellent, and the personnel conducting the survey felt as if detectability of elk was about 50%. In addition to this classification effort, during mule deer and bighorn sheep classification flights on Elk Mtn. about 300 unclassified elk were observed in HA 117 south of Highway 16 near the Wyoming Stateline south of Clifton Canyon.

Tooth age data have been collected from harvested elk most years since 1987.[4] Tooth age data can estimate annual recruitment via the percentage of yearlings in the female segment of the harvest (Figure 4). Since 1987, this figure has averaged 15% (std. dev. 5.9%)[5] suggesting on average 30 yearling elk (cows and bulls combined) are added per 100 adult cows into this population. However, as noted in previous reports (2015 EL740 JCR), recruitment of yearling elk has been significantly lower since 2000, but appears to be increasing. Because of this and enhanced license issuance with extended hunting seasons, there had been a general decline in the harvest of female elk over age five and a slight increase in the relative number of younger (0 - 2 year old) elk taken, while the relative percentage of mid-aged cows has remained fairly stable (Figure 5). However, it is notable that in 2015 & 2016 the percentage of very young cows in the female harvest increased following a couple excellent production and recruitment years. Similarly, the yearling buck:doe ratios in sympatric deer herds increased noticeably in 2015 & 2016 as well, suggesting strong production and recruitment in 2014 & 2015 amongst Black Hills ungulates. Then, in 2017 and 2018, as the calves from 2014 and 2015 aged, a larger percentage of 3-5 year old females were harvested.



[4] Budgetary constraints prevented tooth age data collection in 2002 & 2003.
[5] Omits 1990 data – the inclusion of which raises the average to 15.9% with a std. dev. 7.5%.

Figure 4. Percentage of yearlings in the female segment of the elk harvest (1987 – 2017).

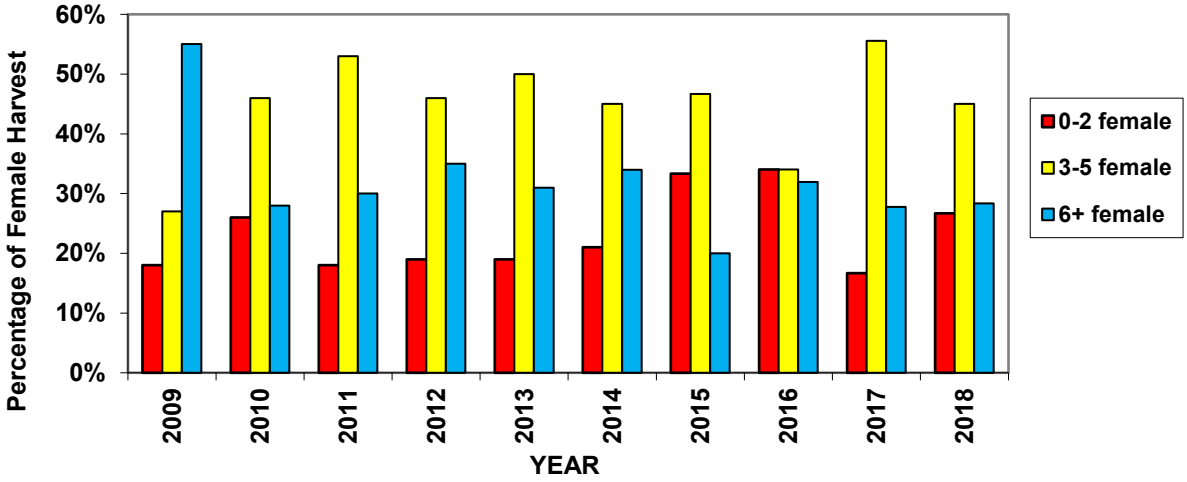


Figure 5. Relative percentages of various age classes of female elk harvested (2009 – 2018).

Of course there is hunter selectivity when it comes to take of bulls. Between 2000 and 2009, tooth age data suggested a slight decline in the relative percentages of both middle-aged (3-5 year old) and young ($\leq$ 2 years old) bulls in the harvest, and an increase in the percentage of older bulls (6^{+} years old) taken. However, since 2010 this trend seems to have reversed itself, as it now appears the trend is towards harvesting fewer young and old bulls, but more middle aged (3-5 year old) bulls (Figure 6). Considering the relatively larger increases in antlerless versus bull harvest in recent years, we have more significantly affected the antlerless segment of the herd. This is apparent in the increasing percentage of female elk in the harvest, which has outpaced take of bulls. Elevated female harvest must be contributing to increasing bull:cow ratios, and perhaps changes in the age distribution of harvested bulls. If this population was rapidly expanding or in decline, given the relatively stable bull harvest, one would expect to see a greater percentage of younger aged bulls harvested. This is because if the population was rapidly increasing, the vast majority of bulls would be young, while in a significantly declining population, the availability of older bulls would drop with decreased recruitment. Thus, it is possible (at least south of I-90) that herd growth has stabilized through antlerless harvest, and bulls are now being under-harvested, leading to an increase in the number of middle-aged bulls taken (Table 1) and the high, observed bull:cow ration found in HA117. Further, local managers report seeing what appears to be an increase in the total number of bulls along with many harvested bulls with broken antlers. Total bull harvest has also increased the past couple of years without significant changes in license issuance. Finally, our ability to meet the secondary objective of age distribution of harvested bulls cannot be met without increasing harvest of younger bulls over the course of the next few years. Consequently, we are creating a Type 2 license valid for spike or antlerless to help manage bull numbers through increased take of younger bulls.

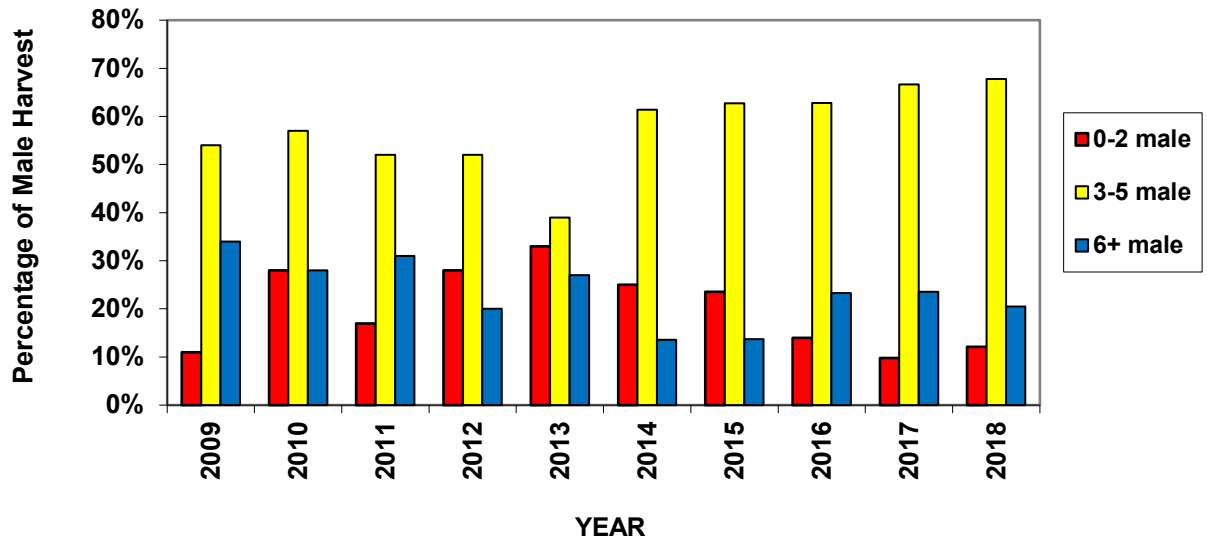


Figure 6. Relative percentages of various age classes of male elk harvested (2009 – 2018).

Segment of Bull Harvest	*Objective*	2016	2017	2018
Bulls 0-2 yrs. old	*20%*	14%	10%	12%
		3 yr. mean		12%
Bulls 3-5 yrs. old	*60%*	63%	67%	73%
		3 yr. mean		68%
Bulls 6+ yrs. old	*20%*	23%	24%	14%
		3 yr. mean		21%

Table 1. Secondary management objective, relative distribution of ages of harvested bulls

HARVEST: The percentage of yearling females in the harvest since 2000 suggests reduced recruitment, as does the fact elk have not been pioneering into unoccupied habitats as they once had. However, the bulk of tooth age data have been returned from elk harvested south of I-90 (HA's 1 & 117), with the vast majority coming from HA 117. Therefore, any changes in recruitment should only be ascribed to that segment of the herd. It does seem harvest rates adequate to manage elk numbers may be achieved some years south of I-90, but poor success by hunters pursuing female elk in HA 116 is likely allowing that portion of the herd to grow. Fluctuating elk management in South Dakota and interstate elk movement further confound our ability to make herd-wide judgments relative to our harvest's capacity to manage elk numbers.

Elk harvest bounced back to "average" levels in 2014, as weather conditions allowed hunters easier access to elk compared to 2013 when travel was severely hindered by winter storm "Atlas." In

2015, with the same hunting season structure in place as the previous two years, total harvest fell midway between that experienced in 2013 and 2014. Field personnel also reported that hunters seemed to struggle a bit more to find and harvest elk in 2015. The same scenario played out in 2016 with fewer total elk being harvested compared to 2015, again with the same season structure in place. In 2017, harvest improved as weather for elk hunting was favorable and creation of a Hunter Management Assistance Program (HMAP) in HA 117 resulted in 58 antlerless elk taken that otherwise likely would not have been killed. Overall, the 2017 harvest was 20% above the average witnessed the preceding seven years (Figure 7). Increased harvest was again experienced 2018 as access to elk hunting improved with more properties enrolled in the HMAP program (resulting in 68 elk harvested), and excellent weather for elk hunting most of the season.

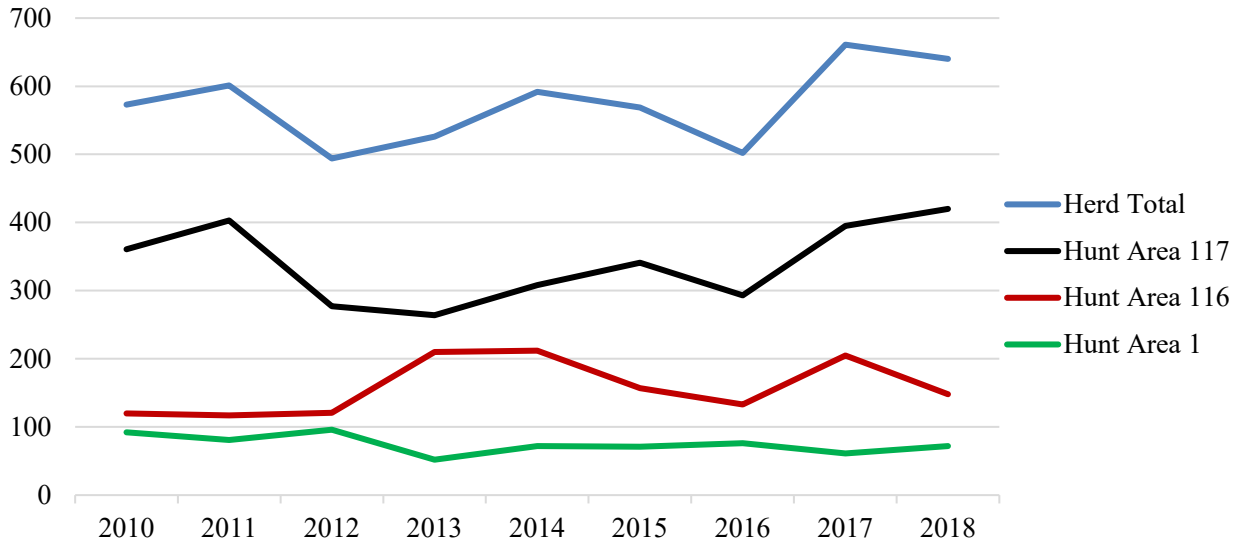


Figure 7. Total Elk Harvest by Hunt Area and Herd Unit (2010 -2018)

In 2017, with the advent of the HMAP and use of the smartphone mediated check station application, the number of field-checked elk increased substantially. This trend continued in 2018, when the number of field-checked elk was further enhanced due to increased Chronic Wasting Disease (CWD) testing. Of the 42 hunter-killed elk tested for CWD, one was positive - yielding a prevalence of 2.4%. The infected elk being a cow taken from HA 117 within the HMAP. Prior to this detection, no other hunter-killed elk had tested positive in this herd unit. Instead, of the 78 elk tested prior to 2018, only a single targeted surveillance elk was positive yielding a total prevalence of 1.2%.

Across Wyoming, elk hunter success is highly correlated with reported hunter satisfaction on a herd unit basis (close to 90% in many years). Beginning in 2013, HA 116 moved from limited quota license hunting to a liberal general license season combined with a significant number of cow/calf licenses. Due to very limited access to elk hunting on private land, this resulted in a large number of license holders hunting the BHNF north of Sundance where few elk reside. Consequently, since 2013 hunter success on general licenses has been very low, averaging 16%. Success on Type 6 cow/calf licenses has averaged only 22% and total active license success

averaged about 19%. These poor success rates are reflected in low hunter satisfaction in HA 116, which has averaged 45% during this same timeframe. That figure biases the herd unit hunter satisfaction numbers low, since well over 50% of the hunters at the herd unit level are sampled each year from HA 116. In contrast, since 2013, hunter satisfaction in HA 1 and HA 117 have consistently been above 60%, and in 2018 it was 74% and 67% in those HA's, respectively.

Given an annual recruitment of 30 yearling elk per 100 cows and assuming a pre-season herd composition of 45 bulls per 100 cows and 50 calves per 100 cows, the 2018 harvest of 575 adult elk (640 total) would have removed the annual recruitment of yearlings from a total population of about 3,750 elk.[6] Thus, based upon anecdotal observations of elk, the 2018 harvest should have reduced this herd some. However, because substantial numbers of elk regularly cross the Stateline and winter in South Dakota, it is difficult to determine the real effect harvest is having on our resident post-season population.

POPULATION: Despite the lack of a population estimate, indications are elk numbers increased substantially between 1990 and 2010 as elk greatly expanded their distribution. Silvicultural practices and wildfires throughout the region have created habitat favorable for elk; and, although habitat changes have favored elk in recent years, elk have not continued to pioneer into previously unoccupied areas. Harvest statistics and tooth age data suggest population growth may have been curbed recently, at least south of I-90. However, it is likely reproduction and survival between 2014 and 2016 allowed this sub-population grow. In contrast, harvest in 2017 and 2018 (45% above that experienced the previous four years) should have helped stabilize elk numbers somewhat, at least in the Newcastle area. Overall, elk numbers seem to be at levels generally supported by landowners who are not experiencing significant damage. Given the high quality habitat in the region, limited access to hunt elk on private land, and sustained high harvest rates of mountain lions, this herd will likely continue to exhibit growth potential in many areas due to limited private land access for hunting.

MANAGEMENT SUMMARY: In 2016, the aforementioned landowner survey contained the following question: "If you think elk numbers are too high, how can we work together to substantially reduce the herd size through public hunting?" Unfortunately, no viable or positive answers were returned. Similarly, in 2017, survey respondents who did not support the current management objectives failed to provide a single constructive alternative when asked. These facts bear out that while some traditional landowners complain about elk numbers, few are willing to allow hunting at the levels needed to significantly reduce this population or work towards feasible solutions. However, beginning in 2017, two landowners in the Skull Creek drainage of HA 117 participated in a Hunter Management Assistance Program (HMAP) to address a sub-herd of about 300 head. To accommodate and facilitate this request, a Type 7 license valid in this portion of the area was added in 2017 with 50 tags available, and HA 117 Type 8 license issuance increased by 25. Then, in 2018, all Area 117 Type 6 and Type 8 licenses were converted to a Type 7 and were valid off National Forest from August 15 – January 31, and two more landowners added to the HMAP. As a result, 58 antlerless elk were harvested through the HMAP in 2017 and 68 in 2018 (accounting for about 20% of the elk harvested in HA 117 both years). Overall, management tactics the past few years seem to be reducing or holding elk numbers in check where there is

[6] calf:cow:bull = 50:100:45 = 51.2% cows. 575/(0.15 X 2) = yrlg. recruitment harvest rate of 1,916 cows. 1,916/0.0512 = 3,742 hd. preseason.

adequate access for hunting, but allowing sub-herds to grow in areas where landowners continue to prohibit adequate hunter access.

Changes to the 2019 hunting season structure are intended to increase bull harvest where we believe this can have a positive effect (HA 117), and more precisely target antlerless harvest where it is most needed (HA 116 off National Forest). The HA 117 Type 1 increase should augment public hunting opportunity and bull harvest to some degree in this high demand area with strong bull numbers. Given the current age distribution of bulls, more older bulls (6^{+} yrs. old) will be available for harvest the next two to three years, and we expect the harvest percentage in this age class to increase with increased Type 1 license issuance. The new Type 2 license will provide an added incentive for folks to purchase a full price license designed to limit herd growth and encourage harvest of younger bulls. This latter condition being necessary to meet our secondary management objectives, as the percentage of younger aged bulls (less than 2 yrs. old) has been declining. Local managers believe private land access for spike hunting will be generally better than for mature bull hunting. Something that should foster success on the new type 2 license. Increases in bull harvest in the older and younger age classes will help begin to bring bull:cow ratios down and reduce the occurrence of broken antlers, along with dropping the percentage of middle aged (3-5 yrs. old) bulls taken.

Consolidating Type 6 and Type 8 licenses in HA 116 into a single Type 7 tag valid off National Forest follows a similar change in HA 117 last year, one that bolstered targeted harvest of elk on private land. This consolidation also simplifies regulations related to cow/calf licenses. Finally, by restricting all Type 7 licenses in the herd unit to lands off National Forest, we can reduce crowding on publically accessible National Forest harboring elk, segregate archery and firearm hunters on these public lands, and provide some incentive for purchasing a full price antlerless or spike/antlerless license.

Given recent hunter participation and success rates and increased license issuance, the 2019 harvest should result in about 685 total elk taken (300 bulls, 320 cows, & 65 calves). This estimate is predicated on another successful HMAP. If these projected harvest levels are reached, elk numbers could decline slightly south of I-90, while elk numbers north of the Interstate will likely continue to increase. Based upon an estimated preseason herd composition of 45:100:45 (calf:cow:bull) and a recruitment rate of 30 yearling elk per 100 cows, a harvest of 680 adult elk would remove the annual yearling recruitment from a herd of around 4,400 elk (all age classes).

2018 - JCR Evaluation Form

SPECIES: Elk

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

HERD: EL741 - LARAMIE PEAK/MUDDY MOUNTAIN

HUNT AREAS: 7, 19

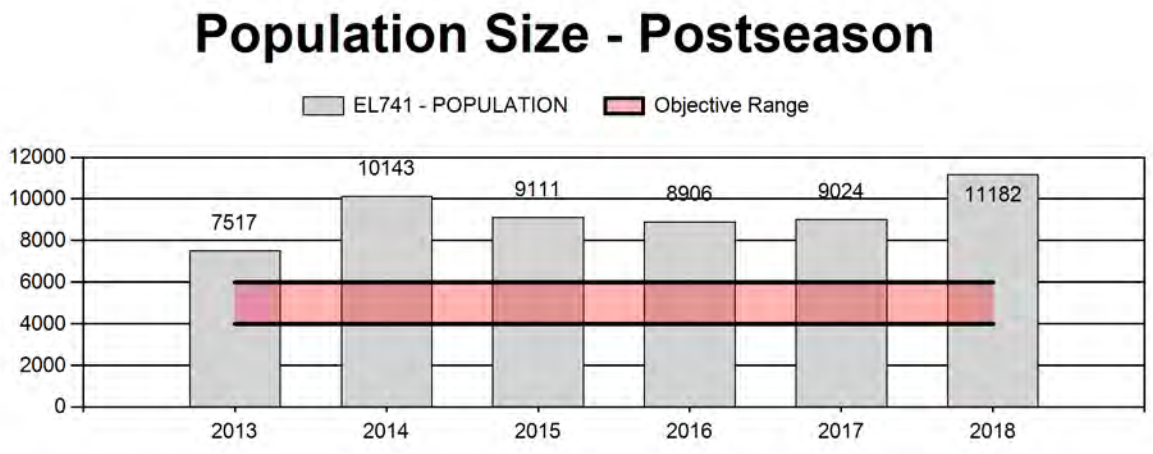
PREPARED BY: HEATHER O'BRIEN

	2013 - 2017 Average	2018	2019 Proposed
Population:	8,940	11,182	11,000
Harvest:	2,474	2,132	2,360
Hunters:	4,885	4,824	4,850
Hunter Success:	51%	44%	49%
Active Licenses:	4,979	4,955	4,980
Active License Success:	50%	43%	47%
Recreation Days:	36,775	34,713	36,200
Days Per Animal:	14.9	16.3	15.3
Males per 100 Females	30	51	
Juveniles per 100 Females	35	42	

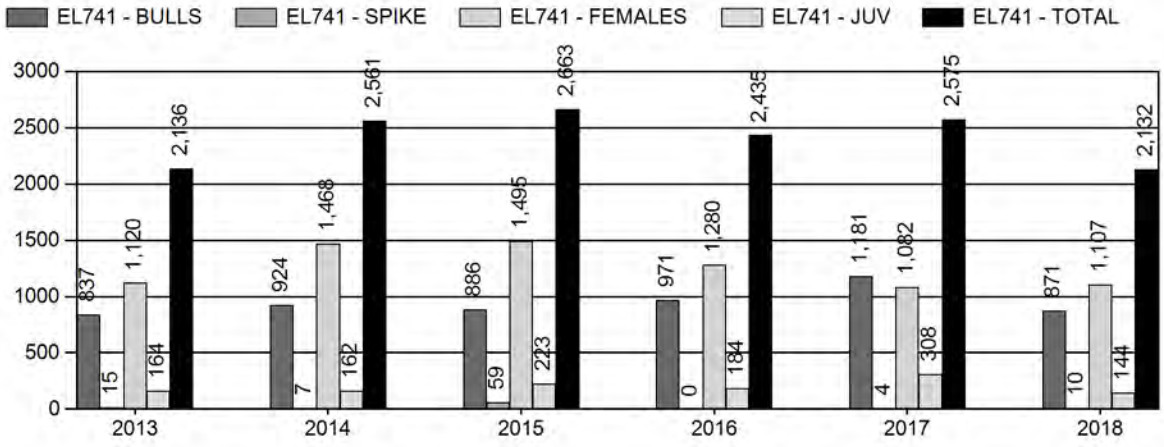
Population Objective (± 20%) :	5000 (4000 - 6000)
Management Strategy:	Special
Percent population is above (+) or below (-) objective:	124%
Number of years population has been + or - objective in recent trend:	18
Model Date:	03/04/2019

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

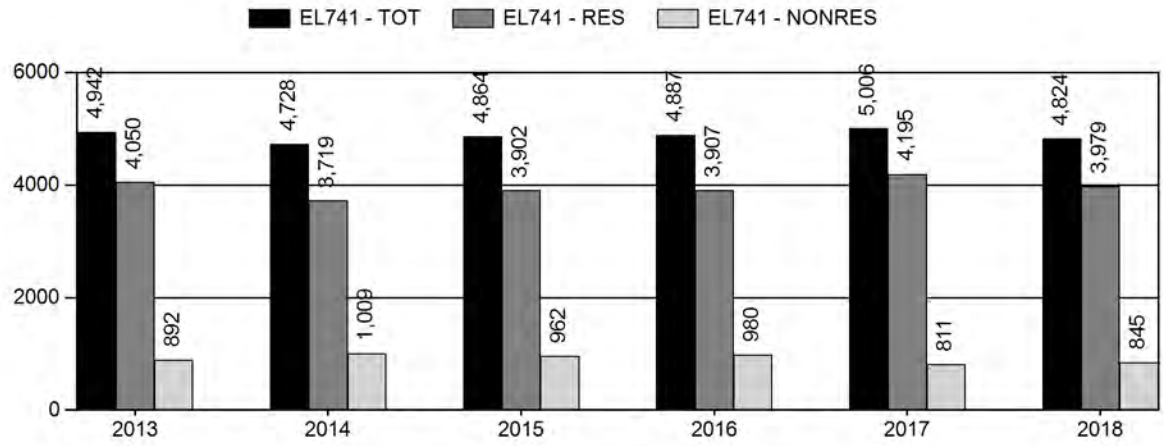
	JCR Year	Proposed
Females ≥ 1 year old:	0.%	0%
Males ≥ 1 year old:	0%	0%
Total:	0%	0%
Proposed change in post-season population:	0%	0%



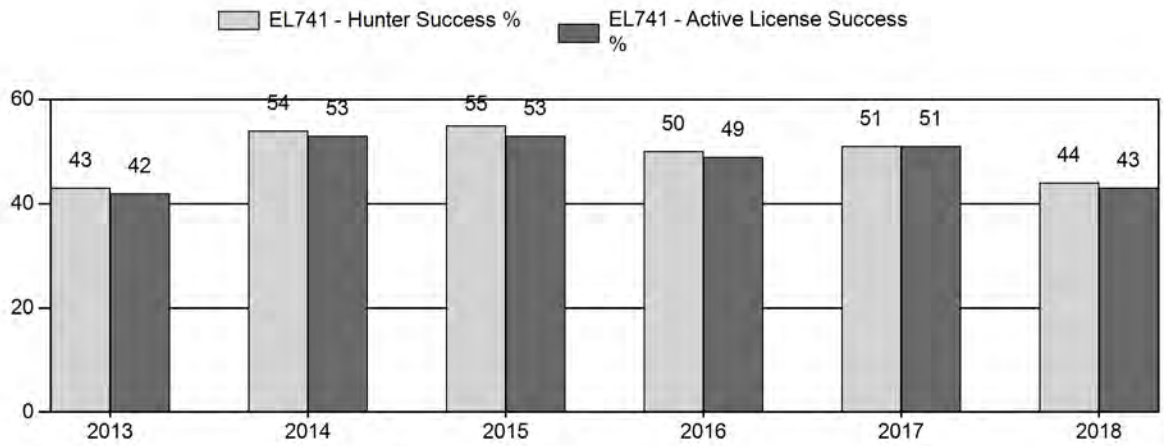
Harvest



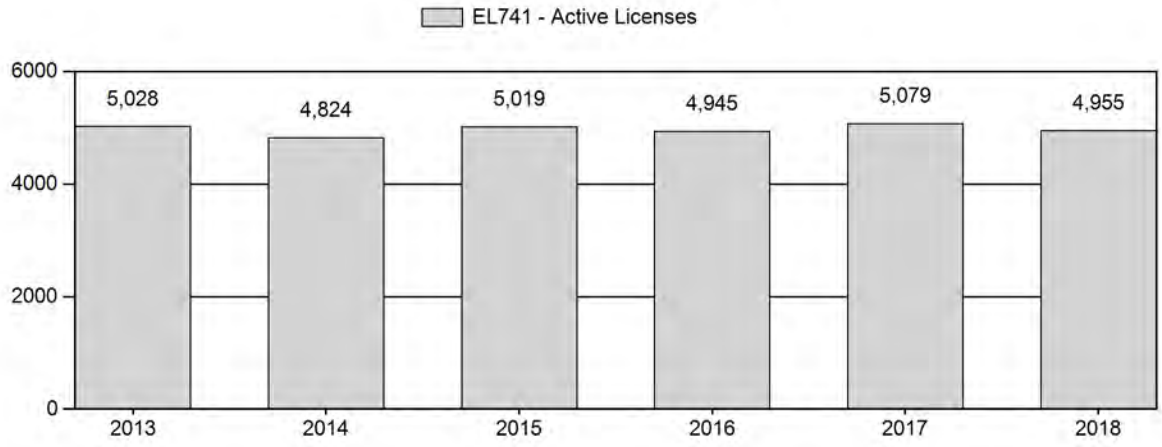
Number of Hunters



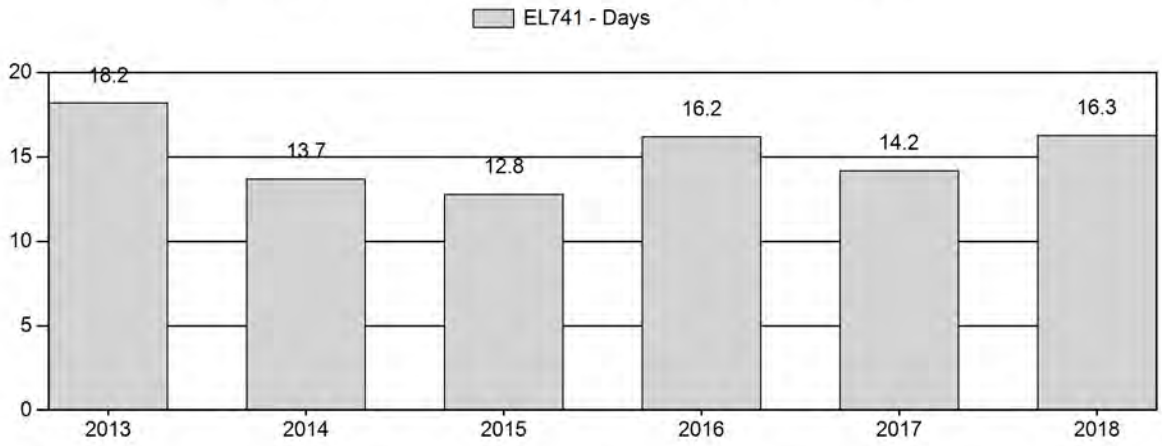
Harvest Success



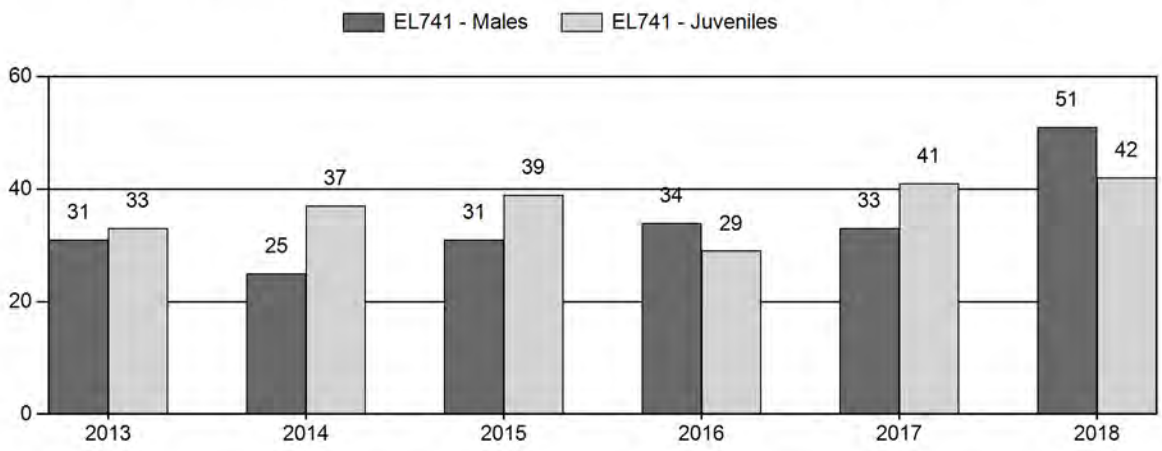
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2013 - 2018 Postseason Classification Summary

for Elk Herd EL741 - LARAMIE PEAK/MUDDY MOUNTAIN

		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	7,517	328	487	815	19%	2,605	61%	869	20%	4,289	535	13	19	31	± 1	33	± 1	25
2014	10,143	383	468	851	15%	3,454	62%	1,270	23%	5,575	592	11	14	25	± 1	37	± 1	30
2015	9,111	404	485	889	18%	2,882	59%	1,116	23%	4,887	504	14	17	31	± 1	39	± 1	30
2016	8,906	383	581	964	21%	2,803	61%	806	18%	4,573	495	14	21	34	± 1	29	± 1	21
2017	9,024	211	339	550	19%	1,645	57%	674	23%	2,869	499	13	21	33	± 2	41	± 2	31
2018	13,319	853	1,630	2,483	27%	4,855	52%	2,021	22%	9,359	602	18	34	51	± 1	42	± 1	28

2019 HUNTING SEASONS
LARAMIE PEAK MUDDY MOUNTAIN ELK (EL741)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
7	1	Oct. 15	Nov. 20	1,500	Limited quota	Any elk
		Nov. 21	Dec. 31			Antlerless elk
7	4	Oct. 15	Dec. 31	1,200	Limited quota	Antlerless elk
7	6	Aug. 15	Oct. 14	2,250	Limited quota	Cow or calf valid in Platte County and on private land in Albany and Converse Counties
		Oct. 15	Dec. 31			Cow or calf valid in the entire area
7	7	Jan. 1	Jan. 31	50	Limited quota	Cow or calf
19	1	Oct. 1	Oct. 14	150	Limited quota	Any elk
		Nov. 21	Jan. 31			Antlerless elk
19	2	Nov. 1	Nov. 20	150	Limited quota	Any elk
		Nov. 21	Jan. 31			Antlerless elk
19	4	Oct. 1	Oct. 14	125	Limited quota	Antlerless elk
		Nov. 21	Jan. 31			Antlerless elk
19	5	Nov. 1	Jan. 31	125	Limited quota	Antlerless elk
19	6	Oct. 1	Oct. 14	225	Limited quota	Cow or calf
		Nov. 1	Jan. 31			Cow or calf
Archery		Sep. 1	Sep. 30			Refer to license type and limitations in Section 2

Hunt Area	Type	Quota change from 2018
7	6	+200
7	7	-200
19	All	No changes

Management Evaluation

Current Postseason Population Management Objective: 5,000
Management Strategy: Special
2018 Postseason Population Estimate: 11,200
2019 Proposed Postseason Population Estimate: 11,000
2018 Hunter Satisfaction: 66% Satisfied, 18% Neutral, 16% Dissatisfied

The Laramie Peak / Muddy Mountain Elk Herd Unit has a postseason population management objective of 5,000 elk. The herd is managed using the special management strategy, with a goal of maintaining postseason bull ratios between 30-40 bulls per 100 cows and a high percentage of branch-antlered bulls in the male harvest segment. The objective and management strategy were reviewed in 2018 (Appendix B). Following an extensive review of surveys from landowners and hunters, no change in the population objective and special management strategy was made based on landowner input. Although this population far exceeds the management objective, there was strong landowner opposition to increasing the population objective. There are considerable challenges to managing this herd, with varying levels of hunter access to private lands and landowner tolerances for elk. Given the large amount of private land within this herd unit and persistent elk damage in some areas, managers give considerable deference to landowner input regarding the management of this herd. While many traditional livestock producers want elk numbers reduced, much of the occupied habitat is owned by non-traditional recreational landowners with much higher tolerances for elk. Thus, the objective of 5,000 elk postseason was maintained, although managers recognize it is likely unrealistic given the current elk population size coupled with restricted hunter access in many locations.

Herd Unit Issues

Hunting access within the herd unit is variable, with a mix of national forest, state lands, and private lands. The addition of Walk-In Areas and Hunter Management Areas greatly expands hunting opportunity within the herd unit as well. Landowners offer varying levels of access to hunting. While most landowners offer some form of access – whether it be free or fee hunting – there are a few ranches that offer little access. These areas tend to harbor high numbers of elk that are inaccessible during hunting seasons, and are problematic when trying to manage a population that is over objective. The main land use within the herd unit is traditional ranching and grazing of livestock; however several properties in the herd unit have become “non-traditional” in that they are owned by individuals who do not make a living by ranching their lands. Industrial-scale developments are minimal within this herd unit, though there is potential for the expansion of wind energy development. Chronic Wasting Disease is present in this herd with a prevalence typically averaging about 6% in hunter-harvested elk.

Weather & Habitat

The 2013-2014 winter brought temperature and precipitation conditions near the recent 30-year average, and the growing season of 2014 was one of the best the region had seen in years. Winter 2014-2015 was generally mild, and the 2015 growing season was just above average for the region. Fall of 2015 was relatively dry, and much of the herd unit remained accessible for hunting for the majority of the hunting season. The spring of 2016 was mild with above average precipitation, but became quite dry for the majority of the summer and fall. Fall temperatures were above average and elk activity was more limited to early morning and late evening, making hunting difficult. Late fall precipitation provided green forage and a nutritional boost for elk prior winter. The early winter of 2016-2017 was snowy, making access to hunt elk difficult in many parts of the herd unit. The growing season of 2017 was similar to the previous year, with a wet spring followed by a dry summer with little precipitation. There was little snow to speak of over the winter of 2017-2018, and access for January hunters was good. The 2018 growing season was average to dry, and water became scarce at higher elevation by fall. Winter conditions set into much of the region by mid-November, and snow accumulation at high elevation became significant over the winter of 2018-2019. Elk deserted most of their high-elevation ranges, and hunters were limited to a few access points at lower elevation during the winter cow season. Persistent snow and drifting hampered access for much of November through January, which was largely responsible for the reduced antlerless elk harvest in 2018. Calf survival for the winter of 2018-2019 may ultimately be below average if spring storms are severe enough to cause additional stress. For detailed weather data see http://www.ncdc.noaa.gov/gac/time-series/us.

Field Data

Calf ratios are typically in the 40s per 100 cows for the Laramie Peak / Muddy Mountain Elk Herd. Managers have high confidence in observed calf ratios from year to year, due to consistent large annual sample sizes of cow/calf groups during classification surveys. While calf survival can vary from year to year, adult elk in this herd are thought to have rather high rates of survival. Predation pressure is relatively low in the herd, and there is little mortality from disease and winter weather. Calf ratios averaged 37 per 100 cows from 2012-2016, which is lower than the long-term average of 43 (1991-2016). This may be due to a number of factors including stress on pregnant cows from extended hunting pressure, changes in habitat quality, or increased competition due to higher elk densities. Ratios were closer to the long-term average in 2017 and 2018 (41 and 42, respectively) despite continued harvest pressure on cows. Improved calf ratios may be more a reflection of mild winters and/or favorable habitat conditions in these years. While lower calf

production/survival from 2013-2016 may have slowed population growth slightly, continued high license issuance and harvest of cows is still necessary to reduce this herd toward objective.

Observed bull ratios for the Laramie Peak / Muddy Mountain Herd historically average in the mid-30s per 100 cows, though there have been years where the ratio has dropped below special management limits into the 20s. Prior to 2016, the accuracy of bull ratios was questionable from year to year in this herd, as sample sizes were highly variable. While post-season classification sampling effort is well distributed within this herd unit, changes in distribution of elk, ability to locate large cow/calf groups, and concealment of bulls in timber during January can influence results from year to year.

In 2016 a new survey method was developed, using stratified random selection of sample units delineated from previous elk location data. The intent of this change was to eliminate surveyor bias and provide a more accurate estimate of bull ratios within the herd. Consistent use of the new survey method should also improve the accuracy of the population model, as it relies strongly on observed male ratios for alignment and predicting population size. The new survey method yielded similar bull ratios in its first two years, with 34 and 33 bulls per 100 cows observed in 2016 and 2017 respectively. In 2018, a more extensive survey was conducted with better coverage than at any other time for the herd unit, and included a sightability survey to develop an abundance estimate (Figure 1)(Appendix C). As a result, the observed bull ratio was 51 per 100 cows, which is above management parameters for elk. Additionally, the distribution of mature elk was confirmed to be disparate within the herd. At the time of the survey in late January and early February, a higher proportion of mature bulls were observed within the northern portions of the herd unit compared to south. A higher proportion of Class-II bulls were observed during 2018 surveys compared to the past several years as well. With such a high level of effort and coverage, these results are considered the most accurate data collected for the herd to date and will help direct management for several seasons to come.

Having conducted such an extensive and inclusive sightability survey, managers can compare observed totals with harvest data to gauge management impacts on population growth within the herd. During 2019 surveys, 853 yearling males were observed. The observed ratio of 18 per 100 cows was slightly higher than the 5-year average of 13 per 100 cows, and annual harvest on males has averaged 1,168 animals over the past five years. Assuming a fraction of yearling males were missed during the sightability survey, this indicates bull harvest in the herd is likely keeping pace or slightly exceeding the 2019 rate of bull recruitment. Similarly, if observed yearling males are doubled, the minimum rate for recruitment of all calves to yearlings in 2019 would be approximately 1,700 animals. Again provided some animals were missed during surveys, the total harvest of 2,206 in 2019 is likely similar to or slightly exceeds recruitment in the herd overall.

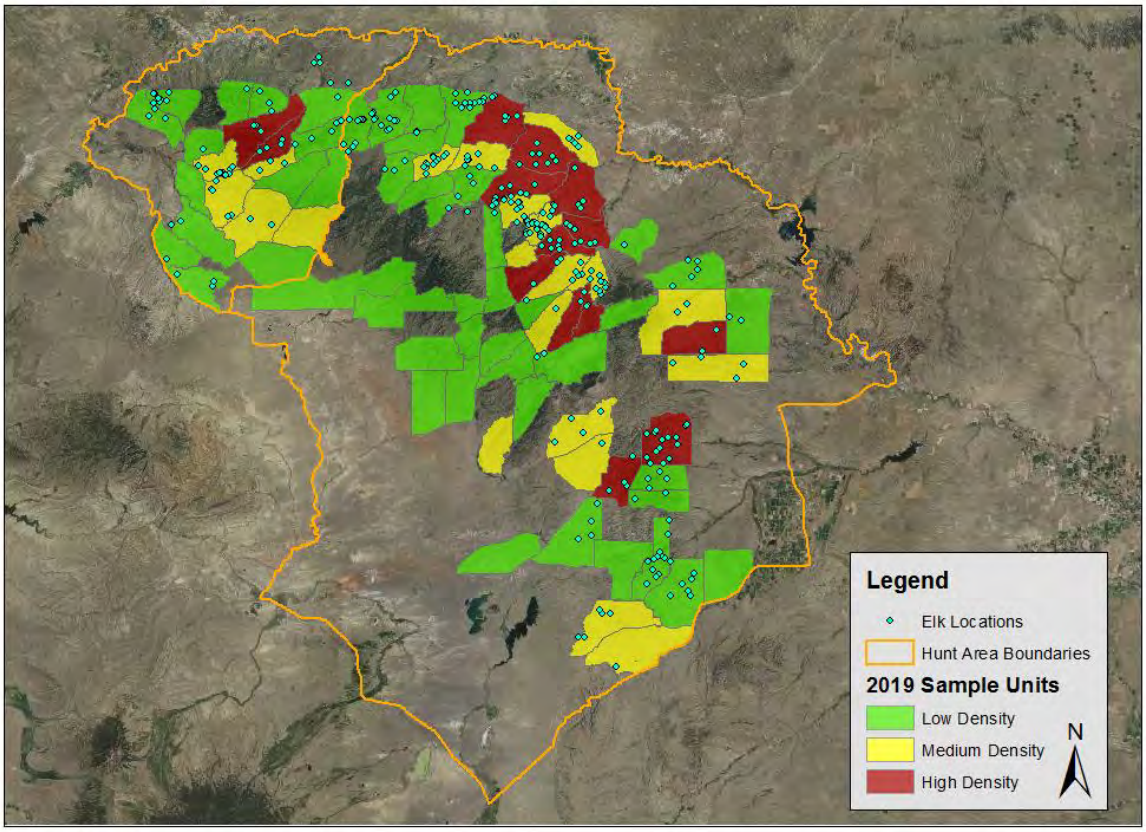


Figure 1. Stratified random sample units selected for classification surveys in the Laramie Peak Muddy Mountain Elk Herd Unit, February 2019.

From 2010-present, any-elk license issuance has fluctuated between 1,500 and 1,750 licenses in Area 7, depending upon hunter, landowner, and manager perceptions of bull quality. Since 2014, any-elk license issuance has been held steady at 1,500 licenses. Annual tooth-age data illustrate hunters are consistently harvesting prime age-class bulls in recent years (Appendix A). This information paired with high bull ratios would normally warrant an increase in any-elk licenses. However, managers feel accessible public lands are saturated with hunters, and extending the bull season to improve harvest success would likely lower cow harvest. Without improved hunting access on private lands, an increase in licenses would likely yield both decreased harvest success and hunter satisfaction.

Contrary to tooth-age and classification data, hunters and managers have also expressed concern about declines in trophy quality within the herd in recent years as well. While consistent harvest pressure on mature bulls may be one contributing factor, other variables including competition for resources may also affect antler quality. It should also be noted that expectations of hunters for large bulls in a prized hunt area may also be influencing perceptions of bull quality. Regardless, 2018 survey results illustrate opportunity is still readily available for a quality hunt, though the distribution of larger bulls may be irregular.

During the 2018 objective review, hunters were asked their satisfaction regarding bull quality in the herd. Sixty percent of respondents were either satisfied or very satisfied, while 13% were either dissatisfied or very dissatisfied. Only 8% of Area 7 hunters felt there were too few any-elk licenses; the remaining respondents were evenly split between wanting 1,500 licenses or wanting more. Considering hunter survey responses in combination with biological data, management goals, and access constraints, any-elk license issuance will be maintained in Areas 7 and 19 at 1,800 licenses, which is typical for this herd unit.

Harvest Data

License success in this herd unit is typically in the 50th percentile. It should also be noted that days per animal can be high in this herd unit compared to others, as hunters have high expectations regarding bull quality and will exert more effort in finding a mature bull. Archery hunting is also very popular in the herd unit, as hunters want to maximize their time in the field to harvest a mature bull. Days per animal was 16 in 2018, which is higher than the 10-year average of 14.7 days per animal. Weather and access conditions were average during much of the 2018 hunting season. Early in the season, open habitats allowed elk to spread widely across the herd unit. Winter conditions set in across higher elevations by mid-November, making access difficult in portions of the herd unit. Overall harvest success in 2018 (46%) was lower than the ten-year average (52%), and success on both any-elk and antlerless licenses was down compared to previous years. Total harvest (2,206) was below the ten year average of 2,380, and lower than harvest totals for the previous four years. Bull harvest (863) was lower than the previous four years, while cow harvest (1,200) was slightly higher than the 10-year average (1,187). In Area 19, an estimated 201 cows and calves were harvested, while in Area 7 the harvest was 1,142. The total cow/calf harvest in Area 19 was above average, and may be attributed to changes in elk distribution in areas with good hunter access in 2018. The total cow/calf harvest in Area 7 was below average, which may be attributed to late-season snows and poor access conditions.

Population

Historically, it has been difficult to model this and other elk herds in the state using age ratios obtained from directed surveys combined with harvest data. Current model designs rely heavily on male ratios, assume even distribution of harvest across available age classes and genders, and cannot rectify sustained high levels of harvest without predicting a sharply declining or crashing population. Field and harvest data frequently contradict model predictions, as managers regularly observe high numbers of elk during surveys and hunters consistently harvest 2,000-2,700 elk annually with stable rates of success. Tooth age data have shown that prime-age bulls and cows

have consistently been harvested from the herd in recent years. All these data suggest the herd is more likely stable than declining. Thus, managers have had low confidence in the validity of the population model.

While the transition to conducting stratified random classification surveys in 2016 and 2017 improved confidence in observed sex and age ratios, survey coverage was not adequate to calculate an abundance estimate. In 2018, managers significantly increased survey coverage and were able to conduct a sightability analysis. A record 9,359 elk were observed, and analysis yielded an abundance estimate of 11,182 elk. This estimate, along with more accurate classification ratios, will be integrated into a new population model in the future. However, due to timing of the survey and the need for additional post-survey stratification and analysis, a new population model will not be constructed until later in the spring of 2019. Regardless, the abundance estimate produced by the sightability model is by far the best estimator of this population ever produced. The 2018 postseason population estimate is approximately 11,200 elk, and managers believe the herd is likely stable.

Managers will hopefully have improved confidence in future modeling efforts for the Laramie Peak / Muddy Mountain Herd Unit, having integrated an abundance estimate and better classification data. Continued use of a stratified random classification survey method should help enhance model quality.

Management Summary

Season dates have been liberalized over time to maximize cow harvest and reduce damage on agricultural fields. Meetings with landowners and surveys of both landowners and hunters were conducted in 2017-2018 in conjunction with the herd unit objective review. The general consensus with the public and managers alike is to continue efforts to maximize female harvest and maintain mature bull quality. The majority of survey respondents expressed approval for the season structure in both Area 7 and Area 19, with the exception of January antlerless seasons. In response, January seasons will be discontinued in Area 19 and a small number of licenses will be maintained in Area 7 to address localized agricultural damage. The remaining Area 7 licenses will be added to the earlier antlerless season to maintain harvest pressure on females. Area 7 Type 6 licenses will remain valid early from August 15th through October 14th to address damage on hay fields. Currently, access is predicted to be similar in 2019 compared to previous years. Managers feel an increase of licenses is unwarranted unless hunting access in the herd unit improves. Goals for 2019 are to continue reduction of the herd toward objective, maintain bull quality while working toward special management limits, maintain or improve harvest success, and reduce elk damage to agricultural fields.

If we attain the projected harvest of 2,360 elk with average calf ratios, this herd will remain stable. The predicted 2019 postseason population size of the Laramie Peak / Muddy Mountain Elk Herd is approximately 11,000 animals, which is 120% above objective.

APPENDIX A:
Tooth-Age and Antler Class Data for Laramie Peak / Muddy Mountain Elk

The Laramie Peak / Muddy Mountain Elk Herd Unit (Wyoming Hunt Areas 7 & 19) has historically built a reputation for superior hunting in terms of high bull ratios, bull quality, and good hunter success. Bull ratios are managed under the special management criteria, with the goal of maintaining 30-40 per 100 cows. Bull quality is monitored annually using cementum annuli tooth aging from a sample of hunter-harvested elk and categorical postseason classifications based on antler size.

Tooth age data from the Laramie Peak / Muddy Mountain herd have been collected in nearly all years from 1997-2018. Tooth samples are solicited from both bull and cow elk hunters, as female age data is more representative of a random sample across age classes, while bull age data is potentially biased towards hunter preferences for more mature age classes. Samples received from calf elk are removed from resulting totals so as not to skew statistics on adult age classes.

Sample size has varied from year to year depending upon hunter response rates. In most years, tooth boxes have been mailed to a large random sample of licensed hunters. However, the percent of participating hunters is frequently low compared to sampling effort. In 2018, tooth boxes were distributed to hunters by mail. Tooth samples were also collected by field and office personnel in conjunction with tissue sampling to test for chronic wasting disease (CWD). Of those solicited, 154 returned teeth from bulls and 108 from cows, which was an improvement compared to the previous year when samples were collected in the field and no tooth boxes were sent to hunters by mail.

Average tooth age of harvested adult males slowly increased from 1999-2015 and was relatively stable from 2016-2018 (Table 1). Average tooth age of harvested female elk has been more variable over time, but has steadily increased since 2011 and was the highest on record in 2018 (Table 2). Median age of males held constant at 6.5 years old in 2018, as did the median age of females at 5.5 years old. This slight divergence between harvested bull and cow ages suggests that hunter selectivity is for larger, older age class bulls; while the younger age class of harvested cows is likely to represent a more abundant age class in this herd. Hunters who harvest a 1.5 year old bull are also less likely to submit teeth for aging, as they are usually aware of the age of their "spike" elk in the field. Tooth data from cow elk has less potential bias from hunters and is considered more representative of true age class distribution.

The percentage of harvested bulls aged 6-10 has remained near the 45-50th percentile since 2013, indicating older age-class bulls have been consistently available for harvest. This contradicts

some years of observed antler class data during the same time period that shows a decline of Class II (6 points on a side or better) bulls in the herd during aerial classification surveys (Table 3 & Figure 1). This disparity may be due to increased selectivity of hunters for older age-class bulls, compared to the more random sample of bulls surveyed during postseason classification flights. In addition, hunters submitting teeth may be biased towards older age class bulls, as hunters who are pleased with the quality of their animals may be more likely to submit samples.

The consistent availability of older age-class bulls seems to indicate this population is not decreasing in size. License issuance has remained high, and one would expect it to become increasingly difficult to find and harvest older age-class bulls if the population were in decline. At the same time, average tooth age of harvested cows has slowly increased, while license issuance and season length have been liberalized. These data are somewhat confounding as they suggest that females are increasingly reaching older age classes in the herd before they are harvested and/or there are relatively fewer younger age class cows available for harvest. However, calf ratios have also declined in recent years, meaning lower calf recruitment may have suppressed the distribution of elk in younger age classes. While managers have prescribed years of liberal hunting seasons in an attempt to decrease population size, tooth data indicate this herd may be stable.

Trends in antler class of classified bull elk are more difficult to interpret on their own. Class I bulls are mature bulls that have < 6 points on both antlers, while Class II bulls have $\geq$ 6 points on either antler. The percentage of Class II bulls has generally declined since the first year of antler class data collection in 2008. During the same time period from 2008-2017, average tooth-age of harvested bulls increased from 5.01 to 6.43. Tooth age of bulls declined slightly in 2018, but the proportion of Class II bulls observed during classification surveys increased slightly. The lack of symmetry between the two data sets suggests antler quality is not always correlated positively with bull age for this herd. Factors such as nutrition and genetics may also be contributing to antler quality. Studies of the tooth-age dataset certainly temper any assumptions made regarding changes in the antler class dataset and aid in making sound management decisions for this herd. Collectively, these data indicate this herd can continue to support the current number of any-elk licenses for the 2019 season without compromising bull ratios or bull quality. Managers must continue to scrutinize harvest data and hunter feedback, and perhaps begin to reduce issuance of any-elk licenses if the percentage of Class II bulls observed during classification surveys declines to a level deemed unacceptable by the hunting public.

Table 1. Tooth-age data analysis for adult bull elk harvested within the Laramie Peak/Muddy Mountain Herd Unit, 1997 - 2018.

	Number of Adult Males per Age Class (Tooth Sampling)																				
Year	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+	18+	19+	20+	21+	22+
1997	7	13	5	5	6	2	2	3	0	2	1	0	0	0	0	0	0	0	0	0	0	0
1998	1	16	19	10	10	4	3	2	1	2	1	0	0	0	0	0	0	0	0	0	0	0
1999	20	26	39	24	16	9	8	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0
2000	22	36	41	28	24	13	6	1	3	1	1	0	0	0	0	1	0	0	0	0	0	0
2001	15	22	27	29	14	10	3	3	1	0	2	2	0	0	0	0	0	0	0	0	0	0
2004	7	8	16	19	6	10	5	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0
2005	6	3	27	16	10	11	6	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0
2007	1	11	24	18	12	12	8	3	0	0	1	1	0	0	0	1	0	0	0	0	0	0
2008	4	2	19	24	22	17	12	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0
2010	4	3	16	27	32	27	13	2	1	2	5	1	0	0	0	0	0	0	0	0	0	0
2011	7	9	11	19	25	24	7	4	6	3	3	0	0	0	0	0	0	0	0	0	0	0
2012	2	9	9	22	22	20	9	3	4	0	1	0	0	0	0	0	0	0	0	0	0	0
2013	3	3	11	33	22	40	11	9	7	4	1	0	2	0	0	0	0	0	0	0	0	0
2014	3	4	19	27	35	31	17	13	7	5	2	0	0	1	0	0	0	0	0	0	0	0
2015	4	6	10	17	18	29	27	11	9	5	2	0	1	0	0	0	0	0	0	0	0	0
2016	1	4	13	20	31	21	18	12	5	2	3	2	0	0	0	0	0	0	0	0	0	0
2017	0	3	10	12	17	17	14	5	4	4	2	0	1	1	0	0	0	0	0	0	0	0
2018	2	6	17	25	25	23	14	20	11	7	0	1	2	0	0	0	0	0	0	0	0	0

Year	1	2-5	6-10	11-12	13+	N	Avg Age
1997	7	29	9	1	0	46	**4.41**
1998	1	55	12	1	0	69	**4.12**
1999	20	105	20	1	0	146	**3.91**
2000	22	129	24	1	1	177	**3.99**
2001	15	92	17	4	0	128	**4.17**
2004	7	49	19	1	0	76	**4.48**
2005	6	56	20	1	0	83	**4.51**
2007	1	65	23	2	1	92	**4.58**
2008	4	67	35	1	0	107	**5.01**
2010	4	78	45	6	0	133	**5.33**
2011	7	64	44	3	0	118	**5.35**
2012	2	62	36	1	0	101	**5.44**
2013	3	69	71	1	2	146	**6.07**
2014	3	85	73	2	1	164	**6.02**
2015	4	51	81	2	1	139	**6.40**
2016	1	63	63	5	0	132	**6.20**
2017	0	42	44	2	2	90	**6.43**
2018	2	73	75	1	2	154	**6.30**

	Percentages				
Year	1	2-5	6-10	11-12	13+
1997	15%	63%	20%	2%	0%
1998	1%	80%	17%	1%	0%
1999	14%	72%	14%	1%	0%
2000	12%	73%	14%	1%	1%
2001	12%	72%	13%	3%	0%
2004	9%	64%	25%	1%	0%
2005	7%	67%	24%	1%	0%
2007	1%	71%	25%	2%	1%
2008	4%	63%	33%	1%	0%
2010	3%	59%	34%	5%	0%
2011	6%	54%	37%	3%	0%
2012	2%	61%	36%	1%	0%
2013	2%	47%	49%	0%	1%
2014	2%	52%	45%	1%	1%
2015	3%	37%	58%	1%	1%
2016	<1%	48%	48%	4%	0%
2017	0%	47%	48%	2%	2%
2018	1%	47%	49%	1%	1%

Table 2. Tooth-age data analysis for adult female elk harvested within the Laramie Peak/Muddy Mountain Herd Unit, 1997 – 2018.

	Number of Adult Females per Age Class (Tooth Sampling)																				
Year	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+	18+	19+	20+	21+	22+
1997	8	3	5	9	5	1	1	2	1	1	3	0	0	0	0	0	0	0	0	0	0	0
1998	3	14	6	10	6	7	5	2	1	2	1	1	1	0	0	0	1	0	0	0	0	0
1999	14	22	16	20	8	8	6	7	3	1	8	3	3	1	0	0	0	0	0	0	0	1
2000	19	26	21	17	13	11	6	4	6	0	4	3	0	1	2	1	0	0	0	0	1	0
2001	11	15	24	11	15	9	10	5	4	4	3	3	0	0	0	1	0	0	0	0	0	0
2004	8	4	13	8	8	6	3	2	3	0	0	1	0	0	0	0	0	0	0	0	0	0
2005	26	14	39	34	21	14	16	15	4	6	5	5	0	4	4	0	0	1	0	0	0	0
2007	4	7	19	24	7	6	8	5	11	4	5	2	2	1	0	2	1	0	0	0	0	0
2008	8	11	14	14	17	8	11	5	3	2	1	2	3	1	0	2	1	1	0	1	0	0
2010	5	7	14	9	13	9	3	5	3	5	1	1	2	0	1	1	0	0	0	0	0	0
2011	4	4	11	10	14	6	7	6	2	1	0	0	0	0	1	2	0	0	0	0	0	0
2012	10	9	15	8	7	5	4	6	2	1	4	1	1	0	0	0	0	0	0	0	0	0
2013	5	1	11	20	14	8	4	3	3	2	1	4	0	0	0	0	0	0	0	0	0	0
2014	9	11	19	25	18	11	13	11	6	4	2	3	0	3	1	1	0	0	0	0	0	0
2015	16	9	12	16	10	3	9	7	3	1	5	4	3	1	2	0	1	0	0	0	0	0
2016	7	12	15	13	7	6	7	5	6	1	2	3	2	1	0	0	3	0	0	0	0	0
2017	3	3	8	10	5	6	4	4	2	0	0	1	3	0	1	0	0	0	0	0	0	0
2018	6	5	17	14	17	14	7	1	4	2	4	3	0	4	4	1	2	1	0	0	0	0

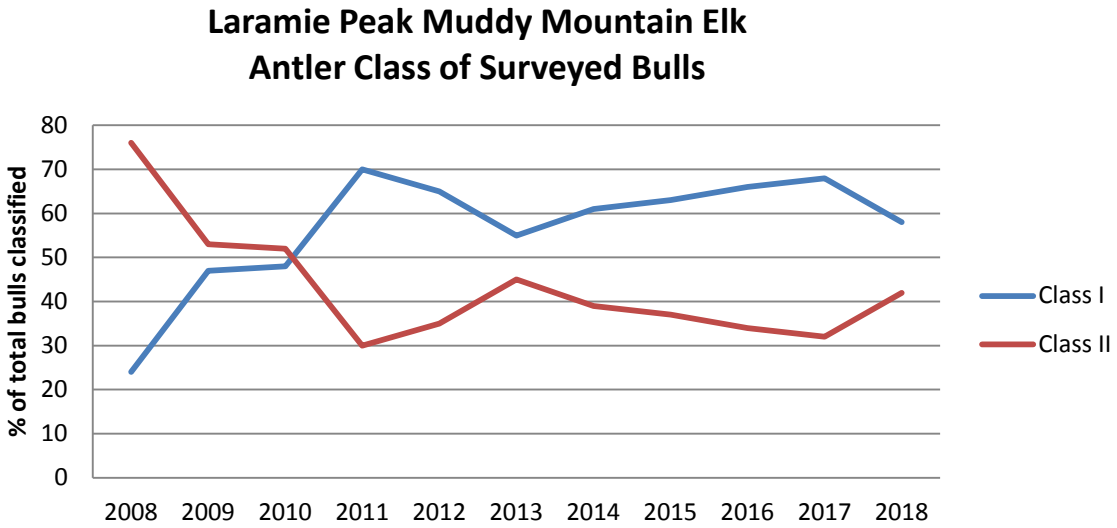
Year	1	2-5	6-10	11-12	13+	N	Avg Age
1997	8	22	6	3	0	39	**4.38**
1998	3	36	17	2	2	60	**4.90**
1999	14	66	25	11	5	121	**5.02**
2000	19	77	27	7	5	135	**4.61**
2001	11	65	32	6	1	115	**4.84**
2004	8	33	14	1	0	56	**4.27**
2005	26	108	55	10	9	208	**5.16**
2007	4	57	34	7	6	108	**5.97**
2008	8	56	29	3	9	105	**5.71**
2010	5	43	25	2	4	79	**5.49**
2011	4	39	22	0	3	68	**5.34**
2012	10	39	18	5	1	73	**5.20**
2013	5	46	20	5	0	76	**5.70**
2014	9	73	45	5	5	137	**5.88**
2015	16	47	23	9	7	102	**6.05**
2016	7	47	25	5	6	90	**6.07**
2017	3	26	16	1	4	50	**6.06**
2018	6	53	30	7	12	108	**6.82**

	Percentages				
Year	1	2-5	6-10	11-12	13+
1997	21%	56%	15%	8%	0%
1998	5%	60%	28%	3%	3%
1999	12%	55%	21%	9%	4%
2000	14%	57%	20%	5%	4%
2001	10%	57%	28%	5%	1%
2004	14%	59%	25%	2%	0%
2005	13%	52%	26%	5%	4%
2007	4%	53%	31%	6%	6%
2008	8%	53%	28%	3%	9%
2010	6%	54%	32%	3%	5%
2011	6%	57%	32%	0%	4%
2012	14%	53%	25%	7%	1%
2013	7%	61%	26%	7%	0%
2014	7%	53%	33%	4%	4%
2015	16%	46%	23%	9%	7%
2016	8%	52%	28%	5%	7%
2017	8%	46%	35%	3%	8%
2018	6%	49%	28%	6%	11%

Table 3. Antler classification of bull elk from the Laramie Peak/Muddy Mountain Herd Unit, 2008-2017.

Mature Bull Antler Classification									
Bio-Year	Area 7 (N / %)			Area 19 (N / %)			**EL 741 (N / %)**		
	Class I	Class II	Total	Class I	Class II	Total	**Class I**	**Class II**	**Total**
2008	82 (23%)	270 (77%)	352	41 (26%)	119 (74%)	160	**123 (24%)**	**389 (76%)**	**512**
2009	211 (49%)	219 (51%)	430	58 (41%)	84 (59%)	142	**269 (47%)**	**303 (53%)**	**572**
2010	246 (47%)	280 (53%)	526	61 (54%)	52 (46%)	113	**307 (48%)**	**332 (52%)**	**639**
2011	278 (69%)	128 (31%)	406	104 (73%)	38 (27%)	142	**382 (70%)**	**166 (30%)**	**548**
2012	76 (56%)	60 (44%)	136	160 (71%)	66 (29%)	226	**236 (65%)**	**126 (35%)**	**362**
2013	213 (56%)	169 (44%)	382	57 (54%)	48 (46%)	105	**270 (55%)**	**217 (45%)**	**487**
2014	165 (64%)	93 (36%)	258	106 (57%)	79 (43%)	185	**271 (61%)**	**172 (39%)**	**443**
2015	212 (74%)	74 (26%)	286	93 (47%)	106 (53%)	199	**305 (63%)**	**180 (37%)**	**485**
2016	318 (70%)	137 (30%)	455	111 (57%)	85 (43%)	196	**429 (66%)**	**222 (34%)**	**651**
2017	258 (71%)	104 (29%)	362	55 (57%)	41 (43%)	96	**313 (68%)**	**145 (32%)**	**458**
2018	820 (59%)	573 (41%)	1393	125 (53%)	112 (47%)	237	**945** (58%)	**685** (42%)	**1630**

Figure 1. Percent of Class I & Class II bull elk from the Laramie Peak/Muddy Mountain Herd Unit, 2008-2018.



APPENDIX B

Laramie Peak / Muddy Mountain Elk Population Objective

2018 Review Summary

Prepared by: Willow Bish

5/1/2018

The population objective for the Laramie Peak/ Muddy Mountain Elk Herd (Hunt Area 7 & 19) was reviewed in 2018. As a component of these efforts, landowner and hunter surveys were conducted. This report summarizes the review process and outcomes.

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OVERVIEW

The Laramie Peak / Muddy Mountain Elk Herd includes limited quota Hunt Areas 7 and 19 and is located in eastern central Wyoming. The herd unit encompasses approximately 4,600 square miles from the city of Casper, east to the town of Douglas, southeast along the North Platte River to Guernsey Reservoir and the town of Wheatland, southwest to Bosler Junction, and northwest to the town of Medicine Bow (Figure 1). Management within these hunt areas is heavily influenced by private landowners who control a substantial proportion of access. Landownership includes traditional agricultural producers with lower tolerances for elk due to damage concerns coupled with non-traditional landowners who bought properties for recreational purposes, and therefore have higher tolerances for elk. However, there are also large tracts of public land as well, making it an important herd to many Wyoming residents and non-resident hunters. Outfitting is also taking place throughout this herd unit. These factors contribute to a strong desire by the public to manage this herd for trophy bull quality. The mixed landownership patterns (United States Forest Service, Bureau of Land Management, and State of Wyoming lands with about 60% private ownership), hunting access issues, large elk population, and desire for quality elk hunting experiences pose many management challenges in this herd unit. Managers therefore used the objective review process to complete a rather extensive public outreach effort to gauge public opinion regarding the population objective and hunting season structures for this herd.

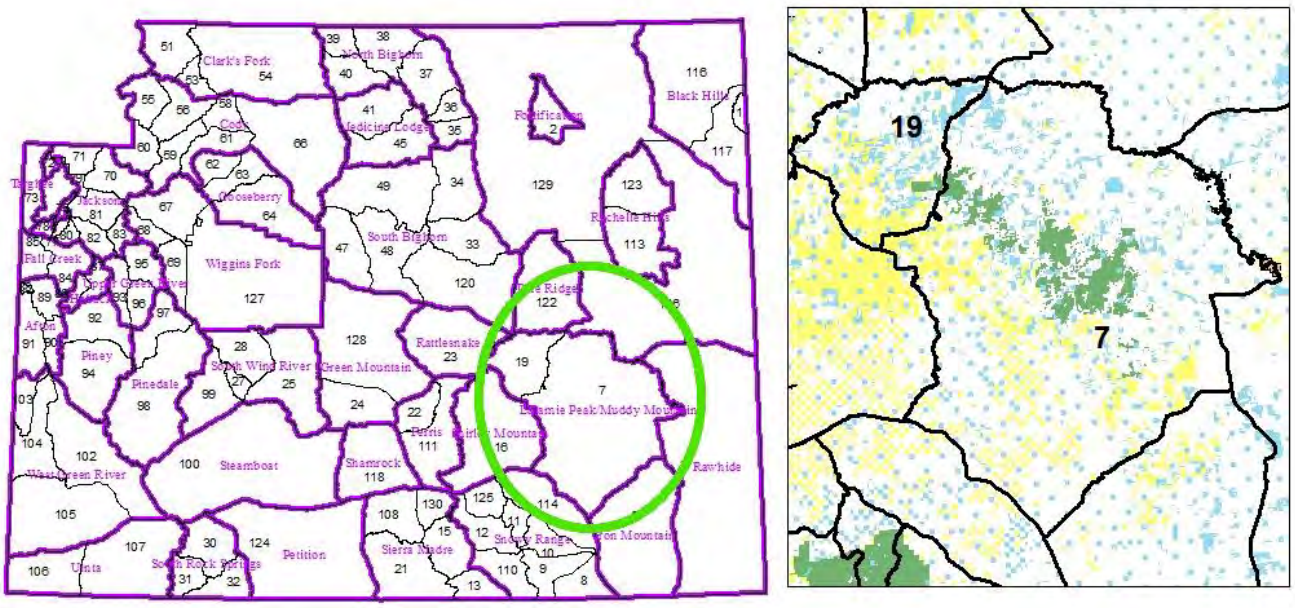


Figure 1. Location maps for Laramie Peak/ Muddy Mountain Elk herd.

Population & Hunting Seasons

The Laramie Peak / Muddy Mountain Elk Herd currently has a management objective of 5,000 elk postseason. In 2001, the objective was changed from 2,550 elk to 5,000 based on landowner and public input. The Department estimates this herd has had 8,000 – 10,000 elk postseason for the past several years. Liberal hunting seasons resulting in very high hunter harvest have prevented population growth in recent years. Rifle seasons begin in August for cow/calves in Platte County and on private land in Albany and Converse counties. Hunting season dates have run through Jan. 31 in Area 7 since 2007 and in Area 19 since 2015. For Areas 7 and 19 combined, total license issuance increased from 2,200 in 2002 to

5,800 in 2013. License issuance has remained at 5,775 since 2014. Since 2010, total elk harvest has averaged 2,412 elk per year in this herd unit (Figure 2).

Managers believe license issuance is near the saturation level, at least on public land, and that issuing more licenses could result in lower hunt quality and possibly lower success rates. Given the extremely liberal hunting season frameworks in these hunt areas, the objective of 5,000 elk postseason is likely unrealistic and unattainable considering extremely high harvest in recent years has not driven this population down to objective levels. The Department was aware that raising the objective would be a contentious issue with traditional agriculture producers given elk damage issues on private land. However, there has been a growing amount of non-traditional land use in this herd unit, where landowner tolerances for elk are much higher. Given these issues and constraints, managers proposed to raise the objective to 8,000 elk, since it is the low end of the current population estimate. The objective change was proposed to the public through landowner outreach and opinion surveys as well as hunter opinion surveys.

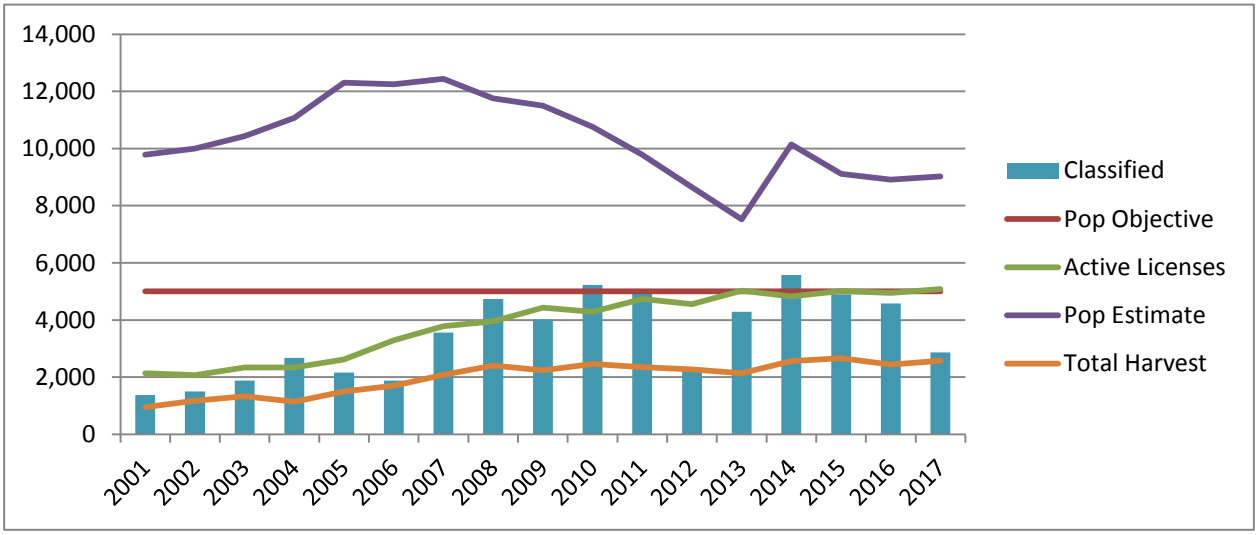


Figure 2. Postseason elk classification survey totals, population objective, active licenses, annual population estimate, and total harvest for Laramie Peak / Muddy Mountain Herd Unit, 2001-2017.

Bull Management

Bull management was also included in this review process. This herd unit is managed using the special management strategy, with a goal of maintaining bull ratios between 30-40 bulls per 100 cows and a high percentage of branch-antlered bulls in the in the male harvest segment. This herd is classified in January, when bulls typically winter away from cow/ calf herds, which leads managers to believe that bulls may be underrepresented in the classification data. To address this, a stratified, random sampling strategy has been in place since 2016. This sampling scheme has yielded bull ratios within management criteria (34 bulls / 100 cows in 2016 and 33 bulls / 100 cows in 2017). Managers also collect antler classification data (Figure 3) and tooth age data (Figure 4). While the tooth age data shows that hunters continue to harvest prime-aged bulls, antler-class data shows a consistent decrease in the percentage of Class II antlered bulls (Class I bulls are mature bulls that have < 6 points on both antlers, while Class II bulls have ≥ 6 points on either antler). This decrease, coupled with some hunters' concerns with declining trophy quality resulted in a further look into hunter opinions regarding bull quality and license issuance during the objective review process.

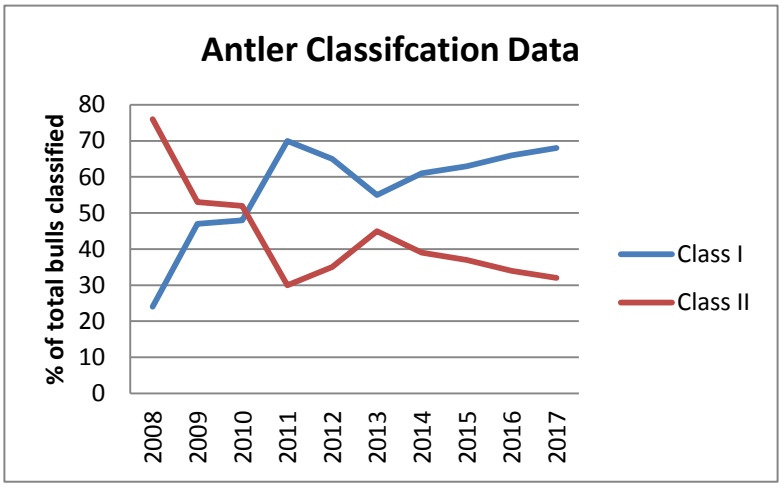


Figure 3. Percent of Class I & Class II bull elk from the Laramie Peak/Muddy Mountain Herd Unit, 2008-2017.

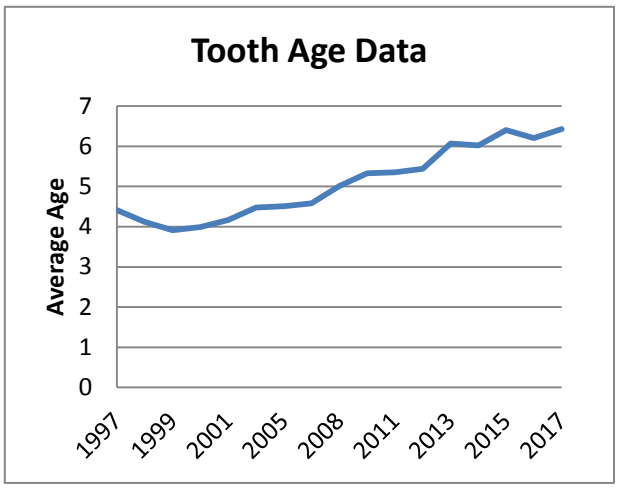


Figure 4. Average age of adult bull elk harvested within the Laramie Peak/Muddy Mountain Herd Unit, 1997 – 2017 based on tooth data.

Habitat

Elk habitat throughout this herd unit is highly variable and ranges from mid elevation sagebrush grassland, mountain mahogany/ mixed mountain shrub slopes, mountain meadows, ponderosa savanna, lodgepole, limberpine, and mixed conifer forest, aspen, and riparian areas. No formal habitat production or utilization information is available for this herd unit. However, habitat conditions throughout the Laramie Range are fairly high-quality with the exception of aspen stands. Aspen stand recruitment is limited by conifer encroachment and herbivory. There are also several locations where elk concentration results in over-use of riparian areas. While managers would like to reduce elk use on these key areas by reducing the population, there is no evidence that this elk herd is near the carrying capacity. Rather, the perception of elk over-population as it relates to habitat is linked to private landowner tolerances for elk use given elk tend to concentrate in private land hay meadows resulting in high payment damage claims throughout the herd unit.

Environmental Factors

Environmental factors are not strongly influencing the ability of the Department to manage this herd towards objective. Energy development within the herd unit primarily consists of wind energy. There are several gravel quarries within this herd unit and there are more expected given oil and gas development in areas adjacent to this herd unit. The quarries are often within or directly adjacent to winter range and have high volumes of large vehicle traffic. Also, a large gas powerplant plant was constructed within this herd unit as well. However, in general there has not been substantial enough development to significantly impact elk in this herd unit although these developments may influence hunting opportunity given concerns with firearm damage to equipment.

Several large-scale wildfires have also occurred in this herd unit in recent years. These fires primarily occurred in forested areas which contained heavy stands of conifer trees. These areas have recovered well and are provided better quality elk habitat than pre-burn conditions.

Land Managers

The United States Forest Service (USFS) and Office of State Lands and Investments (OSLI) are the two major public land owners in this herd unit. The Bureau of Land Management (BLM) has small portions of land within this herd unit, but many are not publicly accessible. These agencies have not expressed many concerns over the elk population; however, the USFS has noted the over-use of some riparian and aspen habitats by wildlife and livestock. Private landowners have raised the highest level of concern regarding the elk population. Therefore, the Department engaged with private landowners first regarding the proposed objective change, but did not initiate discussions with federal or state management agencies since no changes were made to the objective based on responses from private landowners and the public.

REVIEW PROCESS

Landowner Outreach

This herd unit encompasses two Game & Fish Regions, Casper and Laramie. The regions agreed to meet with each of their traditional agriculture producers and landowners enrolled in access programs prior to them receiving a mailed survey. The purpose of this was to avoid leading landowners to the perception that the Department wanted to manage for more elk than there are currently. Field personnel visited most major landowners in-person. The regions also followed up with their annual landowner meetings for Hunt Area 7 in Glenrock (12 individuals attended), Glendo (2 individuals attended), and Sybille (7 individuals attended). Notes from individual and group landowner meetings are included in Appendix A: Landowner Meeting Notes.

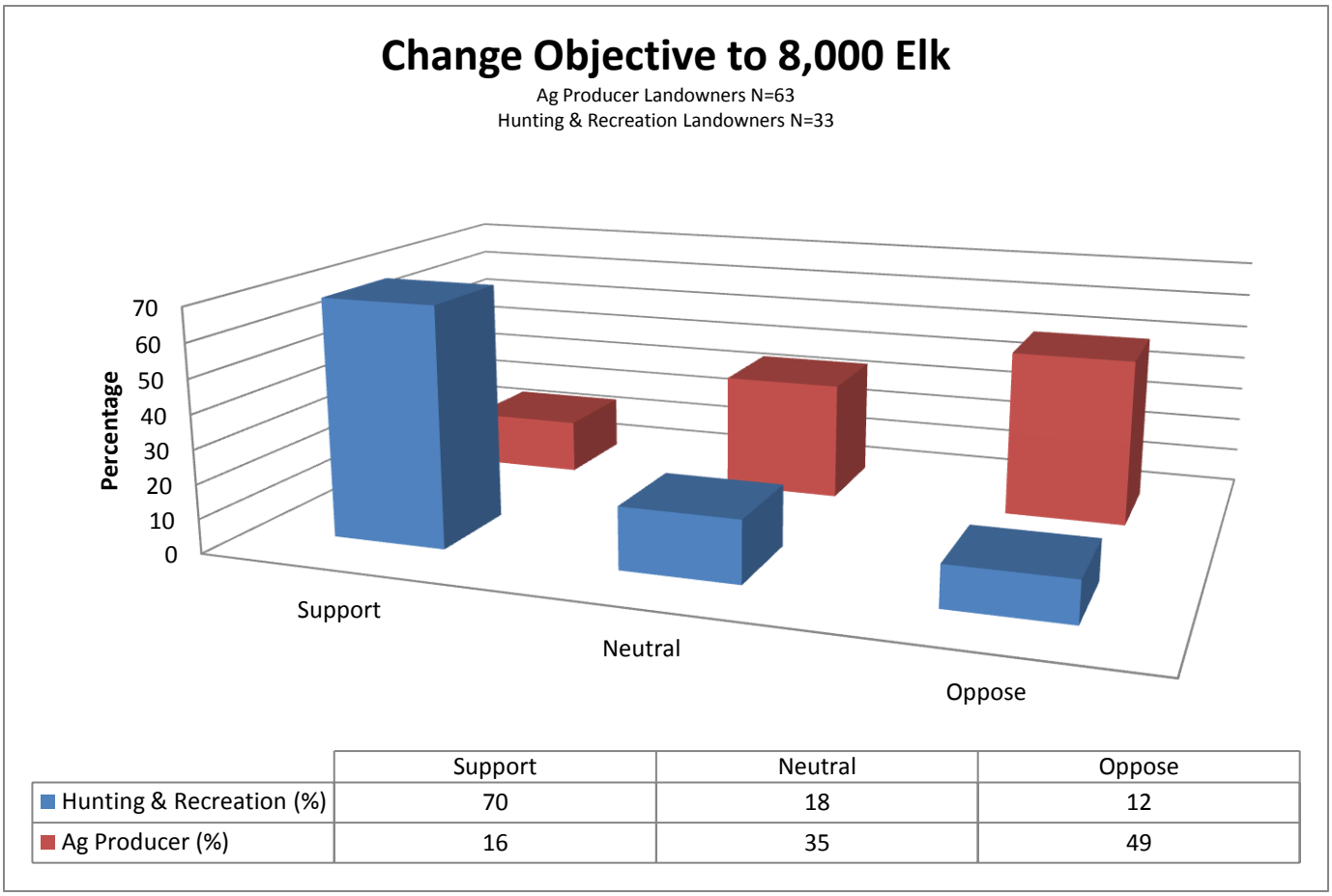
In general, the individual meetings went well with only moderate levels of alarm expressed at raising the objective. Many landowners were not supportive of raising the objective, but they also did not feel the Department could do a lot more to decrease the herd and that access was the main reason. However, strong opposition to raising the objective was expressed during the group meetings. Landowners were concerned about what raising the objective might mean for the future, and how long it would be before we would attempt to raise the objective again if we were unsuccessful in managing for the elk population at the new objective. In addition to these concerns, many landowners requested to end the January season, as they felt it is ineffective in harvesting elk or that seasons are just simply too long. This request was also strongly echoed during the group meeting as well. Additionally, many landowners in the northern part of Area 7 requested a hunting season mechanism to harvest more bulls, particularly small bulls, due to high bull densities. Many landowners also felt that elk distribution has changed in recent years due to high hunting pressure, making it more challenging to harvest cow elk.

Surveys were mailed to both Area 7 and 19 landowners (Appendix B: Landowner Surveys and Responses). In Area 7, 154 landowners received a survey and 99 responded. In Area 19, 20 landowners received a survey and 10 responded. This resulted in an overall response rate of 63%. All support/oppose questions were also provided a neutral options which may not be reported below if the results are not meaningful to the discussion.

Area 7 Landowner Survey Results

Landowners were asked about the principle interest in their properties during these surveys. Agriculture was the primary interest of 66% of the respondents, with 24% identifying themselves as being interested in both agriculture and hunting/recreation, 9% solely in hunting/recreation, and 1% listed conservation as

their primary interest. As a whole, the respondents were fairly evenly divided amongst supporting, opposing, and being neutral to raising the objective to 8,000 elk; although when broken out by interest, 49% of the agriculture interest group was opposed to the objective change, with 70% of hunting and recreation landowners supporting raising the objective (Figure 5). In total, 56% of respondents felt the objective should remain at 5,000 elk (Figure 6), and 55% of respondents that the elk population was above desired levels (Figure 7). When broken out by interest, 58% of hunting/recreation landowners felt the population was about right and 71% of agriculture producers felt the population was too high (Figure 8).



	Support	Neutral	Oppose
Hunting & Recreation (%)	70	18	12
Ag Producer (%)	16	35	49

Figure 5. Elk Area 7 landowner response to raising the elk objective from 5,000 to 8,000 elk broken out by hunting/recreation landowners and agricultural producers.

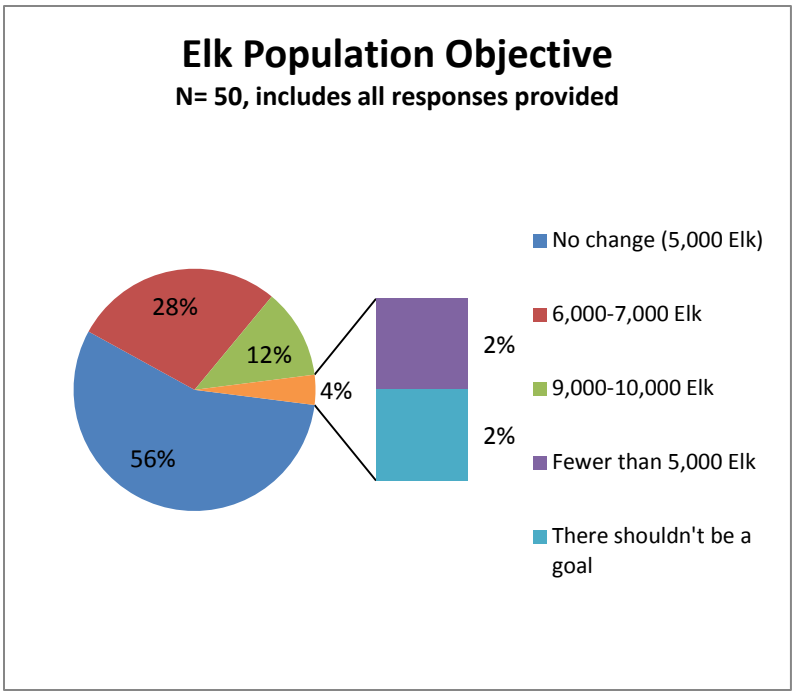


Figure 6. All Elk Area 7 landowner responses regarding what they think the population objective should be.

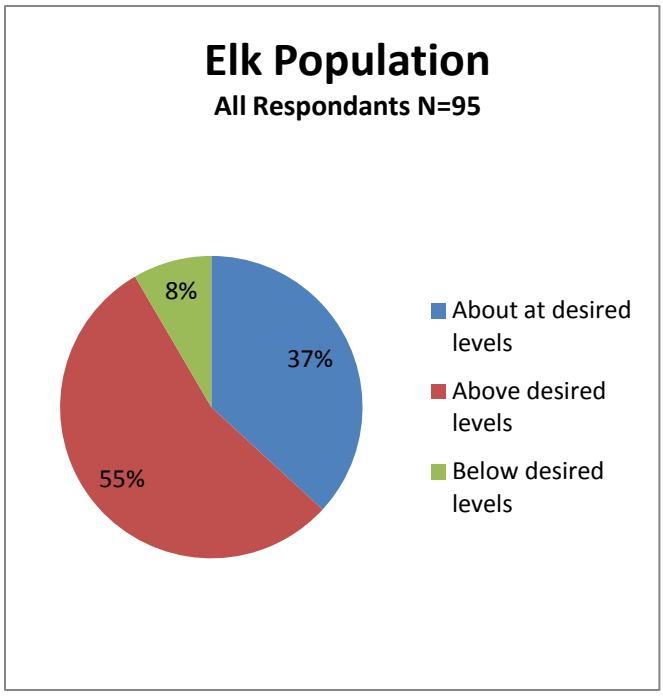
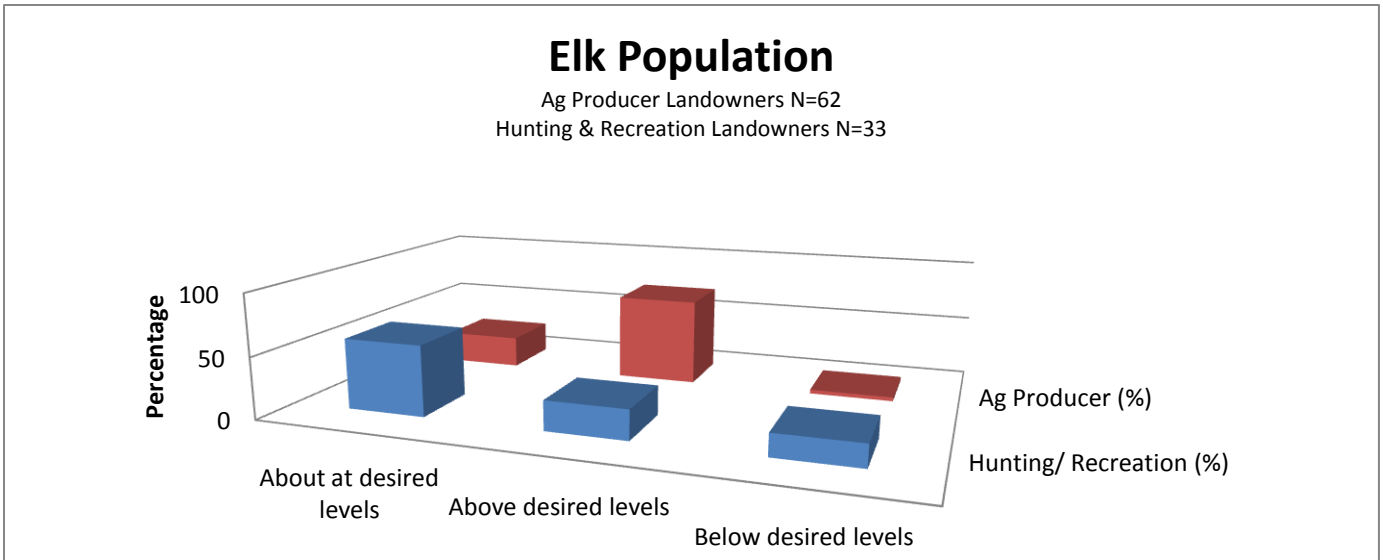


Figure 7. Elk Area 7 landowners' opinions regarding the current population size of the Laramie Peak/Muddy Mountain elk herd.



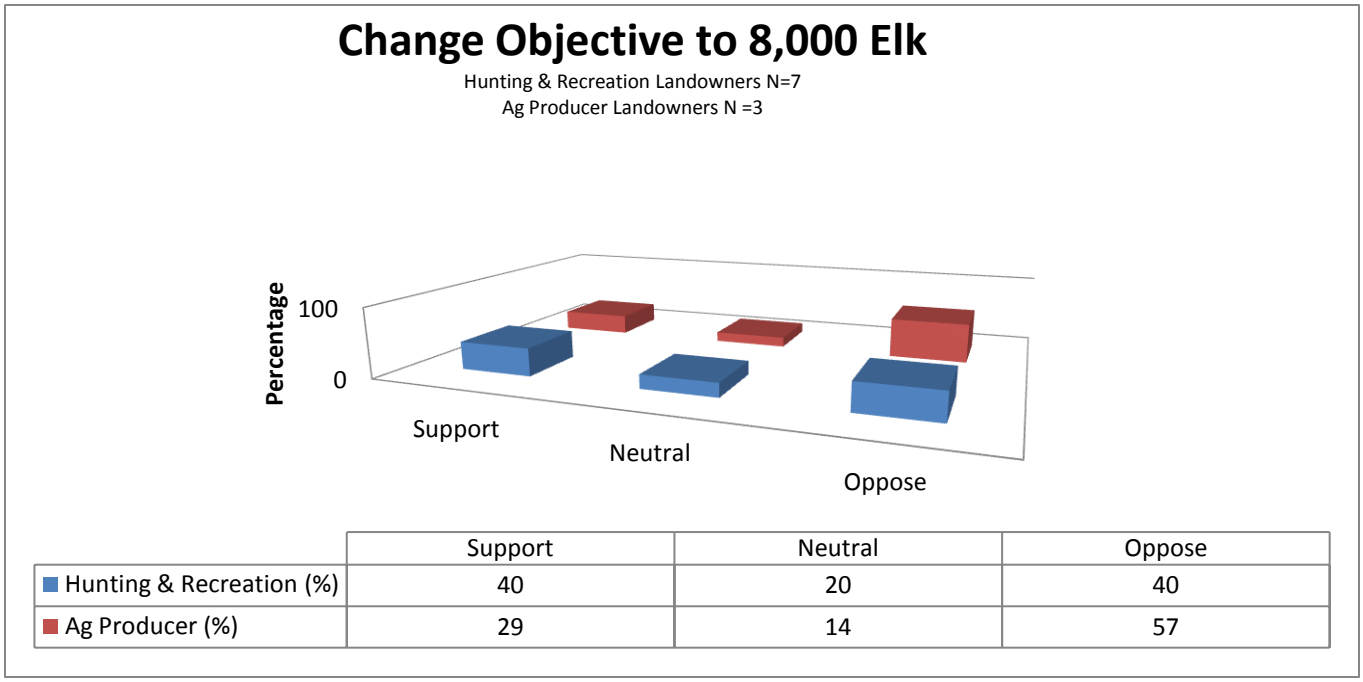
	About at desired levels	Above desired levels	Below desired levels
Hunting/ Recreation (%)	58	24	18
Ag Producer (%)	26	71	3

Figure 8. Elk Area 7 landowners' opinions regarding the current population size of the Laramie Peak/Muddy Mountain elk herd broken out by hunting/recreation landowners and agricultural producers.

Landowners were also asked about hunting season structure. The majority of the support was for current management practices, with the exception of the January season. Fifty-six percent of landowners wanted to maintain antlerless license issuance as is, whereas only 30% and 14% wanted to increase or decrease, respectively. Fifty-seven percent of landowners were either "satisfied" or "very satisfied" with bull quality. Forty-seven percent of landowners supported current bull license issuance and 37% would like to see an increase whereas only 16% felt that too many bull licenses are being issued. The majority of landowners (57%) were either "satisfied" or "very satisfied" with bull quality, however 31% were "dissatisfied" or "very dissatisfied". Sixty-seven percent of landowners support the current October 15th opening date for rifle season (opening area-wide). Lastly, 55% of landowners oppose the January hunting season and only 30% support it (Appendix C: Landowner Survey Figures).

Area 19 Landowner Survey Results

Agriculture was the primary interest of Area 19 landowner respondents (70%). Landowners were evenly split between supporting (40%) and opposing (40%) the proposed objective change, with 20% of landowners reporting they were neutral. Unlike the Area 7 responses, hunting and recreation landowners were only slightly less in opposition (40%) to raising the objective than agricultural producers (57%), although only 3 landowners in Area 19 reported themselves as hunting/recreation landowners, which is a small sample size (Figure 9). Twenty-nine percent of agriculture production landowners and 40% of hunting/ recreation landowners were in support of the objective change (Figure 9). Those who did not support the objective change were asked their opinion on what the objective should be. Four landowners (57%) reported they would like to see no change (remain at 5,000 elk) and 3 landowners (43%) thought the objective should be 9,000-10,000 elk (Figure 10). In total, 50% of landowners felt that the population size was above desired levels, with 40% reporting that they felt that the population size was about right (Figure 11). All of the hunting/recreation landowners (N=3) felt the current elk population size was about right, whereas 72% of the agriculture producers felt the population was too high (Figure 12).



	Support	Neutral	Oppose
Hunting & Recreation (%)	40	20	40
Ag Producer (%)	29	14	57

Figure 9. Elk Area 19 landowners' opinions regarding increasing the elk objective from 5,000 to 8,000 elk in the Laramie Peak/ Muddy Mountain herd broken out by hunting/recreation landowners and agricultural producers.

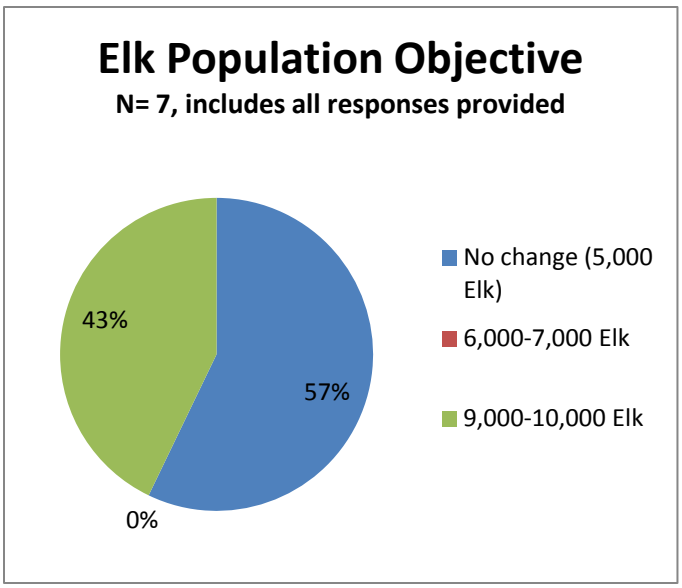


Figure 10. All Elk Area 19 landowner responses regarding what they think the population objective should be.

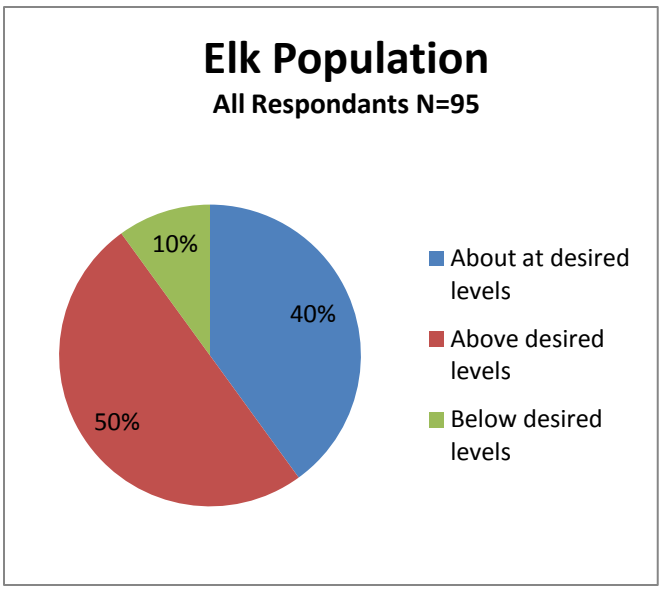
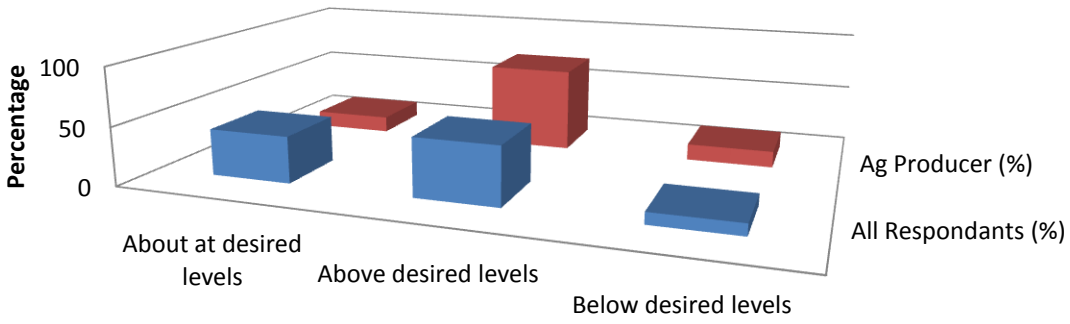


Figure 11. Elk Area 19 landowners' opinions regarding the current population size of the Laramie Peak/Muddy Mountain elk herd.



	About at desired levels	Above desired levels	Below desired levels
All Respondants (%)	40	50	10
Ag Producer (%)	14	72	14

Figure 12. Elk Area 19 landowners' opinions regarding increasing the elk objective from 5,000 to 8,000 elk in the Laramie Peak / Muddy Mountain herd broken out by hunting/recreation landowners and agricultural producers.

Questions regarding hunting season structure yielded majority support for current management practices. Seventy percent of landowners supported current antlerless license issuance and 60% supported current bull license issuance. However, bull quality satisfaction was fairly evenly divided amongst selection categories, with 30% "dissatisfied" or "very dissatisfied", 30% "neutral" and 40% "satisfied" or "very satisfied". Questions were asked regarding the season length for Type 1 and Type 2 licenses, and each resulted in 50% support for current season length, although 30% and 37% of landowners thought the season was too short for Type 1s and 2s, respectively. Area 19 has a split season where Type 1 and 4 licenses are valid from October 1 – October 14 and Type 2 and 5 licenses are valid November 1 – November 20. There was majority support (50%) for the current season structure, whereas only 10% of landowners opposed it. Lastly, 70% of landowners support the January hunting season and only 10% oppose it (Appendix C: Landowner Survey Figures).

Hunter Outreach

Hunter outreach consisted of an online survey. The list of potential survey respondents was developed from compiling license holders across all license types from the past 3 years in order to gain feedback from individuals who had recent hunting experience in Areas 7 and 19. Survey invitations were sent to 30% of hunters within each of the license types. There were 4,389 survey invitations and 867 respondents for Area 7 and 730 survey invitations and 168 respondents for Area 19. This resulted in an overall response rate of 20%. Hunters were asked questions regarding their satisfaction with overall elk numbers, their opinion regarding the population objective, hunter densities, elk availability, hunting access, license issuance, bull quality, season length, opening date, choose your weapon/archery hunting, January seasons, as well as hunt area-specific management questions (Appendix D: Hunter Surveys). All responses in graph form are reported in Appendix E: Hunter Survey Figures. Overall, there was majority support for raising the objective (Figure 13), but this support was not overwhelming as 45% of hunters supported maintaining the objective at 5,000 elk. Hunters reported a fairly high level of satisfaction with overall elk numbers (Figure 14). Hunters made 453 and 83 additional comments for Areas 7 and 19, respectively. The majority of these comments are focused on the private land access issue and ability to access elk.

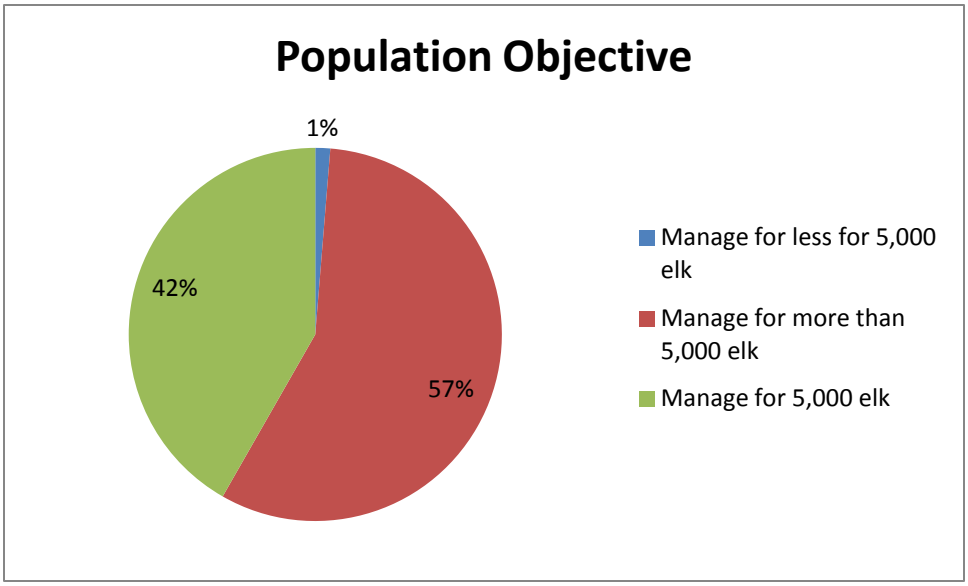


Figure 13. Hunter responses from Elk Hunt Areas 7 & 9 combined regarding the Laramie Peak/Muddy Mountain Elk population objective.

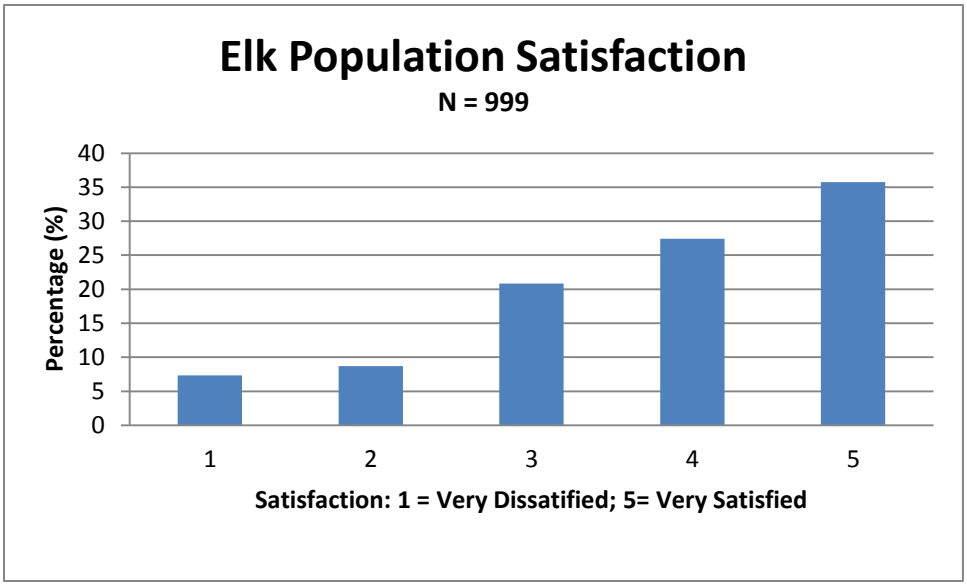


Figure 14. Hunter responses from Elk Hunt Areas 7 & 9 combined regarding their satisfaction with the current population of the Laramie Peak/Muddy Mountain Elk Herd.

Area 7 Hunter Survey Results

Over 62% of hunters were satisfied or very satisfied with elk numbers. Hunters supported managing for more than 5,000 elk, but about 42% felt we should continue to try to manage for 5,000 elk. Public land/ Access Yes land hunters were the bulk of the respondents (65%); and about half of these hunters felt that hunter densities were about right on public lands, with the other half feeling that hunter densities were too high. A little over half (53%) of the public land hunters were dissatisfied with elk numbers and availability on public land, and the majority of hunters felt that increasing access to public land and/or with Access Yes programs was the solution to this issue. Only 8% of hunters felt that we issue too many bull licenses, with the remaining hunters being fairly evenly split between wanting more licenses and supporting current bull license issuance. The majority of hunters (55%) reported being either satisfied or very satisfied with trophy bull quality, while 13% reported being either very dissatisfied or somewhat dissatisfied. On a scale of 1 to 5 with 1 being very dissatisfied and 5 being very satisfied, trophy bull quality averaged a score of 3.6. About 60% of people felt bull hunting season length was about right. There was strong support (75%) for continuing to be able to hunt with both archery and rifle equipment in the same year. The majority of hunters (61%) supported the current rifle season opening date. Forty-one percent of people were satisfied or very satisfied with access to hunt antlerless elk, although a large percentage of hunters (28%) were either very dissatisfied or somewhat dissatisfied. There was considerable support for January seasons to hunt cow/calves (61%) with only 16% of people opposing the season. Hunters also supported mid-August rifle seasons on private land (50%), although 25% of people opposed August seasons.

Area 19 Hunter Survey Results

Area 19 hunters reported high (68%) satisfaction with elk numbers. Hunters supported managing for more than 5,000 elk (60%), but about 40% felt we should continue to try to manage for 5,000 elk. Public land/Access Yes land hunters were the bulk of the respondents (81%), and about 62% of these hunters felt hunter densities were about right on public lands, with only 24% feeling that hunter densities were too

high. Public land hunters reported dissatisfaction (41%) with elk numbers and availability on public land, and the majority of hunters felt that increasing access to public land and/or with Access Yes programs was the solution to this issue. Only 6% of hunters indicated we issue too many bull licenses, with the majority of hunters wanting more or the same number of bull licenses. The majority of hunters (65%) reported being either satisfied or very satisfied with trophy bull quality, while 13% reported being either very dissatisfied or somewhat dissatisfied. On a scale of 1 to 5 with 1 being very dissatisfied and 5 being very satisfied, trophy bull quality averaged a score of 3.6. The majority of hunters (47% for Type 1 and 59% for Type 2) supported current bull season length but 36% and 25% of hunters felt it was too short for Type 1 and Type 2 licenses, respectively. As with Area 7, there was strong support (73%) for continuing to be able to hunt with both archery and rifle equipment in the same year. Area 19 has a split season where Type 1 and 4 licenses are valid from October 1 – October 14 and Type 2 and 5 licenses are valid November 1 –November 20. There was majority support (59%) for the current season structure, whereas only 10% of people opposed it. Hunters were asked about their satisfaction regarding access to hunt cow/calves/ antlerless elk on a scale from 1-5. About one third of the hunters chose a "3", with the remaining hunters split between 1 & 2 (dissatisfied) and 4 & 5 (satisfied). There was considerable support for January seasons to hunt cow/calves (70%), with only 11% of people opposing the season. The majority of hunters were neutral (49%) regarding managing for fewer elk in the Lone Tree Creek area to benefit mule deer, with 36% of hunters supporting the management, and 15% opposing it.

OBJECTIVE AND MANAGEMENT RECOMMENDATIONS

Considering the substantial public and landowner input obtained during this objective review, the Department recommends the population objective be maintained at 5,000 elk postseason. This is due to lack of majority support from landowners and hunters, and strong objections from some landowners to raising the objective. Also, raising the objective would not result in any significant changes in current management direction since managers would still issue the same number of licenses that has been issued in recent years. Regardless, the extensive public outreach proved to be a useful and meaningful exercise in engaging with the public and gathering feedback on perceptions and opinions regarding this herd. In reviewing responses and comments, field managers discovered there is widespread support for the current management direction and season structures from both the landowner community and the general public.

Hunters and landowners generally support current license issuance for bulls and cow/calves/ antlerless elk, as well as season dates and lengths. However, in hindsight, managers should have asked an additional question regarding reasoning behind why they wanted the same or more bull licenses. Judging from overall responses and comments, hunters are primarily concerned with access and opportunity. Therefore, hunters may have responded to the bull license question as they did out of desire to continue to be able to draw the license. However, the majority of landowners and hunters in both hunt areas indicated satisfaction with bull quality, although there was less satisfaction amongst landowners than there was with hunters. This may be due to landowners' relatively longer history with the herd unit and potential loss in trophy quality over time relative to years' past. In general, the consensus is that trophy bull quality has diminished somewhat due to overall high elk densities, or may be a function of increased harvest pressure on the mature bull segment (although bull densities remain very high throughout much of the herd unit). Decreasing overall elk densities and total bull numbers may actually improve trophy quality, although this is purely speculative. Through this process, managers have also identified that there may be a difference in bull density between the northern and southern portions of the herd unit, with higher densities of bulls in the northern portion. This has also been borne out during recent classification surveys. This will be further explored in future years through the classification sampling efforts. The current structure of allowing both archery and rifle equipment for a hunter for the same year was strongly supported as well.

These data will prove very helpful for field managers given consistent requests to issue archery-only licenses.

Access issues were the most common comment and concern brought forth by hunters. The intermingled and non-traditional landownership results in private land havens for elk, which is a strong point of contention and frustration amongst hunters and landowners interested in reducing elk numbers. Given high outfitting fees throughout the herd unit, substantial levels of additional public access is unlikely, although there are currently 224,089 acres of private land enrolled in the Department's Access Yes program for elk hunting within the herd unit. Field managers will continue to build relationships with private landowners in an effort to provide access whenever possible.

January seasons (Type 7 licenses) were supported by hunters, but strongly opposed by the majority of landowners in Area 7. Area 19 landowners still support January seasons, but this could be due to the fact that they have only been in place for 3 hunting seasons. Area 7 landowners are growing weary of the long hunting season. Landowners in the northern portion of Area 7 are unsupportive of January seasons because the season is ineffective on their ranches. Elk tend to congregate on only a few larger ranches during January which have taken fewer public hunters in recent years. The bulk of the access available to hunters in Area 7 is provided by the Hunter Management Areas administered by the Laramie Region. In 2017, 151 elk were harvested in Area 7 in January, meaning the Type 7 season is still somewhat successful in harvesting elk. However, given private landowners provide the bulk of the access for this season (as well as other elk hunting opportunities in addition to the Type 7), deference is given to landowners regarding this season. Current management actions are to reduce January licenses by 250 (from 500) and add them on the Type 6 cow/calf quota. Based on input from this review process, managers will evaluate eliminating the Type 7 license for the 2019 season. The total license issuance of around 5,000 licenses in Area 7 will remain and managers will evaluate season structure options to allow the same number of tags without a January season and without placing additional hunting pressure near the October 15th rifle opening day.

Landowners who were mailed a survey were sent a follow-up letter to discuss some of the major findings from the objective review process and to inform them of the Department's decision to maintain the population objective of 5,000 elk (Appendix F: Landowner Follow-up Letter).

APPENDIX A.1: Landowner Meeting Notes – In-Person Meetings with Area 7 Landowners

- Craig Hiser:
    - Not in favor of January season
    - Need to be flexible with seasons if we want cow harvest, cows are responding to pressure of long seasons which is limiting harvest potential
    - Ok with raising objective, but not with harvest
    - Has seen cow elk shift in his neck of the woods in the past 10 years, not the amount of cow elk there used to be during hunting season
    - Plenty of elk during growing season and substantial damage to growing crops
    - Elk nocturnal during aug-sep cow rifle season
    - Supports Dec. raghorn season

- Mark Grant
    - Not excited about raising objective but understands, suggests 7,500 for objective
    - Do Not decrease harvest
    - January season makes no difference to them
    - Hunter mentality has changed
    - Supports Dec. raghorn season
- Frank Prado
    - Strongly supports Dec. raghorn season
    - Indifferent on raising objective, understands why the need
- Will Grant
    - Wants data to show why we can raise the objective, are we at carrying capacity? What is the carrying capacity for this herd.
    - Supports Dec. raghorn season
    - Wants to make sure that it will not affect the way they get reimbursed for elk damage
    - No decrease in harvest
- Rick Grant
    - Killing elk is difficult with season length, cows respond rapidly to pressure
    - Indifferent on objective number, understands the need to raise it
    - Supports Dec raghorn season
    - Wants a type 9 archery for HA 7
- John Ralph Sulivan
    - Ok with objective raise, but not by much
    - Fewer elk available for hunters due to long season and pressure on cows
- Elsie Deininger
    - No January season
    - Hunt elk too long has made harvest more difficult

    - Greg Whittenburg (nephew) from South Dakota manages hunting on ranch
- Larry Chamberlin
    - Understands need to raise objective
    - Supports Dec. raghorn season
- Connie Bowen
    - Understands need to raise objective
    - No January season, long season has changed cow elk behavior, elk on meadows until season then cannot get harvest
- Wayne Smith
    - Fairly neutral on objective change
    - Does not think G&F can do much more to increase harvest- although flexible seasons may help given elk response to continual pressure
    - Would like to see a mechanism to increase small bull harvest; suggests making Type 1s valid for bulls only and cut the season off in November and not roll the season over to cow elk
    - Not a fan of high archery season opportunity given the skill level of archery hunters
    - Ending January season wouldn't hurt his feelings
- Tim Pexton
    - Understands the need to change the objective, but thinks we should just keep it where it is since we do not intend to change harvest (although mostly neutral on the matter)
    - Does not think G&F can do much more to increase harvest
    - Would like to see a raghorn season; esp. as a way to change hunting pressure dynamics and provide youth opportunity
    - August hunting season helpful; elk have been pressured enough that he no longer has as many issues although they are no longer killing many because the elk move on right before shooting hours
    - January season growing tiresome – doesn't have cows in January
    - Need flexible season to continue to obtain harvest – elk are responding to pressure and long seasons making it difficult to continue to harvest them
- Bob Hageman
    - Understands need for objective change – neutral
    - Does not have much elk damage issues beyond some fencing damage
    - Does not think G&F can do much more to increase harvest
    - January season not really effective in our country
- Aaron Clausen
    - Doesn't have elk damage issues

    - Understands the need to change the objective although mostly neutral – doesn't think it's really worth it to go through the work of changing it because it's just a number.
    - Appreciated the heads-up
- Shane Cross
    - Understands the objective issue – fairly neutral – thinks it's just a number and doesn't really impact them much
    - Mostly interested in education about how our seasons, populations, management, etc.
      work

- Dax McCarty
    - Raise the objective!
    - Supports late season raghorn hunting- feels that there are far too many small bulls. Wagonhound would allow for opportunity to shoot small bulls
    - Doesn't like January season – although that's when ranch employees get the opportunity to hunt.
    - Wants Type 9, archery only licenses

- Garrett Falkenburg
    - Wary of the objective change – we said the same thing back in 2001- but understands
    - Doesn't like January season
    - Wants the population to stay about where it's at now or a bit less

APPENDIX A.2: Landowner Meeting Notes- Group Meeting in Glenrock

February 2018

Attendance: Stuart McCrary, Kevin Christopherson, Dax McCarty, Dustin Ewing, Mark Grant, John Sullivan, Jim Bowen, Rick Grant, Will & Rachel Grant, Jim Huxtable, Howard Huxtable

- The majority of these landowners were contacted in-person prior to this meeting. While many of them were not extremely alarmed at the proposal to increase the objective during in-person meetings, the traditional ag producers were very vocal about not raising the objective during the group meeting.
    - The primary concern for raising the objective seems to be based primarily on fear of the unknown- landowners are unsure as to what it will mean in the future.
    - Landowners are concerned about what the next people in our positions will do regarding elk if the objective is raised.
    - Landowners feel that grass competition between elk and wildlife is considerable and that "every blade of grass up there is either spoken for via ownership or lease payments" which is not understood by the public.
- Landowners strongly agreed that they would like to end the January season.
- August season is becoming less effective but still has support.
- There was support for maintaining the current level of harvest and pressure, however landowners would like to see "out-of-the-box" solutions for continuing harvest. Simply adjusting quotas doesn't seem adequate.
    - It was pointed out that record harvest was achieved this year. However, elk behavior and adaptations to long hunting seasons are causing concern.
- A season to increase small bull harvest was discussed at length and strongly supported.
    - Landowners would like to see the licenses from January seasons turned into a raghorn or spike tag valid after the Type 1 season.
    - Regardless of whether we can do a small bull season, landowners supported cutting off Type 1 licenses in November to force hunters to shoot an elk.
    - It was pointed out that some level of cow harvest is achieved on a Type 1 licenses but landowners still strongly felt that hunters could still get a cow tag if cow harvest was a priority – shortening season lengths puts pressure on people to harvest an elk and then get out of the field.
    - Landowners supported maintaining 1,500 Type 1 licenses regardless of whether there is a raghorn season or not.
- There was moderate support for archery only Type 9 licenses.

WYOMING GAME AND FISH DEPARTMENT

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DAVID RAEL
MIKE SCHMID

February 5, 2018

Dear Landowner:

The Wyoming Game and Fish Department (Department) is currently reviewing the population objective for the Laramie Peak/ Muddy Mountain Elk Herd, which includes Hunt Areas 7 and 19. As a landowner who provides valuable wildlife habitat in the Laramie Range, your opinion is very important to us. Please review the following information and respond to the corresponding survey.

The Laramie Peak / Muddy Mountain Elk Herd currently has a management objective of 5,000 elk after the hunting season. The objective was last revised in 2001 when it was changed from 2,550 elk to 5,000 based on landowner and public input. The Department estimates this herd has had 8,000 – 10,000 elk postseason for the past several years. Hunt Area 19 typically holds about 2,000 of these elk, with the remaining population residing in Hunt Area 7. This herd has been fairly stable over the past 5-7 years due to extremely liberal hunting seasons resulting in very high hunter harvest preventing population growth. In an attempt to manage this herd toward the objective of 5,000 elk, the Department has issued 5,775 licenses in these two hunt areas annually for the past several years with season dates running from mid-August (in Area 7) to the end of January (in both hunt areas). These liberal seasons have resulted in an average of 2,412 elk being harvested per year in this herd since 2010.

Increasing license issuance beyond current levels will likely result in lower harvest success given the level of saturation in hunting access. Obviously, private landowners continue to provide a tremendous amount of access for elk hunting considering hunters have been harvesting over 2,400 elk per year over the past several years. We sincerely thank all private landowners that provide hunting access, as we are fully aware of the challenges this can create. However, it appears both public lands and private landowners that provide access have reached somewhat of a saturation point with hunter numbers given the high number of licenses issued. Additionally, much of the private land in the Laramie Range is owned by non-traditional landowners that bought their properties in large part for the purposes of hunting (although many also raise livestock), and often have a much higher tolerance for elk or do not allow enough hunting access to increase elk harvest beyond current levels. While many of these "non-traditional" landowners do provide substantial hunting access, many do not. In cases where large parcels of private land provide little or no hunting access, elk often seek refuge there as long as hunting seasons are going on. Liberal seasons have also compromised hunting quality and elk harvest on public land as elk increasingly shift to private lands before the rifle season starts (or quickly thereafter). Finally, the Department continues to strive to manage this herd toward objective while also managing for trophy quality bulls given widespread public and landowner interest.

Despite 5½ month-long hunting seasons (in Area 7) and extremely high license issuance for the past decade, this herd has still not decreased to 5,000 elk. This begs the question: How realistic and desirable is the objective of 5,000 elk postseason? Regardless, **the Department has no intention of managing this herd for more elk than we currently have** (8,000-10,000). We also have no intention of decreasing harvest pressure as long as this elk population remains at or near current levels (although we do recognize that January seasons are opposed by numerous landowners). The Department also fully recognizes that high concentrations of elk can cause substantial localized damage situations to growing

and stored hay, other cultivated crops, fences, and generally compete with livestock. Along this vein, we will continue to address any and all damage situations to the best of our ability.

Considering all of the issues mentioned above, the Department is proposing to increase the postseason population objective to 8,000 elk to better reflect reality. Again, this comes with the caveat that we will not manage for any more elk than we currently have and will maintain high harvest pressure. Considering where large concentrations of elk typically occur, if this herd was actually reduced to 5,000 elk it is likely the vast majority of elk would be relegated to a handful of private properties for much of the year. This could lead to dissatisfaction amongst many in the landowner community. The intention of increasing the objective is to establish a realistic and honest goal for population management that takes into account the broad diversity of interests in this elk herd. If accepted, this proposal will not alter the Department's current management strategy of achieving continued high female harvest for this elk herd.

Because private landowners provide much of the habitat for wildlife in the Laramie Range, the Department needs your opinion on the proposal to manage for 8,000 elk after the hunting season. To ensure the Department completely captures your thoughts regarding this objective review, please take a few minutes to respond to the enclosed questionnaire. Please return your survey in the envelope provided by **February 20th, 2018**, or bring your survey to one of our annual landowner meetings (locations and times below).

Annual WGFD landowner meetings will be held at the following locations and times:

February 21, 2018 – 6 p.m.	**February 20, 2018 – 6 p.m.**	**February 21, 2018 – 6 p.m.**
Glenrock Town Hall	**Glendo Town Hall**	**Sybille Research Center**
219 S. 3rd Street	**204 S. Yellowstone Hwy**	**2362 HwyWY-34, Wheatland**

Thank you for your time and participation. Please contact your local biologist or warden if you have any questions or concerns.

Sincerely,

Justin Binfet
Casper Region Wildlife Coordinator
Wyoming Game and Fish Department

Willow Bish Douglas Biologist 307-436-9617	Martin Hicks Wheatland Biologist 307-322-3821	Lee Knox Laramie Biologist 307-745-5180 x231	Kelly Todd N. Laramie Warden 307-745-4402
Cody Bish Glenrock Warden 307-436-9617	Rod Lebert Douglas Warden 307-358-3249	David Ellsworth Wheatland Warden 307-322-2067	Dylan Bergman Med Bow Warden 307-379-2337

Laramie Peak/Muddy Mountain Elk Herd Unit Landowner Survey – Area 7

1) As a landowner in this herd unit, what is your principle interest?
   a) Agriculture_____
   b) Hunting/Recreation_____
   c) Other_____

2) Do you support or oppose the proposal to change the postseason population objective to 8,000 elk?
   a) Support_____
   b) Neutral_____
   c) Oppose_____

3) If you disagree, what do you think would be an *acceptable, realistic, and attainable* population objective for this elk herd?
   a) No change (5,000)_____
   b) 6,000-7,000_____
   c) 9,000-10,000_____
   d) Other (please indicate)_____

4) Based on your experience with the Laramie Peak/Muddy Mountain Elk Herd, do you think the current size of the elk population is (pick one):
   a) About at desired levels_____
   b) Above desired levels_____
   c) Below desired levels_____

5) Do you feel current number of antlerless (cow) elk licenses:
   a) Should be maintained as is_____
   b) Should be increased_____
   c) Should be decreased_____

6) WGFD has been issuing between 1,500 – 1,750 Type 1 (*any elk*) licenses in Elk Hunt Area 7 in recent years. In your opinion,
   a) Too many any elk (bull) licenses are issued_____
   b) About the right number of any elk (bull) licenses are issued_____
   c) Could issue more any elk (bull) licenses_____

7) How satisfied are you with bull trophy quality in Elk Hunt Area 7?
   a) Very satisfied_____
   b) Somewhat satisfied_____
   c) Neutral_____
   d) Somewhat dissatisfied_____
   e) Very dissatisfied_____

(OVER)

8) In Elk Hunt Area 7, Type 1 season dates for rifle any elk (bull) hunting run from October 15 through November 20. In your opinion,
   a) The Type 1 season length is too long_____
   b) The Type 1 season length is about right_____
   c) The Type 1 season length is too short_____
   d) No opinion_____

9) For Elk Hunt Area 7, do you support or oppose the current October 15 opening date for rifle season (same as general deer)?
   a) Support_____
   b) Neutral_____
   c) Oppose_____

10) If you oppose the October 15 rifle season opening date, would you prefer
   a) An earlier rifle season opening date_____
   b) A later rifle season opening date_____
   c) NA_____

11) Do you support or oppose January elk seasons to hunt antlerless elk?
   a) Support_____
   b) Neutral_____
   c) Oppose_____

Please provide any additional comments you may have regarding this elk herd:

I do not support the harvest of cow elk in January due to fetus size in pregnant cows, not only that but there seems to be a lot of hunters running around getting stuck etc and then needing help which is a burden on the local landowners. Usually this time of year the elk have moved and migrated out of the area anyways. I have problems as it is every year with trespassers and fence damage anyway so it is a problem when they are in the mts. in January during inclement weather. I would like to see plenty of elk and not a decrease in size. TKS. I would propose that bulls be spike or 4 points or better to help the young bulls mature to trophy quality and help bring back the desire for area 7 for economic reasons.
Seasons are way too long. August season is ridiculous!! The damage is already done by them and letting people in to shoot and run around only tears up fences and hurts landowners chances of getting money from bow hunters. Cow season could start October 1st and run to December 20th. A December 20th close date is more then long enough to reach goals of herd size and give people plenty of chances to harvest an elk. If people have a close date they will go out and try. Most people don't try anyways just drive up and down the roads and all over the place doing damage to land driving everywhere. I was denied damages because didn't turn in on time and in report it was made out like its my fault elk did damage. If I have to have so many hunters to get damages the have to wait tell December to see if get hunters before can turn in damage report. Game warden saw how many elk were eating meadows. I also provided pictures sufficient evidence of damages. So 60 day limit was stupid. Showed proof should have got damage.
I would propose that unused type 1 licenses be allowed to kill a cow elk after December 31st, January 1st to January 31st.
As a participant inthis exercise some years back where other suggestions by landowners were made the license growth and season length. Clearly 6 months has been a dismal failure. The elk have conditioned themselves to migrate "out of area" or onto big inaccessible large tracts of land. It will now take gererations to get this herd comfortable and huntable again for many road hunters. Too little access to Muddy Mountain, Upper Deer Creek and Wagon Hound. Fix that.
In the past 20+ years the elk population has really increased. The quality of area 7 gene pool seams to be good but I feel that quality of the bulls I see overall are some what lacking. I support hunter mgt. and has worked great for us. Kelly Todd and company have been tremendous to work with. In the past 2 years in the program and the harvesting of cows seems again to improve our bull population, so this might be on right track. From a non-resident landowner I would like to see an increase of any elk tag for landowners. We get 2 for 6,000 leaded + 4,000 lease would like to see it increase to 3 or 4 per year.
I would like to see the type 1 season open a week earlier Oct 7 go to Nov 20 after the first week of rifle season the elk start getting into "big herds" more fun hunting them when in small herd spread out. Rest of seasons and types ok. January is too late end in Dec.
Landowner type 1 tags should be valid for any season open on our property. We have to pay the same price - so WGFD gets their money whether or not we get an elk. We lose a lot of feed for our livestock to these big herds of elk - hay damage that cost us fuel & equipment to put up! Our labor and fence materials have increased! We put up with idiots that tear up our roads and tear down fences while trying to find an elk. Seems like a small favor from WGFD to help us. Also landowners should NOT have to buy a conservation stamp. You say you want to help us - then prove it.
Still too many elk. We are over run with elk and can't afford to keep feeding so many!
Forget the stupidly of cow licenses and make the permit for any elk. ANY ELK you've got to many bulls. You have miss managed this herd to disgusting levels; if you were in the beef business you'd have gone broke years ago. Who ever heard of running a herd successfully with half of it bulls. You're getting much inbreeding it's detestable. Get up to speed and start managing for quality. Stop harassing your cows you bunch of nitwits - how long do you think you will have a herd? The Game & Fish Dept. has become greedy only wanting to raise revenue by selling as many licenses as possible you are not managing this resource entrusted to you by the people of NY. Either start managing your elk i.e., get the bull numbers in proper percentage or you'll have destroyed your future reputation. Already the bulls show the effects of inbreeding, your type system needs to cease and when people get an elk license they have the ability to shoot any elk. This one change will eliminate the excess bull population possibly the first year.
Like to have control of a percentage of the licenses. The Game and Fish have too much control. Damages paid for tearing

down fences isn't adequate and generally nonexistent. During the season large herds stay on lands that don't allow any hunting.
Hunting elk in August & Sept. with guns, De? The bow hunting experience. I also think a lot of area 7 elk have moved to area 19 due to pressure. There are way more than 3000 elk in 19. One video from a few years back shows about that many in one herd. See YouTube "Trike flying with massive elk heard." We have far fewer elk on Boxelder Creek now than we had in the past all the pressure pushed them west and they don't come back.
I think the number of elk in our country is about right but worried about cwd. Don't like the idea that we are shooting a bunch of cows and the trashing the carcass because of cwd. We tested 2 of 5 elk killed on ranch last year and both were positive. I don't like elk and deer season opening on the same day. It is too early for elk (way too hot to process the carcass correctly.) and it's getting crowded for the deer hunters. I think it would be best to get deer season over and then start elk season. I don't allow elk hunters on the ranch until after the deer hunters have moved out. The January elk cow season is a pain we end up with a lot of folks trying to fill their tag when the weather is pretty poor. We usually let folks hunt then unless the roads are wet and susceptible to damage or if I think it will be tough getting a carcass to a road where it can be loaded. Bottom line: I'd like to see elk seasons pushed back . P.S. are you guys going to pick up the number of cwd tests in area 7 next year? seems appropriate.
#2Relucantly support as long as tag #'2 for type 1 decreases to maintain trophy herd and cow tags and cow/calf stay he same or increase. #3 We are concerned about reports of wolves moving into our area? Answers to those ?'s will effect our answer. #4 Based on our conversations w/people who run cattle in wolf country, we are seeing the same behaviors in our cattle. #6 Decrease to 1500 to manage for quality 1500 tags is good but we'd like to see more be made available to non residents. #7 (B) Archery season only + we've seen better in previous years. (D) Rifle season only. Last season 2017, we felt quality was a little better and attribute that to lowering type 1 tags back down to 1500. #10 We'd like to suggest a type 1 season starting OCt.1 - Oct 15th (rifle) on private land only. #11 You're going to get someone killed. No cell service on our ranch. No one there to pull them out. Plus on our ranch the late season is pointless. Additional comments: We have done an HMA for many years and want to commend Jason Sherwood and his helpers for doing a top notch job? But the bottom line is, the HMA hunters are poor hunters. They run the elk around and harvest is poor. Our HMA hunters caused our neighbors (Christensen Ranch) to the south to get angry w/us. Fact is we killed 60% more cow elk on our ranch last (2017) year w/our outfitter, than we have on our best year w/ HMA. The neighbors stayed happy, fences weren't torn up as bad and revenue was way up.! If the G&F wants more elk killed, they need to make it so more non-residents can get tags - changes to state statute to allocate higher % age to non-residents or give private landowners tags to sell. Let's not forget about deer in all these equations. What is the deer population objective? What are the current deer # estimates? What are your management plans for deer?
General license for area 7 not manage for trophy elk. Eliminate Aug. and Jan. seasons. Divide area 7 into smaller management area.
I would like the bull season to start Nov. 1 and end Nov. 20. This would save a lot of the bulls and keep better quality of larger bulls in the heard. The cows would continue to be taken Aug 15 - Dec 31. I think the objective numbers are for you the game managers to put in we know that it seems to be impossible to cut numbers back and herd range is changing to pressures from hunter access in our area.
Don't open the rifle season before October 15. If you do all our mature big bulls will be killed.
As a landowner I would like to comment on the Game & Fish's proposal to raise the postseason objective on elk areas 7 and 19. I personally object to the changing of the postseason objective number as do many other landowners. When looking back into the history of this elk herd, the Game & Fish has a terribly poor track record of managing this herd. Mismanagement has let this elk herd increase from approximately 2,500 to as high as 11-13,000 head. All the while, landowners were telling you of the increase but you continued to ignore us for some 15 years until you could no longer doubt it. I have for years, seriously questioned your numbers and your data on this herd, while you continued to defend your numbers. To this day, you continue to use the same form of data collection that has let this herd run wild over the objective. When the Game & Fish cannot get their herd data accurate, the area landowners carry the load of your inconsistencies. Your means of data collecting was inefficient then as it still is now. With your poor response time to

herd changes, you are more reactive than proactive. Drought is always on the forefront and if and when we have our next drought, we still have too many elk. They will be in places that are undesirable to landowners. Ag is very tolerant of wildlife as long as there is feed enough for both, if not wildlife are the first to go. You give a lot of reasons as to why you cannot reduce this herd any further in your letter, while pointing the finger at landowners and landownership's as being the reason. Nowhere do you address sportsmen and their lazy hunting habits. Because sportsmen insist on continuously road hunting instead of getting out and ethically hunting, harvest success rate is not what it should or could be. Sportsmen are now locked out of a lot of private that they used to have access to for this very reason. This is not a good practice, as control of this herd unit depends on them. I do not see this getting any better in the future. In fact, I foresee it getting worse over time. When addressing disease in the elk, they also have CWD. Thank goodness this is not to the extent as in the mule deer. My own observation is that we have hit bottom with our deer losses and are starting to rebound. They are going to need our help, in order to have a fighting chance. Giving your lack of a starting point on this disease, we do not know if elk spread the disease to other areas, or how it interacts with in the two species. We (including the Game & Fish) know elk are in critical deer habitat and compete with overall deer numbers and their feed sources. As a landowner, I am also concerned with the migrating and comingling of our elk with elk in other areas. This is a great way for diseases to be moved from one area to another. Elk migrations are on the increase possibly due to overpopulation. No sufficient data shows where they are coming from or where they are going. In the big picture, managing the elk herd in areas 7 and 19 can still be done without changing the postseason objective number. I strongly recommend leaving the number the same and continue to harvest the same amount of elk, or more This leaves you the flexibility to manage for an overharvest. i.e.: two excellent harvest years back to back, further reducing the herd for the betterment of mule deer or drought issues. I also have thoughts on the proposal to do away with the January elk season... I'm not in favor of the January season BUT in order to keep harvest numbers the same or to decrease the overall herd numbers we must continue to have the January season. Moreover, I do not trust the Game & Fish to adjust the license numbers. In your letter you talk about saturation of land and hunters. By shortening the season, you have now compounded the problem. By doing away with the January season, you have to absorb the January license numbers into other seasons, if not, you are increasing the herd. I also think that we are losing calves because of herd harassment, either through abortion or fetus absorption. If not given careful consideration, then you are once again unintentionally increasing the herd. Never in the last thirty years has the Game & Fish ever overharvested or over-issued licenses for this herd unit and I definitely don't foresee you starting now.
G&F involvement and responsiveness to me is commendable and appreciated. My contacts are Martin Hicks and David Ellsworth. They are great professionals.
Area 7 is too big. You should break it onto smaller more manageable units. I also would prefer more and shorter seasons. Type 1 - Oct. 10-31, Type 2 Nov 1 - 20 or 30, Type 9 Sept 1 - 30. This would increase the quality of the outdoor experience and allow better opportunity. I'd also like to see 3-4 separate cow seasons. You can make more money and the hunters will have a better/higher quality experience. Good luck in the world of Biopolitics.
The type 1 hunting season should be open until Dec. 1st.
Continue to increase means to harvest antlerless elk. Easier said that done I realize, but greater access before the weather turns cold/snowy, and allow more activity on hunter management monitoring and management, but that's what it takes. The bull quality has declined due to really opening of rifle season and length of season as well. Number of licenses....I'm not sure, but that may be a factor as well. Hope this helps!....ha!
Biggest complaint is letting season run through Jan. I have 300 - 400 elk cross thru me and neighbor who only have a few acres strip and they allowed hunters in this year and of course they only have these few acres/ran all these elk back through my fences and totaled out all my gates plus 3 elk died in my fences. Its a total mess. These animals are used to crossing for water and it totally disrupts what they are used to. They now have come closer in to house wells/tanks to find water. I don't let elk hunters come until after deer season is over. Have not had only 1 elk hunter (cow) the last 3 yrs. Hunters complain they can not draw 7 - 9 yrs. There are 6 coming from Oregon that are on 9 points and hoping the will draw this yr. Grant you I don't understand a lot about this hunting but when you see that many elk crossing and still being shot at in cold Jan. it just don't seem right to me. Our fences are so tight and when you run that many through

them there is going to be deaths. I see lions are getting their share as well. Lived here 50 yrs. and never been short on elk hunters until these last 4 - 5 yrs.
True agriculture producers are the landowners that carry the burden of supporting the elk herd in this unit. Many have crops, fences and pasture that are extraordinarily damaged every year by this elk herd. If the herd objective is increased and efforts to decrease the herd are diminished, the landowners have to bear this economical burden. If these landowners fail because of this burden and sell their property, thousands of acres of private land will become unavailable to the hunting public. Often access to public land through the private land will also be lost. I feel that it is in the best interest of the Game and Fish Department to continue to strive to decrease the elk herd to the current objective for the health of the elk herd, protecting hunter access and protecting natural resources that allow the ranching tradition to persevere in this area.
The elk herd can never be under control until there is more access available. And there won't be more access available until the landowners lower their fees and charge less especially since the landowners are already receiving access fees from the G&F.
Landowner licenses should be increased for 1000 acres or more - 4 licenses should be allowed. Many operating ranches have more than 2 owners.
The bull/cow ratio would support additional harvest of bulls, many would not be "quality" "trophy" animals, but a reduction of these animals has long term benefits to trophy quality.
I would like to see adoption of a system like New Mexico and other states that allow landowners a few bull tags that they can do whatever they want to - sell to outfitters etc. These could even be the landowners license that they can now get but have the ability to let someone else use the tag.
I don't feel the game and fish should pay any damage to land owners who do not allow hunting or charge a high trespass fee.
Should regulate taking of smaller bull elk so they might grow to better trophy size.
Type 1 (bull) should go from Oct 15 - Nov 15. Get rid of Jan elk season, it is a waste time and resources. Typically the elk are not up here (N. Albany Co.) or they are not accessible to hunters due to winter conditions. It seems a lot of time is put into locating lost of stuck hunters in January. Turn the type 7 tags to type 6 and get rid of Jan. hunting.
To reduce #, late season cow tags will help decrease total #'s as cows are generally bad at this time. If taken then will reduce future load of elk.
I feel the biggest issues concerning the herd management in area 7 has more to do with the lack of public land that can be accessed. This often leads to overcrowding on the limited public land and increased pressure on the private landowners to allow access/kill elk. Whatever the elk objective ends up at, the problems we face will still be there. I feel that this elk herd could be better managed if there was distinction between licenses on private and public land and allow for landowners to better manage the elk on their land. Though other idea would be to built a better incentives than the walk-in /HMA programs for landowners to provide access to allow the killing of elk. Area 7 & 19 are unique to our state b/c of the checker boarding of public/private land and the lack of public access. The landowners shouldn't have to bare the majority of the burden for the elk numbers or hunter access w/o better incentive to do so.
Archery only licenses, type 7 in December
Squaw Mtn. is predominately a bull haven during the hunting season. With late warm weather predominating it is often prudent not to hunt early in the season as there is only foot access (no roads) to get an animal out once it is harvested (meat spoils/ flies etc...) I recommend extending bull harvest to the same time as cow/calf season for those with type 1 tags. This might encourage hunters with those tags to be out longer a field in this quest and as the season nears its end, harvest a cow/calf if no bulls are found. Have you identified the ? hunt allowed landowners? What endearments can be offered to those people to change their attitude?? I suspect there are some hunters willing to do work for those people (e.g. fence repairs etc) for the chance to hunt virgin ground? P.S. Keep up your efforts on the landowners behalf.
Our land Nunemaker Middle Fork Ranch LLC 1,000 acre 80 acre-John Nunemaker Family joins NMFR land. 161 acre - John Nunemaker Family along Deer Creek & FS 610 All located in 40 mile area N Albany co. (Wyoming Game & Fish doing good job of mgr. these elk areas 7. 161 ac is used for Belle-Otte Ranch Grazing. 1,080 acre grazed by Rodeman Family

brood cows and calves (June - Oct 1) This is a high altitude 7,600' - 8,675' elevation mtn land, only good for elk - antelope - bighorn sheep - mtn. lion usage, mule deer. Yes we like the hunting also. John Nunemaker age 90 yrs. (B 11-19-27) has hunted this tract since 1956 x 2 till wife Doris died Aug 18, 2017. Yes Doris hunted with John here. I remember when elk scarce till G&F released Yellowstone elk in 1960 era, the shot 2 of these elk cows.
I did not see the wolves during elk season this year and heard them seldom, but never heard the coyotes, which meant the wolves were there. The bulls move onto my converse county land about the first part of December, but if you can get there is very limited. My Albany land, the forest service closes the road at elk season.
Could more land owner tags be issued to land owners with larger ranches? This would provide an opportunity for them to create guided hunting in areas that the elk are hiding during rifle season.
It looks to me as if there has been a 3 fold increase in animals in less that 15 years and the current program is barely keeping these numbers in check. Outfitters are cutthroat in bull season but hide under a rock about killing cows. There has to be a way to eliminate some cows. Work on the outfitters and "no hunting" landowners and get rid some problems or compensate those "hunting yes" landowners for putting up with the problem.
I don't see any signs that the herd in 7 is shrinking any, so you could set the population objective to anything less that actual and the herd numbers would not change assuming the same number of hunters. I think you need to change things up a little to keep hunter interest up. Maybe a rag (?) horn tag, or something for youth, or the ladies.
Since part of the issue seems to be lack of adequate harvest on private property where landowners do not allow public access perhaps a temporary solution might be an increase in landowner permits on a temporary basis from the direct family to some increment number of permits that do not have to be direct family. This increase of landowner tags would not impact the number of public draw tags. This would get more harvest on those posted lands. The increment tags would be valid only on that particular ranch including leased public land so as to have impact only on that previously closed ranch. Problem might be bigger ranches actually closing off some previously granted public hunting, but maybe some sort of requirement to allow certain amount of public hunting in exchange for those temporary incremental landowner directed tags? Don't change existing landowner tag requirement and rules.(ratio 1:1 or 2:1)
Bow hunters seem to put enough pressure to more cow herds into non-hunt area's earlier in season. Herd habits are changing, not staying in higher elevations year long. Would it be beneficial to have hunters declare only one hunting type? If they bow hunt then they can't rifle hunt. May cut down on number of bow hunters that are just out getting the lay of the land. Just a thought.
Cut type 1 by 250 this will help trophy numbers and type 6 by 250 close season about Dec 20. I think in the last 10 years the number of trophy bulls has dropped 50%
Late season encourages trespassing. Stresses elk. People who complain about elk numbers should allow hunting.
You want to kill more elk, how about offering an incentive to landowners (that feed "your" elk all year with our grass and hay) . Since you increased license fees for 20187, pay $20.00 for landowner coupons if they submit say over 25 - 30 coupons and your $16.00/ below that number. Money talks! You may have landowner allowing a few more hunters to hit that magic number for a bigger payout.
For those wanting to hunt antlerless elk. The season through end of December should be adequate time as they have over one month past type 1 season close. Many times weather can close applicants ability to get into this country. Through all of January limits the ability of local wardens to oversee hunter activity.
As a landowner with land in areas 6 and 7, I would like to se the type 1 season for both areas better aligned.
The type 1 license should be bull only. May be extend the season 10 days and maybe hunters will harvest more of the junk bulls I this area rather than kill cows later area 7 is getting to many rag and junk bulls and that is not good management for a trophy elk area.
If the quota increases to 8,000 do you increase # of licenses? How would increase in elk herd be obtained? What do the experts think the area could support without disease and over grazing?
Access has always been the issue for good harvest numbers in area 7. Many landowners in the higher portions of area 7 don't allow hunting early in the season (Oct - Nov) because cattle are still present and they are still working the land. Just wondering if many of these ranchers make the statement of "no hunting" for the entire season because they are still

working the land. One they have brought their cattle out maybe these hunters would allow cow hunting (etc (Dec & Jan) without even permission. I know once this time of year comes we are out of our country and it would not bother us at all if people are hunting. Depending on weather the elk still seem to pass through in the late season. Maybe a list of landowners who allow late hunting without permission would be nice.
The only way you will lower the elk herd is to let people hunt on the Big Ranches that let little to no public huninting. They keep it all for them self and don't really care if they make a profit or not with agriculture. The elk go right to that land and stay until season is over then they travel to the smaller Ranches that have to deal with them. The Game and Fish is doing the best job that they can, but without the public land they will have a hard time managing.
The 2001 objective was established before the fires destroyed large swaths of forest within hunt areas 7 & 19. Since this deforestation, there is far more grass and forage for support of a larger herd presence. I would whole-heartedly agree with the biologists and the departments intend to manage a larger elk population of 8k - 10 animals. The winter forage and habitat would indicate that a larger herd has not diminished the quality nor quantity of that most important habitat. I would even state that a larger herd is sustainable in the immediate vicinity of my lands on Crow Creek drainage. Thank you for the phenomenal job that WGFD and the wardens and biologists have performed.
We are just beginning to reduce numbers which is finally after 20 years of cooperation between my ranch and G&F Dept. Why would G&F Dept. even contemplate raising post seasons population objective? This essentially wastes my 20 yrs of cooperation with the G&F Dept. If you raise the post season population objective my ranch will o longer cooperate with the G&F Dept. in regard to hunter access to my land. If you raise the population objective, my policy will swing from aggressive cow elk de-population to an aggressive ranch policy of monetary compensation for all damages including fences, grazing, and hay crops. Leave the population objective at the current 5000 had post season objective or be advised that the spirit of cooperation from my ranch will be over. "William Sturgeon"
As a landowner the ever increasing elk numbers there is extraordinary damage to grass in many areas, which will become more evident during the next drought. 10,000 elk/1.7 (number of elk to = 1AUM) = 5882.3529 AUM X 12 months = 70584 AUM used /year. With elk leaving the area in many places and larger concentrations at more traditional area I think there is more elk than ever. If some objective can't be met, it is time to pay damages. Hunters are never going to be able to harvest enough elk to maintain a lower the numbers.
Hunting access
Cow elk numbers have definitely increased, older age class bull numbers have not increased along with population, cow elk numbers have increased since late cow season implementation, increased pressure on bulls since late cow season implementation. * if season structure and management stay the same the next herd unit survey will be asking should we go from 10,000 to 15,000 elk. Need to divide area 7 so Casper can manage their old bull elk and Laramie (southern area 7) can work on growing older bull numbers. (use the division boundary line Martin Hicks was working on.) These population and age class changes started about 10 years ago.
I think that one should be able to hunt spikes and freaks in the cow season. We are getting many of the trash bulls In our area. This would make it a better trophy area. As stands if they don't get a big bull then they just go for a cow,
I appreciate the work you do, and support a healthy elk population. We could take more elk on our place as we keep our cattle numbers down to help the wildlife.
Cutting the north part of area 7 off and making it 19 so harvest could satisfy the elk numbers.
If the department has no intention in managing for more elk then why increase the objective? We believe that the management objective after the hunting season should be set considering several factors including habitat and forage resources, levels of damages to private or public resources, hunter access, shared resources with other species and management objectives for those species. We believe the management objective after the hunting season should remain at 5,000 or be lowered. We believe mule deer habitat has suffered with the current elk herd and/pr crop resources have suffered far beyond acceptable levels due to the current herd size. Managing for an objective elk herd size of 8,000 basically accepts defeat and would seem to say that excessive damage to private resources is acceptable. When the going gets tough, please don't move the goal line closer to celebrate a false success. Please stay the course.

WYOMING GAME AND FISH DEPARTMENT

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January 11, 2018

Dear Landowner:

The Wyoming Game and Fish Department (Department) is currently reviewing the population objective for the Laramie Peak/ Muddy Mountain Elk Herd, which includes Hunt Areas 7 and 19. As a landowner who provides valuable wildlife habitat in the Laramie Range, your opinion is very important to us. Please review the following information and respond to the corresponding survey.

The Laramie Peak / Muddy Mountain Elk Herd currently has a management objective of 5,000 elk after the hunting season. The objective was last revised in 2001 when it was changed from 2,550 elk to 5,000 based on landowner and public input. The Department estimates this herd has had 8,000 – 10,000 elk postseason for the past several years. Hunt Area 19 typically holds about 2,000 of these elk, with the remaining population residing in Hunt Area 7. This herd has been fairly stable over the past 5-7 years due to extremely liberal hunting seasons resulting in very high hunter harvest preventing population growth. In an attempt to manage this herd toward the objective of 5,000 elk, the Department has issued 5,775 licenses in these two hunt areas annually for the past several years with season dates running from mid-August (in Area 7) to the end of January (in both hunt areas). These liberal seasons have resulted in an average of 2,412 elk being harvested per year in this herd since 2010.

Increasing license issuance beyond current levels will likely result in lower harvest success given the level of saturation in hunting access. Obviously, private landowners continue to provide a tremendous amount of access for elk hunting considering hunters have been harvesting over 2,400 elk per year over the past several years. We sincerely thank all private landowners that provide hunting access, as we are fully aware of the challenges this can create. However, it appears both public lands and private landowners that provide access have reached somewhat of a saturation point with hunter numbers given the high number of licenses issued. Additionally, much of the private land in the Laramie Range is owned by non-traditional landowners that bought their properties in large part for the purposes of hunting (although many also raise livestock), and often have a much higher tolerance for elk or do not allow enough hunting access to increase elk harvest beyond current levels. While many of these "non-traditional" landowners do provide substantial hunting access, many do not. In cases where large parcels of private land provide little or no hunting access, elk often seek refuge there as long as hunting seasons are going on. Liberal seasons have also compromised hunting quality and elk harvest on public land as elk increasingly shift to private lands before the rifle season starts (or quickly thereafter). Finally, the Department continues to strive to manage this herd toward objective while also managing for trophy quality bulls given widespread public and landowner interest.

Despite 5½ month-long hunting seasons (in Area 7) and extremely high license issuance for the past decade, this herd has still not decreased to 5,000 elk. This begs the question: How realistic and desirable is the objective of 5,000 elk postseason? Regardless, **the Department has no intention of managing this herd for more elk than we currently have** (8,000-10,000). We also have no intention of decreasing harvest pressure as long as this elk population remains at or near current levels (although we do recognize that January seasons are opposed by numerous landowners). The Department also fully recognizes that high concentrations of elk can cause substantial localized damage situations to growing

and stored hay, other cultivated crops, fences, and generally compete with livestock. Along this vein, we will continue to address any and all damage situations to the best of our ability.

Considering all of the issues mentioned above, the Department is proposing to increase the postseason population objective to 8,000 elk to better reflect reality. Again, this comes with the caveat that we will not manage for any more elk than we currently have and will maintain high harvest pressure. Considering where large concentrations of elk typically occur, if this herd was actually reduced to 5,000 elk it is likely the vast majority of elk would be relegated to a handful of private properties for much of the year. This could lead to dissatisfaction amongst many in the landowner community. The intention of increasing the objective is to establish a realistic and honest goal for population management that takes into account the broad diversity of interests in this elk herd. If accepted, this proposal will not alter the Department's current management strategy of achieving continued high female harvest for this elk herd.

Because private landowners provide much of the habitat for wildlife in the Laramie Range, the Department needs your opinion on the proposal to manage for 8,000 elk after the hunting season. To ensure the Department completely captures your thoughts regarding this objective review, please take a few minutes to respond to the enclosed questionnaire. Please return your survey in the envelope provided by February 25th, 2018.

Thank you for your time and participation. Please contact myself or Jake Kettley if you have any questions or concerns.

Sincerely,

Heather O'Brien
Casper Wildlife Biologist
Wyoming Game and Fish Department
307-473-3411

Jake Kettley
East Casper Game Warden
Wyoming Game and Fish Department
307-473-3419

Laramie Peak/Muddy Mountain Elk Herd Unit Landowner Survey – Area 19

1) As a landowner in this herd unit, what is your principle interest?
   a) Agriculture_____
   b) Hunting/Recreation_____
   c) Other_____

2) Do you support or oppose the proposal to change the postseason population objective to 8,000 elk?
   a) Support_____
   b) Neutral_____
   c) Oppose_____

3) If you disagree, what do you think would be an *acceptable, realistic, and attainable* population objective for this elk herd?
   a) No change (5,000)_____
   b) 6,000-7,000_____
   c) 9,000-10,000_____
   d) Other (please indicate)_____

4) Based on your experience with the Laramie Peak/Muddy Mountain Elk Herd, do you think the current size of the elk population is (pick one):
   a) About at desired levels_____
   b) Above desired levels_____
   c) Below desired levels_____

5) Do you feel current number of antlerless (cow) elk licenses:
   a) Should be maintained as is_____
   b) Should be increased_____
   c) Should be decreased_____

6) WGFD has been issuing 300 Type 1 and 2 (*any elk*) licenses in Elk Hunt Area 19 in recent years. In your opinion,
   a) Too many any elk (bull) licenses are issued_____
   b) About the right number of any elk (bull) licenses are issued_____
   c) Could issue more any elk (bull) licenses_____

7) How satisfied are you with bull trophy quality in Elk Hunt Area 19?
   a) Very satisfied_____
   b) Somewhat satisfied_____
   c) Neutral_____
   d) Somewhat dissatisfied_____
   e) Very dissatisfied_____

(OVER)

8) In Elk Hunt Area 19, Type 1 season dates for rifle any elk (bull) hunting run from October 1 through October 14. In your opinion,
   a) The Type 1 season length is too long_____
   b) The Type 1 season length is about right_____
   c) The Type 1 season length is too short_____
   d) No opinion_____

9) In Elk Hunt Area 19, Type 2 season dates for rifle any elk (bull) hunting run from November 1 through November 20. In your opinion,
   a) The Type 1 season length is too long_____
   b) The Type 1 season length is about right_____
   c) The Type 1 season length is too short_____
   d) No opinion_____

10) For Elk Hunt Area 19, do you support or oppose the current split season whereby Type 1 and 4 licenses are valid from October 1 – October 14, and then Type 2 and 5 licenses are valid from November 1 – November 20?
   a)Support_____
   b) Neutral_____
   c) Oppose – just have one set of license types valid for the entire rifle season _____

11) Do you support or oppose January elk seasons to hunt antlerless elk?
   a) Support_____
   b) Neutral_____
   c) Oppose_____

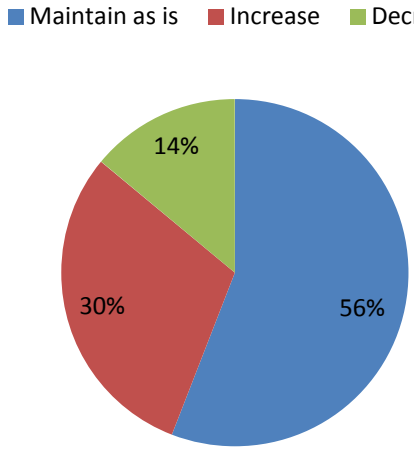
Please provide any additional comments you may have regarding this elk herd:

Overall in support of increasing objective to current levels, would be interested in having longer bull season (especially October) but do not wont to overlap with deer as it is already very crowded! Need to limit pressure in September on the forest service, please consider closing archery end of month (25th) to give a break before rifle opens. Currently suppotive of January season but are concerned for the elk, 5 months of pressure is too long, potentially review if necessary in the future. Access is getting more difficult do not increase the number of tags it is already too crowded. Bull quality and numbers appear to not be as good as they were a few years ago, need to monitor this.
Public elk. Fly and push elk off Lone Star and Shook you would get more elk killed until then leave numbers high so people can try to get a elk. When you open type 1 quality went way down on bulls.
Somehow this elk herd needs to be reduced.
There seem to be a good number of bulls in 19, however, over the last five years or more bulls of trophy caliber have decreased. Not sure what that means, but that is my observation.
This elk herd has been growing for 10 years. The only way to manage it is hunting. More hunters is not the answer. Access is . Explore more access!!
Type 2 should be 1st Nov to 30 on account of weather and access. Bow hunter should have to pick weapon to hunt. Rifle or bow. Bow hunters run all the elk out of the hunting grounds to the reserve. Open the road on top of 2nd range so eldery hunters can get to west and east end.
Would like to see a Sept. 25 open for the early season. Makes both seasons the same length and doesn't give the headache of over lapping with deer. Bull herd needs thinned out. Less bulls means less fighting and maybe not as many broken horns. Since we can't kill more cows maybe by lowering the number of bulls we might be able to lower the bred up. Might also take the pressure off my winter range. The January season does't do me any good but I will support it as long as it is working on the other side of the mtn.
You are doing a great job.

APPENDIX C.1: Area 7 Landowner Survey Response Graphs

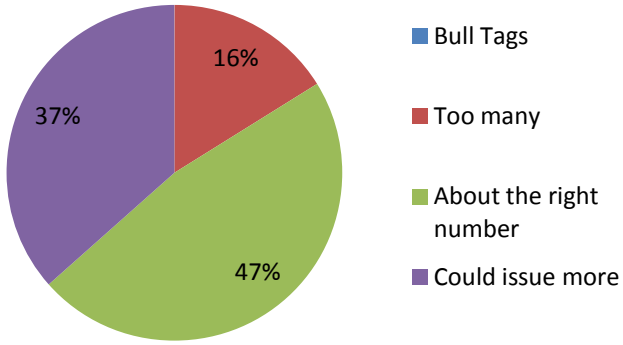
N=99

Antlerless License Issuance

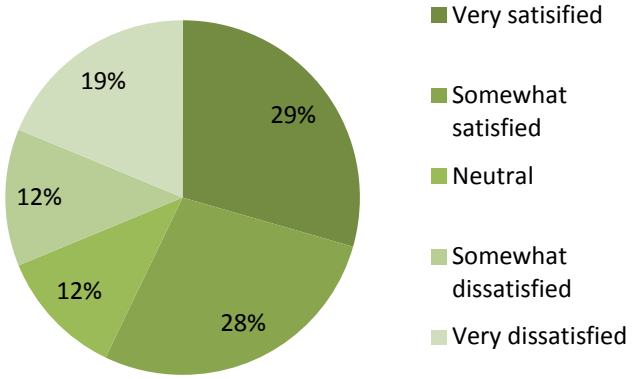


Bull License Issuance

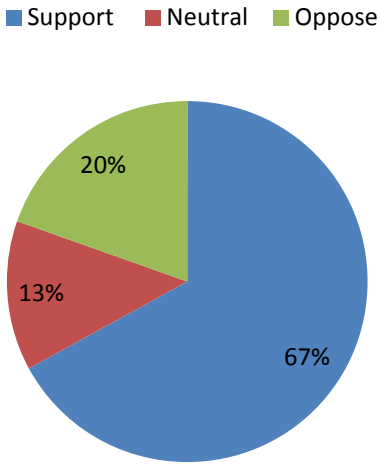
*Regarding recent license issuance at 1,500-1,750 licenses



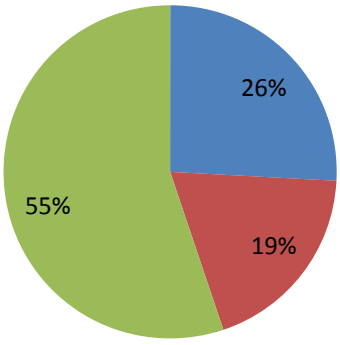
Bull Quality



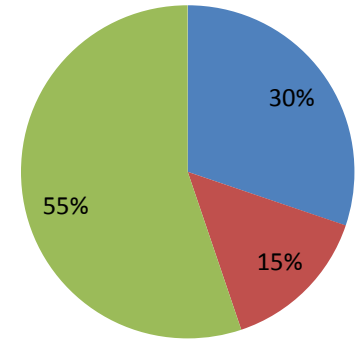
October 15th Opening Date



Alternative Opening Date



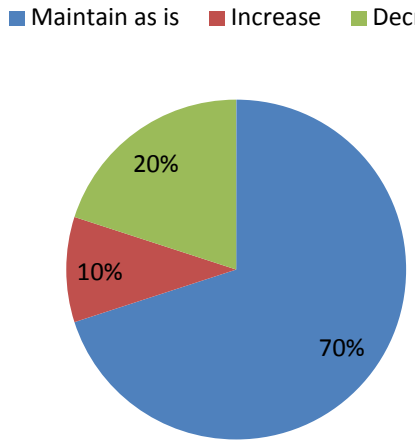
January Elk Seasons



APPENDIX C.1: Area 19 Landowner Survey Response Graphs

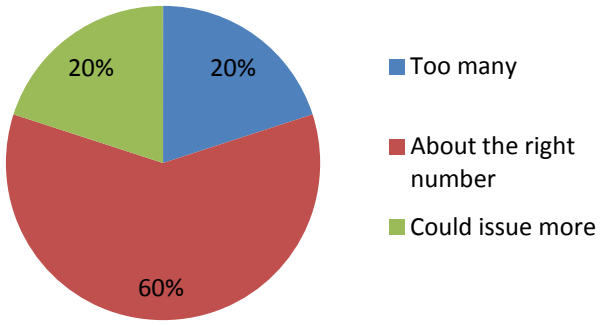
N=10

Antlerless License Issuance

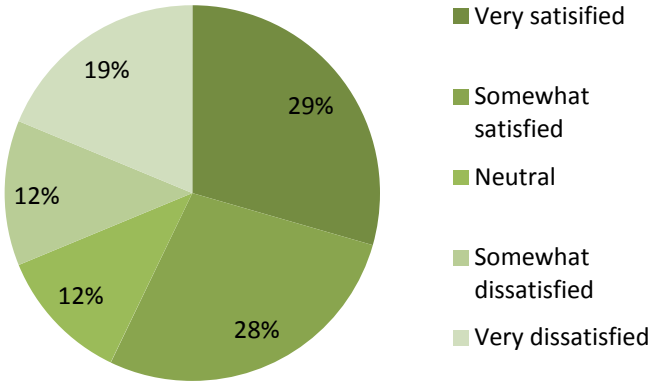


Bull License Issuance

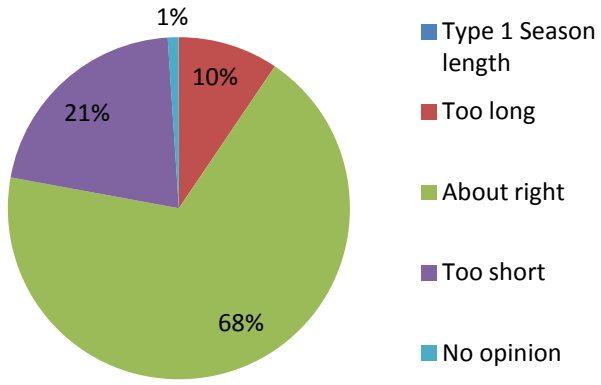
*Regarding recent license issuance at 300 licenses



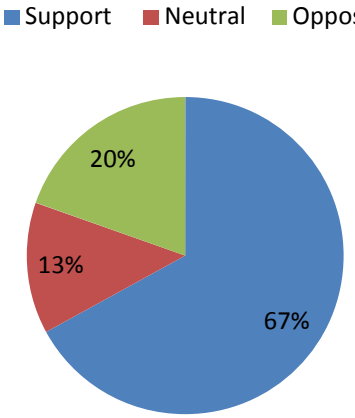
Bull Quality



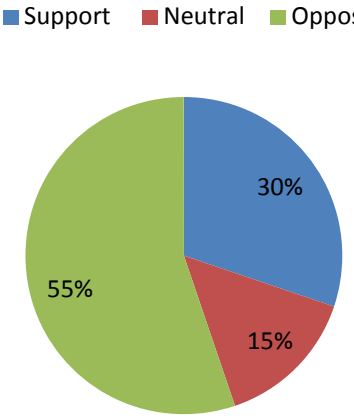
Type 1 Season Length



October 15th Opening Date



January Elk Seasons



APPENDIX D.1: Area 7 Hunter Survey

Laramie Peak Herd Unit, Elk Hunt Area 7
2017 Hunter Attitude Survey

SECTION 1: OVERALL ELK NUMBERS IN HUNT AREA 7

1) How satisfied are you with overall elk numbers in Hunt Area 7?
a) Very satisfied_____
b) Somewhat satisfied_____
c) Neutral_____
d) Somewhat dissatisfied_____
e) Very dissatisfied_____

2) The population objective for this elk herd is 5,000 elk postseason (for both Hunt Areas 7 and 19). The current population estimate is between 8,000 – 10,000 elk postseason. Should the Department continue to manage to reduce this herd to 5,000 elk?
a) Yes_____
b) No- manage for more than 5,000 elk_____
c) No- manage for less than 5,000 elk_____

3) In Elk Hunt Area 7, do you primarily hunt public land or Access Yes lands?
a) Yes_____
b) No, I primarily hunt private land_____

4) If you typically hunt public land in Elk Hunt Area 7, are hunter numbers/densities on **PUBLIC** land
a) Too high_____
b) About right_____
c) Could hold more hunters_____
d) No opinion; I do not hunt public land_____

5) If you typically hunt public land in Elk Hunt Area 7, how satisfied are you with elk numbers /availability on **PUBLIC** land?
a) Very satisfied_____
b) Somewhat satisfied_____
c) Neutral_____
d) Somewhat dissatisfied_____
e) Very dissatisfied_____
f) No opinion; I do not hunt public land____

6) If you are dissatisfied with elk numbers/availability on public land in Elk Hunt Area 7, then in your opinion, what are some possible solutions?
a) Manage for a higher number of elk_____
b) Increase access to public land (e.g. easements, Access Yes, land trades)_____
c) Limit the number of licenses available on public land _____
d) No opinion; I do not hunt public land____
d) Other_____

SECTION 2: BULL ELK HUNTING IN HUNT AREA 7

7) How many times, in the last ten years, have you held an Elk Hunt Area 7 Type 1 (*any elk*) license?
a) 0_____
b) 1-3_____
c) 4-6_____
d) 6-10_____

8) WGFD has been issuing between 1,500 – 1,750 Type 1 (*any elk*) licenses in Elk Hunt Area 7 in recent years. In your opinion,
a) Too many any elk (bull) licenses are issued_____
b) About the right number of any elk (bull) licenses are issued_____
c) Could issue more any elk (bull) licenses_____

9) How satisfied are you with bull trophy quality in Elk Hunt Area 7?
a) Very satisfied_____
b) Somewhat satisfied_____
c) Neutral_____
d) Somewhat dissatisfied_____
e) Very dissatisfied_____

10) In Elk Hunt Area 7, Type 1 season dates for rifle any elk (bull) hunting run from October 15 through November 20. In your opinion,
a) The Type 1 season length is too long_____
b) The Type 1 season length is about right_____
c) The Type 1 season length is too short_____
d) No opinion_____

SECTION 3: WEAPON OF CHOICE FOR ELK HUNTING IN AREA 7

11) What weapon do you typically hunt elk with in Elk Hunt Area 7?
a) Rifle_____
b) Archery (bow or crossbow)_____
c) Both_____

12) Do you think hunters should be able to hunt with both archery and rifle equipment in the same year (as is currently allowed) in Elk Hunt Area 7?
a) Support_____
b) Neutral_____
c) Oppose - Hunters should be able to only archery hunt or only rifle hunt, but not both in the same year_____

SECTION 4: HUNTING SEASON STRUCTURE IN ELK HUNT AREA 7

13) For Elk Hunt Area 7, do you support or oppose the current October 15 opening date for rifle season (same as general deer)?
a) Support_____
b) Neutral_____
c) Oppose_____

14) If you oppose the October 15 rifle season opening date, would you prefer
a) An earlier rifle season opening date_____
b) A later rifle season opening date_____
c) NA_____

15) How satisfied are you with access to hunt cow/calf/antlerless elk in Elk Hunt Area 7?
a) Very satisfied_____
b) Somewhat satisfied_____
c) Neutral_____
d) Somewhat dissatisfied_____
e) Very dissatisfied_____

16) Do you support or oppose January elk seasons to hunt cow/calf/antlerless elk in Elk Hunt Area 7?
a) Support_____
b) Neutral_____
c) Oppose_____

17) Do you support or oppose mid-August cow/calf rifle seasons on private land to address elk damage situations in Elk Hunt Area 7?
a) Support_____
b) Neutral_____
c) Oppose_____

Additional Comments/Thoughts You Would Like to Provide Regarding Elk Hunt Area 7

_____
_____
_____
_____

Laramie Peak Herd Unit, Elk Hunt Area 19
2017 Hunter Attitude Survey

SECTION 1: OVERALL ELK NUMBERS IN HUNT AREA 19

1) How satisfied are you with overall elk numbers in Hunt Area 19?
a) Very satisfied_____
b) Somewhat satisfied_____
c) Neutral_____
d) Somewhat dissatisfied_____
e) Very dissatisfied_____

2) The population objective for this elk herd is 5,000 elk postseason (for both Hunt Areas 7 and 19). The current population estimate is between 8,000 – 10,000 elk postseason. Should the Department continue to manage to reduce this herd to 5,000 elk?
a) Yes_____
b) No- manage for more than 5,000 elk_____
c) No- manage for less than 5,000 elk_____

3) In Elk Hunt Area 19, do you primarily hunt public land or Access Yes lands?
a) Yes_____
b) No, I primarily hunt private land_____

4) If you typically hunt public land in Elk Hunt Area 19, are hunter numbers/densities on **PUBLIC and ACCESS YES** land
a) Too high_____
b) About right_____
c) Could hold more hunters_____
d) No opinion; I do not hunt public land_____

5) If you typically hunt public land in Elk Hunt Area 19, how satisfied are you with elk numbers /availability on **PUBLIC and ACCESS YES** land?
a) Very satisfied_____
b) Somewhat satisfied_____
c) Neutral_____
d) Somewhat dissatisfied_____
e) Very dissatisfied_____
f) No opinion; I do not hunt public land____

6) If you are dissatisfied with elk numbers/availability on public and Access Yes land in Elk Hunt Area 19, then in your opinion, what are some possible solutions?
a) Manage for a higher number of elk_____
b) Increase access to public land (e.g. easements, Access Yes, land trades)_____
c) Limit the number of licenses available on public land _____
d) No opinion; I do not hunt public land____
d) Other_____

SECTION 2: BULL ELK HUNTING IN HUNT AREA 19

7) How many times, in the last ten years, have you held an Elk Hunt Area 19 Type 1 or Type 2 (*any elk*) license?
a) 0_____
b) 1-3_____
c) 4-6_____
d) 6-10_____

8) WGFD has been issuing 300 Type 1 and 2 (*any elk*) licenses in Elk Hunt Area 19 in recent years. In your opinion,
a) Too many any elk (bull) licenses are issued_____
b) About the right number of any elk (bull) licenses are issued_____
c) Could issue more any elk (bull) licenses_____

9) How satisfied are you with bull trophy quality in Elk Hunt Area 19?
a) Very satisfied_____
b) Somewhat satisfied_____
c) Neutral_____
d) Somewhat dissatisfied_____
e) Very dissatisfied_____

10) In Elk Hunt Area 19, Type 1 season dates for rifle any elk (bull) hunting run from October 1 through October 14. In your opinion,
a) The Type 1 season length is too long_____
b) The Type 1 season length is about right_____
c) The Type 1 season length is too short_____
d) No opinion_____

11) In Elk Hunt Area 19, Type 2 season dates for rifle any elk (bull) hunting run from November 1 through November 20. In your opinion,
a) The Type 1 season length is too long_____
b) The Type 1 season length is about right_____
c) The Type 1 season length is too short_____
d) No opinion_____

SECTION 3: WEAPON OF CHOICE FOR ELK HUNTING IN AREA 19

12) What weapon do you typically hunt elk with in Elk Hunt Area 19?
a) Rifle_____
b) Archery (bow or crossbow)_____
c) Both_____

13) Do you think hunters should be able to hunt with both archery and rifle equipment in the same year (as is currently allowed) in Elk Hunt Area 19?
a) Support_____
b) Neutral_____
c) Oppose - Hunters should be able to only archery hunt or only rifle hunt, but not both in the same year_____

SECTION 4: HUNTING SEASON STRUCTURE IN ELK HUNT AREA 19

14) For Elk Hunt Area 19, do you support or oppose the current split season whereby Type 1 and 4 licenses are valid from October 1 – October 14, and then Type 2 and 5 licenses are valid from November 1 – November 20?
a) Support_____
b) Neutral_____
c) Oppose – just have one set of license types valid for the entire rifle season _____

15) How satisfied are you with access to hunt cow/calf/antlerless elk in Elk Hunt Area 19?
a) Very satisfied_____
b) Somewhat satisfied_____
c) Neutral_____
d) Somewhat dissatisfied_____
e) Very dissatisfied_____

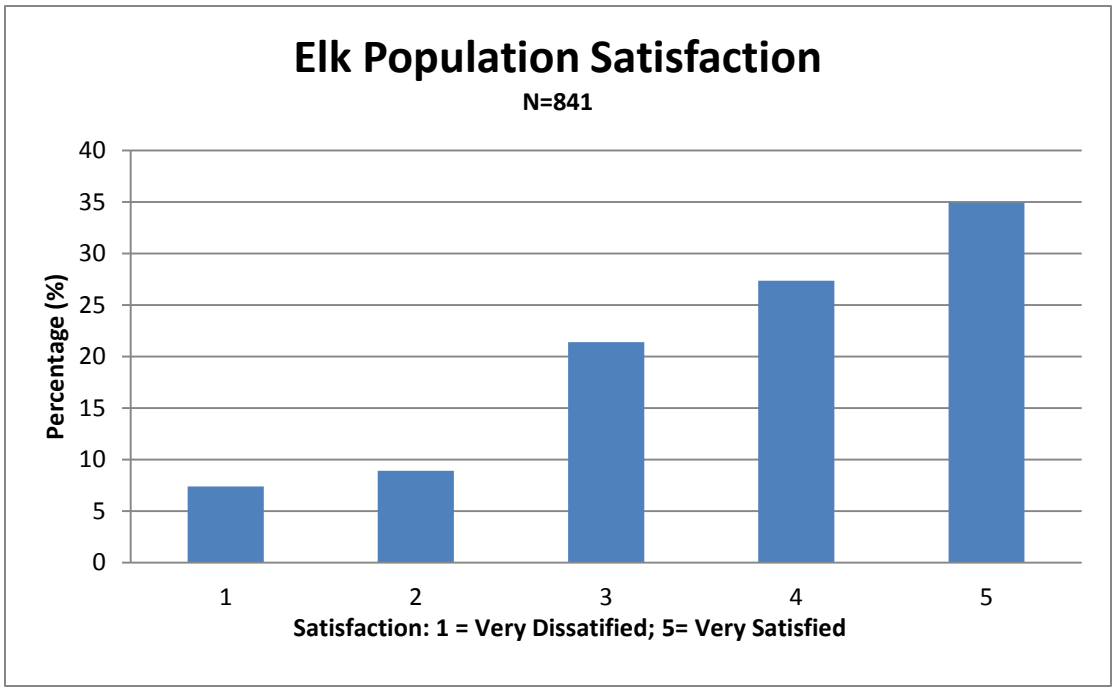
16) Would you support managing for fewer elk in the Lone Tree Creek area (by Hwy 487 rest area) to benefit mule deer?
a) Support_____
b) Neutral_____
c) Oppose_____

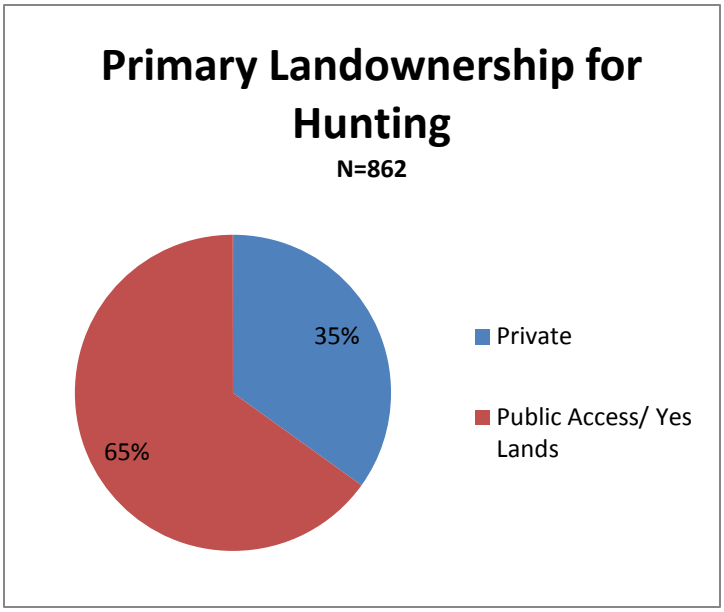
17) Do you support or oppose January elk seasons to hunt cow/calf/antlerless elk in Elk Hunt Area 19?
a) Support_____
b) Neutral_____
c) Oppose_____

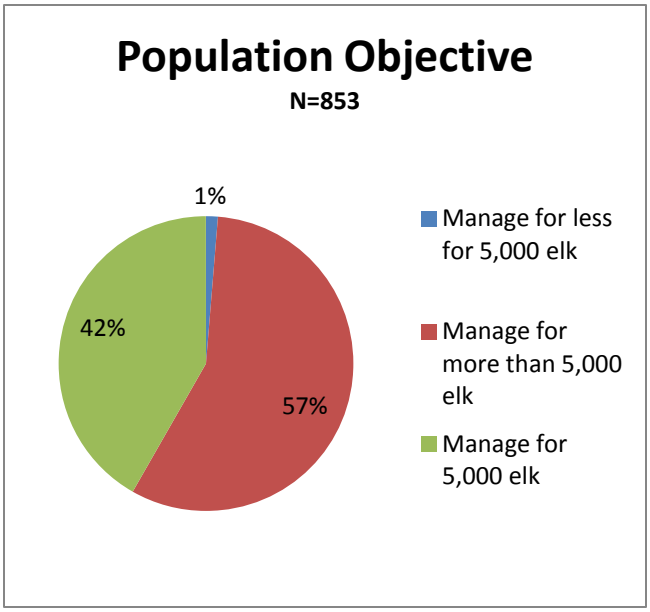
Additional Comments/Thoughts You Would Like to Provide Regarding Elk Hunt Area 19

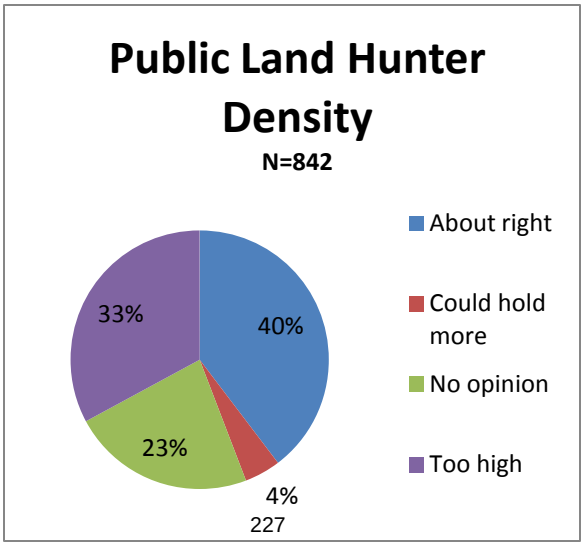
_____
_____
_____
_____

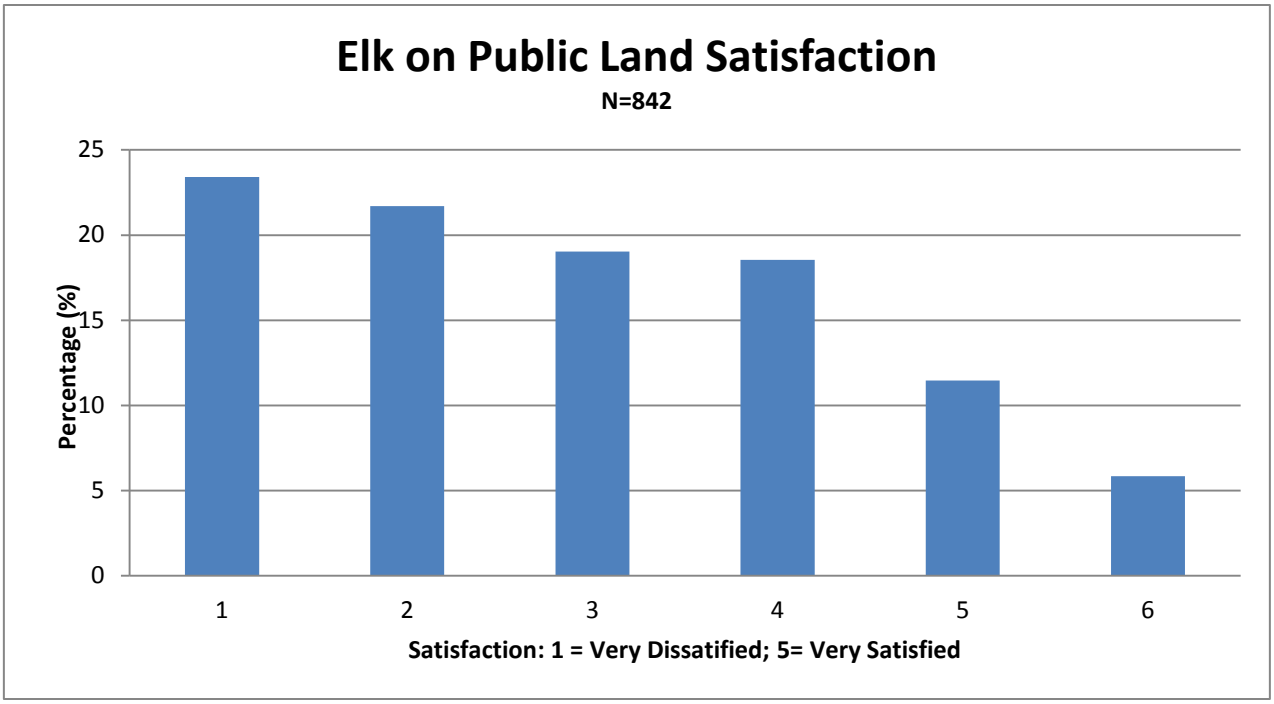
APPENDIX E.1: Area 7 Hunter Survey Response Graphs

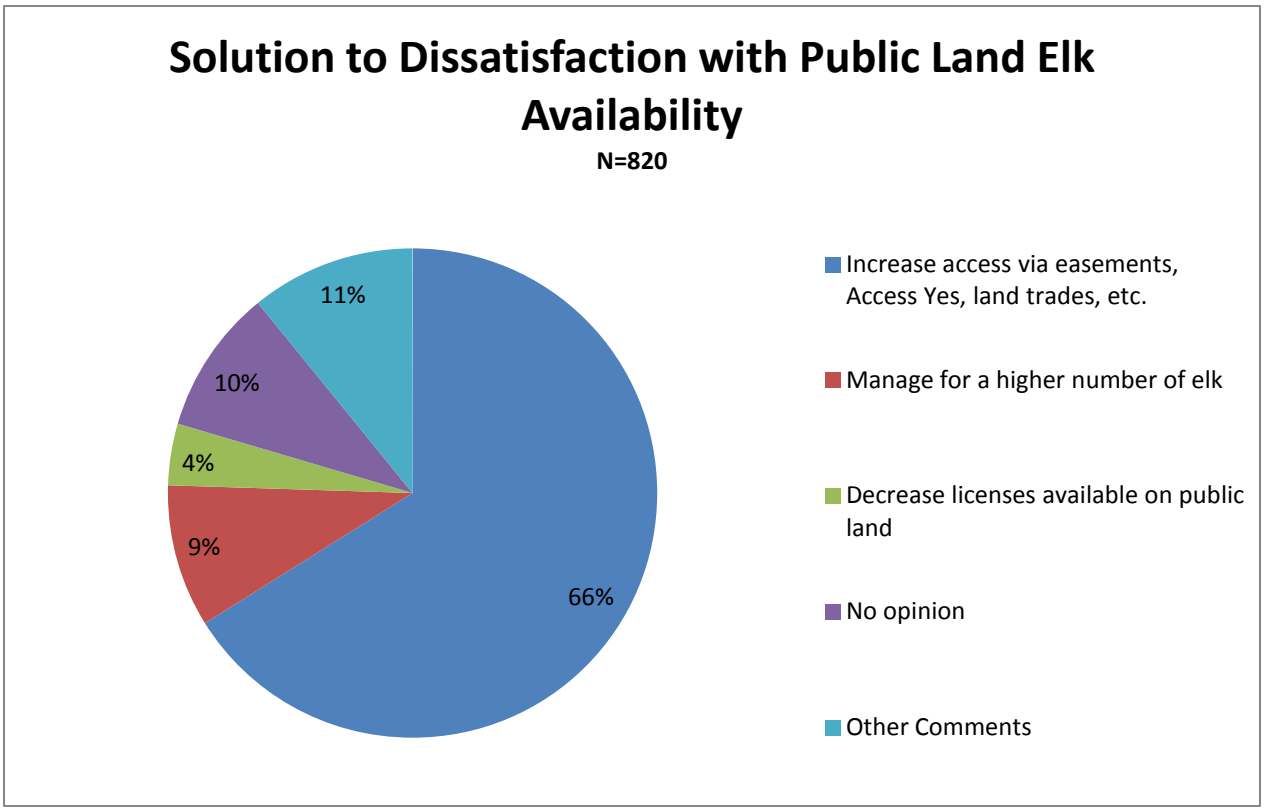


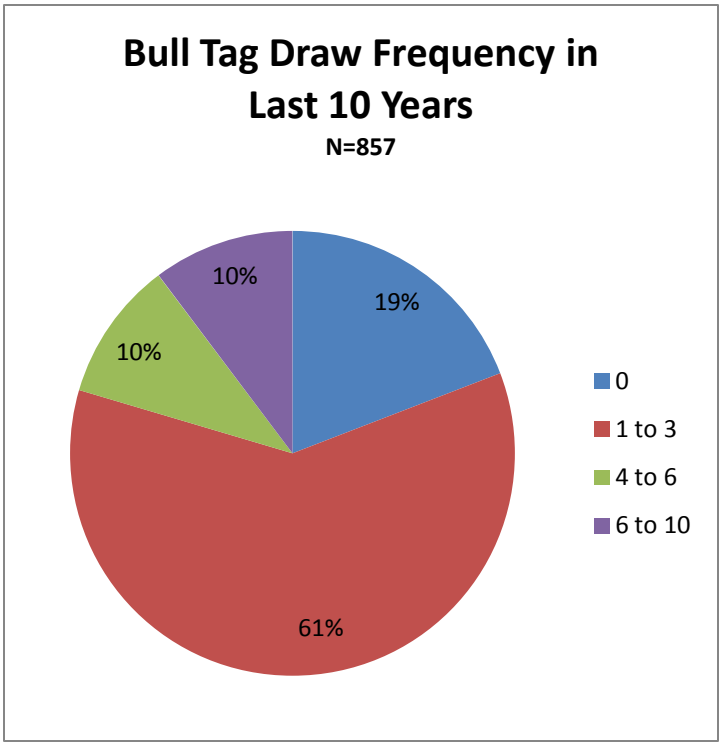


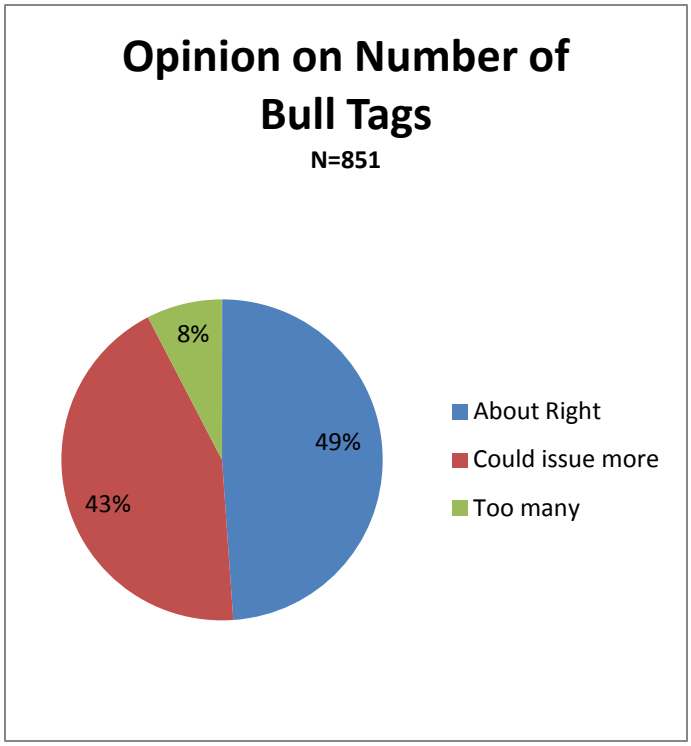


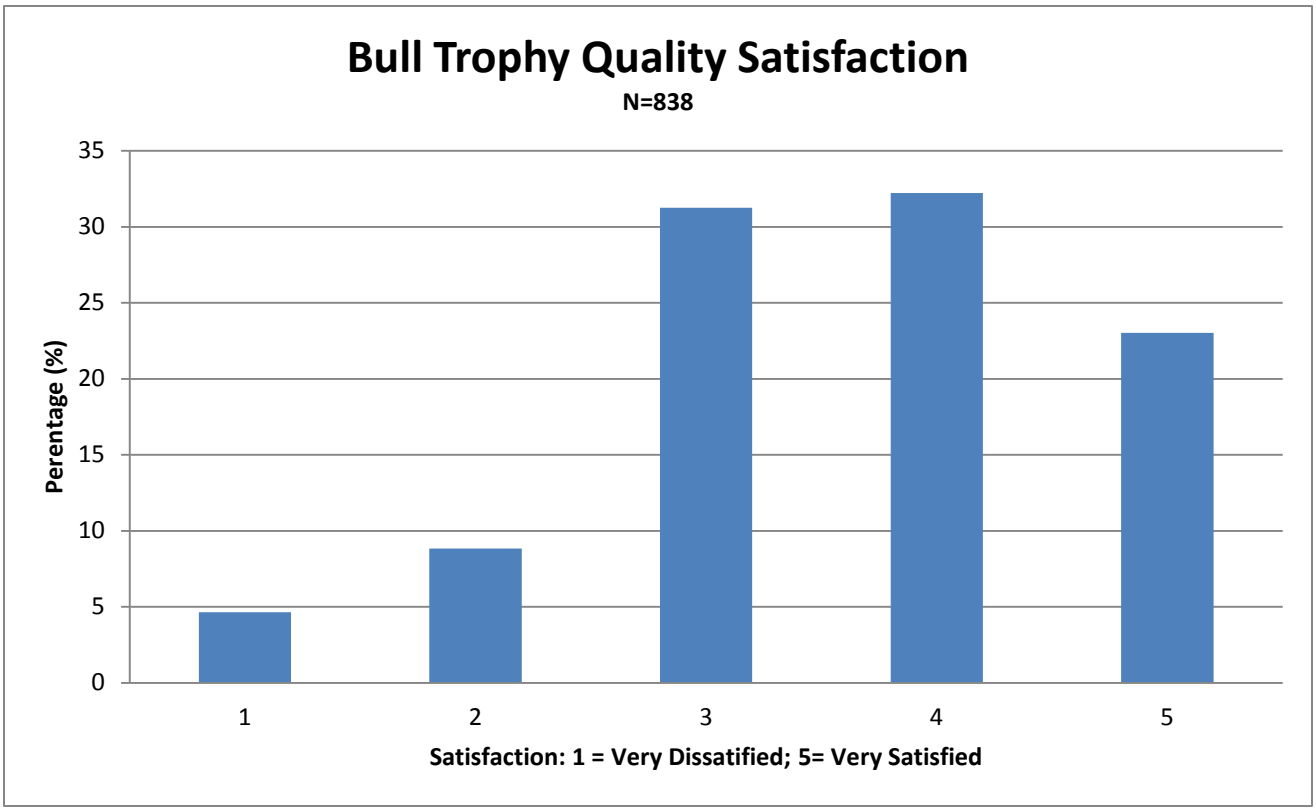


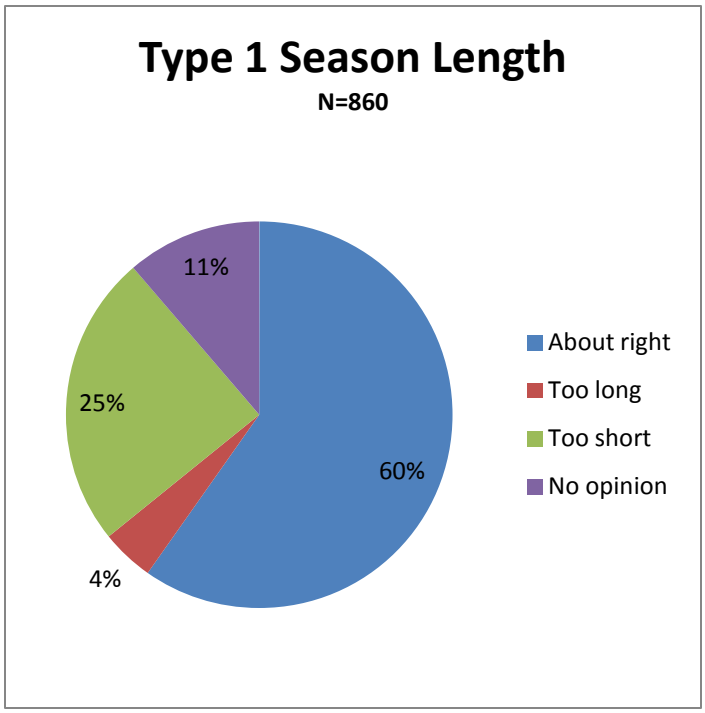

Elk on Public Land Satisfaction
N=842
Percentage (%)
25
20
15
10
5
0
1
2
3
4
5
6
Satisfaction: 1 = Very Dissatified; 5= Very Satisfied

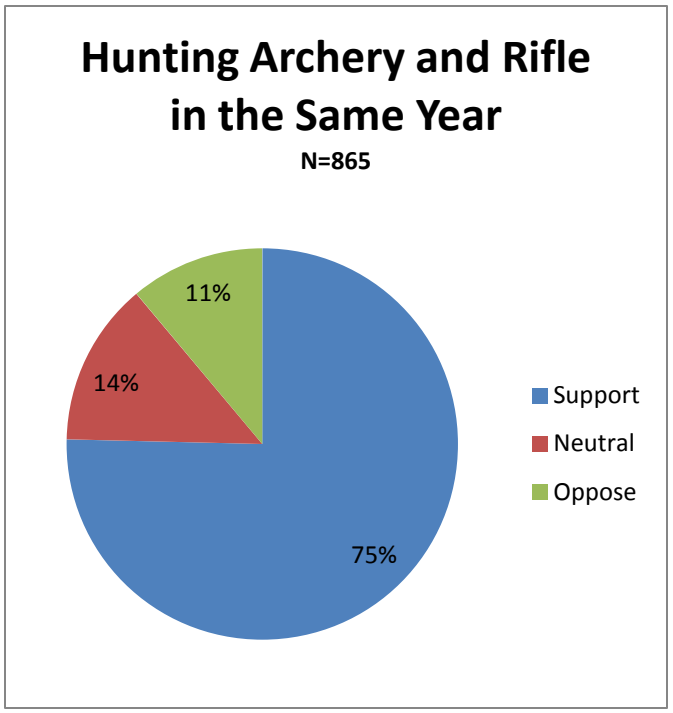

Solution to Dissatisfaction with Public Land Elk Availability
N=820
11%
10%
4%
9%
66%
Increase access via easements, Access Yes, land trades, etc.
Manage for a higher number of elk
Decrease licenses available on public land
No opinion
Other Comments

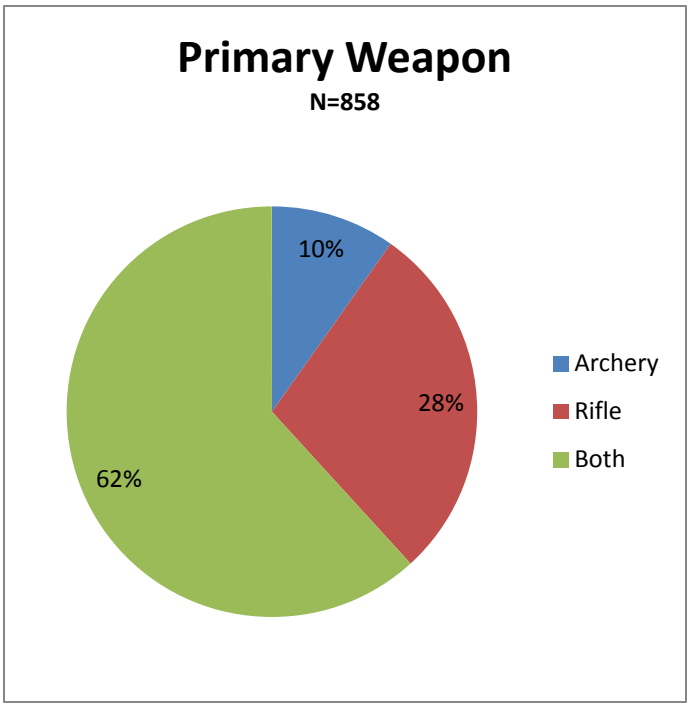

Bull Tag Draw Frequency in Last 10 Years
N=857
19%
61%
10%
10%
0
1 to 3
4 to 6
6 to 10

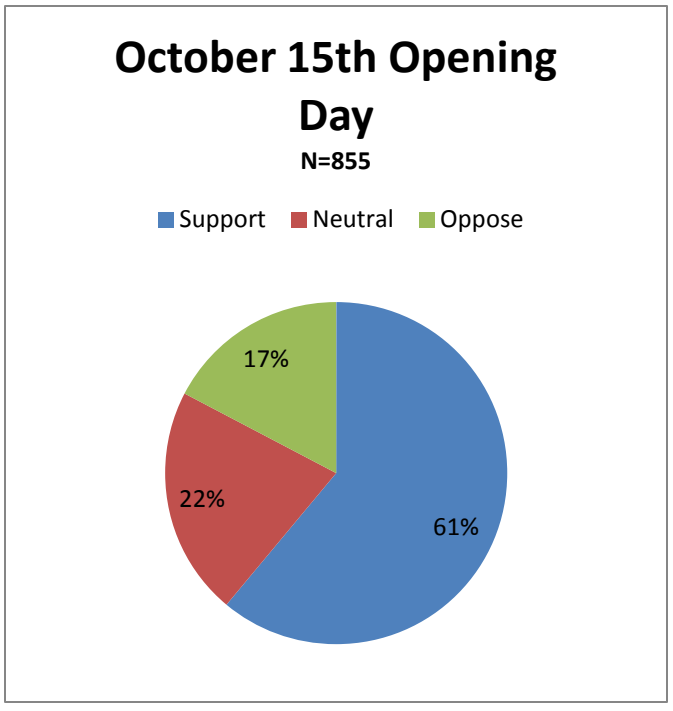

Opinion on Number of Bull Tags
N=851
49%
43%
8%
About Right
Could issue more
Too many

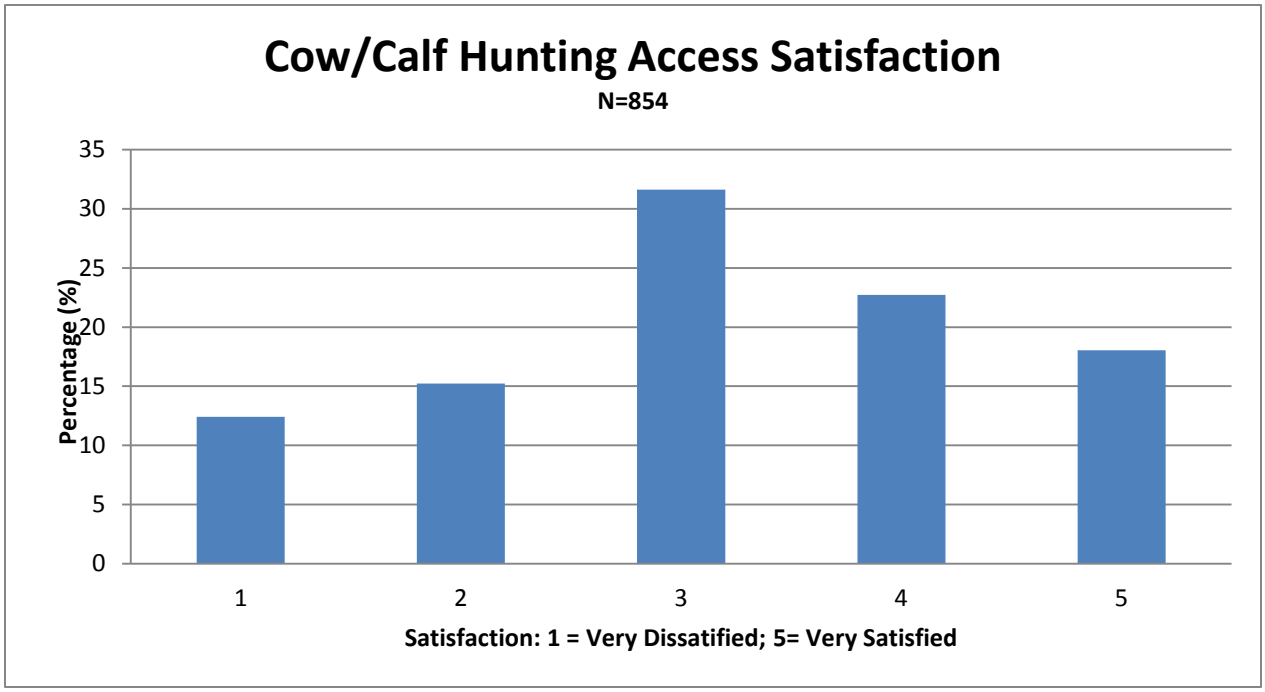

Bull Trophy Quality Satisfaction
N=838
Perentage (%)
35
30
25
20
15
10
5
0
1
2
3
4
5
Satisfaction: 1 = Very Dissatified; 5= Very Satisfied

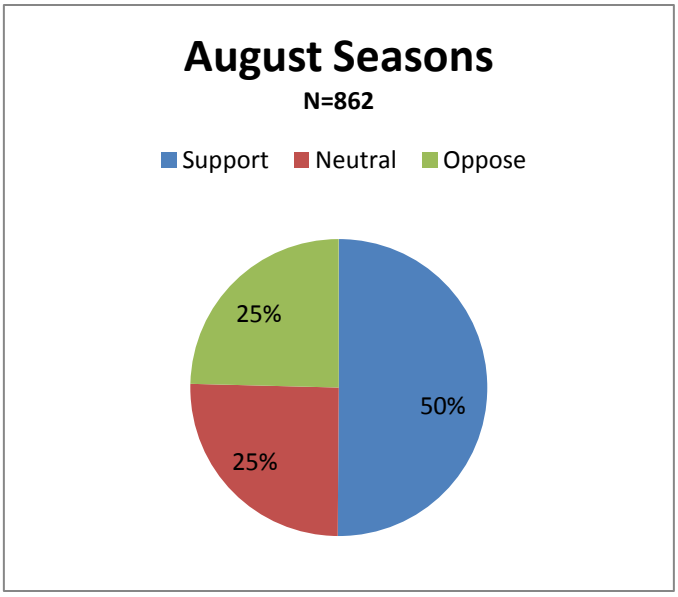

Type 1 Season Length
N=860
11%
25%
60%
4%
About right
Too long
Too short
No opinion

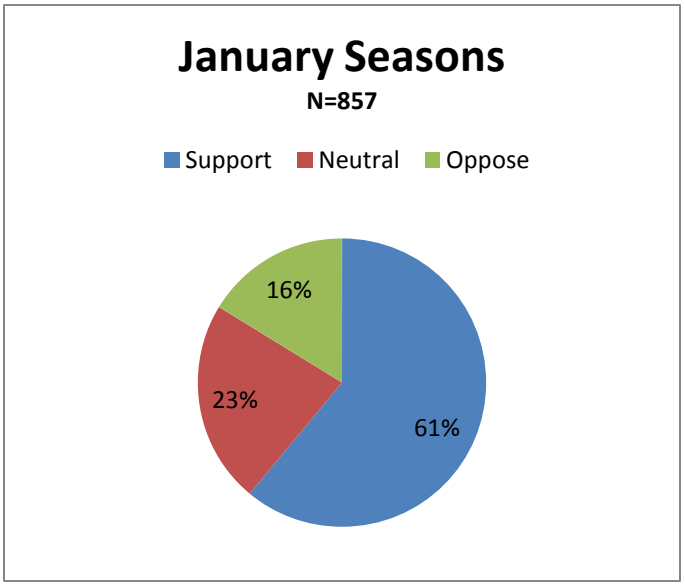

Hunting Archery and Rifle in the Same Year
N=865
11%
14%
75%
Support
Neutral
Oppose


Primary Weapon
N=858
10%
28%
62%
Archery
Rifle
Both

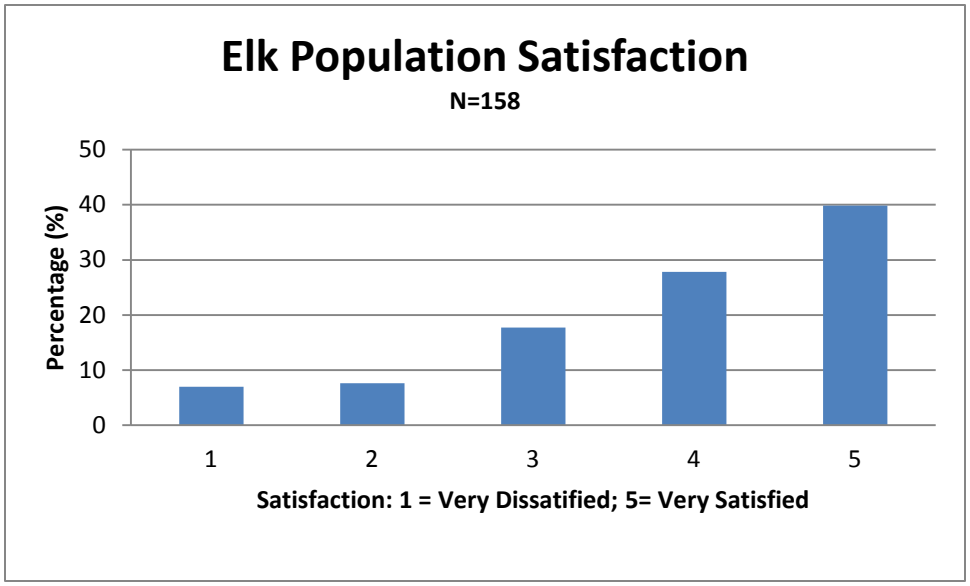

October 15th Opening Day
N=855
Support
Neutral
Oppose
17%
22%
61%

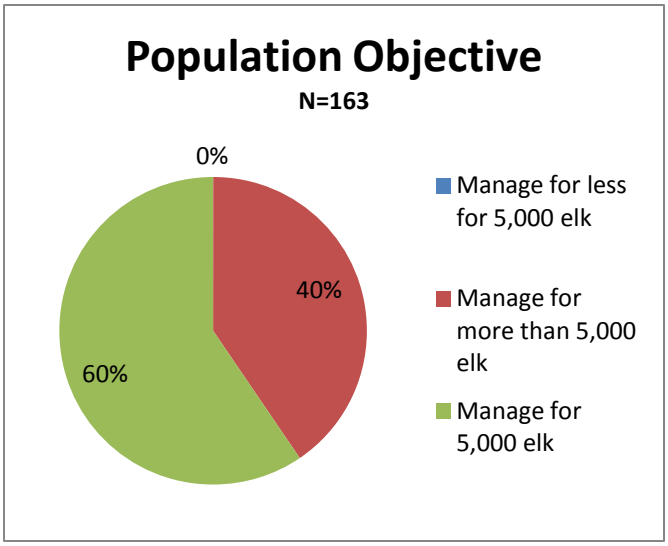

Cow/Calf Hunting Access Satisfaction
N=854
Percentage (%)
35
30
25
20
15
10
5
0
1
2
3
4
5
Satisfaction: 1 = Very Dissatified; 5= Very Satisfied

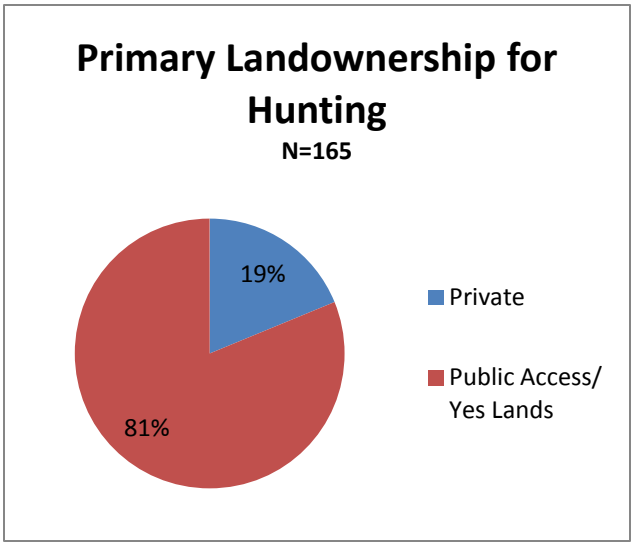

August Seasons
N=862
Support
Neutral
Oppose
25%
50%
25%

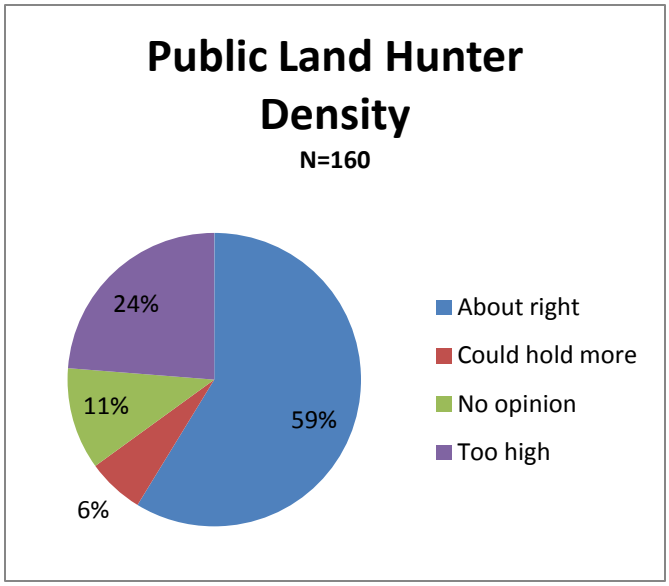

January Seasons
N=857
Support
Neutral
Oppose
16%
23%
61%

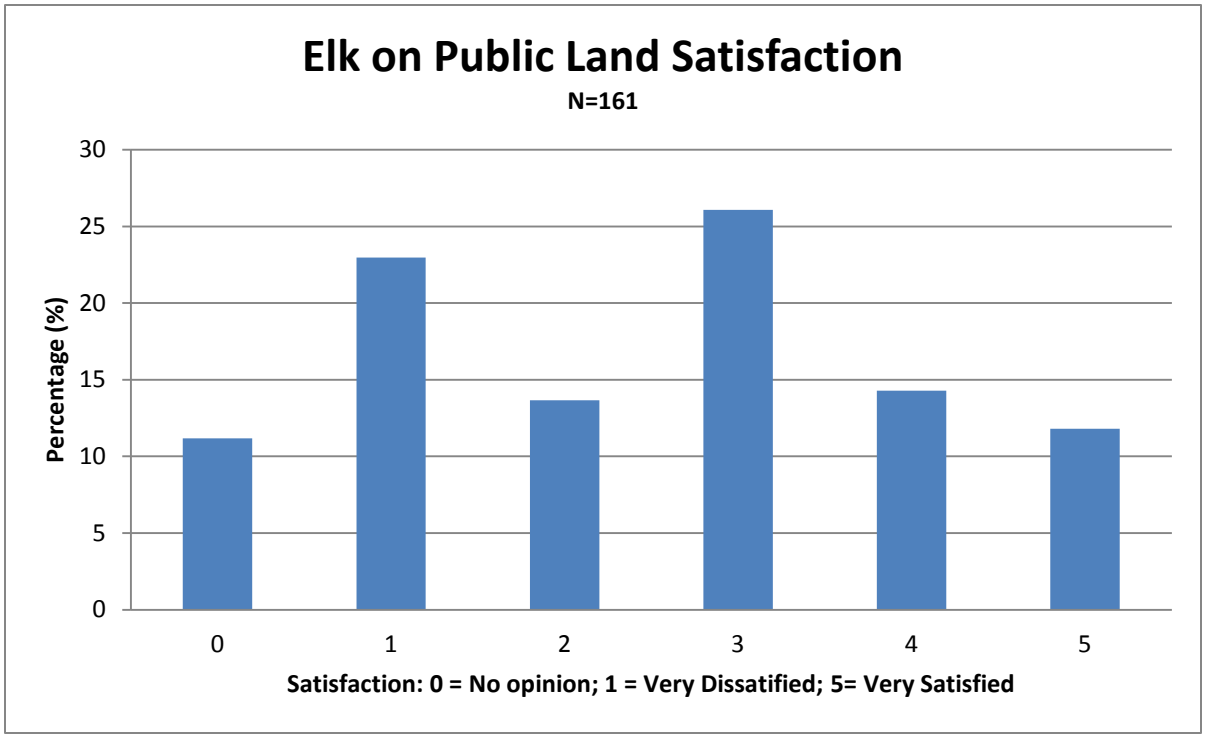
APPENDIX E.2: Area 19 Hunter Survey Response Graphs

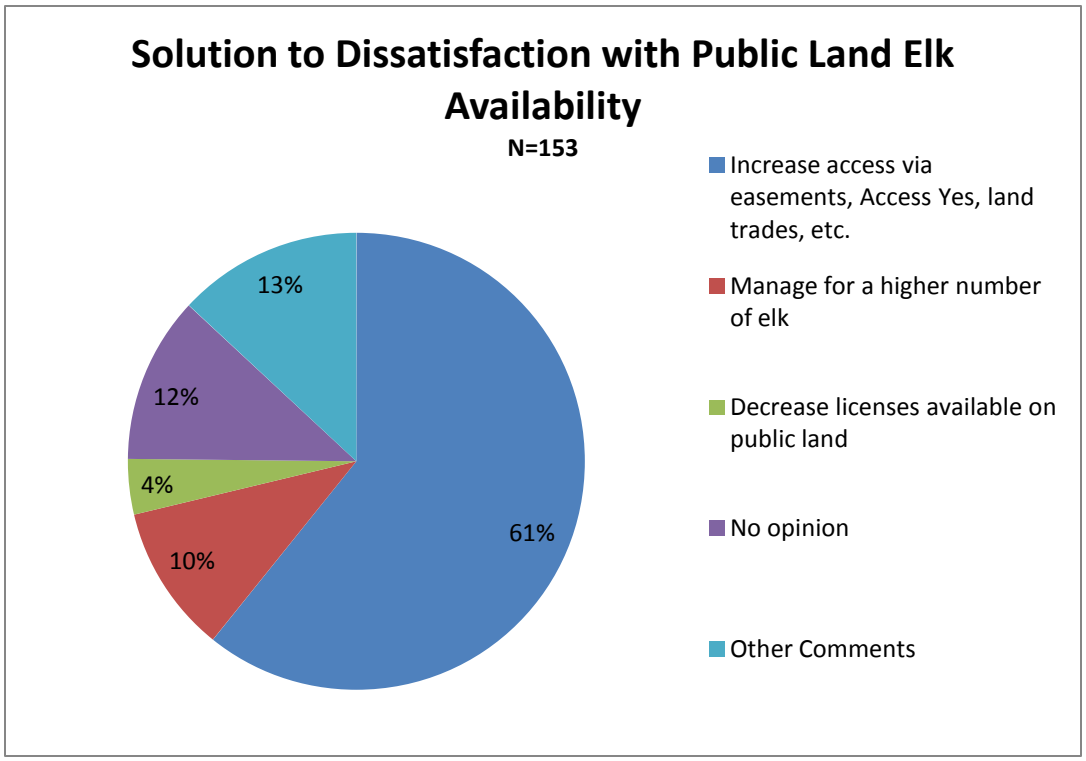


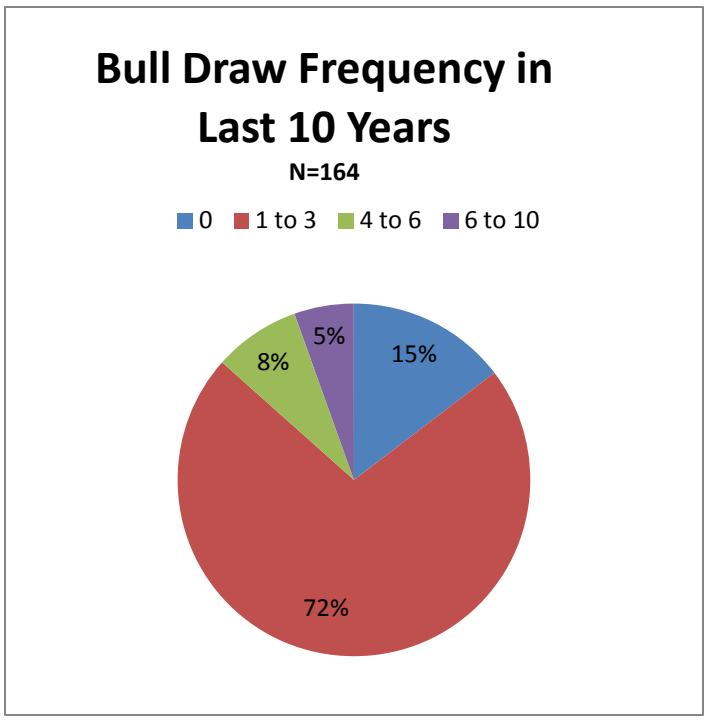


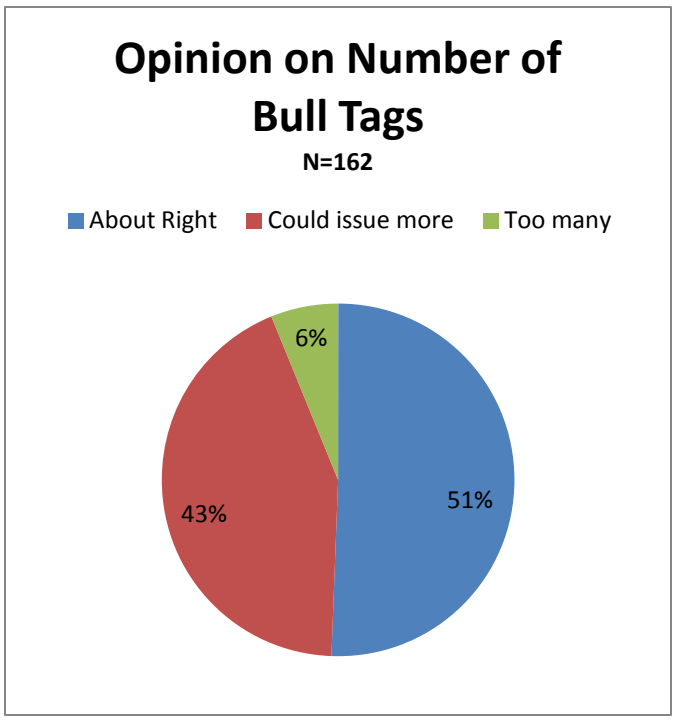


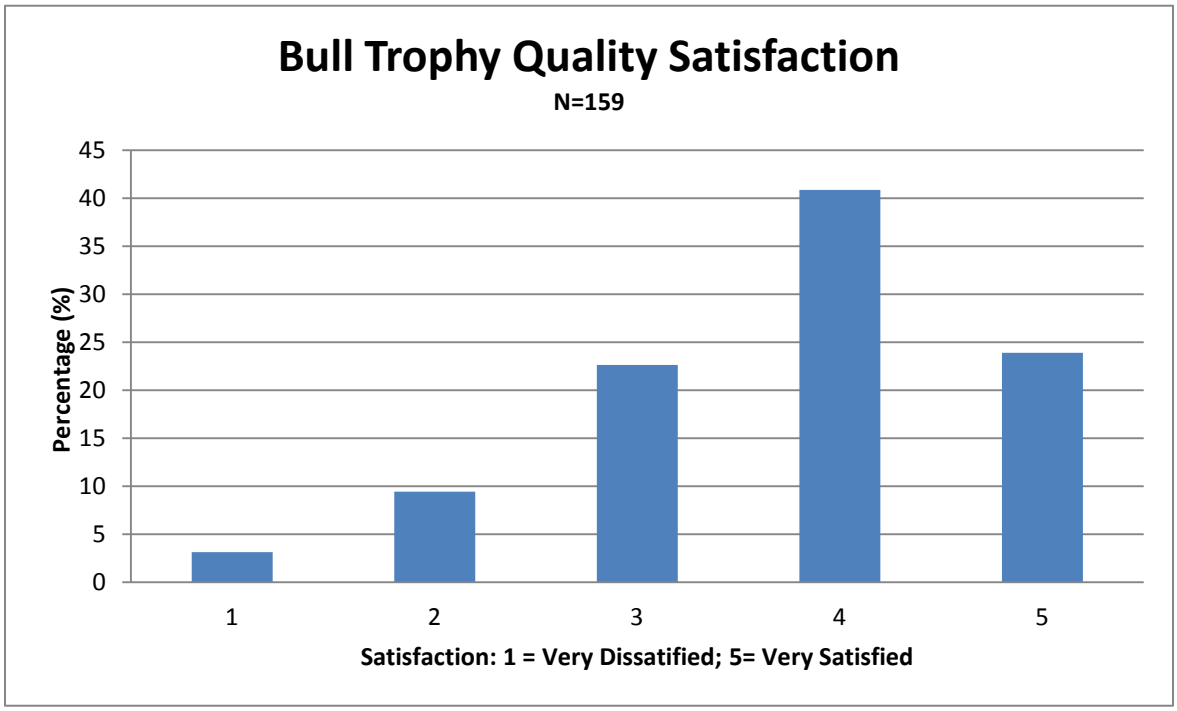



Elk on Public Land Satisfaction
N=161
Percentage (%)
30
25
20
15
10
5
0
0
1
2
3
4
5
Satisfaction: 0 = No opinion; 1 = Very Dissatified; 5= Very Satisfied


Solution to Dissatisfaction with Public Land Elk Availability
N=153
13%
12%
4%
10%
61%
Increase access via easements, Access Yes, land trades, etc.
Manage for a higher number of elk
Decrease licenses available on public land
No opinion
Other Comments

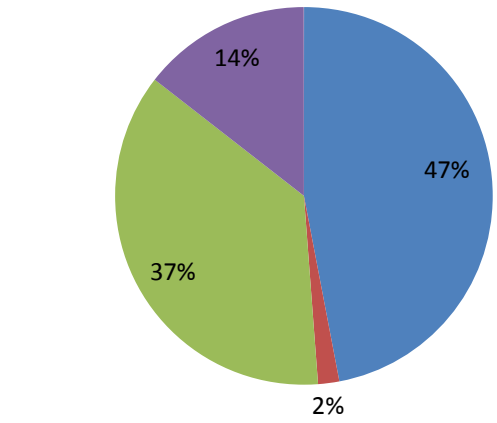

Bull Draw Frequency in Last 10 Years
N=164
0
1 to 3
4 to 6
6 to 10
15%
72%
8%
5%


Opinion on Number of Bull Tags
N=162
About Right
Could issue more
Too many
51%
43%
6%


Bull Trophy Quality Satisfaction
N=159
Percentage (%)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
Satisfaction: 1 = Very Dissatified; 5= Very Satisfied

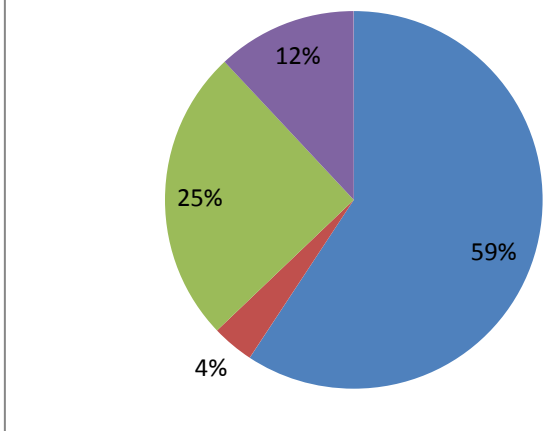
Type 1 Season Length

N=166



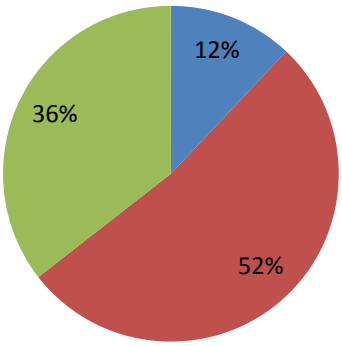
Type 2 Season Length

N=166



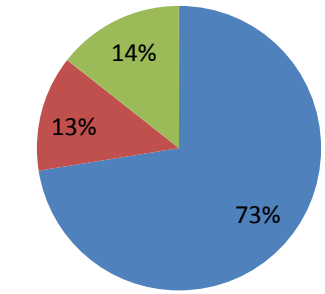
Primary Weapon

N=166



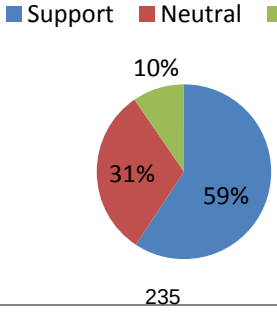
Hunting Archery and Rifle in the Same Year

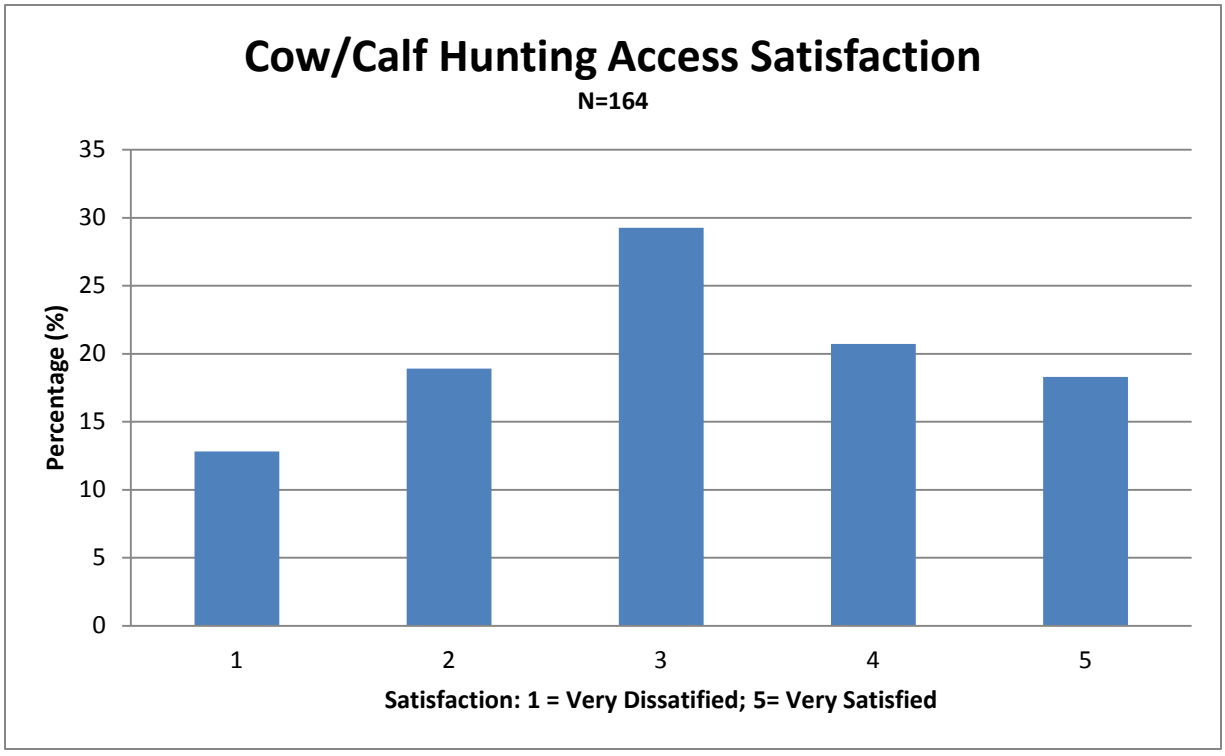
N=167

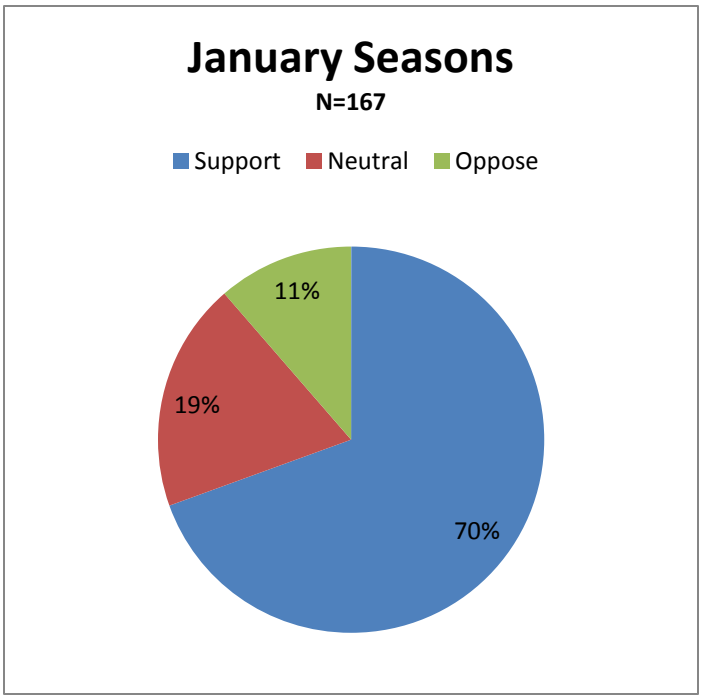


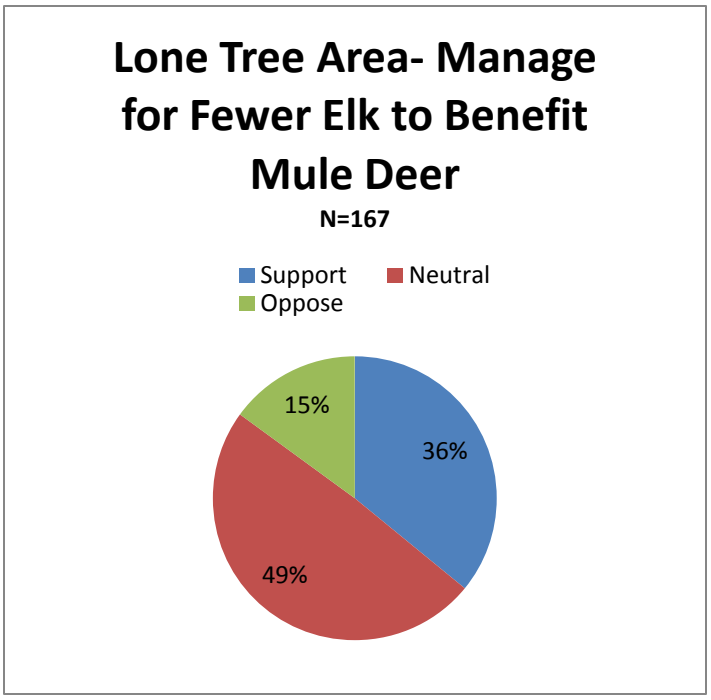
Season Split

N=167




Cow/Calf Hunting Access Satisfaction
N=164
Percentage (%)
35
30
25
20
15
10
5
0
1
2
3
4
5
Satisfaction: 1 = Very Dissatified; 5= Very Satisfied


January Seasons
N=167
Support
Neutral
Oppose
11%
19%
70%


Lone Tree Area- Manage for Fewer Elk to Benefit Mule Deer
N=167
Support
Neutral
Oppose
15%
36%
49%

WYOMING GAME AND FISH DEPARTMENT

5400 Bishop Blvd. Cheyenne, WY 82006

Phone: (307) 777-4600 Fax: (307) 777-4699

wgfd.wyo.gov

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May 1, 2018

Dear Landowner;

This spring you were mailed a survey regarding the future management of the Laramie Peak Elk Herd Unit (Hunt Areas 7 and 19). We appreciate you taking the time to express your thoughts on the population objective and overall management of this elk herd. During this survey, our initial proposal was to increase the population objective from 5,000 to 8,000 elk for several reasons: 1) liberal seasons over the past decade have not successfully reduced this herd to 5,000 despite record harvest levels (this population is still estimated to be between 8,000-10,000 elk); 2) there continues to be large acreages with limited access for antlerless harvest providing refuge for elk; 3) hunter saturation levels have been reached, limiting our ability to increase license issuance beyond current levels given access constraints; and 4) season length cannot be extended any further, especially considering how contentious January seasons have become with many landowners in the Laramie Range.

We thank you for taking the time to respond to this important survey. It is important to gauge your perceptions of elk numbers and management considering the vital role private landowners play in providing valuable habitat for this elk herd and other wildlife. Given the dramatic changes in license issuance and season length over the past 15 years, it is beneficial to have data that quantifies landowner attitudes toward various aspects of elk management. We received responses from 65% of all surveyed landowners, meaning results from this survey should adequately represent the overall landowner community. Here are the highlights: 1) slightly more landowners (38%) opposed changing the objective to 8,000 than support it (34%), with the remaining 28% being neutral; 2) 55% of landowners oppose January seasons while 30% support them, with 15% being neutral; 3) 16% feel WGFD is issuing too many bull licenses while 36% feel we are issuing too few, with 48% indicating we are issuing about the right number of bull tags; 4) 56% agree with the number of antlerless licenses we issue, with 30% indicating we should issue more while 14% feel we should issue less; 5) 37% perceive elk numbers to be at desired levels while 55% indicated there are too many, and 8% saying there are too few; 6) there was broad support for the current bull hunting season structure, with 69% of landowners agreeing with current bull season length, and 67% supporting the October 15th opening date (Area 7 landowners only).

Generally speaking, this survey indicates most landowners prefer to stay the course with the current management framework. The Department will therefore propose to maintain the current population objective of 5,000 elk. The next herd objective review will occur in 2023. In addition, the majority of landowners would like to see the January season removed. The future of January seasons in both Hunt Areas 7 & 19 will be decided during the annual season setting process next spring, although we will remove the Area 7 Type 7 season from our application information for 2019 (although we could still have a January season in some capacity if there is demand).

Again, we appreciate your time and commitment to managing this herd. Landowners allowing significant hunting access, as well as those properties enrolled in the Department's Access Yes Program, have been instrumental in helping achieve record elk harvests in recent years. However, in order to reduce this herd to 5,000 elk, we will need additional assistance to achieve this goal, especially if we are going to consider removing the January season. Please feel free to contact Matt Withroder, Casper Access Yes Coordinator (307-473-3437) or Jason Sherwood, Laramie Access Yes Coordinator (307-745-4046) if you would like to discuss antlerless elk hunting access.

If you would like a copy of the final objective review or have any additional questions, please contact your local game warden or wildlife biologist, or feel free to contact me at 307-473-3408. Thanks for your time and all you do to help manage Wyoming's wildlife!

Sincerely,

Justin Binfet
Casper Region Wildlife Management Coordinator

Willow Bish Douglas Biologist 307-436-9617	Martin Hicks Wheatland Biologist 307-322-3821	Lee Knox Laramie Biologist 307-745-5180 x231	Kelly Todd N. Laramie Warden 307-745-4402
Cody Bish Glenrock Warden 307-436-9617	Rod Lebert Douglas Warden 307-358-3249	David Ellsworth Wheatland Warden 307-322-2067	Dylan Bergman Medicine Bow Warden 307-379-2337

JB/jb/mh

APPENDIX C

Laramie Peak Muddy Mountain Elk Herd Unit
Sightability Survey 2019 Summary

Heather O'Brien – Casper Wildlife Biologist

INTRODUCTION

The Laramie Peak / Muddy Mountain Elk Herd Unit (EL 741) contains hunt areas 7 & 19 and is located in east central Wyoming (Figure 1). The herd unit encompasses an area of 4,788 square miles from the city of Casper, east to the town of Douglas, southeast along the North Platte River to Guernsey Reservoir and the town of Wheatland, southwest to Bosler Junction, and northwest to the town of Medicine Bow. Elk occupy the mountainous habitats of the Laramie Range, Muddy Mountain, and adjacent foothills. Major habitat types include sagebrush (*Artemisia tridentata*) grassland steppe, mixed mountain shrub, ponderosa pine (*Pinus ponderosa*) and lodgepole pine (*Pinus contorta*) forests intermixed with aspen (*Populus* spp.) stands. Elevations range from 5,500 to 10,500 feet (1,600-3,200 meters). The herd is very popular with hunters, as it is very large and has a reputation of producing trophy-sized bull elk.

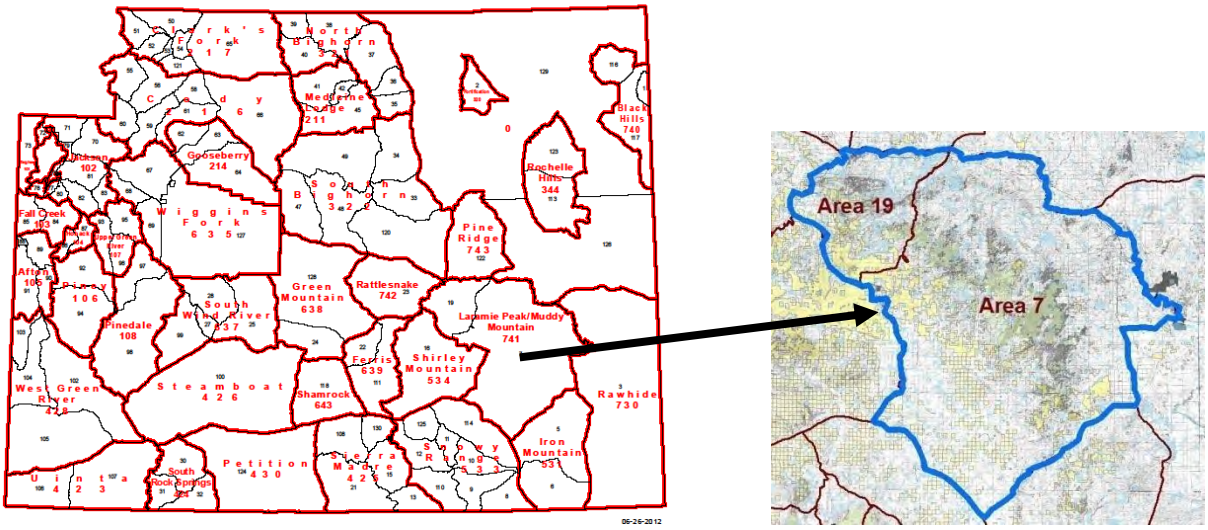

Figure 1. The Laramie Peak / Muddy Mountain Elk Herd Unit, which includes hunt areas 7 and 19 in east central Wyoming.

Due to its popularity and reputation for producing trophy-quality bulls, Casper and Laramie Region managers typically devote a considerable amount of effort to classification surveys in this herd. More recently, surveys have been altered from directed techniques to a stratified random

sampling method with the goal of improving distribution of survey effort and results (Wyoming Game and Fish Department 2017). In 2019, managers allocated additional funding to the herd unit for a more intensive abundance survey, utilizing sightability methods and incorporating classifications simultaneously. Consequently, the herd unit was surveyed more intensely and completely in 2019 than any previous assessment.

METHODS

Survey design and implementation followed standard sightability methods and guidelines summarized by Unsworth et.al (1994). Due to the large size of this herd unit, a complete sightability survey was not possible. Subunit mapping and stratification were completed previously for stratified random classification surveys using ArcMap (ESRI 2011). These subunits and strata were utilized for this survey as well, though the 2019 survey allowed a much higher sampling total of subunits compared to previous years (Figure 2).

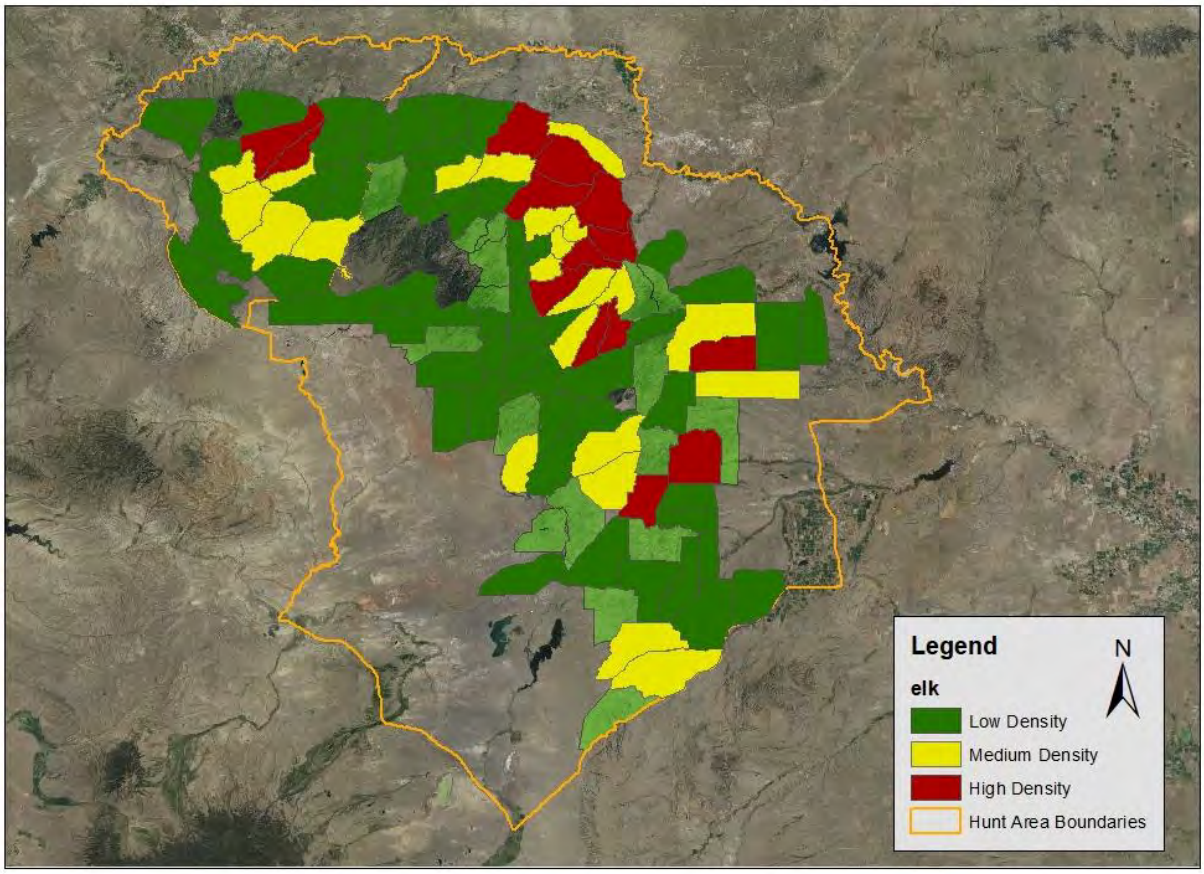

Figure 2. Total and selected subunits for sightability and classification surveys for the Laramie Peak Muddy Mountain Elk Herd Unit, 2019. Subunits that were not selected by stratified random sampling are light green.

Prior to initiating flights, all potential observers were trained in proper data collection following the protocol for WGFD sightability surveys and safety standards outlined by WGFD flight policy (Wyoming Game and Fish Department 2017; Wyoming Game and Fish Commission 2011). PowerPoint training presentations are available within the Department for both sightability surveys and approved flight policy. Flights were conducted from 29 January through 8 February 2019 on days when weather conditions were suitable for flights. Surveys were flown in Bell Jet Rangers piloted by Kent Potter of Helicopter Solutions MT, Inc. from Laurel, Montana and by David Stinson of Sky Aviation Corporation from Worland, WY. Two observers were aboard every survey flight, and pilot observations were also included during data collection. The back-seat observer was positioned to view out the opposite side of the helicopter compared to the front-seat observer to visually survey the greatest area per transect line. Observers were replaced mid-day whenever possible to avoid eye fatigue and maximize survey performance. However, this was not always feasible due to scheduling conflicts for some observers. In these instances, 30-45 minute breaks were taken approximately every three hours during helicopter refueling to provide some rest for all-day observers.

Winter severity conditions during 2019 flights were considered average to above average in terms of snow accumulation and daily temperatures. Higher elevation portions of the herd unit had deep and persistent snow cover, with little to no sagebrush or other vegetation visible. Lower elevation portions of the herd unit were more open or broken in terms of snow cover. Snows in these areas was not as deep, with exposed shrubs and ground in most areas and deeper drifted snow along drainages and hillsides. Wind conditions were severe enough on several days within the survey period to cancel flights. Conversely, there were low-wind days during the survey were fog persisted in low-lying areas. Managers either canceled flights on days when high winds or poor visibility compromised survey conditions and safety, or surveyed subunits in the herd where conditions were favorable and scheduled the remaining subunits later.

Data collection was performed by the back-seat observer in most instances using a hand-held GPS and standardized data sheet for sightability surveys (Appendix A). Location, activity of elk upon first sighting, percent snow cover, percent vegetative cover, and vegetative type were recorded for every survey observation. Observed elk were totaled and classified as cows, calves, yearling males, class I mature bulls, and class II mature bulls. Other notable species (coyotes, winter sage-grouse flocks, congregations of pronghorn, etc.) were also recorded during flights as a means to maximize survey time and collect other useful wildlife data. Flight time to complete each subunit was recorded for evaluation purposes, so managers could modify subunit sizes for future surveys as needed.

Following the completion of all survey flights, data were compiled into a Microsoft Excel spreadsheet and standardized for import into the software program Aerial Survey for Windows (Unsworth el. al 1999). The pilot and all observers were debriefed and offered the opportunity to provide feedback on survey methods to consider for improvement of future surveys.

RESULTS

A total of 9,374 elk were surveyed within 305 group observations (Figure 3). Out of 107 subunits, 90 were selected for the survey and 84 were flown completely. Six high-elevation, low-density subunits were not flown due either to deep snow and lack of elk sign, or limited survey time. These units were eliminated from analysis. Several groups of elk were observed outside of a designated subunit during a concurrent mule deer survey. These elk were recorded as present in the nearest adjacent subunit, which will be enlarged to include this area for future surveys.

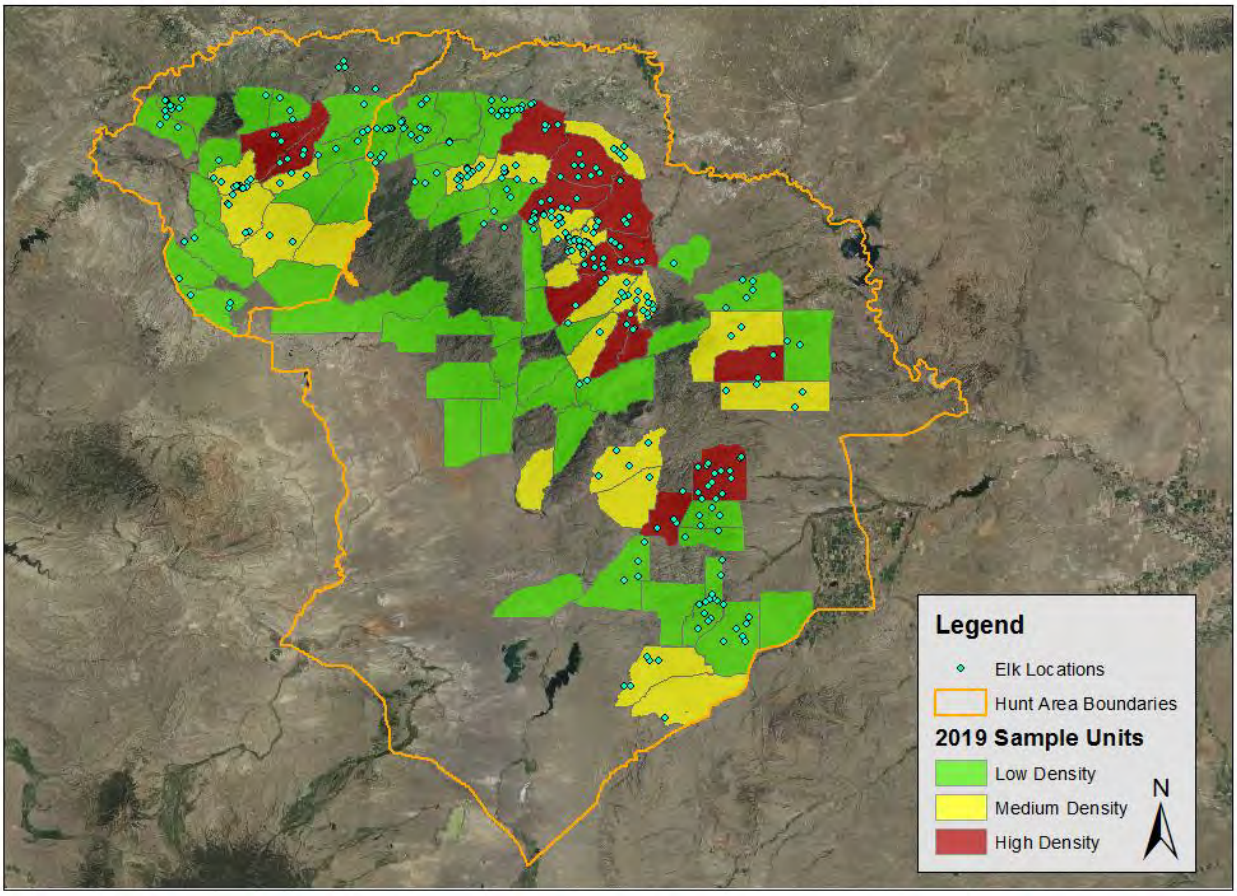

Figure 3. Elk group locations surveyed subunits for the Laramie Peak Muddy Mountain sightability and classification survey, 29 January – 8 February 2019.

Distribution of elk across the herd unit was uneven, with higher densities of elk at low to mid elevations in more open habitats containing available winter forage. Elk were sexually segregated in many instances, with very large groups consisting mainly of cows and calves typically found in more open habitats, and smaller groups of mature bulls found in more variable or timbered habitats. Many higher elevation habitats were devoid of elk due to deep snow and lack of exposed forage.

Sightability data analysis using Aerial Survey for Windows yielded a population estimate of 11,182 elk ±2,571 using a 95% bound, with a resulting confidence interval of 1,312 around the

correction (Appendix B). The increase of 1,808 elk compared to total elk observed accounts for those presumably missed. Analysis assumes that 178 elk were missed by observers due to variations in activity, vegetation, and snow cover in flown subunits. Observers noted that elk which remained bedded or motionless in timbered habitats were difficult to see in several instances. On colder mornings, several groups of observed elk remained bedded despite being flown over at low altitude. The remaining 1,630 elk added by the analysis are due to the assumption that a mean number of elk present in observed low-strata subunits (65.2) were also present in those low-strata subunits that were not surveyed.

The resulting abundance estimate and standard error from the sightability survey were added into the existing spreadsheet model for the Laramie Peak Muddy Mountain Elk Herd. Incorporating the abundance estimate from this sightability survey resulted in a much higher population estimate for the herd unit as a whole. Population estimates prior to the sightability survey predicted a post-season herd of 7,000-8,000 elk in 2018. The addition of abundance data to the model shifted that estimate to around 13,000 elk post-season. While classification surveys the past three years have been stratified to reduce bias, data from previous years are highly variable and likely inaccurate in their estimates for mature bull ratios. The resulting population trend represented by the model does not seem accurate to managers. For these reasons, managers discarded the current spreadsheet model for the herd unit in 2019 and are reconstructing it for 2020. Older classification data will likely be excluded in an effort improve model performance. Improved classification data from recent years, paired with harvest data and the sightability estimate should generate a more accurate population estimate.

DISCUSSION

Sightability surveys seek to estimate absolute animal abundance, and provide some of the strongest data available to wildlife managers (Steinhorst & Samual 1989). These models may have their own limitations in terms of cost, and can be biased if groups of animals are undercounted. Despite these limitations, they are a powerful source of information for managers compared to traditional directed surveys. The 2019 sightability and classification survey for the Laramie Peak Muddy Mountain Elk Herd Unit is the most complete, comprehensive, and intensive survey ever conducted for this herd. The resulting census and distribution data alone are extremely valuable. The subsequent abundance estimate and classification ratios are conceivably the most accurate representation of population size and structure managers have ever developed for the herd.

Distribution of elk during the 2019 survey were somewhat different compared to surveys conducted during the previous milder winters. While some habitats remained open and contained high densities of elk, areas at higher elevation had deep persistent snows and contained few to no elk. During survey flights, several subunits designated as low-strata (low elk density) areas contained higher than predicted numbers of observed elk. These observations of large groups in low-strata subunits created a higher than expected mean for low-strata subunits that were not surveyed, which in turn increased the abundance estimate and standard error for the survey. This

new knowledge regarding elk distribution will be used to update and refine subunit stratification, and is even being used to post-stratify and re-analyze data from this survey to derive an improved 2019 estimate.

Overall, managers felt very good about the design and implementation of this stratified sightability survey. Minor adjustments will be made to improve the current design and results of future surveys in this herd unit. GIS map files will be cleaned up to improve data analysis, as some shape file errors created confusion during the analysis phase for 2019. Additionally, two subunits will be redrawn to incorporate elk found outside of a delineated unit in multiple years. Flying this survey has given managers more knowledge of above-average winter conditions associated elk distribution for the herd unit. This knowledge will be used to refine subunit stratification to improve future abundance estimates and standard error. The continued application of abundance surveys should help managers improve their knowledge of population dynamics and trend, and inform better management decisions in this and other big game herds.

RECOMMENDATIONS FOR FUTURE SURVEYS

- Modify subunits to encapsulate elk located outside current subunit boundaries
- Evaluate strata of each subunit using previous 3 years of survey data; change strata of subunits as needed using natural cut points
- Post-stratify 2019 survey data and re-run analysis. If the resulting estimate and standard error improve, replace current estimate in a new spreadsheet model for the herd

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APPENDIX A:

Sightability and Classification Survey Data Collection Form for the Laramie Peak Muddy Mountain Elk Herd Unit, Winter 2019.

Sightability

Date:		PRIMARY SPP:	Mule Deer	Page:		of		
Tach Time	Start:		End:		*Weather:*			
Time Spent Flying Unit				Temperature		Cloud cover		
Start				Wind		Precipitation		
End				Primary Observer				
Area		Sub area		Secondary Observer				

					Males				Sightability			
Way Point	Spp.	UN-CLASS	Female	Juv.	Yrlg	Class I	Class II	Class III	Activity	% Snow Cover	% Veg Cover	Veg Class

Activity	1 = Bedded, 2 = Standing, 3 = Moving
Vegetation Classes	1 = Grassland, Ag. Field, Open, 2 = Sagebrush, 3 = Juniper, Mtn. Mahogany, 4 = Aspen, Riparian Brush, Mtn. Brush, 5 = Conifer
male class:	Elk males: **Class I** - raghorn < 270", **Class II** - Mature adult > 270" **Class III** - BIG > 320"
Spp.	**E -** elk, **M -** moose, **D -** mule deer, **Wt -** whitetail, **A -** antelope, **SG -** sage grouse, **C -**coyote, **F -** fox, **GE -** golden eagle, **BE -** bald eagle, **BC-** bobcat, **ML -** mtn. lion, **GH -** gosshawk

APPENDIX B:

Sightability Data Analysis from Aerial Survey for Windows
Laramie Peak Muddy Mountain Elk Herd Unit, Winter 2019

Aerial Survey for Windows, Version 1.00 Beta 6.1.4 (12-Feb-2000)

Monday, February 25, 2019 06:22 PM

Model: Elk, Hiller 12-E, Idaho (with snow)

[Files]
Title   = C:\Users\wschul1\Desktop\Beta6.1.3\2018_EL721_1st_Strat.ttl
Summary = C:\Users\wschul1\Desktop\Beta6.1.3\2018_EL721_1st_Strat.sum

2018_EL721_1st_Strat

Section 1: Summary of Raw Counts

Stratum	Units Sampled	Total	Number of Each Class Counted: Cows	Bulls	BABull	Calves	Spikes	Raghrn	AdBull	Unclas
1	48	3128	1557	989	688	582	301	446	242	0
2	22	2150	876	839	637	435	202	316	321	0
3	14	4096	2423	669	318	1004	351	194	124	0
Total	84	9374	4856	2497	1643	2021	854	956	687	0

Section 2: Summary of Raw Counts for Perfect Visibility Model

This table projects the number of animals that would have been counted if every unit had been flown and visibility had been perfect (no animals obscured
by vegetation, etc.)

No of Units	Number of Each Class Counted

Strat	Popn	Sample	Total	Cows	Bulls	BABull	Calves	Spikes	Raghrn	AdBull	Unclas
1	73	48	4757	2368	1504	1046	885	458	678	368	0
2	22	22	2150	876	839	637	435	202	316	321	0
3	14	14	4096	2423	669	318	1004	351	194	124	0
Total	109	84	11003	5667	3012	2001	2324	1011	1188	813	0

Section 3: Estimates for Total Number

Total

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	4859	1632857	682	4	2505
2	22	22	2202	0	406	6	40
3	14	14	4121	0	169	1	26
Total	109	84	11182	1632857	1257	11	2571

Cows

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	2371	666551	14	0	1600
2	22	22	880	0	20	0	9
3	14	14	2426	0	18	0	8
Total	109	84	5677	666551	52	0	1600

Bulls

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	1597	50089	567	4	441
2	22	22	885	0	345	6	37
3	14	14	690	0	130	1	22

Total	109	84	3172	50089	1042	11	443

Branched-antlered bulls

	Number of Units			Variance			Bound
Stratum	Popn.	Sample	Estimate	Sampling	Sightability	Model	95%
1	73	48	1133	19496	523	3	277
2	22	22	681	0	327	5	36
3	14	14	338	0	122	1	22
Total	109	84	2152	19496	972	9	280

Calves

	Number of Units			Variance			Bound
Stratum	Popn.	Sample	Estimate	Sampling	Sightability	Model	95%
1	73	48	891	83516	14	0	566
2	22	22	437	0	7	0	5
3	14	14	1005	0	2	0	3
Total	109	84	2333	83516	23	0	566

Spikes

	Number of Units			Variance			Bound
Stratum	Popn.	Sample	Estimate	Sampling	Sightability	Model	95%
1	73	48	463	17159	16	0	257
2	22	22	204	0	5	0	4
3	14	14	352	0	4	0	4
Total	109	84	1019	17159	25	0	257

Raghorns

	Number of Units			Variance			Bound
Stratum	Popn.	Sample	Estimate	Sampling	Sightability	Model	95%
1	73	48	732	10547	253	2	204
2	22	22	332	0	90	1	19
3	14	14	204	0	45	0	13
Total	109	84	1268	10547	388	3	205

Adult bulls

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	401	3042	166	1	111
2	22	22	348	0	151	4	24
3	14	14	133	0	34	0	12
Total	109	84	882	3042	351	5	114

Unclassified

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	0	0	0	0	0
2	22	22	0	0	0	0	0
3	14	14	0	0	0	0	0
Total	109	84	0	0	0	0	0

Section 4: Estimates for Proportions

Cows

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	0.48805	0.00194	0.00001	0.00000	0.08648
2	22	22	0.39965	0.00000	0.00001	0.00000	0.00680
3	14	14	0.58884	0.00000	0.00000	0.00000	0.00323
Total	109	84	0.50777	0.00037	0.00000	0.00000	0.03762

Bulls

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	0.32864	0.00309	0.00001	0.00000	0.10912
2	22	22	0.40182	0.00000	0.00003	0.00000	0.01030
3	14	14	0.16736	0.00000	0.00001	0.00000	0.00450
Total	109	84	0.28361	0.00058	0.00000	0.00000	0.04749

Branched-antlered bulls

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%

1	73	48	0.23328	0.00323	0.00001	0.00000	0.11167
2	22	22	0.30913	0.00000	0.00003	0.00000	0.01140
3	14	14	0.08198	0.00000	0.00001	0.00000	0.00483
Total	109	84	0.19245	0.00061	0.00000	0.00000	0.04860

Calves

	Number of Units			Variance			Bound
Stratum	Popn.	Sample	Estimate	Sampling	Sightability	Model	95%
1	73	48	0.18331	0.00020	0.00000	0.00000	0.02744
2	22	22	0.19853	0.00000	0.00000	0.00000	0.00352
3	14	14	0.24380	0.00000	0.00000	0.00000	0.00140
Total	109	84	0.20859	0.00004	0.00000	0.00000	0.01195

Spikes

	Number of Units			Variance			Bound
Stratum	Popn.	Sample	Estimate	Sampling	Sightability	Model	95%
1	73	48	0.09536	0.00002	0.00000	0.00000	0.00963
2	22	22	0.09269	0.00000	0.00000	0.00000	0.00199
3	14	14	0.08538	0.00000	0.00000	0.00000	0.00087
Total	109	84	0.09115	0.00000	0.00000	0.00000	0.00421

Raghorns

	Number of Units			Variance			Bound
Stratum	Popn.	Sample	Estimate	Sampling	Sightability	Model	95%
1	73	48	0.15071	0.00126	0.00001	0.00000	0.06964
2	22	22	0.15091	0.00000	0.00001	0.00000	0.00683
3	14	14	0.04962	0.00000	0.00000	0.00000	0.00297
Total	109	84	0.11349	0.00024	0.00000	0.00000	0.03031

Adult bulls

	Number of Units			Variance			Bound
Stratum	Popn.	Sample	Estimate	Sampling	Sightability	Model	95%
1	73	48	0.08257	0.00054	0.00001	0.00000	0.04570
2	22	22	0.15822	0.00000	0.00002	0.00000	0.00904
3	14	14	0.03235	0.00000	0.00000	0.00000	0.00265
Total	109	84	0.07896	0.00010	0.00000	0.00000	0.01996

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	0.00000	0.00000	0.00000	0.00000	0.00000
2	22	22	0.00000	0.00000	0.00000	0.00000	0.00000
3	14	14	0.00000	0.00000	0.00000	0.00000	0.00000
Total	109	84	0.00000	0.00000	0.00000	0.00000	0.00000

Unclassified

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	0.00000	0.00000	0.00000	0.00000	0.00000
2	22	22	0.00000	0.00000	0.00000	0.00000	0.00000
3	14	14	0.00000	0.00000	0.00000	0.00000	0.00000
Total	109	84	0.00000	0.00000	0.00000	0.00000	0.00000

Section 5: Estimates for Ratios

Bulls per 100 Cows

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	67.3	227.0	0.7	0.0	29.6
2	22	22	100.5	0.0	4.7	0.1	4.3
3	14	14	28.4	0.0	0.2	0.0	0.9
Total	109	84	55.9	39.6	0.3	0.0	12.4

Calves per 100 Cows

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	37.6	0.0	0.0	0.0	0.3
2	22	22	49.7	0.0	0.2	0.0	0.8
3	14	14	41.4	0.0	0.0	0.0	0.2
Total	109	84	41.1	0.0	0.0	0.0	0.2

Spikes per 100 Cows

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	19.5	0.0	0.0	0.0	0.3
2	22	22	23.2	0.0	0.1	0.0	0.4
3	14	14	14.5	0.0	0.0	0.0	0.1
Total	109	84	18.0	0.0	0.0	0.0	0.1

Spikes per 100 Bulls

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	29.0	16.7	0.1	0.0	8.0
2	22	22	23.1	0.0	0.2	0.0	0.9
3	14	14	51.0	0.0	0.7	0.0	1.6
Total	109	84	32.1	4.2	0.1	0.0	4.1

Raghorns per 100 Bulls

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	45.9	0.0	0.2	0.0	0.9
2	22	22	37.6	0.0	0.5	0.0	1.4
3	14	14	29.7	0.0	0.4	0.0	1.2
Total	109	84	40.0	0.0	0.1	0.0	0.7

Adult bulls per 100 Bulls

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	25.1	7.9	0.0	0.0	5.5
2	22	22	39.4	0.0	0.0	0.1	0.5
3	14	14	19.3	0.0	0.0	0.0	0.2
Total	109	84	27.8	2.0	0.0	0.0	2.8

Branched-antlered bulls per 100 Bulls

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	71.0	0.0	0.1	0.0	0.7
2	22	22	76.9	0.0	0.2	0.1	1.1
3	14	14	49.0	0.0	0.7	0.0	1.6
Total	109	84	67.8	0.0	0.1	0.0	0.6

Spikes per 100 Branched-antlered bulls

Stratum	Number of Units Popn.	Sample	Estimate	Variance Sampling	Sightability	Model	Bound 95%
1	73	48	40.9	106.1	0.5	0.0	20.2

```
    2      22      22       30.0      0.0          0.6        0.0     1.6
    3      14      14      104.1    591.5         11.6        0.1    48.1
------- ------  ------  -------- -------- ------------ --------- -------
 Total    109      84       47.4     44.0          0.5        0.0    13.1
======= ======  ======  ======== ======== ============ ========= =======
```

Section 6: Summary Statistics

Percent correction from perfect visibility model

```
          Units
 Stratum Sampled  Total   Cows  Bulls BABull Calves Spikes Raghrn AdBull
Unclas
 ------- ------- ------ ------ ------ ------ ------ ------ ------ ------ -
-----
    1       48      2.1    0.1    6.2    8.3    0.6    1.2    8.0    9.0
0.0
    2       22      2.4    0.5    5.5    6.9    0.5    1.1    5.2    8.6
0.0
    3       14      0.6    0.1    3.1    6.2    0.1    0.2    5.4    7.5
0.0
 ------- ------- ------ ------ ------ ------ ------ ------ ------ ------ -
-----
  Total     84      1.6    0.2    5.3    7.5    0.4    0.8    6.7    8.5
0.0
 ======= ======= ====== ====== ====== ====== ====== ====== ====== ======
======
```

[Total variances (i.e., standard error squared) are in parenthesis]

Total estimates...

```
     11182 ( 1634125) Total
      5677 (  666603) Cows
      3172 (   51142) Bulls
      2152 (   20477) Branched-antlered bulls
      2333 (   83539) Calves
      1019 (   17184) Spikes
      1268 (   10938) Raghorns
       882 (    3398) Adult bulls
         0 (       0) Unclassified
```

Proportions...

```
    0.5078 (0.000368) Cows
    0.2836 (0.000587) Bulls
    0.1925 (0.000615) Branched-antlered bulls
    0.2086 (0.000037) Calves
```

```
    0.0912 (0.000005) Spikes
    0.1135 (0.000239) Raghorns
    0.0790 (0.000104) Adult bulls
    0.0000 (0.000000) Unclassified

Ratios...
        56 (      40) Bulls per 100 Cows
        41 (       0) Calves per 100 Cows
        18 (       0) Spikes per 100 Cows
        32 (       4) Spikes per 100 Bulls
        40 (       0) Raghorns per 100 Bulls
        28 (       2) Adult bulls per 100 Bulls
        68 (       0) Branched-antlered bulls per 100 Bulls
        47 (      44) Spikes per 100 Branched-antlered bulls
================================================================================
=====
```

2018 - JCR Evaluation Form

SPECIES: Elk

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

HERD: EL742 - RATTLESNAKE

HUNT AREAS: 23

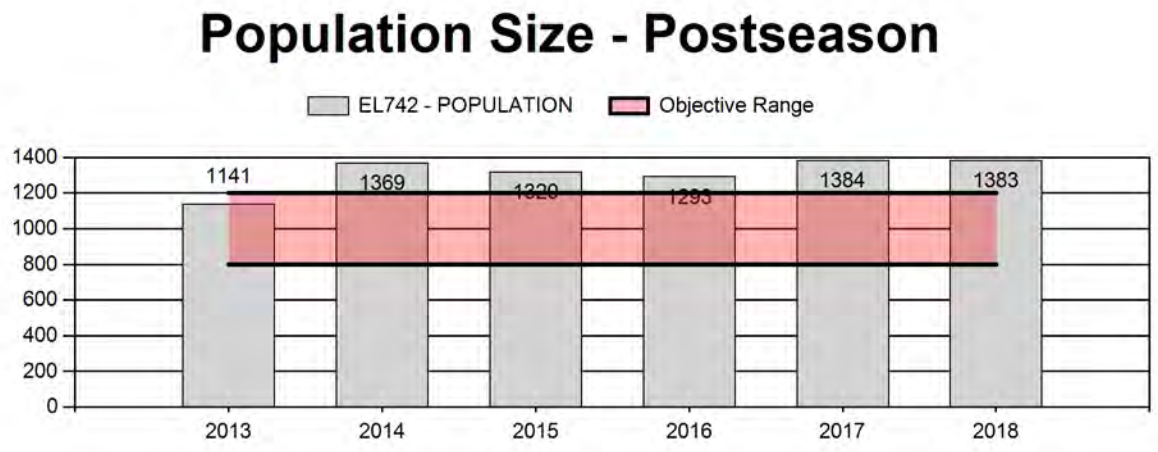
PREPARED BY: HEATHER O'BRIEN

	2013 - 2017 Average	2018	2019 Proposed
Population:	1,301	1,383	1,322
Harvest:	188	189	201
Hunters:	387	421	400
Hunter Success:	49%	45%	50%
Active Licenses:	409	456	440
Active License Success:	46%	41%	46%
Recreation Days:	3,316	4,262	3,600
Days Per Animal:	17.6	22.6	17.9
Males per 100 Females	46	31	
Juveniles per 100 Females	35	35	

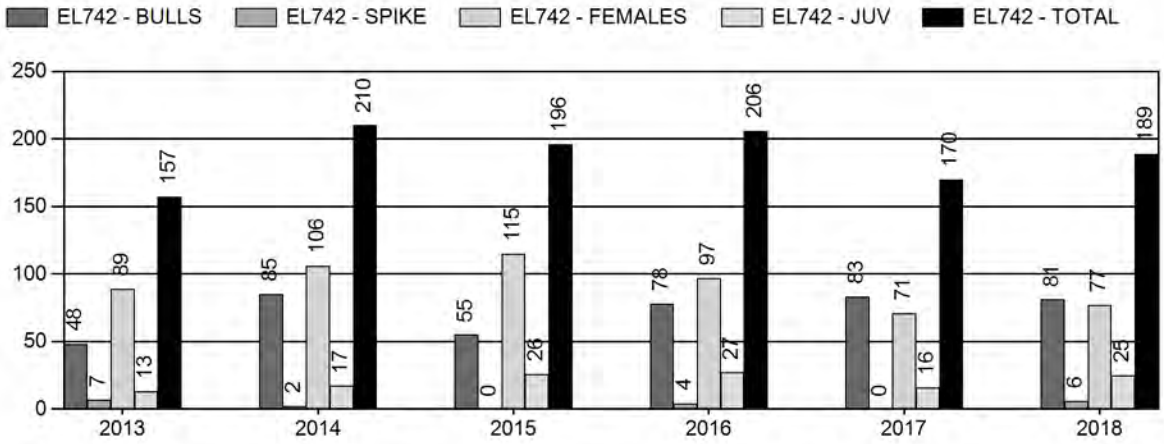
Population Objective (± 20%) :	1000 (800 - 1200)
Management Strategy:	Recreational
Percent population is above (+) or below (-) objective:	38%
Number of years population has been + or - objective in recent trend:	27
Model Date:	02/25/2019

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

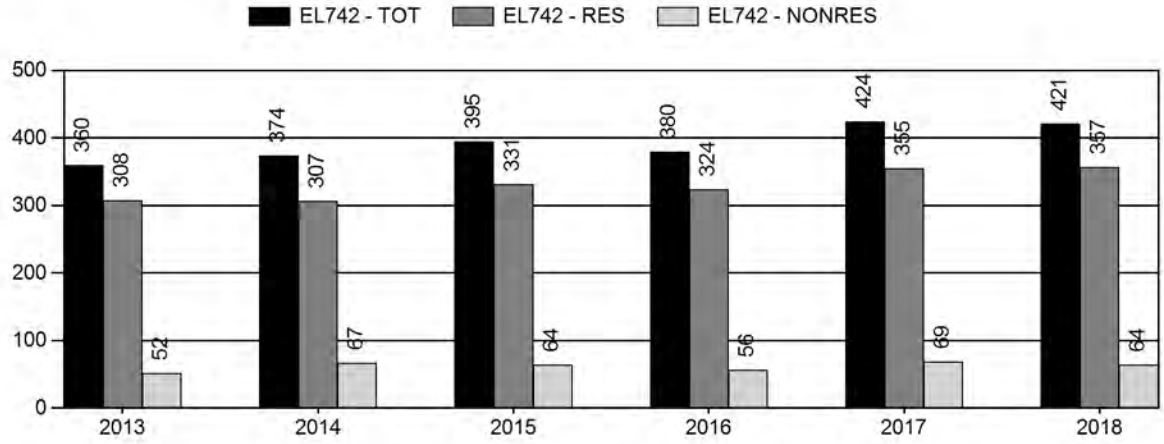
	JCR Year	Proposed
Females ≥ 1 year old:	13.0%	12.5%
Males ≥ 1 year old:	25.2%	23.8%
Total:	13.2%	13.0%
Proposed change in post-season population:	-4.3%	-4.4%



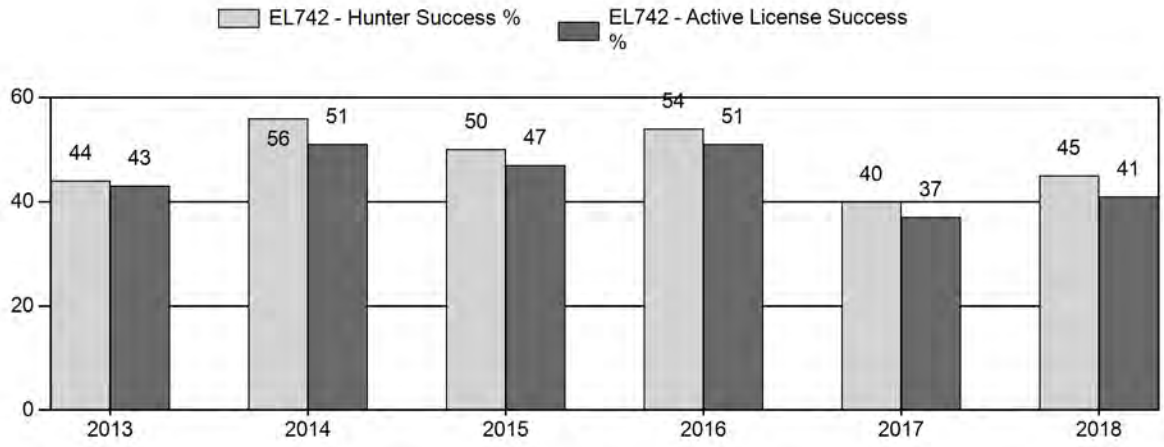
Harvest



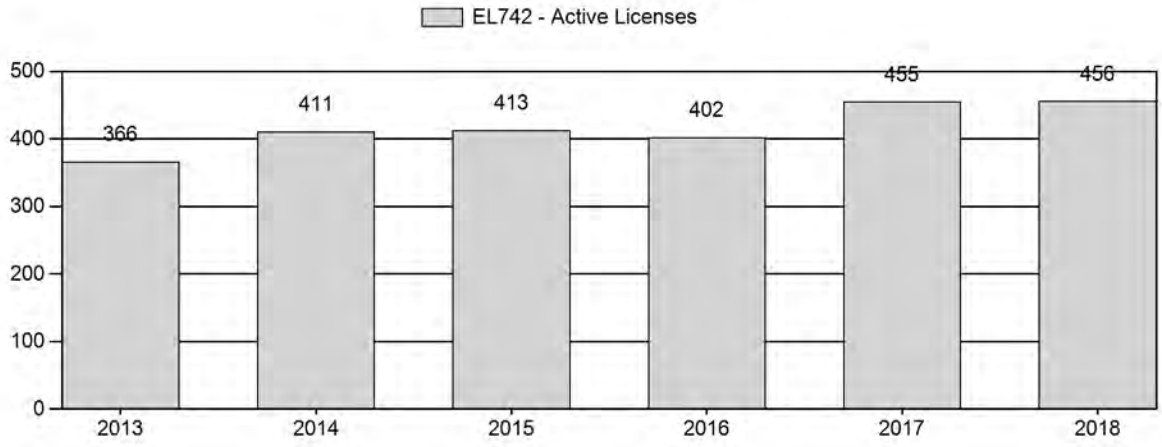
Number of Hunters



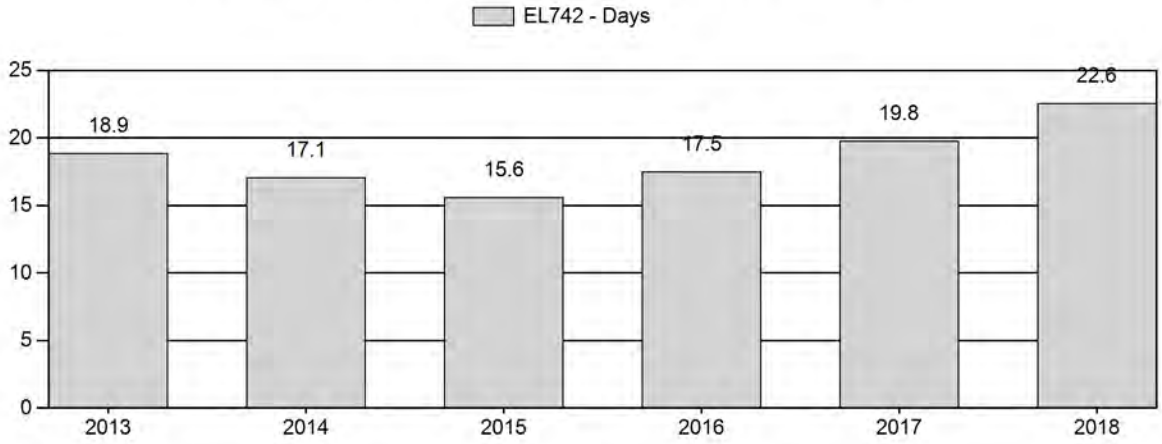
Harvest Success



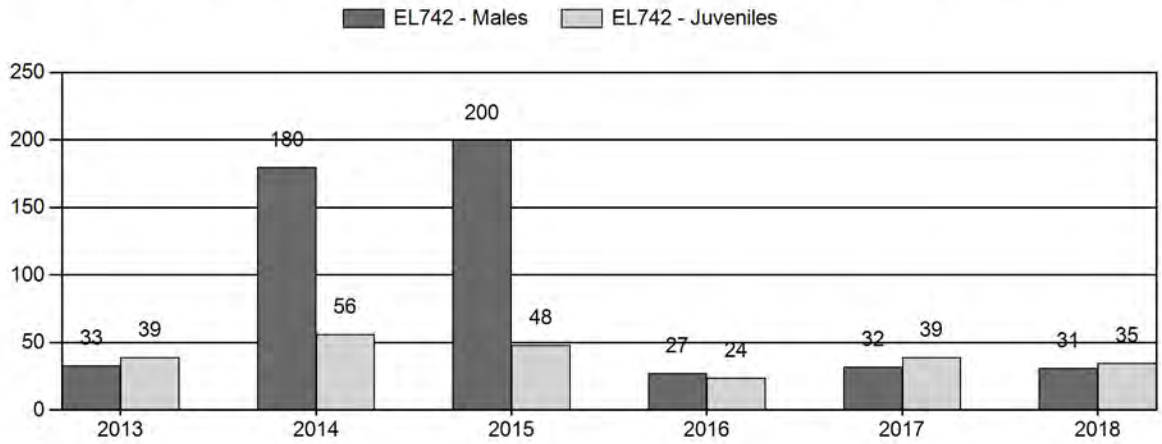
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2013 - 2018 Postseason Classification Summary

for Elk Herd EL742 - RATTLESNAKE

		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	1,141	26	102	128	19%	390	58%	153	23%	671	479	7	26	33	± 3	39	± 3	30
2014	1,369	35	113	148	54%	82	30%	46	17%	276	406	43	138	180	± 28	56	± 12	20
2015	1,320	10	86	96	57%	48	29%	23	14%	167	390	21	179	200	± 42	48	± 15	16
2016	1,293	53	77	130	18%	478	66%	114	16%	722	395	11	16	27	± 2	24	± 2	19
2017	1,384	23	71	94	19%	295	58%	116	23%	505	375	8	24	32	± 4	39	± 4	30
2018	1,383	131	107	238	18%	776	60%	274	21%	1,288	441	17	14	31	± 1	35	± 1	27

2019 HUNTING SEASONS
RATTLESNAKE ELK (EL742)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
23	1	Oct. 1	Oct. 31	150	Limited quota	Any elk
	1	Nov. 15	Dec. 15			Any elk
	4	Oct. 1	Oct. 31	125	Limited quota	Antlerless elk
	4	Nov. 15	Dec. 15			Antlerless elk
	6	Oct. 1	Oct. 31	200	Limited quota	Cow or calf
	6	Nov. 15	Dec. 15			Cow or calf
	7	Nov. 15	Dec. 15	50	Limited quota	Cow or calf
Archery						Refer to license type and limitations in Section 2

Hunt Area	Type	Quota change from 2018
23	1	No changes
	4	No changes
	6	No changes
	7	No changes

Management Evaluation

Current Postseason Population Management Objective: 1,000
Management Strategy: Recreational
2018 Postseason Population Estimate: 1,400
2019 Proposed Postseason Population Estimate: 1,300
2018 Hunter Satisfaction: 56% Satisfied, 20% Neutral, 23% Dissatisfied

The Rattlesnake Elk Herd Unit has a postseason population management objective of 1,000 elk. The herd is managed using the recreational management strategy, with a goal of maintaining postseason bull ratios of 15-29 bulls per 100 cows. The objective and management strategy were revised in 2012 and reviewed in 2017.

Herd Unit Issues

Hunting access within the herd unit is variable. The majority of occupied elk habitat is accessible for hunting via public land and Hunter Management Area access. However, there is one ranch within the central part of occupied habitat that does not allow any access for hunting and harbors the vast majority of elk within the herd unit. Hunters have expressed frustration when elk take refuge in this area, as they tend to remain there due to low hunter pressure and good forage conditions. The main land use within the herd unit is traditional ranching and grazing of livestock, with isolated areas of oil and gas development. There is the potential for future mining of precious metals and rare earth minerals in the hunt area, but current levels of activity are low. Disease outbreaks are not a current concern in this herd unit.

Weather

From 2013 to the present, weather trends have been generally favorable, and elk have fared well within the herd. Range conditions were particularly good from 2013 to 2015, when spring and summer moisture improved and winters were mild. The winter of 2015 was fairly average, though some areas experienced prolonged periods of persistent snow. The spring of 2016 had above average precipitation, but summer was extremely dry causing rangeland habitats to cure early. Fortunately, precipitation in October resulted in a late surge of plant growth, which may have provided elk with a boost in nutrition going into the winter months. While there were several notable snow storms and cold snaps during the winter of 2016-2017, there were also periods of warm weather and high winds that melted and drifted snow to expose forage. The 2017 growing season was very similar to the previous year, with ample spring moisture followed by a dry summer with little precipitation. Moisture improved during the fall, though there was little snow to speak of over the winter of 2017-2018. Elk dispersed widely over much of their range in the herd unit, and access for December hunters was very good. Precipitation was below average for the 2018 growing season, and many reservoirs became dry by late summer. Some sparse rain events provided some moisture during the fall months, but the 2018-2019 winter has been fairly mild in the herd unit. Thus far, the region has received average to below-average snowfall combined with many windy days to drift snow and open habitats for elk to access and forage. For detailed weather data see http://www.ncdc.noaa.gov/gac/time-series/us.

Habitat

This herd unit has no established habitat transects that measure production and/or utilization on vegetation preferred by elk. Anecdotal observations indicate late summer forage was in below average condition, but scattered precipitation may have improved fall forage for elk in 2018.

Harvested elk and those observed during November aerial surveys appeared to be in good body condition.

Field Data

Observed calf ratios are erratic in this herd unit due to varying classification survey conditions and levels of effort across years. Thus it is difficult to correlate changes in population size based on observed calf ratios and corresponding recruitment. In both 2017 and 2018, elk were classified from excellent video footage, and survey sample sizes exceeded the objective. The resulting calf ratios were also similar, with 39 and 35 calves per 100 cows, respectively. These results are likely more accurate than some previous years when survey conditions were not as optimal. These high calf ratios along with corresponding yearling bull ratios illustrate the capacity for this herd to grow rapidly. Managers continue to focus on maximizing cow harvest without over-saturating public lands with hunter pressure. Increases in cow license issuance are not warranted unless access improves and there are no large areas where elk can take refuge from harvest pressure.

Observed bull ratios are also highly erratic as a result of variable survey conditions and levels of effort from year to year. Since 2001, observed bull ratios have ranged from 13 to 58 per 100 cows during favorable survey years. Years with low observed bull ratios were followed by years with much higher observed ratios, indicating bulls were likely missed during classification surveys in some years and/or elk were immigrating/emigrating to and from adjacent hunt areas. In years when large cow/calf groups are missed during aerial surveys, resulting bull ratios appear to be artificially high. While real survey data in these years are reported in classification results; long-term averages are applied in the population model to represent more realistic bull ratios. Coverage during 2018 classification surveys was not as thorough as previous years due to budget constraints. Nevertheless, managers were fortunate to locate a good sample of adult bulls during surveys. The resulting bull ratio of 31 per 100 cows is similar to the previous year, and is considered a fair representation of real bull ratios within this herd. While license issuance and season structure changes in this herd are not typically based on observed classification ratios, current harvest pressure on bulls seems to be well tolerated. Future season structure should continue to maximize cow harvest while maintaining relatively good license success without overcrowding hunters.

Harvest Data

License success in this herd unit is typically in the 40th percentile and is fairly consistent, given license issuance and hunter opportunity have remained relatively similar across years. Hunter days per animal fluctuate from year to year, but this may be a function of changes in access due to weather and road conditions. The persistence of unattainable elk in the aforementioned private

land refugia most certainly contributes to increased hunter days, low harvest success, and low hunter satisfaction in most years. In 2018, large groups of cows and calves remained habitually on private lands with no hunting access. As a result, harvest success on antlerless and cow/calf licenses was relatively low (28%), but was markedly better on late-season cow/calf licenses (50%). This distinction seems to imply cow/calf distribution on public lands improved in late November and early December. Overall cow/calf harvest for 2018 was 102, which is near the 5-year average of 112. Bulls typically distribute themselves in smaller groups across favorable habitat on both public and private lands in the herd unit. Thus, harvest success on any-elk licenses is typically better compared to antlerless harvest. This was again the case in 2018, as harvest success was 63% on any-elk licenses, with 87 bulls harvested. Overall harvest success improved to 45% with 189 animals harvested, and was in line with the 5-year average of 49%.

Since 2013, late-season licenses have been valid in the adjacent Hunt Area 128, where portions of the herd sometimes migrate during the fall and winter months. Harvest success has declined for hunters with Area 23 licenses in recent years, and in 2018 only 3 cows were harvested by Area 23 hunters in Area 128. Managers feel that some hunters may be spending undue time searching in vain for elk in unsuitable habitats in Area 128. In an effort to refocus hunting pressure on antlerless elk in Area 23, late season licenses will no longer be valid in Area 128 for 2019. Late seasons will still run through December 15th to maximize opportunity for hunters to harvest an elk within the regular herd unit boundaries.

Population

The 2018 postseason population estimate was approximately 1,400 elk. No sightability or other population estimate data are currently available to further align the model in conjunction with classification and harvest data. There have been few complaints from landowners in recent years with regard to elk numbers. Harvest pressure and success have increased with longer seasons since 2013, but may also be dependent on weather and its effects on access and elk movements. It is difficult to determine how many elk may emigrate from the herd unit into adjacent areas, but managers believe this population to be relatively stable.

The “Time-Specific Juvenile – Constant Adult Survival – Male Survival Coefficient” (TSJ,CA, MSC) spreadsheet model was selected for the postseason population estimate of this herd. This population is difficult to model as it is small in size and appears to have consistent interchange with an adjacent herd, thus violating the closed population assumption of the model. High variability in observed bull and calf ratios also render this herd challenging to model. Long-term classification averages are used in years when adequate sample sizes are not reached during postseason surveys to avoid inaccuracies from high variability in the model. Trend count data are also included in the model to document higher numbers of elk that have been seen in some years

but could not be classified. The TSJ,CA and CJ,CA models were discarded, as they predict population sizes that are lower than observed survey totals. When juvenile survival was increased in years known to have mild winter conditions, the SCJ,CA model predicted a reasonable population size. However, the model applied the extreme lower survival constraint for juveniles and the upper survival constraint for adults, indicating poor model performance and quality. While the TSJ,CA,MSC model appears to be the best choice to represent the herd, it should be noted that this model frequently selected for the upper and lower juvenile survival constraints and selected the highest adult survival constraint, indicating that it is of poor quality. If the model continues to be troublesome and inaccurate in reflecting trends and known numbers of elk, managers may consider changing to trend-count based management for this herd.

Management Summary

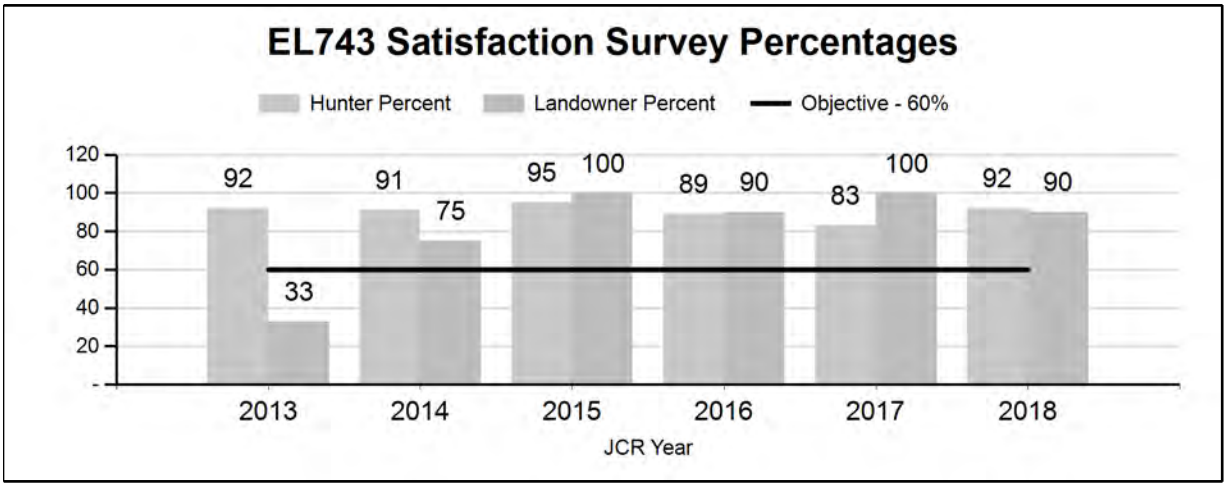
Opening day of hunting season in this herd is traditionally October 1st, and closing dates have differed with changing harvest prescriptions from year to year. Season structure has also changed to include a split season in recent years to maximize cow harvest while extending opportunity for bull elk hunting. Longer split season dates with a closure from November 1 – 14 have been well-received the last five years by hunters, and have resulted in improved harvest success and totals. Since this has worked well, the same season structure is being implemented for 2019. The 4-week late cow season will be continued as a means to provide extended opportunity for those license holders. Goals for 2019 are to continue high harvest pressure on cows, maintain extended opportunity to hunt bulls, and maintain or improve overall harvest success.

If we attain the projected harvest of approximately 200 elk and assuming average calf production/survival, this herd should decrease slightly. The predicted 2019 postseason population estimate for the Rattlesnake Elk Herd is approximately 1,300 animals, or 30% above objective.

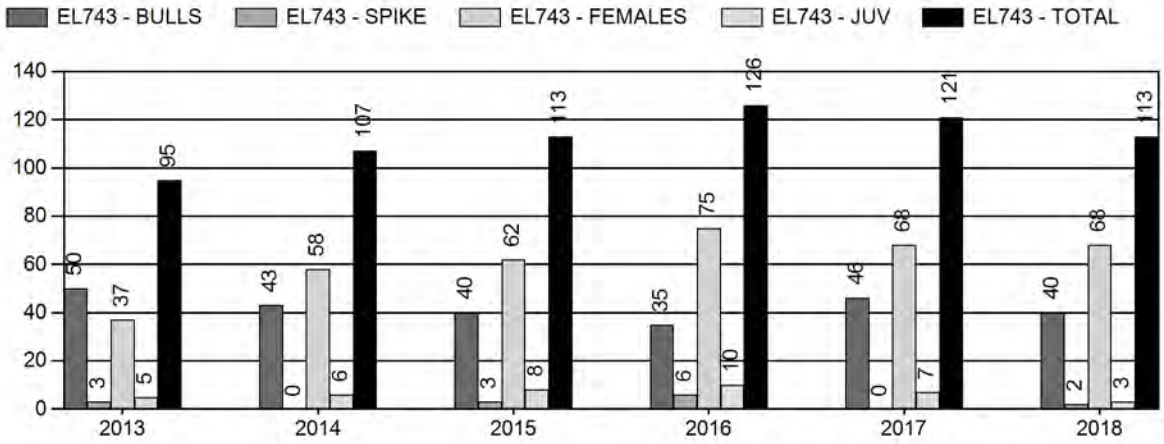
2018 - JCR Evaluation Form

SPECIES: Elk
PERIOD: 6/1/2018 - 5/31/2019
HERD: EL743 - PINE RIDGE
HUNT AREAS: 122
PREPARED BY: WILLOW BISH

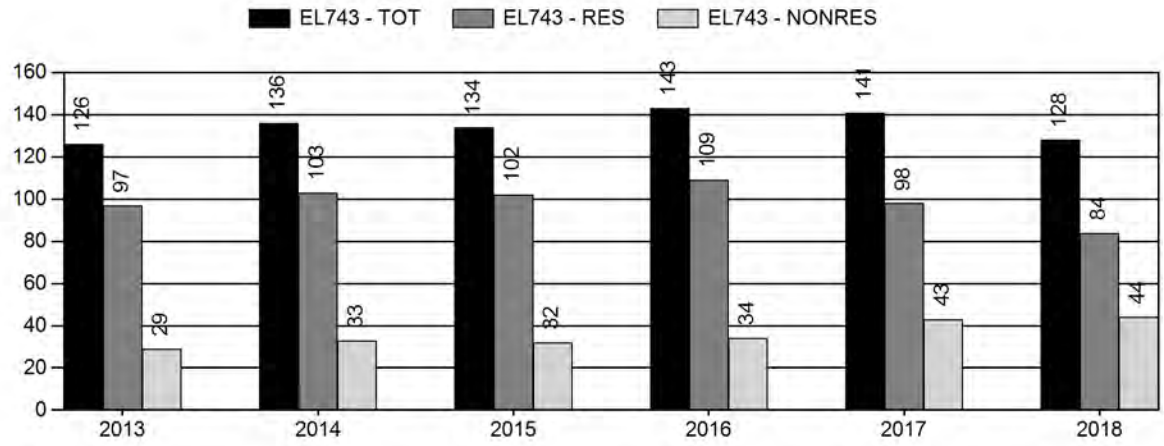
	2013 - 2017 Average	2018	2019 Proposed
Hunter Satisfaction Percent	90%	92%	90%
Landowner Satisfaction Percent	83%	90%	90%
Harvest:	112	113	125
Hunters:	136	128	130
Hunter Success:	82%	88%	96%
Active Licenses:	145	140	150
Active License Success:	77%	81%	83%
Recreation Days:	561	490	525
Days Per Animal:	5.0	4.3	4.2
Males per 100 Females:	0	0	
Juveniles per 100 Females	0	0	
Satisfaction Based Objective			60%
Management Strategy:			Private Land
Percent population is above (+) or (-) objective:			31%
Number of years population has been + or - objective in recent trend:			5



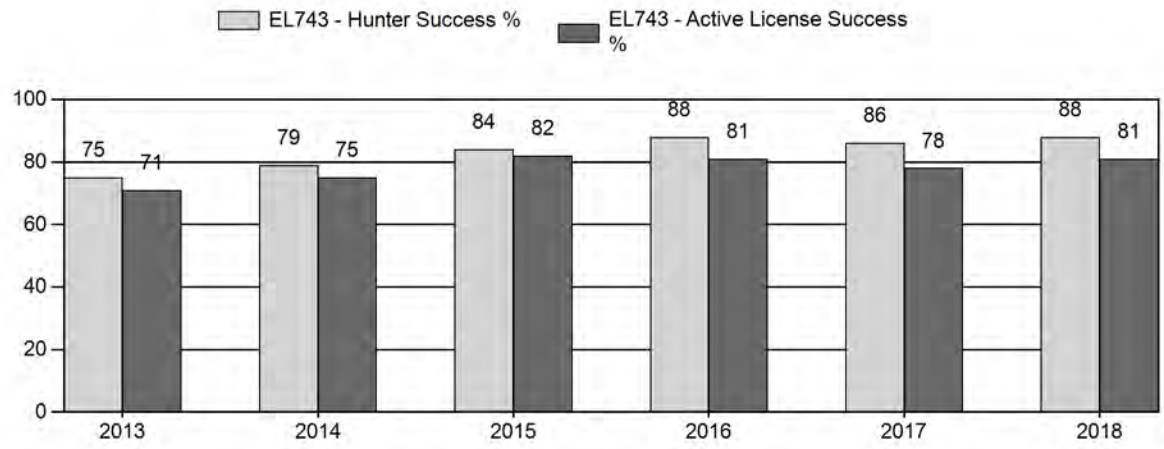
Harvest



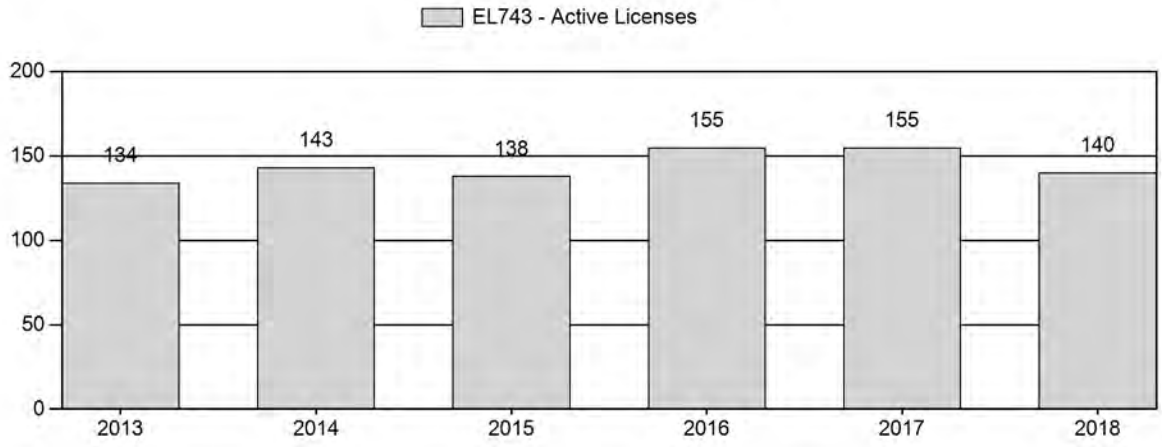
Number of Hunters



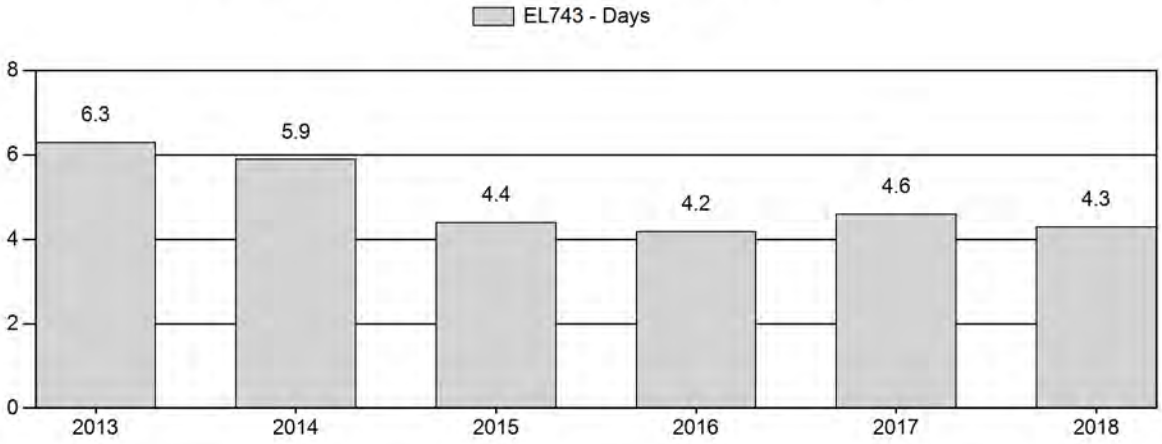
Harvest Success



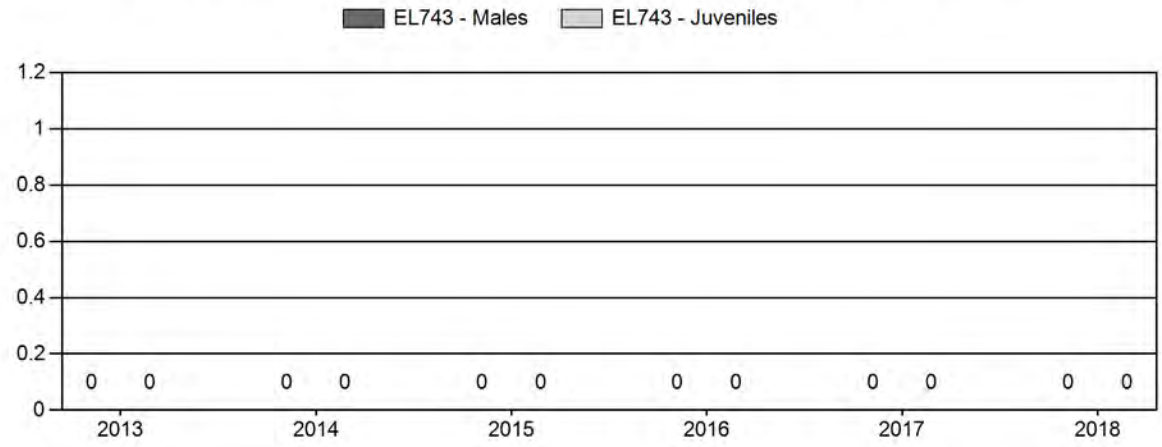
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2019 HUNTING SEASONS
PINE RIDGE ELK HERD (EL743)

Hunt Area	Type	Season Dates Opens	Closes	Quota	License	Limitations
122	1	Oct. 15	Nov. 30	75	Limited quota	Any elk
		Dec. 1	Dec. 31			Antlerless elk
	6	Oct. 15	Dec. 31	150	Limited quota	Cow or calf
Archery		Sep. 1	Sep. 30			Refer to license and type limitations in Section 2

Management Evaluation

Current Hunter/Landowner Satisfaction Management Objective: 60% hunter/landowner satisfaction; bull quality
Management Strategy: Private Land
2018 Hunter Satisfaction Estimate: 92%
2018 Landowner Satisfaction Estimate: 90%
Most Recent 3-year Running Average Hunter Satisfaction Estimate: 88%
Most Recent 3-year Running Average Landowner Satisfaction Estimate: 93%
2018 Postseason Population Estimate: *~ 900 (Field Estimate)*
2019 Proposed Postseason Population Estimate: *~ 900 (Field Estimate)*

The Pine Ridge Elk Herd Unit has a management objective based on 60% or higher landowner and hunter satisfaction. As a secondary objective, managers strive to maintain a bull harvest consisting of 60% mature, branch-antlered bulls. This objective was revised in 2012, and was last reviewed in 2017. An objective based upon postseason population estimates was not feasible for this herd unit.

Herd Unit Issues

Nearly all elk in this herd reside in and along the timbered Pine Ridge escarpment in the north central portion of the herd unit. Land use consists of traditional ranching and livestock grazing mixed with areas of intensive oil and gas, wind, and uranium development. Access to hunting is tightly controlled by private landowners, and achieving adequate harvest to manage growth of this herd can be difficult, although it has been significantly improved in recent years. Given the private-land nature of this elk herd, the Department gives serious deference to landowner desires.

In past years, landowners have expressed dissatisfaction with growing elk numbers. However, the majority of landowners are now expressing satisfaction with current season structure, level of harvest, and elk numbers. Recently liberalized season structure, as well as increased commitment from landowners to harvest cow elk, have resulted in continually increasing harvest rates, which appear to be maintaining elk numbers.

Weather & Habitat

The Pine Ridge Elk Herd resides in relatively low-elevation habitat, and weather typically has minimal influence on elk productivity, survival and movements. In addition, there are no habitat or classification data collected in this herd unit given the Department's minimal management influence and budgetary constraints. Thus no meaningful analysis of weather and habitat data will be presented.

Field Data

Fixed-wing winter trend counts are conducted in this herd unit as budget and weather conditions allow. Past trend counts of this herd typically found between 150 and 350 elk. In 2013, a winter trend count conducted under optimum conditions found a total of 840 elk, indicating this herd was larger than previously believed. A trend count conducted in February 2014 found a total of 454 elk; however snow conditions were not ideal and elk were difficult to see bedded amongst exposed rocks and shrubs. In February 2015, a trend count yielded only 276 elk despite good survey conditions and thorough coverage. In November of 2015, field personnel attempted to conduct the trend count during deer helicopter classification flights, but were only able to locate 49 elk. In 2016, elk were counted during deer flights in November (total of 271 elk) as well as a trend count in February under ideal conditions (566 elk). In 2017, the trend count was conducted in November during helicopter deer flights only and yielded 648 elk. During deer flights in November of 2018, only 88 elk were seen, although field personnel placed more emphasis on finding mule deer. Field managers planned to conduct a fixed-wing flight in February to conduct a trend count but weather and availability issues prevented this from occurring. Based on past and current elk observations as well as landowner input, managers still estimate this herd likely numbers 800-1,000 elk.

Current information on this herd is somewhat limited given budget constraints and the private land nature of this herd. Despite these limitations, field managers and many landowners feel this population is stable. However, given typical calf ratios found in other central Wyoming herds (in the 40s), if the population is indeed at about 900 elk, the average level of harvest in this herd (5-year average of 75 cow/calves; 118 total elk), is not sufficient to curtail population growth. Managers therefore assume emigration may be occurring from this herd. There are few major geographical or anthropogenic barriers to elk movement in this area. Managers and landowners

routinely observe small groups of elk, particularly bulls, moving east from Pine Ridge, often crossing Highway 59. If significant emigration is occurring, this herd unit may not be properly defined if interchange is exceeding 10%. However, lack of specific information regarding these elk movements precludes re-defining the herd unit boundaries at this time.

Landowner and hunter satisfaction surveys are used to gauge management of the Pine Ridge Elk Herd. Annual survey results must show at least 60% of hunters were either "satisfied" or "very satisfied" with the previous year's hunting season. In addition, landowner surveys must show at least 60% or more respondents are satisfied with elk numbers in their area. Should these satisfaction thresholds not be met, changes in management should be prescribed to address reasons for dissatisfaction. A secondary objective is also used in the Pine Ridge Elk Herd Unit to anchor the results of satisfaction surveys to a population parameter. In this case, age class targets are determined from the harvest survey and used as a measure of bull quality. The percentage of mature branch-antlered bulls in the male portion of the annual harvest is used, with a 3-year average of 60% minimum being the threshold for management action.

In the past, Pine Ridge landowners were mailed surveys to provide feedback on the elk population and hunting season structure. However, landowners expressed preference for in-person meetings, phone calls, or visits in recent years as opposed to the survey. Many landowners also did not return their surveys resulting in low sample sizes for landowner satisfaction. Therefore, field managers have found that discussing their satisfaction with the population and asking for opinions regarding season structure has been much more constructive. Group meetings have been held every year in recent years, but given the level of satisfaction landowners have expressed in recent years regarding elk seasons and preliminary discussions between field managers and landowners which did not indicate that any changes were desired, field managers called or visited Pine Ridge landowners individually to discuss seasons and populations.

For the 2018 season, 90% of landowners (N=10) contacted by Department personnel were satisfied. The one landowner who reported a lack of satisfaction has only recently become engaged in elk management. This landowner reported sentiments similar to concerns in the past from other Pine Ridge landowners. Field managers believe that relationship building and education regarding elk management, license allocation, hunting access etc., and resulting improved efforts from landowners to harvest cow elk have adequately addressed satisfaction issues in the past and will continue to do so in the future.

In 2018, 92% of hunters who returned surveys were "satisfied" or "very satisfied" with their hunting experience in the Pine Ridge Elk Herd Unit. For the secondary objective, the three-year average for mature bulls in the harvest was 92%. Landowner satisfaction, hunter satisfaction, and the percentage of mature bulls in the harvest all exceeded the 60% threshold for bio-year 2018.

Harvest Data

Hunter success has remained high for the last 5 years (79-95%). In the past, antlerless elk licenses were undersubscribed as landowners were unwilling to allow access for cow hunters. However, landowners have recently become more willing to allow hunting access and harvest more elk. A majority of Type 6 licenses were available as leftovers after the initial drawing in 2018, and 27 remained unsold. Despite the unsold licenses, total harvest was the second highest it has ever been in 2018 with 113 elk harvested. Of these, 63% were cows or calves. In years prior to 2013, total harvest was typically somewhere between 45 and 50 elk. Since 2012, there has been a steady increase in total harvest, ranging from 95 to 126 elk.

Perceived loss of bull quality was also a concern amongst certain landowners in the past. However, landowners in recent years agreed that bull quality was still high and that a quota of 75 Type 1 licenses being issued was desirable. License success on the Type 1 license averaged 74% in the last 5 years and was 79% in 2018. Antlerless harvest has comprised 7 – 20% of the Type 1 harvest in the past 5 years, which is most likely a result of increased landowner efforts to harvest cows rather than a lack of bull availability. In 2018, 95% of bulls harvested were branch-antlered bulls which is comparable to the previous 5-year average of 94%.

Management Summary

The hunting season in this herd unit opens on October 15 and closes on December 31. In recent years, closing dates and quotas have been extended as landowners agreed to liberalize access for cow elk hunting later in the season. Type 1 license issuance will remain at 75, and Type 6 license issuance at 150. Harvest levels in Pine Ridge have improved in recent years, although Type 6 licenses have remained undersubscribed at current issuance. Therefore, landowners and managers feel that it is not necessary to add more licenses. Under-subscription can be attributed to landowners feeling as though they are near capacity with the number of hunters they can allow to hunt. Having Type 6 license issuance remain at 150 licenses will enable landowners to achieve more harvest if conditions allow in the future. While a few landowners still feel this herd should be reduced, many are satisfied with the current population, given it has stabilized in recent years and population growth appears to have halted. Therefore, management goals for 2019 are to continue to maximize harvest to limit population growth and allow for population reduction if conditions and landowner tolerances for hunters permit.