

2014 - JCR Evaluation Form

SPECIES: Bighorn Sheep

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

HERD: BS106 - TARGHEE

HUNT AREAS: 6

PREPARED BY: ALYSON COURTEMANCH

	<u>2009 - 2013 Average</u>	<u>2014</u>	<u>2015 Proposed</u>
Average Harvest Age	6.5	3.5	6.5
Hunter Success	43%	100%	67%
Harvest:	1	1	2
Hunters:	2	1	3
Hunter Success:	50%	100%	67%
Active Licenses:	2	1	3
Active License Success:	50%	100%	67%
Recreation Days:	12	7	24
Days Per Animal:	12	7	12
Males per 100 Females:	35	0	
Juveniles per 100 Females	33	0	

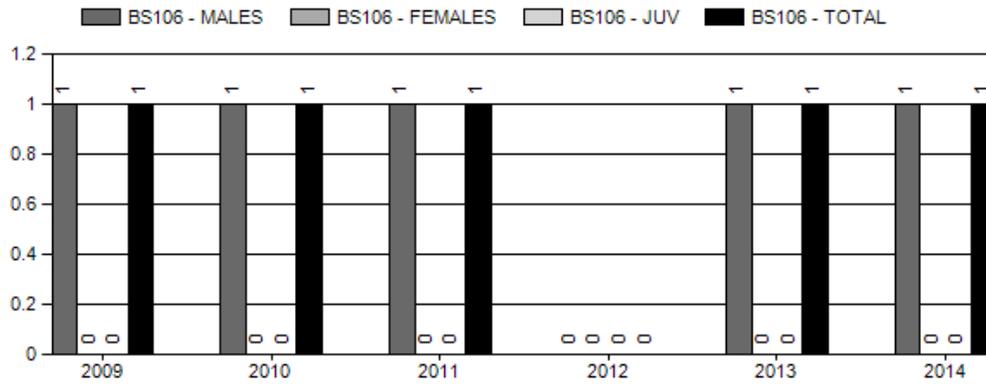
Alternative Population Objectives:

6-8 years old
≥ 50% success

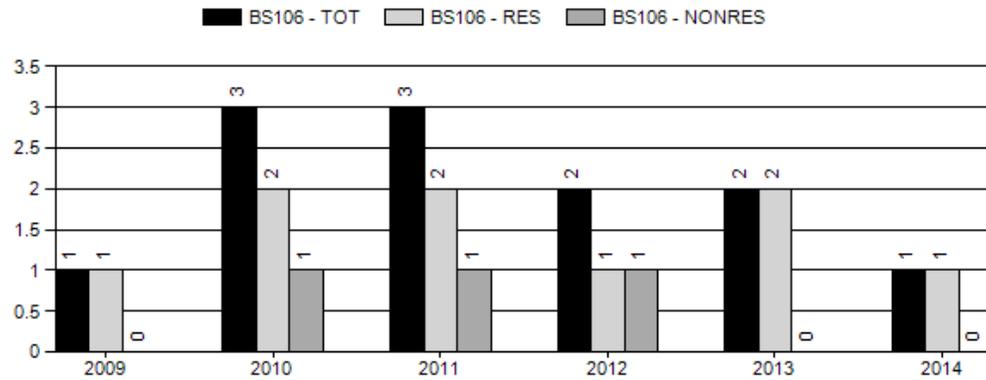
Management Strategy:

Special

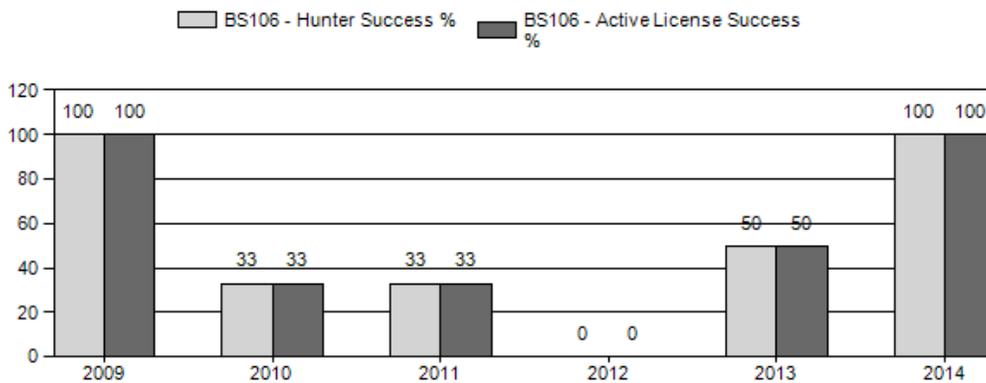
Harvest



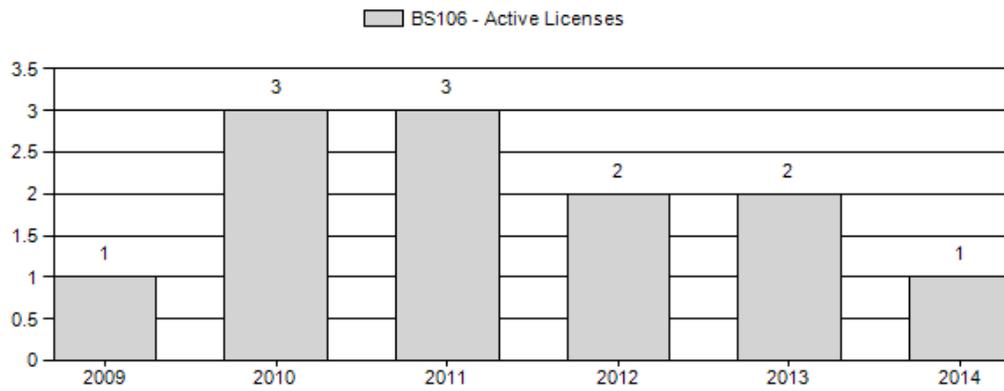
Number of Hunters



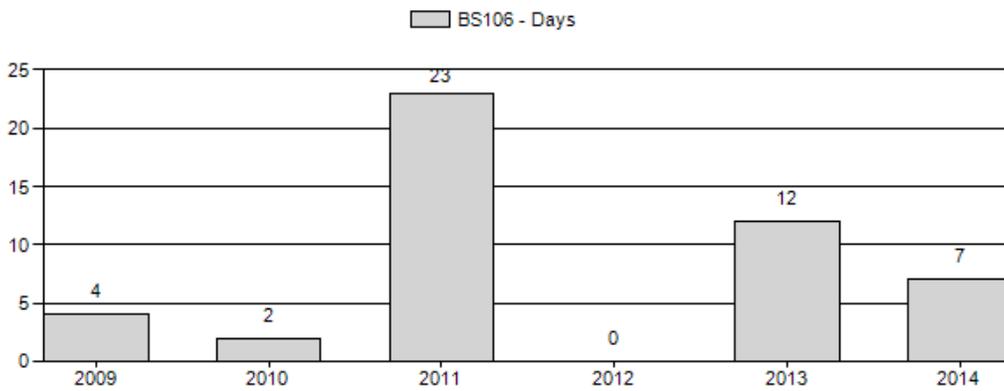
Harvest Success



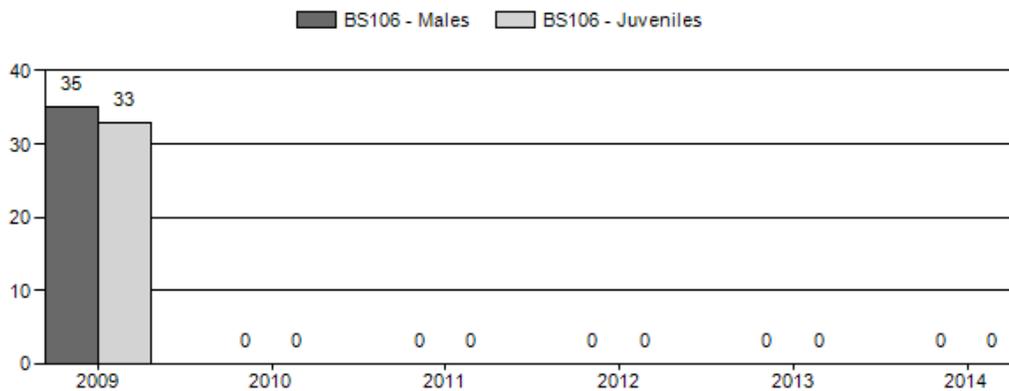
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2004 - 2014 Postseason Classification Summary

for Bighorn Sheep Herd BS106 - TARGHEE

Year	Post Pop	MALES				FEMALES		JUVENILES		Tot CIs	Cls Obj	Males to 100 Females				Young to		
		Ylg	Adult	Total	%	Total	%	Total	%			Ylg	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2004	0	0	8	8	38%	9	43%	4	19%	21	0	0	89	89	± 0	44	± 0	24
2005	0	0	0	0	0%	0	0%	0	0%	0	0	0	0	0	± 0	0	± 0	0
2006	0	0	2	2	17%	6	50%	4	33%	12	0	0	33	33	± 0	67	± 0	50
2007	0	8	22	30	31%	51	53%	15	16%	96	0	16	43	59	± 0	29	± 0	19
2008	0	0	0	0	0%	0	0%	0	0%	0	0	0	0	0	± 0	0	± 0	0
2009	0	1	16	17	21%	48	59%	16	20%	81	0	2	33	35	± 0	33	± 0	25
2010	0	0	0	0	0%	0	0%	0	0%	0	0	0	0	0	± 0	0	± 0	0
2011	0	0	0	0	0%	0	0%	0	0%	0	0	0	0	0	± 0	0	± 0	0
2012	125	0	0	0	0%	0	0%	0	0%	0	0	0	0	0	± 0	0	± 0	0
2013	125	0	0	0	0%	0	0%	0	0%	0	0	0	0	0	± 0	0	± 0	0
2014	125	3	28	31	54%	20	35%	6	11%	57	122	15	140	155	± 42	30	± 13	12

2015 HUNTING SEASONS TARGHEE BIGHORN SHEEP HERD (BS106)

Hunt Area	Type	Dates of Seasons		Quota	License	Limitations
		Opens	Closes			
6	1	Aug. 15	Oct. 31	2	Limited quota	Any ram (2 residents)

Summary of 2015 License Changes

Hunt Area	Type	Change from 2014
6	1	+ 1 resident, - 1 nonresident

Management Evaluation

Management Strategy: Special

Alternative Population Objectives:

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

The Wyoming Game and Fish Department (WGFD) proposed changing the objective for the Targhee Bighorn Sheep Herd from a postseason population objective to an alternative population objective in 2014. The objective change was needed because the herd is rarely surveyed due to budget constraints, challenging weather conditions, and spreadsheet models do not appear to adequately simulate observed population trends. Alternative population objectives were adopted in 2014 after public review (listed above).

In 2014, one resident hunter harvested a 3.5 year-old ram. The non-resident hunter applied for a medical deferral and plans to hunt in 2015. The 5-year average age of harvested rams is 6.5 years. Therefore, the first objective of a 5-year average harvest age of 6-8 years is currently met.

In 2014, hunter success was 100%. The 5-year average hunter success is 43%. Therefore, the second objective of a 5-year average hunter success of $\geq 50\%$ was not met. Success is highly variable year to year due to extremely challenging terrain and movement of sheep between Caribou-Targhee National Forest (CTNF) and Grand Teton National Park (GTNP).

WGFD staff conducted 5 days of bighorn sheep ground surveys in Hunt Area 6 during August 2014. Weather conditions were challenging with poor visibility due to rain and snow. One yearling ram was observed on Mount Bannon and several adult rams were observed in Fox Creek. In addition, an aerial survey of the Targhee Bighorn Sheep Herd was conducted in March 2015 using grant money from the Wyoming Wild Sheep Foundation. A summary report of this survey is included in Appendix I. A total of 57 sheep were observed during the survey, including 20 ewes, 6 lambs, 3 yearling rams, 18 rams with $< \frac{3}{4}$ curl horns, and 10 rams with $> \frac{3}{4}$ curl horns. All of the $> \frac{3}{4}$ curl rams were observed within Hunt Area 6 on CTNF. Observability of sheep was difficult due to the unusually warm weather this year, which caused sheep to move off their high elevation winter ranges early and onto open, south-facing slopes at mid-elevations during the survey. As a result, sheep were widely distributed and difficult to track and observe from the air, which led to a lower count than expected. The third objective is met because rams were documented using areas on National Forest lands in summer and in late winter.

Herd Unit Issues

Current bighorn sheep occupied habitat is located at high elevations year-round in the Teton Range, mostly in GTNP. Bighorn sheep winter on high elevation, windswept ridgelines in upper Jensen Canyon, Mt. Hunt, Prospectors Mountain, Static Peak, Mt. Wister, Ranger Peak, Doane Peak, and Elk Mountain. Winter habitat is most likely the limiting factor for this population. Transitional and summer ranges also include Darby, Fox, Moose and Teton Creeks on CTNF. Historically, this population was migratory and wintered at low elevations around Jackson Hole and Teton Valley, Idaho. In the past, hunters have had a difficult time locating sheep outside of GTNP. However, bighorn sheep have recently increased their use of habitats on CTNF due to willing-seller buy-outs of domestic sheep allotments brokered by the Wyoming Wild Sheep Foundation. In 1997 the revised CTNF Plan called for the retirement of the domestic sheep allotments on the west side of the Tetons. In 2004, the fifth and final domestic sheep allotment was bought with bighorn sheep conservation funds and closed by CTNF. Recently, data from radio-collared bighorn sheep have showed the importance of these areas, especially during the spring.

Mountain goat sightings have been increasing north of Wyoming Highway 22 indicating that their distribution is expanding north from the Snake Range into the Teton Range. In 2008, the first confirmed sighting of a nanny with kids was reported, suggesting an establishing population. It is estimated that approximately 30 mountain goats currently occupy the Teton Range. GTNP deployed radio-collars on 5 mountain goats in December 2014. Disease sampling of those individuals found that they carry the respiratory bacteria *Bibersteinia trehalosi*. In the

future, field managers may need to consider potential impacts of an expanding mountain goat population on this small, native bighorn sheep herd.

Expanding winter backcountry recreation also impacts available winter habitat for bighorn sheep. Recent research from the Wyoming Cooperative Research Unit indicates that Targhee bighorn sheep avoid backcountry ski routes, even if they are in otherwise high quality habitat. This further constricts available winter habitat for bighorn sheep (Courtemanch, 2014)

Weather

Summer and fall 2014 produced consistent moisture, leading to good forage production. The Snake River Basin received above-average snowfall in December and early January, but weather turned warm and dry by February. Many low elevation slopes were snow-free by mid-February, but snow remained deep and heavy with a hard crust on north-facing slopes and higher elevations. At the time of the mid-winter survey, winter precipitation was reported at 91% of normal. Please refer to the following web sites for specific weather station data.

<http://www.wrds.uwyo.edu/wrds/nrcs/snowprec/snowprec.html> and
<http://www.ncdc.noaa.gov/oa/climate/research/prelim/drought/pdiimage.html>

Habitat

A habitat treatment in Teton Canyon is currently in the planning stages to improve historical bighorn sheep winter and summer habitat. The WGFD is assisting Caribou-Targhee National Forest (CTNF) with vegetation monitoring pre and post-treatment. Please refer to the 2014 Annual Report Strategic Habitat Plan Accomplishments for Jackson Region habitat improvement project summaries (<https://wgfd.wyo.gov/web2011/wildlife-1000708.aspx>).

Field Data

WGFD staff conducted 5 days of bighorn sheep ground surveys in Hunt Area 6 during August 2014. Weather conditions were challenging with poor visibility due to rain and snow. One yearling ram was observed on Mount Bannon and several adult rams were observed in Fox Creek. In addition, an aerial survey of the Targhee Bighorn Sheep Herd was conducted in March 2015 using grant money from the Wyoming Wild Sheep Foundation. A summary report of this survey is included in Appendix I. A total of 57 sheep were observed during the survey, including 20 ewes, 6 lambs, 3 yearling rams, 18 rams with $< \frac{3}{4}$ curl horns, and 10 rams with $> \frac{3}{4}$ curl horns. All of the $> \frac{3}{4}$ curl rams were observed within Hunt Area 6 on CTNF. Observability of sheep was difficult due to the unusually warm weather this year, which caused sheep to move off their high elevation winter ranges early and onto open, south-facing slopes at mid-elevations during the survey. As a result, sheep were widely distributed and difficult to track and observe from the air, which led to a lower count than expected.

Harvest Data

Data from the 2014 harvest survey indicate that 1 hunter harvested a 3.5 year-old ram. The hunter spent 7 days in the field. The relatively young age of this ram is atypical for most rams that hunters select from this population. The non-resident hunter took a medical deferral and plans to hunt in 2015.

Population

This population is thought to be stable at approximately 125 animals.

Management Summary

Two licenses will be available for this herd in 2015 (2 resident hunters) plus 1 non-resident hunter is expected to use a medical carry-over from 2014. No changes are proposed to the 2015 hunt season. This bighorn sheep population is distributed both within GTNP and along its boundary in remote steep terrain making it difficult for hunters to locate and stalk sheep. As a result, harvest levels have remained low and on some years no sheep are harvested. Given the limited number of ram-only licenses available and periodic harvest, hunting is likely not having an impact on this population. Two licenses for any ram will be offered for future hunts until more sheep are observed occupying areas outside GTNP on CTNF lands.

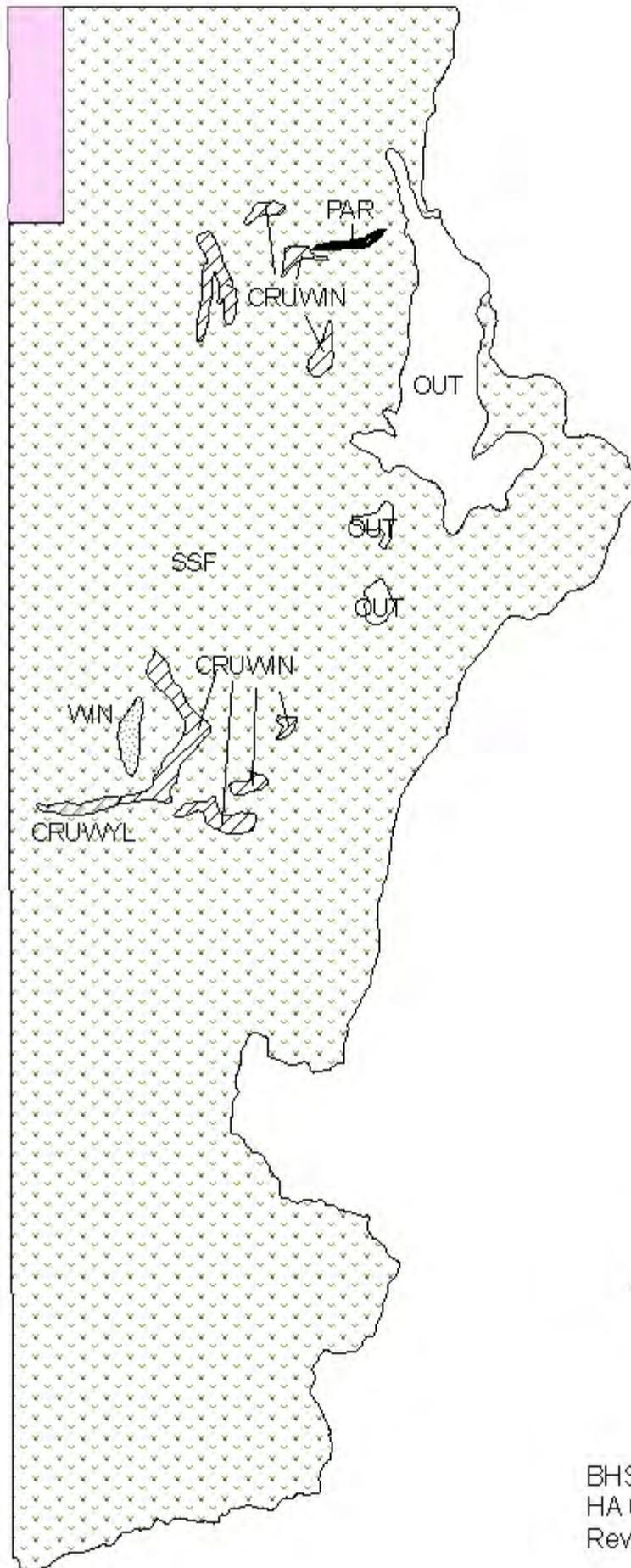
Bibliography

Courtemanch, A.B. 2014. Seasonal habitat selection and impact of winter backcountry recreation on a formerly migratory bighorn sheep population in northwest Wyoming. M.S. Thesis. University of Wyoming, Laramie, WY, USA.

Fitzsimmons, N., S.W. Buskirk, and M.H. Smith. 1995. Population history, genetic variability and horn growth in bighorn sheep. *Conservation Biology* 9:314-323.

Kardos, M.D., S. Dewey, S.J. Amish, J. Stephenson, and G. Luikart. *In prep.* Strong fine-scale population structure of Grand Teton National Park bighorn sheep suggests important role of philopatry in bighorn population subdivision.

Whitfield, M.B. 1983. Bighorn sheep history, distributions and habitat relationships in the Teton Mountain Range, Wyoming. M.S. Thesis. Idaho State University, Pocatello, Idaho, USA.



BHS106 - Targhee
 HA 6
 Revised 9/02

APPENDIX I

2015 Targhee Bighorn Sheep Classification Summary Report

Prepared by: Alyson Courtemanch, Wildlife Biologist, Wyoming Game and Fish Department

A post-season classification flight was flown March 29-30, 2015 in the Targhee Bighorn Sheep Herd (Hunt Area 6 and Grand Teton National Park). The survey took place between 800 and 1400 hours using a Bell helicopter with pilot Dave Savage of Savage Air Services and totaled over 11 hours of flying. Observers included Alyson Courtemanch, Jackson Wildlife Biologist and Kyle Lash, South Jackson Game Warden.



Fig. 1. Three rams observed in Moose Creek in Hunt Area 6 during the 2015 survey.

The purpose of the survey was to obtain post-season classification information on the Targhee Bighorn Sheep Herd. This herd is a core, native sheep herd, but is only surveyed periodically due to budget constraints. The last two surveys have been funded using outside grants, including the Wyoming Wild Sheep Foundation in 2015.

A total of 57 bighorn sheep were classified during the survey (Table 1).

This is lower than the last surveys when 81 sheep (2010) and 96 sheep (2008) were classified. One factor that likely led to the high counts in 2008 and 2010 was the use of radio telemetry to help locate groups containing GPS-collared sheep. However, this option was not available during the 2015 survey because no sheep are currently collared in the population. Also, the unusually warm weather this year caused sheep to move off their high elevation winter ranges early and the majority of sheep were located on open, south-facing slopes at mid-elevations during the survey (Figs. 1, 2, 3). As a result, sheep were widely distributed and difficult to track and observe from the air, which led to a lower count than expected. In fact, aerial counts have varied greatly depending on snow tracking conditions and weather over the years. Counts have ranged from 37-104 sheep from 1988-2015, but managers believe that the population has remained stable over that time around 100-125 sheep. The population is currently estimated to be 125 sheep.

Table 1. Bighorn sheep classification and ratios by location in the Targhee Herd Unit, March 29-30, 2015.

Location	Ewes	Lambs	Rams > ¾ curl	Rams < ¾ curl	Yearling rams	Total	:100 Ewes		
							Lambs	Adult rams	Yearling rams
HA 6	4	2	10	15	2	33			
GTNP	16	4	0	3	1	24			
Total	20	6	10	18	3	57	30	140	15

The lamb:ewe ratio across the surveyed area was 30:100. The mature ram ratio was 140:100 and the yearling ram ratio was 15:100 (Table 1). We observed 10 rams with horns over $\frac{3}{4}$ curl, including 1 full-curl ram, indicating that there are multiple rams in the older age classes available for harvest in the population (Fig. 3). In addition, 10 mountain goats were observed during the flight (8 adults and 2 kids) (Fig. 4).



Fig. 2. High elevation winter ranges in the Targhee Herd Unit. The majority of sheep had moved to mid-elevation transitional ranges by the time of the 2015 survey.

This flight provided important late winter/spring bighorn sheep distribution information for managers. Bighorn sheep were located in several former domestic sheep allotments on the west slope of the Teton Range (Fig. 5), including new areas where bighorn sheep have not been previously observed by WGFD (i.e. lower Conant Creek and Boone Creek) (Figs. 3, 4). Managers believe that these mid-elevation habitats are especially important for this non-migratory herd during late winter and early spring to allow sheep to access nutritious vegetation green-up. Although conditions made it difficult to observe a high number of sheep on the 2015 flight, documenting sheep distribution in transitional habitats was very beneficial.



Fig. 3. Eight rams observed in Conant Creek in Hunt Area 6 during the 2015 survey.

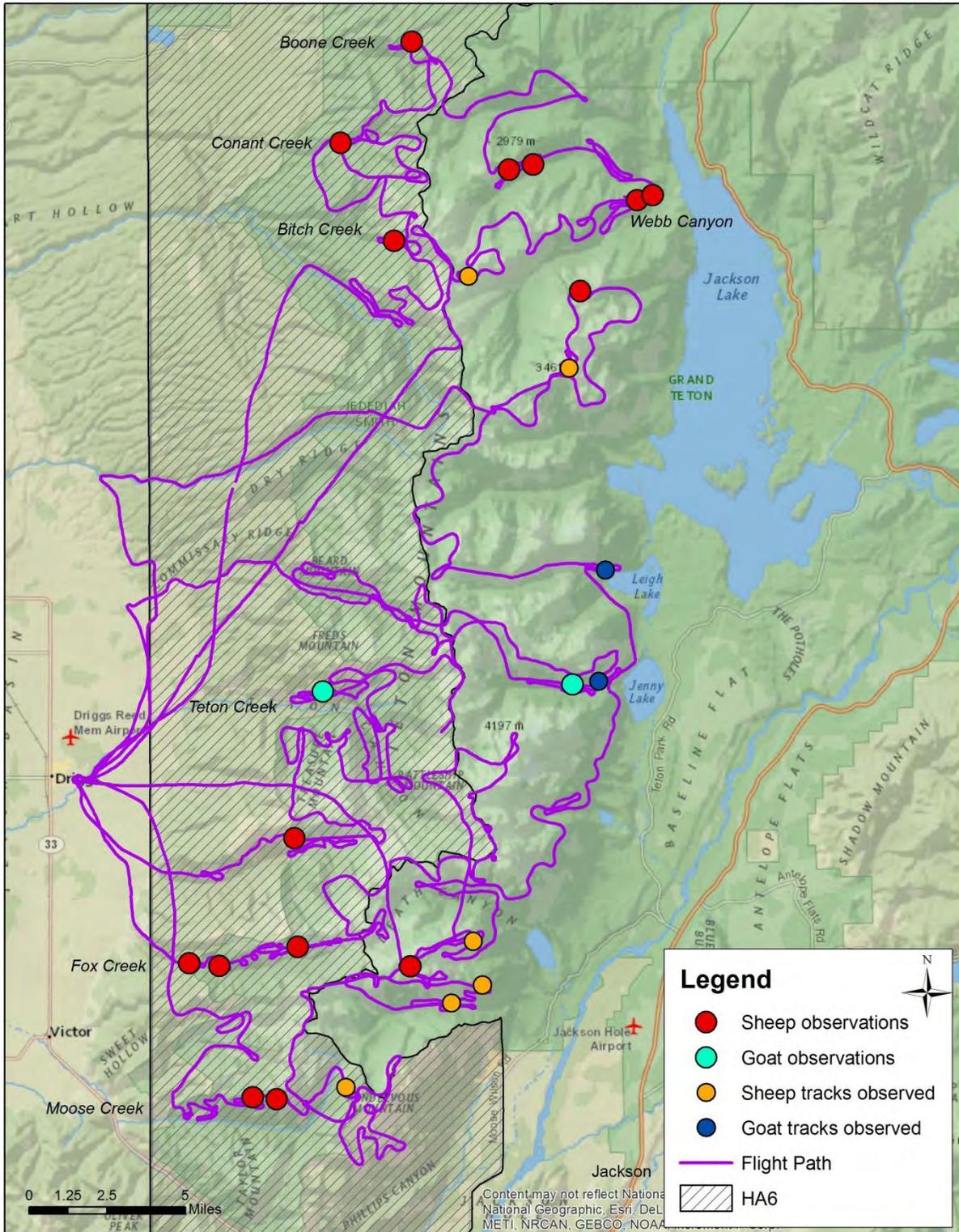


Fig. 4. Locations of bighorn sheep (red), mountain goats (teal), sheep tracks (orange), and mountain goat tracks (dark blue) observations from the 2015 Targhee survey, including the helicopter flight path (purple line). Hunt area 6 (polygon with diagonal lines) is located on the western slope of the Teton Range; the east slope is within Grand Teton National Park.

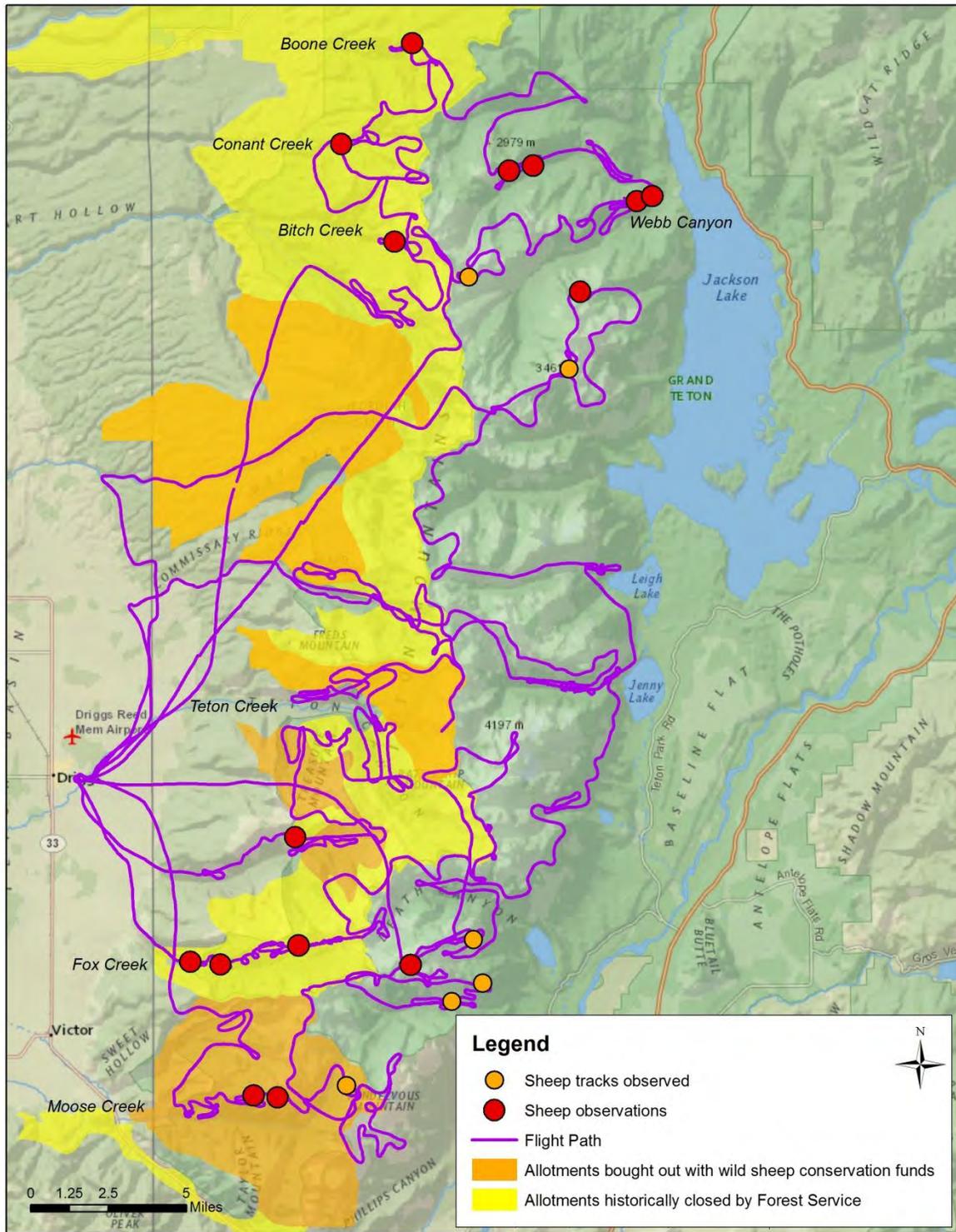


Fig. 5. Locations of bighorn sheep (red dots) and bighorn sheep tracks (orange dots) from the 2015 Targhee survey. Many bighorn sheep were observed utilizing former domestic sheep allotments that were bought out with wild sheep conservation funds (orange shading) or livestock allotments historically closed by the Forest Service (yellow shading).

2014 - JCR Evaluation Form

SPECIES: Bighorn Sheep

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

HERD: BS107 - JACKSON

HUNT AREAS: 7

PREPARED BY: ALYSON
COURTEMANCH

	<u>2009 - 2013 Average</u>	<u>2014</u>	<u>2015 Proposed</u>
Population:	400	400	425
Harvest:	8	8	11
Hunters:	10	9	11
Hunter Success:	80%	89%	100 %
Active Licenses:	10	9	11
Active License Success:	80%	89%	100 %
Recreation Days:	71	67	100
Days Per Animal:	8.9	8.4	9.1
Males per 100 Females	62	54	
Juveniles per 100 Females	33	36	

Population Objective ($\pm 20\%$) : 500 (400 - 600)

Management Strategy: Special

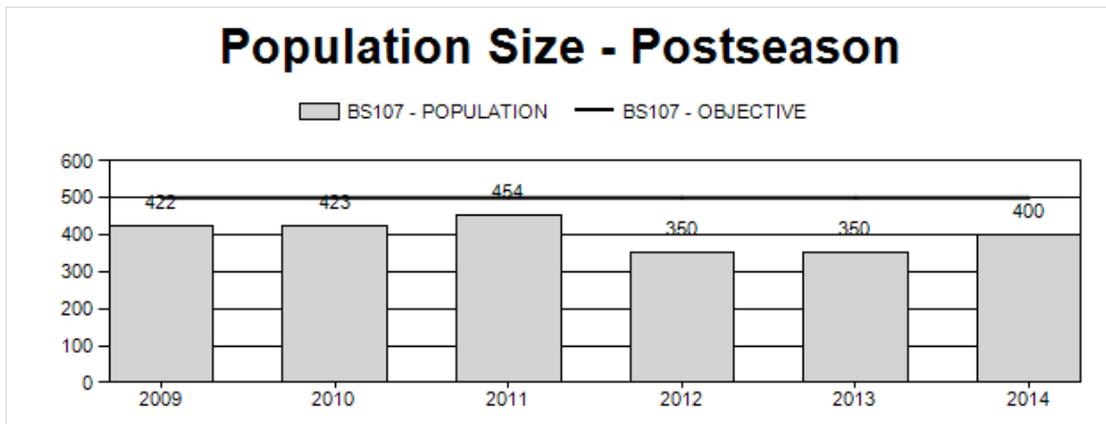
Percent population is above (+) or below (-) objective: -20%

Number of years population has been + or - objective in recent trend: 2

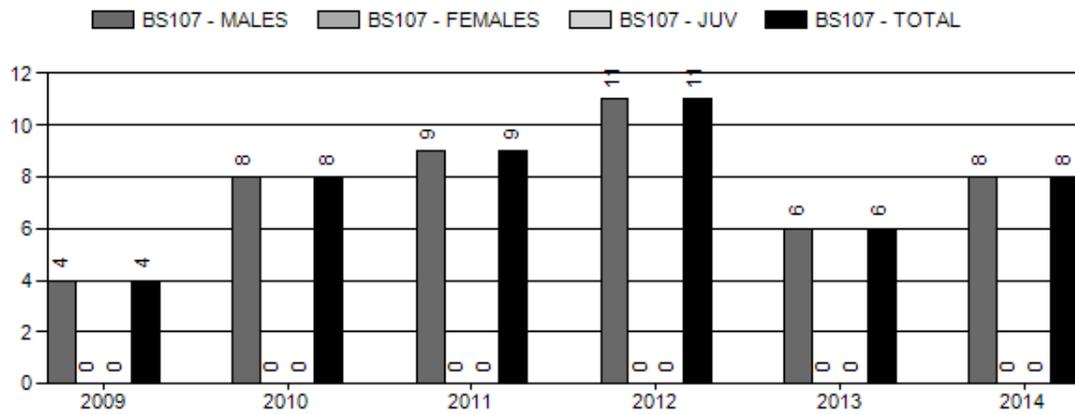
Model Date: None

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

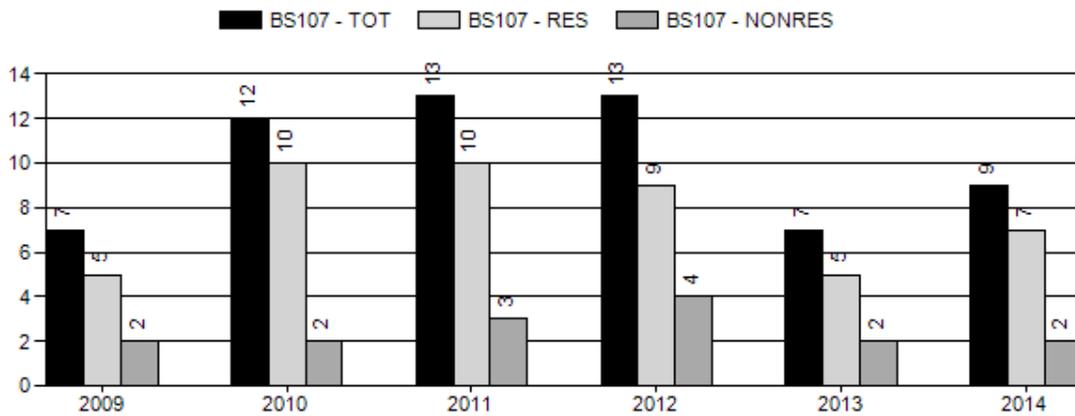
	<u>JCR Year</u>	<u>Proposed</u>
Females ≥ 1 year old:	na%	na%
Males ≥ 1 year old:	na%	na%
Juveniles (< 1 year old):	na%	na%
Total:	na%	na%
Proposed change in post-season population:	na%	na%



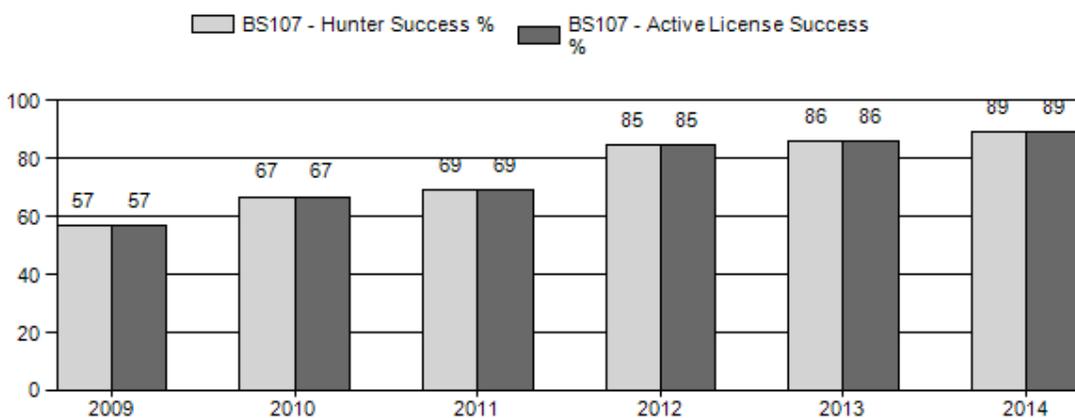
Harvest



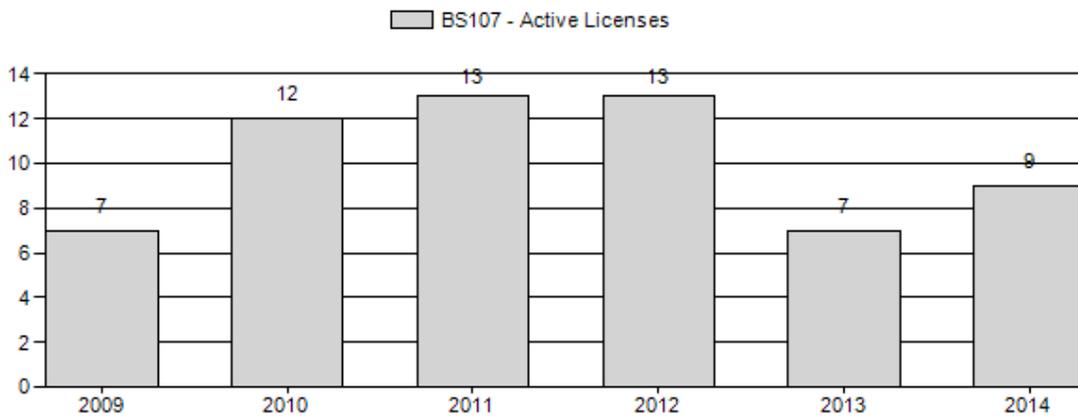
Number of Hunters



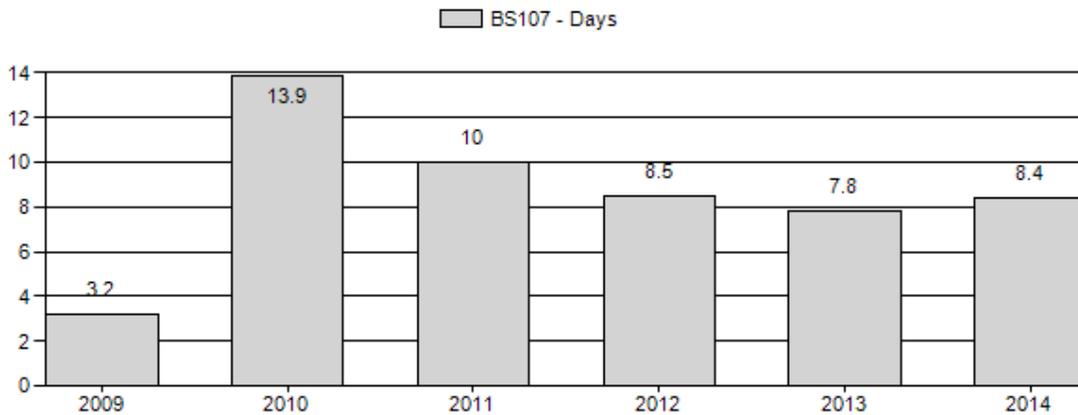
Harvest Success



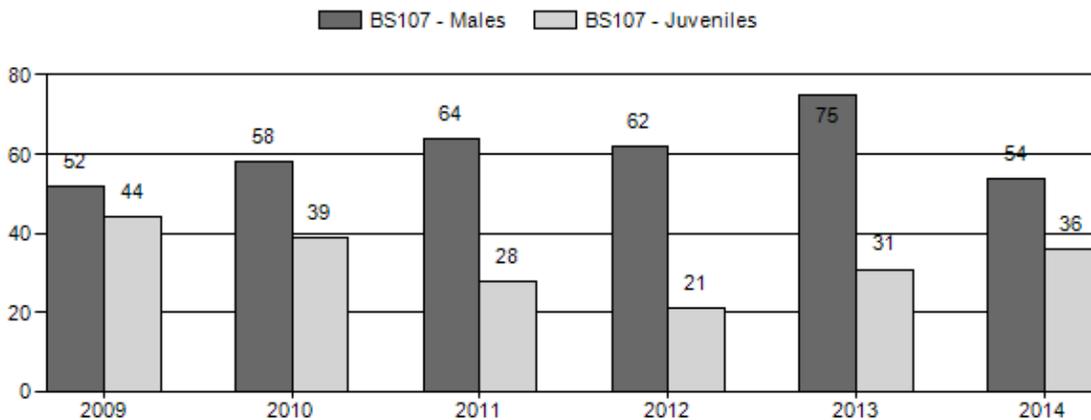
Active Licenses



Days per Animal Harvested



Postseason Animals per 100 Females



2009 - 2014 Postseason Classification Summary

for Bighorn Sheep Herd BS107 - JACKSON

Year	Post Pop	MALES				FEMALES		JUVENILES		Tot Cls	Cls Obj	Males to 100 Females				Young to		
		Ylg	Adult	Total	%	Total	%	Total	%			Yng	Adult	Total	Conf Int	100 Fem	Conf Int	100 Adult
2009	422	33	68	101	27%	194	51%	86	23%	381	312	17	35	52	± 0	44	± 0	29
2010	423	17	71	88	29%	152	51%	59	20%	299	298	11	47	58	± 6	39	± 4	25
2011	454	18	121	139	33%	217	52%	61	15%	417	349	8	56	64	± 3	28	± 1	17
2012	350	17	65	82	34%	133	55%	28	12%	243	256	13	49	62	± 6	21	± 3	13
2013	350	14	84	98	37%	130	49%	40	15%	268	292	11	65	75	± 6	31	± 3	18
2014	400	10	84	94	28%	173	52%	63	19%	330	285	6	49	54	± 4	36	± 3	24

2015 HUNTING SEASONS JACKSON BIGHORN SHEEP HERD (BS107)

Hunt Area	Type	Season Dates		Quota	License	Limitations
		Opens	Closes			
7	1	Sep. 1	Oct. 31	11	Limited quota	Any bighorn sheep (8 residents, 3 non-residents)

Special Archery Seasons

Hunt Area	Season Dates	
	Opens	Closes
7	Aug. 15	Aug. 31

Summary of 2015 License Changes

Area	Type	Quota change from 2014	Other changes from 2014
7	1	+3	+3 licenses will be 2 resident, 1 non-resident

Management Evaluation

Current Postseason Population Management Objective: 500

Management Strategy: Special

2014 Postseason Population Estimate: ~400

2015 Proposed Postseason Population Estimate: ~425

The management objective for the Jackson bighorn sheep herd unit is 500 sheep. Spreadsheet models developed for this herd do not appear to adequately simulate observed trends and therefore managers will develop a proposal using the mid-winter trend count as a benchmark for this population for public review in 2015. The population is currently estimated to be within 20% of the population objective of 500 sheep.

Herd Unit Issues

This population is approximately 20% below the postseason management objective of 500 sheep. This population likely experienced a pneumonia related die-off in 2002 and again in 2012. An estimated 30% of the population died during the latest pneumonia event. However, lamb survival rebounded within a couple of years after both outbreaks, leading to relatively quick herd recoveries. If the current trajectory continues, the population should reach objective again within 2-3 years. From 2011–2014, over 30 bighorn sheep were radio-collared to monitor disease, herd demographics, and migration patterns (see Appendices I and II). There has also been an effort to survey for respiratory pathogens in the herd as a result of the pneumonia outbreak and to date, approximately 38 bighorn sheep have been sampled.

Weather

Summer and fall 2014 produced consistent moisture, leading to good forage production. Sheep migrated relatively late in the fall due to warm temperatures and late snowfall. The Snake River Basin received above-average snowfall in December and early January, but weather turned warm and dry by February. Many low elevation slopes were snow-free by mid-February, but snow remained deep and heavy with a hard crust on north-facing slopes and higher elevations. At the time of the mid-winter survey, winter precipitation was reported at 91% of normal. Please refer to the following web sites for specific weather station data.

<http://www.wrds.uwyo.edu/wrds/nrcs/snowprec/snowprec.html> and
<http://www.ncdc.noaa.gov/oa/climate/research/prelim/drought/pdiimage.html>

Habitat

The Wyoming Game and Fish Department (WGFD) and Bridger-Teton National Forest (BTNF) initiated a project in 2012 to evaluate the short-term and long-term nutritional changes in bighorn sheep forage after wildfire. This project will track the nutritional content over 10 years of key forage species that burned at different fire severities during the Red Rock Fire in the Gros Ventre. Other than this project, there are no established vegetation transects in this herd unit.

The Bryan Flats Habitat Enhancement and Fuels Reduction Project is scheduled for implementation in fall 2015. This prescribed burn project is led by BTNF and will improve bighorn sheep habitat in the Hoback Canyon area. Please refer to the 2014 Annual Report Strategic Habitat Plan Accomplishments for Jackson Region habitat improvement project summaries (<https://wgfd.wyo.gov/web2011/wildlife-1000708.aspx>).

Field Data

In the Gros Ventre drainage, approximately 30% of radio-collared bighorn ewes died during a pneumonia outbreak in 2012 and lamb ratios declined from a high of 50 lambs:100 ewes in late June 2012 to 15:100 by February 2013. Carcasses retrieved during the summer indicated that sheep likely died from pneumonia. Additional sampling of live sheep during and after the outbreak indicates that Jackson sheep carry *Mycoplasma ovipneumoniae*, leukotoxin-positive *Mannheimia spp.*, and leukotoxin-positive *Bibersteinia spp.* Sampling in 2014 and 2015 did not isolate leukotoxin-positive *Mannheimia haemolytica* in the Jackson Herd (see Appendix II). Additional research is planned for 2015-2017 to track respiratory pathogens, seasonal body condition, pregnancy, and lamb recruitment of individual ewes over time in collaboration with WGFV Vet Services and Wyoming Cooperative Fish and Wildlife Research Unit.

In February 2015, classification surveys were flown over low elevation winter ranges and some high elevation ranges in the Curtis Canyon, Flat Creek, Crystal Creek, and Gros Ventre River areas. High elevation ranges were not surveyed thoroughly this year. Bighorn sheep on Miller Butte and Camp Creek were classified from the ground. The overall trend in sheep numbers increased from last year's survey of the same areas. A total of 330 sheep were observed including 173 females, 63 lambs, 84 adult males and 10 yearling males. This is 62 more sheep than were observed for 2013. Herd unit ratios in 2014 were 36 lambs:100 ewes, 49 adult rams:100 ewes and 6 yearling rams:100 ewes. The lamb ratio is higher than last year's ratio of 31:100, and a ratio of 21:100 in 2012, which suggests that the population is recovering from the pneumonia outbreak.

Harvest Data

Data from the 2014 harvest survey indicate that 9 hunters harvested 8 rams (89% success). One hunter took a medical deferral in 2013 and hunted in 2014. The median age of harvested rams in 2014 was 7.5 years, similar to 2013 at 8.5 years. The number of licenses was reduced for the 2013 season from 13 to 8 in response to the pneumonia outbreak. Based on classification surveys and the number of rams observed in February 2015 (n=94), ram harvest has not affected the ability of the population to recover from the pneumonia outbreak. Ram ratios remain high. Given the recent trend of population recovery, managers are increasing licenses to 11 for 2015. Licenses will be distributed to 8 residents and 3 non-residents.

Population

This population is estimated to be approximately 20% below the postseason management objective based on aerial surveys for 2014. Spreadsheet models developed for this herd do not appear to adequately simulate observed trends and therefore managers will develop a proposal using a mid-winter trend count as a benchmark for this population in 2015. Past trends seem to indicate that pneumonia outbreaks occur when the population reaches 500-600 animals. Currently, the population is increasing due to relatively high lamb:ewe ratios and may approach the 500 objective within 2-3 years. Therefore, the public and managers should expect another pneumonia outbreak potentially to occur in 2-5 years.

Management Summary

Trend data indicate that the Jackson Bighorn Sheep Herd is recovering relatively quickly from a pneumonia outbreak in 2012. Overall numbers have increased in the past 2 years and lamb:ewe ratios continue to improve. Based on past history, pneumonia outbreaks seem to occur when the population reaches 500-600 animals. Therefore, another outbreak should be expected within 2-5 years. Due to the increasing population and availability of rams, managers are increasing licenses from 8 to 11 for 2015. Licenses will be distributed to 8 residents and 3 non-residents. Although this level of ram harvest is not expected to affect population increase, it will provide hunters with harvest opportunities before another pneumonia outbreak occurs. The WGFD plans to continue to monitor the population using radio-collars, disease sampling, and body condition measurements in 2015-2017 to learn more about the interaction of respiratory pathogens, body condition, and population density in causing pneumonia outbreaks.

References

Honess, R.F. and N.M. Frost. 1942. A Wyoming bighorn sheep study. Wyoming Game and Fish Department Bulletin No. 1, 127 pp.

APPENDIX I

2014 Jackson Bighorn Sheep Monitoring Annual Report Chapter 33 Permit #798

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Project Background

The Jackson bighorn sheep herd experienced a die-off during 2001-2002 in which approximately 50% of the population died. However, bighorn sheep numbers rebounded to within 10% of the population objective (500 animals) by 2010. During 2010, two male lambs were removed from Russold Hill in early March after it was observed that some of the animals wintering on Russold Hill were exhibiting signs of pneumonia (e.g. coughing, runny nose etc.). Both lambs had minor cases of pneumonia (~15% of the lungs affected), but otherwise were in good health with moderate fat stores. Over the next couple of years, an effort was made to capture and radio-collar bighorn sheep on winter ranges north of Jackson and in the Camp Creek area to track survival and movements. In 2011 and 2012, approximately 30% of radio-collared sheep died, with several confirmed pneumonia cases. Population classifications also showed an overall 30% decline in the herd, likely due to another pneumonia outbreak. Efforts have continued to maintain a sample of collared sheep to track survival and movements. Sheep have also been tested for bacterial pathogens during the past two years as part of the Statewide Bighorn Sheep Disease Surveillance Program.

Results

During 2014, 8 additional ewes were captured and fitted with GPS collars using both helicopter netgunning and ground darting. Six ewes were captured in the Curtis Canyon and Flat Creek winter ranges using a helicopter and two were darted near Camp Creek (Table 1). Animals were fitted with a GPS collar, which is programmed to drop off after 2 years, and VHF micro collars. This approach will enable two tiers of data collection; GPS collars will provide fine-scale movement data while VHF collars allow us to track survival over the longer term. These captures were part of the Statewide Disease Surveillance Program under Chapter 33 Permit #854. Additional details regarding capture locations and disease testing results can be found in that permit's 2014 report.

Table 1. Bighorn sheep capture and GPS-collaring details for 2014.

Sheep ID	Capture Date	Est Age	Age Class	Sex
150.211	1/26/2014	3	Adult	F
150.410	1/26/2014	4	Adult	F
150.530	1/26/2014	4+	Adult	F
150.560	1/26/2014	3	Adult	F
150.662	1/26/2014	4-5	Adult	F
150.754	1/26/2014	5	Adult	F
150.763	1/26/2014	2	Adult	F
150.783	1/26/2014	3	Adult	F

Data from radio collars recovered during 2012-2014 were shared with the Greater Yellowstone Area Mountain Ungulate Project at Montana State University. This research is a collaborative initiative to study the ecology and population dynamics of bighorn sheep and mountain goats throughout the Yellowstone ecosystem (<http://www.mtbighorninitiative.com/gyamup-home.html>). Data were also shared with the Wyoming Migration Initiative at the University of Wyoming.

Three GPS collars detached on scheduled and were retrieved in spring 2014, from sheep IDs 743, 893, and 630. VHF micro collars remain on these sheep to track survival. Several other GPS collars detached in spring 2014, but had been damaged (likely by the double collaring) and were no longer transmitting signals. Therefore, these were not retrieved.

One GPS-collared bighorn sheep was detected on mortality on the November 2014 flight, but we were unable to recover the GPS collar due to winter conditions and mountainous terrain. The collar will be retrieved in spring 2015. Four other sheep with micro collars were not heard or observed during 2014 (Table 2).

There were two telemetry flights conducted in 2014 to monitor collared bighorn sheep, one in January and one in November (Figure 1, Table 3).

Due to the damage to GPS collars we have observed over the past several years and subsequent loss of data due to double-collaring, we will likely move away from the double-collaring approach in future years.

During 2015, captures are proposed to continue disease sampling and also gain information on nutritional condition.

Table 2. Bighorn sheep collar frequencies in the Jackson herd, 2014.

Sheep ID	GPS collar frequ	Micro VHF collar frequ	Visibility tags	Capture Date	Last heard/sighted
211		150.263			Jan. 2015
653		150.352			Jan. 2015
684		150.482			Jan. 2015
743		150.493	Yellow #26	4/11/2013	Jan. 2015
893		150.540		12/10/2012	unknown
390	150.390	150.390	blue 7B		unknown
500	150.500	150.500	green 2B		unknown
630		150.630	white/yellow 6B		Nov. 2015
410	150.160	150.160	purple 1B	3/5/2013	Jan. 2015
219	219.010				unknown
218		218.160		5/8/2012	Nov. 2015
218_2		150.464	Yellow #27	4/17/2013	Nov. 2015
110	149.110		Yellow #28	5/1/2013	Jan. 2015
755	150.754	150.754	Yellow #5 (L), #6 R	1/26/2014	Nov. 2015
530	150.530	150.530	Yellow #2 (L), #1 R	1/26/2014	Jan. 2015
562	150.560	150.560	Yellow #5 (8), #67 R	1/26/2014	Mort. detected Nov. 2015
411	150.410	150.410	Yellow #4 (L), #3 R	1/26/2014	Nov. 2015
662	150.662	150.662	Yellow #10 (L), #9 R	1/26/2014	Nov. 2015
212	150.211	150.211	Yellow #12 (L), #11 R	1/26/2014	Nov. 2015
763	150.763	150.763	Yellow #15 R	1/26/2014	Nov. 2015
783	150.783	150.783	Yellow #14 R	1/26/2014	Nov. 2015

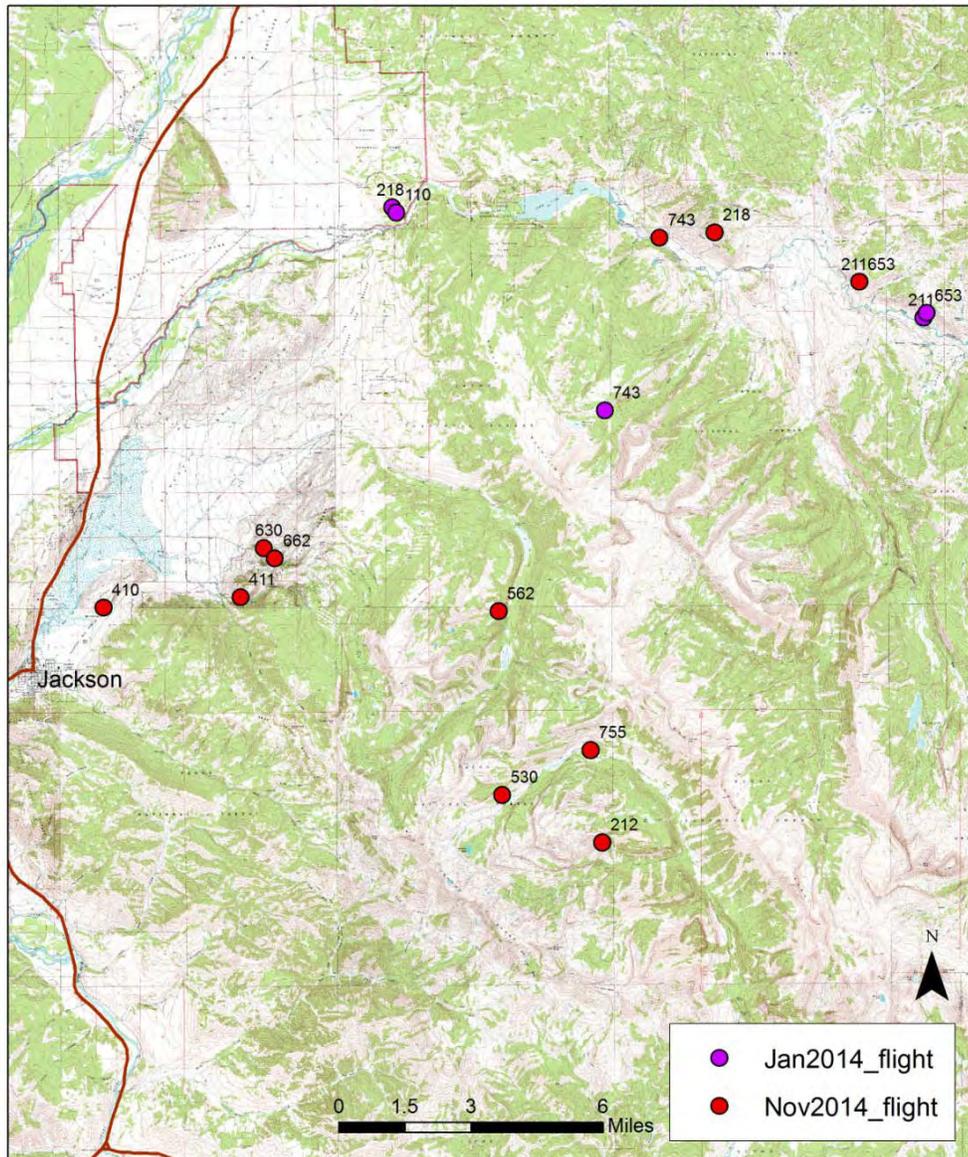


Figure 1. Collared bighorn sheep locations from telemetry flights, 2014.

Table 3. Locations of GPS-collared sheep located on January and November 2014 telemetry flights.

Date	UTMX	UTMY	SheepID	Notes
1/25/2014	551745.70	4827031.10	211	Telemetry flight
1/25/2014	551861.70	4827202.00	653	Telemetry flight
1/25/2014	540091.40	4823627.40	743	Telemetry flight
1/25/2014	532325.40	4831076.10	218	Telemetry flight
1/25/2014	532465.20	4830889.20	110	Telemetry flight
11/20/2014	549402.08	4828345.69	211	Telemetry flight
11/20/2014	549402.08	4828345.69	653	Telemetry flight
11/20/2014	542095.93	4829972.15	743	Telemetry flight
11/20/2014	527627.66	4818577.41	630	Telemetry flight
11/20/2014	521760.57	4816392.77	410	Telemetry flight
11/20/2014	544102.82	4830163.61	218	Telemetry flight
11/20/2014	539576.55	4811175.31	755	Telemetry flight
11/20/2014	536347.57	4809527.21	530	Telemetry flight
11/20/2014	536216.44	4816261.82	562	Telemetry flight
11/20/2014	526770.32	4816779.50	411	Telemetry flight
11/20/2014	528021.41	4818204.29	662	Telemetry flight
11/20/2014	539994.19	4807783.71	212	Telemetry flight

Wyoming Game and Fish Department 2014 Respiratory Disease Surveillance in Bighorn Sheep and Mountain Goats

Methods:

The Wyoming Game and Fish Department's Wildlife Disease Laboratory monitored nine bighorn sheep herds and two mountain goat herds for respiratory pathogens in 2014. Target herds were selected for surveillance based on accessibility, health status (e.g. significant changes in lamb recruitment, high death loss, etc.), or the likelihood of serving as a potential source herd for future reintroductions. Animals were captured by helicopter net-gunning, drop net, or immobilization drugs. Opportunistic sampling of road-killed animals was also utilized. Numerous samples were collected from each animal including nasal, tonsil, and ear swabs, feces, and blood.

To ensure accurate detection of bacterial pathogens associated with respiratory disease, several measures were adopted for sample collection in the field. One of the primary steps was inoculation of a Columbia Blood Agar (CBA) or Columbia Selective Agar culture plate immediately after sampling the tonsillar crypts. Culture plates were placed into a 37°C mobile incubator as soon as possible to ensure bacterial survival. An additional tonsil swab was collected and placed into preservation media (Port-A-Cul) for inoculation of an additional culture plate that evening once the day's captures had ended (within 8 hours of collection). Culture plates were examined every 24 hours; suspect isolates were subcultured and purified. Initial tonsil culture plates were washed with phosphate buffered saline after 48 hours of incubation for polymerase chain reaction (PCR) analysis. Purified isolates were preserved for later identification and characterization.

Once field samples and cultures arrived in the laboratory, analysis included further bacterial culture and identification utilizing classical microbiological techniques and PCR. Plate washes were analyzed with PCR for the detection of undiscovered isolates as well as for the presence of the genes responsible for leukotoxin production. Mycoplasma cultures from nasal swabs were enriched in Modified Tryptone Soya Broth, plated on CBA and analyzed with PCR. Fecal samples were submitted to the Wyoming State Veterinary Laboratory (WSVL) for parasitological analysis. Serum samples were submitted to the WSVL for serological testing for past exposure to respiratory viruses. Serum was also banked for future testing as needed.

Results:

A total of 120 sheep were sampled from nine bighorn sheep herd units in 2014: The Clark's Fork (hunt area (HA) 1), Trout's Peak (HA2), Wapiti Ridge (HA 3), Franc's Peak (HA 5), Jackson (HA 7), Whiskey Mountain (HA 8-10, 23), Devil's Canyon (HA 12), Laramie Peak (HA 19), and the Elk Mountain herd in the Black Hills (HA 20). Thirteen mountain goats were sampled from two herd units; the Beartooth (HA 1,3) and the Palisades (HA 2).

Known or suspected bacterial respiratory pathogens were recovered from each of the herd units. The Trout's Peak, Wapiti Ridge, Franc's Peak, and Whiskey Mountain herds were found to be infected with the full range of pathogens: *Mannheimia haemolytica*, *Mannheimia* spp (*M. rumenalis* or *M. glucosida*), *Bibersteinia trehalosi* with leukotoxin, and *Mycoplasma ovipneumoniae*, whereas the Clark's Fork herd to the north had only *B. trehalosi* with

leukotoxin, and *M. ovipneumoniae*. The Jackson herd was found to carry all of the pathogens with the exception of *M. haemolytica*, but the Devil's Canyon and Elk Mountain herds have all pathogens but are lacking *M. ovipneumoniae*. The final bighorn sheep herd was Laramie Peak and only *M. ovipneumoniae* was isolated. The sample size for this herd was limited to three animals so caution should be exercised when comparing this herd to the other populations.

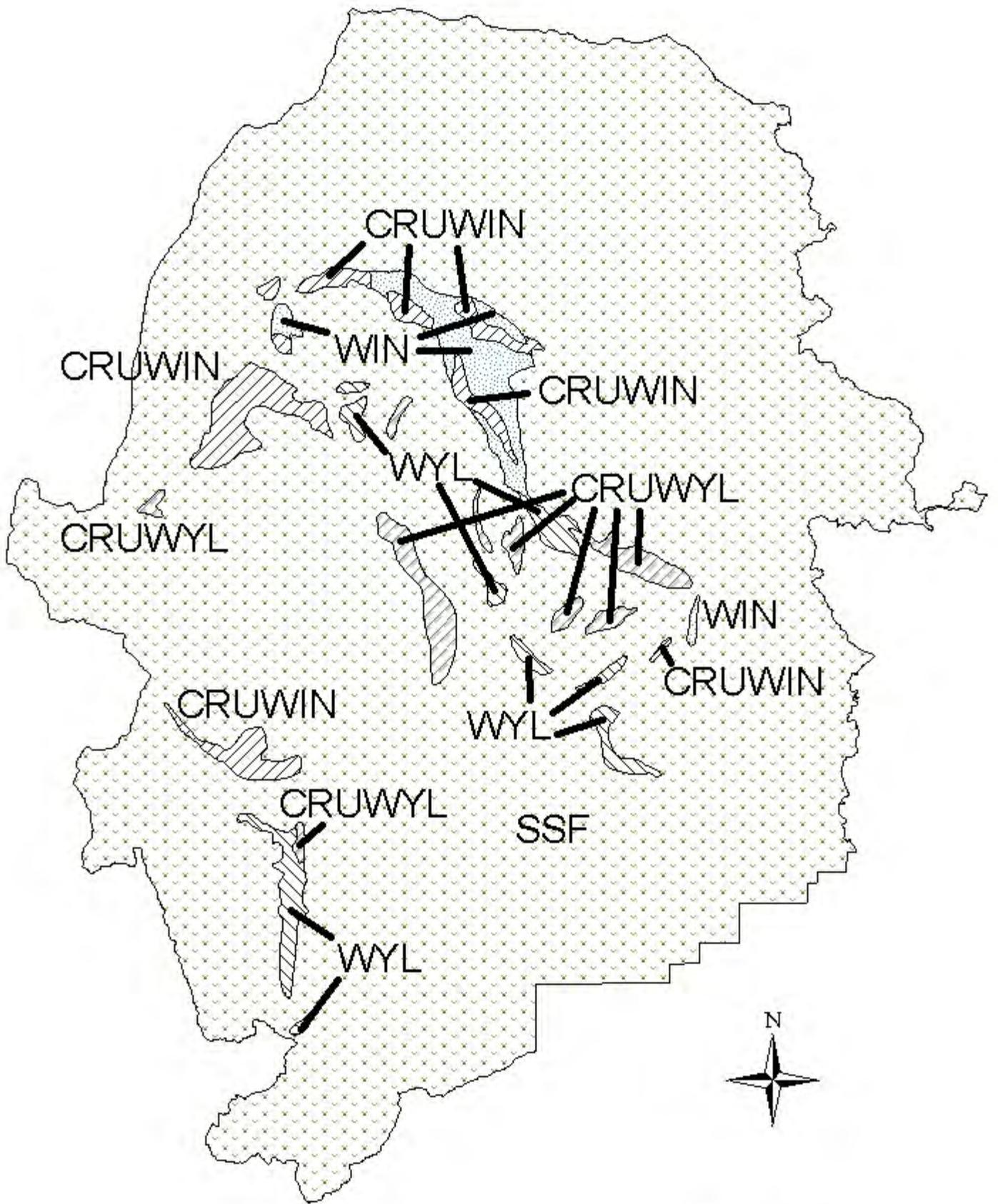
Mountain goats from both units were found to host all pathogens listed above. The Trout's Peak bighorn sheep herd and the southern population of the Beartooth mountain goat herd unit share the same pathogens. In contrast, both the Clark's Fork sheep and the northern Beartooth herd as well as the Palisades goats and the Jackson sheep share all pathogens but *M. haemolytica*, which is carried by both goat populations.

Lungworm larvae (*Protostrongylus sp*) were isolated from numerous fecal samples, but most worm burdens were considered low to moderate. All herds demonstrated minimal exposure to the respiratory viruses IBR, BRSV and OPP/CAE. Moderate titers were observed to PI3, but this is considered inconsequential.

Discussion:

The Wildlife Disease Laboratory has made bighorn sheep diagnostics a priority over the past two years. This has resulted in a significant improvement in both the isolation and identification of bacterial pathogens. With increased diagnostic capability has come the surprising discovery of several bacterial respiratory pathogens in all bighorn and mountain goat herds across the state. All of these organisms have been implicated in numerous die-offs in bighorn sheep populations across the west, and yet Wyoming has several herds that are thriving in their presence. Because these organisms were recovered from healthy animals, these are likely biotypes that are not highly pathogenic, but their occurrence does pose many questions. Research at our Sybille facility over the next two years is designed to answer the pathogenicity question by observing naturally infected adults and lambs over several weeks. This research should shed some light on which organisms are of concern and which can be considered normal flora. Diagnostic assays may need to be developed to accurately identify pathogenic biotypes.

Future surveillance efforts in free ranging herds will complement the Sybille research by concentrating on mapping respiratory pathogens across the state and comparing their occurrence with overall herd health. Verbal cooperative agreements have been established with Montana and Colorado wildlife health officials to perform the same analysis in their states in order to better understand what effect some pathogens have on bighorn sheep and mountain goat herds across the tri-state region.



BHS107 - Jackson
 HA 7
 Revised 9/02

