Elk Mountain Bighorn Sheep Project

Weston County, Wyoming

Performed by: Weston County Predator Management Board, Wyoming Game and Fish, Wildlife Services

Funded by: ADMB of Wyoming

2011-2012 Elk Mountain Bighorn Sheep Predator Project

Project Overview:

In 2001, 20 bighorn sheep (3 rams, 11 ewes, & 6 lambs) were reintroduced on the South Dakota side of Elk Mountain by the South Dakota Game, Fish and Parks (SDGF&P) from their Spring Creek herd. Since then, this herd has established itself along the WY/SD state line. In 2005, an additional 7 ewes from Wheeler Peak, New Mexico, were added to the herd by SDGF&P to enhance genetic diversity. Over time, this herd has established itself into several small "sub-herds" in Wyoming and South Dakota. The largest group of bighorns, which is compromised primarily of ewes, lambs, and young rams, resides almost exclusively in Wyoming.

In Wyoming, the sheep reside on Elk Mountain, which is located south east of Newcastle, WY. The project area consists approximately 41,000 acres in size and is known for its rocky landscape, deep canyons, and bighorn sheep. Land ownership in this areas is composed of seventy one percent (71%) private, twenty five percent (25%) federal (either BLM or USFS), and ten percent (4%) Office of State Lands and Investments.

Collars were put on several rams and ewes in this bighorn sheep herd the winter of 2009. These collars dropped off January 2010 providing a year's worth of habitat use and sheep distribution. Using this data, several critical lambing areas and wintering areas were identified within the project area. During the lambing season, 75% of the collared sheep stayed on 388 acres and 50% of the collared sheep stayed on 88 acres. With the bighorn sheep concentrating on such small areas during the lambing season, they could potentially be more susceptible to coyote predation.

Coyote control work will be focused in these areas prior to lambing and if deemed necessary during the critical winter months. It is anticipated that 15 "ground" days would be sufficient to identify coyote denning areas and place and check control equipment. Wildlife Service's estimates twenty five (25) hours of fixed wing aircraft time and at least twelve (12) hours of helicopter time will be necessary to conduct needed control work and achieve measurable success.

Stomach contents from those coyotes killed will be examined to estimate prey preference in the project area. All coyotes killed during this project will be field aged to estimate age composition of the local coyote population.

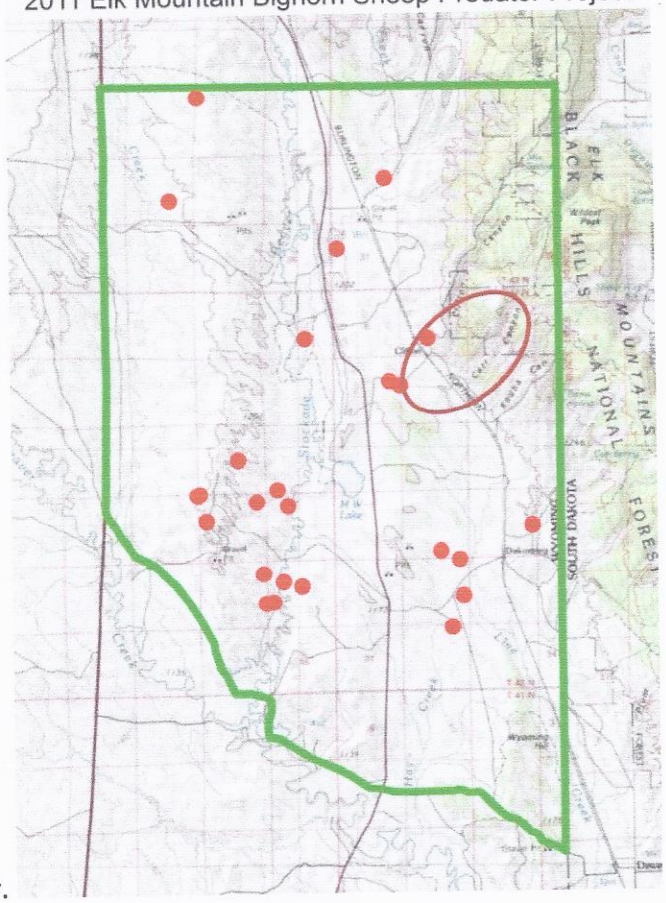
This project will help wildlife managers understand predator/prey relationships on small isolated bighorn sheep populations. It will help to identify if the Elk Mountain bighorn sheep herd is experiencing predation to lamb survival.

2011 Project Summary:

Wildlife Service's personnel focused their effort in the project area from February 2011 through November 2011. Wildlife Service's personnel conducted six aerial flights using fixed-wing aircraft during this time. The duration of the flights spent working in the project area varied from 2.5 - 4.5 hours, averaging 3.8 hours per flight. The total amount of fixed-wing aircraft flight time for 2011 was 22.7 hours and based on a $150/hr rate, approximately $3,405.00 was spent. The helicopter was not utilized in 2011 due to scheduling and weather related issues. Wildlife Service's personnel used a total of 43.5 man hours to remove thirty-five coyotes from the project area in 2011 by various control methods, including aerial control, den removal methods,

predator calling, snares, and setting M-44's. The average age of the coyotes taken in the first yeas was 2.4yrs old. The 2011 post season lamb:ewe ratio was 59:100, the data was collected from November 2011 through February 2012. The 2010 post season (before project) lamb:ewe ratio was 40:100, while this data was collected from December 2010 through January 2011. Due to the small population size of the bighorn sheep herd and relative small sample size the lamb:ewe ratio will vary from year to year. Each coyote location is represented by a red dot, the bighorn sheep lambing area is circled in red, and the green border makes up the project area boundary.

2011 Elk Mountain Bighorn Sheep Predator Project



2011 Coyote Locations

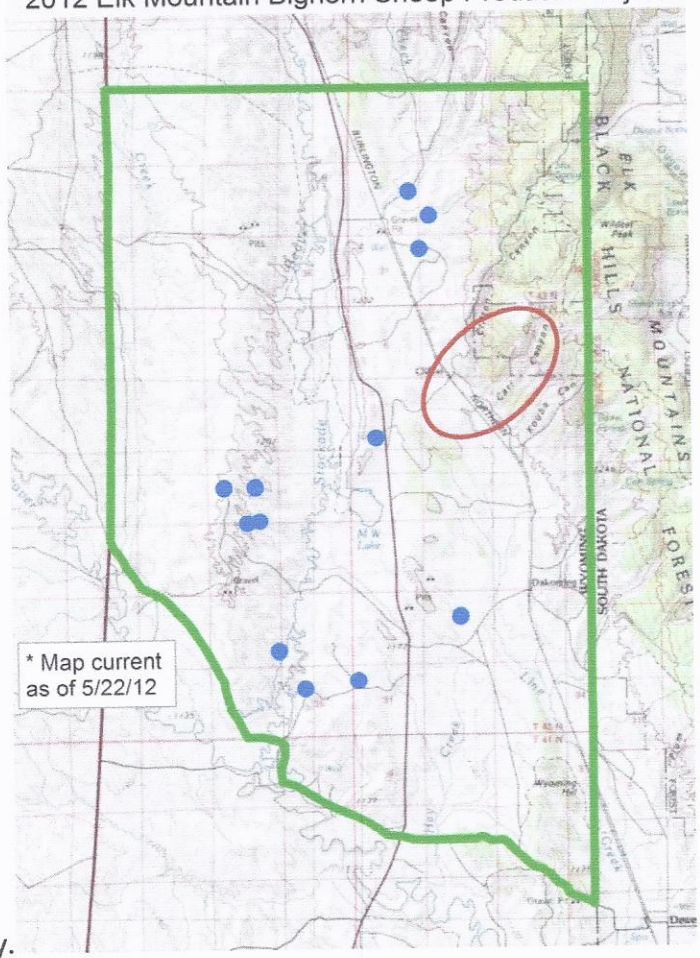
2011 Coyote Data

2012 Project Summary (as of 8/30/2012):

Wildlife Service's personnel focused their effort in the project area beginning in early February 2012. Wildlife Service's personnel conducted three aerial flights using fixed-wing aircraft as of 8/30/12. The duration of the flights spent working in the project area varied from .7 - 4 hours, averaging 2.9 hours per flight. The total amount of fixed-wing aircraft flight time for 2012 (as of 8/30/12) was 8.7 hours and based on a $150/hr rate, approximately $1,305 was spent. The helicopter was not utilized in 2012 due to scheduling and weather related issues. As of 8/30/12,

Wildlife Service's personnel used a total of 61 man hours to remove thirteen coyotes from the project area by various control methods, including aerial control, predator calling, snares, and setting M-44's. The average age of the coyotes taken in the second year was 2.3yrs old. Each coyote location is represented by a blue dot, the bighorn sheep lambing area is circled in red, and the green border makes up the project area boundary.

2012 Elk Mountain Bighorn Sheep Predator Project

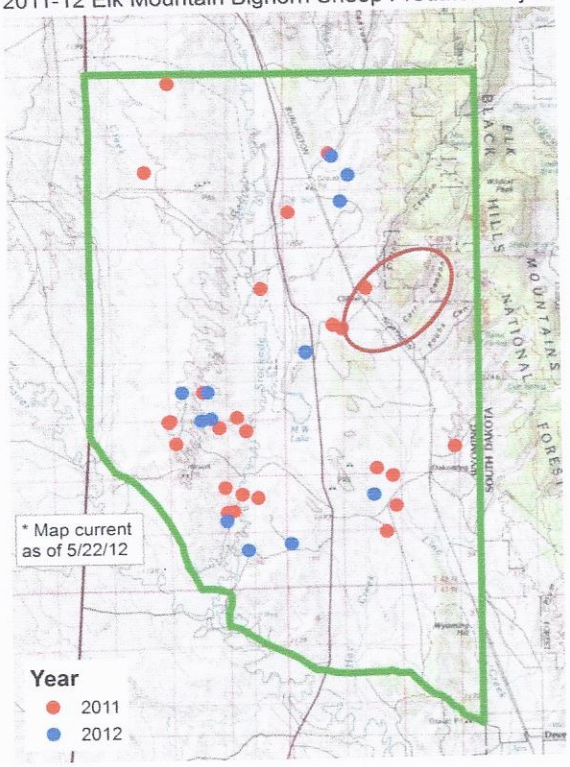


2012 Coyote Locations

Two year total

Below is the total for the first two years of the project. 2011 coyote locations are in red and 2012 coyote locations are overlapped in blue. The Bighorn Sheep lambing area is circled in red and the project area boundary is outlined in green.

2011-12 Elk Mountain Bighorn Sheep Predator Project



Conclusion

The first two years of the project are online with project goals to date. Wildlife Services personnel have removed a total of 43 adult coyotes and two coyote dens in the project area using all the methods available. Coyote densities were considerably lower the second year of the project after the timely removal of adults in the first year of the project. Some of the test results on the coyotes have been returned and yielded one coyote testing positive for plague that was removed from the project area. The average age of the coyotes did decrease slightly although the smaller sample size of year two could skew the numbers and actual age difference slightly. There has been some new GPS collars put on sheep in the herd so we should have new information on the herds dynamics. There has been some documented depredation by Mountain Lion on at least one lamb and one ewe that were collared. Stomach analysis on the coyotes removed has shown Antelope, Rodent, Rabbit, Deer, Prairie dog. We would like to thank everyone that has helped with the funding as well as work on the ground to help the first two years of this project go so smoothly.

WYOMING GAME AND FISH DEPARTMENT

5400 Bishop Blvd. Cheyenne, WY 82006

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7 June 2012

Co-Chairman Jason Fearneyhough and Co-Chairman Scott Talbott
Wyoming Animal Damage Management Board
2219 Carey Avenue
Cheyenne, Wyoming 82002

Dear Co-Chairmen Fearneyhough and Talbott,

The intent of this letter is to provide the Wyoming Animal Damage Management Board (ADMB) with an update for the "***Identification of mule deer seasonal ranges to maximize predator control benefits in the Platte Valley herd unit,***" project. This project is part of a multi-facetted mule deer research project which began in July of 2010. The research is being conducted in joint by Wyoming Game and Fish Department (WGFD), and the University of Wyoming's Cooperative Fish and Wildlife Research Unit. The primary funding source for this research is the Wyoming Game and Fish Department. During fiscal year 2011, ADMB granted $22,000, towards capture and GPS radio-collaring of mule deer for this project to delineate seasonal ranges in order to maximize any future predator control benefit.

In January of 2011, 70 mule deer were captured in the Platte Valley mule deer herd unit using a helicopter/net-gun capture technique. Each mule deer was fitted with a radio-collar (GPS collars on 50 does, VHF collars on 15 bucks and 5 does) and subsequently released. The 50 GPS radio-collars will record doe locations at 2 hour intervals until April of 2013, when the collars are programmed to drop off for collection. The data collected from the GPS radio-collars will allow managers to identify specific areas, and habitat types, selected by the does for fawning in the Platte Valley herd unit.

The radio-collared mule deer have also been invaluable in evaluating a mule deer abundance estimation technique known as the sightability survey. Sightability surveys have now been conducted 3 times in Platte Valley herd unit. We believes this technique to be a more accurate method of estimating mule deer numbers, and has recently adopted this technique as the method which will be used to produce future abundance estimates in this herd unit, and perhaps in other mule deer herd units as well.

During the first year of this project 19 mortalities occurred. This represented 27% of the radio-collared deer and was assumed to be representative for the herd unit. We considered the observed mortality level to have been higher than normal, and attributed the increase to the long and severe winter of 2010-2011.

The causes of death were the following: undetermined (10); malnutrition (4); mountain lion predation (2); wounding loss (2); and legal harvest (1). The 19 radio-collars were redeployed on "new" mule deer in February of 2012. The GPS radio-collars will all drop off for data retrieval in April of 2013.

Carbon County Predator Management District, in cooperation with USDA/Wildlife Services, and WGFD, has presented a grant application to the ADMB for the development of a coyote removal project in the Platte Valley mule deer herd unit. This project centers on using the habitat use data from the radio-collared mule deer to target coyote removal efforts in parturition areas. This removal project would occur in those areas during late spring and early summer months, when mule deer fawns are most vulnerable.

We thank the Wyoming Animal Damage Management Board for their financial support of this project. The Wyoming Animal Damage Management Board's contributions to this project have been recognized in WGFD presentations and publications regarding the progress of this important mule deer research.

Sincerely,

Will Schultz
Saratoga Wildlife Biologist

WS/ws

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Sincerely,

Will Schultz
Saratoga Wildlife Biologist

WS/ws

October 23, 2011

FROM: Dr. Michael Conover and Jonathan Dinkins
Jack Berryman Institute
Wildland Resources Department
Utah State University
Logan, UT 84322-5230

IMPACTS OF RAVEN ABUNDANCE ON GREATER SAGE-GROUSE NESTING SUCCESS IN SOUTHERN WYOMING

Update:

Greater sage-grouse (*Centrocercus urophasianus*) distribution and abundance in western North America has declined over the last century. These declines recently led the U.S. Fish and Wildlife Service to conclude that sage-grouse are warranted for protection under the Endangered Species Act of 1973, but because threats were moderate in magnitude and did not occur across their range at an equal intensity, the listing was precluded in favor of other species under severe threat of extinction. Many factors have been attributed to this decline including: predation, habitat loss, and habitat fragmentation. Common raven (*Corvus corax*) predation of sage-grouse nests may be one of the most influential factors limiting sage-grouse productivity in some areas.

We have studied sage-grouse habitat selection, nest success, and hen survival in relation to avian predators (American kestrels, black-billed magpies, *Buteo* hawks, common ravens, golden eagles, and northern harriers). Research was conducted at 12 study sites around sage-grouse leks within two broad study areas in Wyoming: 1) Lincoln, Sweetwater, and Uinta counties, and 2) the Atlantic Rim Project Area south of Rawlins in Carbon County. Utah State University monitored 48, 80, 115, 115, and 69

sage-grouse hens in Lincoln, Sweetwater, and Uinta County study areas during 2008-2012 respectively. In the Atlantic Rim Project Area and in northeast Sweetwater County, the Bureau of Land Management and the University of Wyoming monitored approximately 120 sage-grouse hens in 2008 and 2009, and Utah State University monitored approximately 60, 65, and 29 sage-grouse hens in 2010, 2011, and 2012, respectively. These sage-grouse hens were fitted with 17.5 g or 22 g necklace radio collars with mortality sensors. Sample sizes were smaller in 2012, because we did not capture any new sage-grouse hens in 2012; thus, we were only monitoring sage-grouse hens from previous years that had functioning radio-collars and were still alive.

Raven abundance was monitored by establishing point-count locations near sage-grouse nests and broods (100-200 m away from nests) and at random locations to assess raven and other avian predator abundance. Point-counts were surveyed during daylight hours weekly during sage-grouse breeding season. Table 1 details the number of nests and random locations monitored for avian predators. United States Department of Agriculture, Animal and Plant Health Inspection Service, and Wildlife Services removed ravens from some locations within these study areas yearly.

We are currently completing analyzes of sage-grouse habitat selection, nesting success, brood success, and survival related to avian predators, anthropogenic features (proximity to oil and gas structures, power lines, and roads), landscape features (proximity to forested and riparian habitat and topographic ruggedness), and local vegetation parameters ($10m^2$ sagebrush, grass, litter, bare ground, and forb cover; and average sagebrush and grass heights at $10m^2$). These analyses will constitute five stand-alone research chapters in Jonathan Dinkins's dissertation and will be submitted to peer-

reviewed scientific journals (1 chapter is in press, 1 chapter is in review, and the remaining 3 are in preparation for submission).

Table 1. Approximate number of sage-grouse monitored, nests found, and random locations. All sage-grouse nests and random locations had 3-8 avian point-counts conducted per breeding season.

Year	Sage-grouse Monitored	# Nests	# Random Avian Predator Point-Count Locations
2008	**170**	**53**	**164**
2009	**200**	**77**	**177**
2010	**170**	**85**	**160**
2011	**180**	**110**	**170**
2012	**69**	**32**	**185**

Study Funders:

Anadarko

Bureau of Land Management

Lincoln County Predator Management Board

Predatory Animal District of Sweetwater County

South-central Sage-grouse Local Working Group

Southwest Sage-grouse Local Working Group

Uinta County Predator Management Board

Wyoming Animal Damage Management Board

Wyoming Game and Fish Department

Wyoming Land Conservation Initiative

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FY12 PROJECT FINAL REPORT

July 1, 2011- June 30, 2012

Project Title: Large Carnivore-Livestock Depredation Prevention and Control

Brief Synopsis of the Project: This project is in cooperation with the Wyoming Animal Damage Management Board to fund the Wyoming Game and Fish Department (WGFD) contract with USDA-Wildlife Services (USDA-WS) up to a maximum of $25,000.00 for services to investigate and control damage caused by black bears, grizzly bears, mountain lions, and wolves. Work to control damage by these species to livestock, bees, and beehives qualify for reimbursement.

Project Details: During FY12, USDA-WS managed 26 incidents involving grizzly bears totaling 83.5 hours of grizzly bear damage investigation and control. The total charged to the WGFD for grizzly bear management for the project duration was $2,608.08. USDA-WS managed 92 incidents involving mountain lions that totaled 308.8 hours of mountain lion damage investigation and control for total charges of $9,645.22. USDA-WS managed 55 incidents involving black bears resulting in 299.15 hours of black bear damage investigation and control that total $9,343.81 in charges. During FY12, USDA-WS did not charge the WGFD for any management work associated with gray wolf damage because of their federally protected status.

During the project period, USDA-WS managed 173 incidents involving large carnivores which totaled 691.45 hours of work for a total monetary obligation of $21,597.11. Additional costs for administrative support at a rate of 16.15% of the field work charges resulted in $3,487.94 of additional billing. The total expenses associated with the contract with USDA-WS to manage livestock damage caused by black bears, grizzly bears and mountain lions for FY12 were $25,085.05. Total hours and charges by species are detailed in Table 1.

Table 1. Hours and costs charged by USDA-Wildlife Services for work performed for the WGFD to investigate and manage trophy game damage.

Species	Hours	Cost
Grizzly Bear	83.5	$2,608.08
Mountain Lion	308.8	$9,645.22
Black Bear	299.15	$9,343.81
Admin. Support	NA	$3,487.94
Total	**691.45**	**$25,085.05**

Final billing for the grant cycle have been completed.

Submitted by: Scott Edberg
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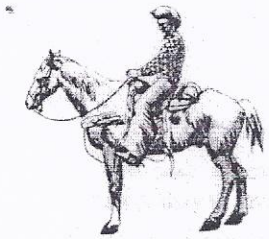

Meeteetse Conservation District

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October 24,, 2012

Kent Drake
Wyoming Animal Damage Management Board
2219 Carey Avenue
Cheyenne, WY 82002

Dear Kent,

Please find enclosed the financial reporting documents for the ADMB grant-funded project "Monitoring Causes of Mortality and Predation Rates of Greater Sage Grouse in the Big Horn Basin". This project is ongoing as described in the presentations made to the ADMB.

In summary, there are detailed records supporting the expenditure of the $62,000.00 grant funds plus documentation that the required supporting funds exceeded the $230,115.00 required by the grant contract:

Additional Grant Funds Match	$ 8,000.00
Contributions	33,100.00
Meeteetse Conservation District In-Kind	20,736.91
Wildlife Services Personnel and Flight Time In-Kind	160,798.35
ARGOS Transmitters Donated by Fidelity Exploration & Production Co.	79,000.00
Total Supporting Funds	**$301,635.26**

On October 24, 2012 the Big Horn Basin Local Working Group awarded the Meeteetse Conservation District $22,000 for the project titled "Spatial and Temporal Movements of Sage-Grouse in the Western Big Horn Basin". That grant will provide matching funds to "Monitoring Causes of Mortality and Predation Rates of Greater Sage Grouse in the Big Horn Basin" for location and tracking work.

Respectfully Submitted,

Steve Jones

Steve Jones
Resource Management Coordinator

Mortality, Predation, and Space Use of Greater Sage-Grouse (*Centrocercus urophasianus*) in the Bighorn Basin

Beth Orning-Tschampl[a], Julie K. Young[ab], and James J. Pehringer[c]

[a]Utah State University , [b]USDA-Wildlife Services-National-Wildlife Research Center, [c]USDA-Wildlife Services

Sage-grouse & Predators

Sage-grouse adults, nests, and chicks are depredated by terrestrial and avian predators

- Most common cause of adult sage-grouse mortality is predation.[1]
- Nest predation has been identified as the main cause of nest failures.[2,3,4,5]
- Up to 81% of chick mortality is due to predation.[5]

Sage-grouse hens are vulnerable to increased predation risk during nesting

- Hens prefer nest locations obscured from visual but not olfactory predators.[3]
- Female mortality by predators is greatest in May and June.[1]

Why remove predators for sage-grouse?

Greater sage-grouse distribution and population densities have declined across western North America where they now occupy 56% of their historic range.[6] Lethal coyote control programs are important to livestock industry and big game management, but effects on other wildlife is largely unknown.[7]

Overall Goal: To test the effects of predator removal on adult sage-grouse survival and nest success.

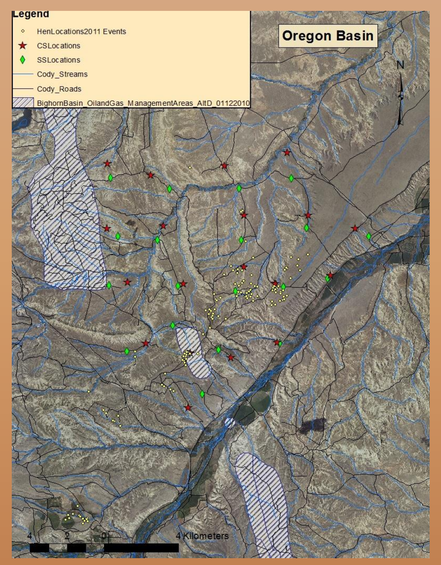
Objectives:

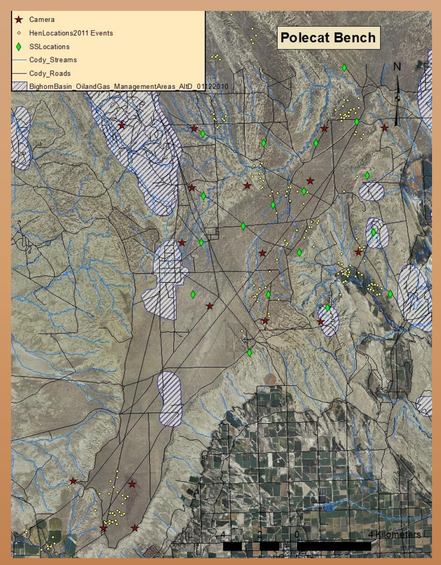
1) Obtain data on the types and impacts of predators on sage-grouse survival and nest success.
2) Compare effect of experimental predator removal treatments on sage-grouse populations.

Table 1. Summary of capture, nesting, and survival data for sage-grouse in two study sites in BHB (April – September 2011).

	Polecat Bench	Oregon Basin
# Radio-collared	10	15
# Nests	9	15**
Avg. Nest distance (km) to Lek	9.6	3.7
Nest Successes	2	6**
Nest Predations	6	7**∫
Other Losses	2*	3
Hen Mortalities	2	9
Fate Unknown	1	0
% Nest Predations	57	67
%Mortality	20	60

* One nest abandoned may also have been partially predated
** Includes two second nest attempts
∫ Includes a partial predation





Methods

Field

Study Site:

- The 2011 pilot study was on two lek complexes in the Bighorn Basin Conservation Area (BHB) in north-central Wyoming:
  - Oregon Basin (OB) & Polecat Bench (PB)

Capture and Monitoring:

- Sage-grouse hens were captured on leks with rocket nets and fitted with VHF necklace style transmitters.
- Hens were monitored every 48-72 hrs via telemetry from April – August.
- Nesting, brood movements, long-distance migration, and causes of adult mortality were documented.
- Infrared trail cameras were used to monitor and document nest predations.

Predator Surveys

- Terrestrial and avian predators surveys were conducted using average nesting distances and a 3x3 km grid-interval plot centered at each lek.
  - Scent stations (SS) were checked daily for 10 days, and consisted of a 1-m circle of sifted dirt scented with a fatty-acid scent tab in a 6-in central hole.
  - Camera trap stations (CS) were ≥ 200 m from the nearest scent station and run for 14 non-concurrent days to scent surveys.
  - Road transects were established through grid plots and sampled twice, one hour after sunrise and at mid-day.

Abundance Estimation

- Distance sampling methods and the Unmarked package in Program R were used to calculate detection probabilities, densities and raptor abundance in both complexes.
- Passive tracking indices (PTI) were estimated for scent and camera trap station surveys.[8]

Survival Analysis

- Maximum likelihood estimation (MLE) of known-fate using Cox proportional hazard models in R to estimate survival rates of adult sage-grouse.
- Nest models were used in Program MARK to obtain daily survival rates (*dsr*) and nest success, and 95% confidence intervals were calculated using the DELTA METHOD.

Data Summary

Sample Size

- 25 sage-grouse hens were captured and fitted with necklace radio collars.
- Coyotes (n=5) and ravens (n=2) were found to be the primary predators of nests.
- Coyotes (n=4) and golden eagles (n=2) were found to be the primary predators of adult sage-grouse.
- Other hen losses were attributed to badgers (n=2), bodily trauma of undetermined origin (n=1), and unknown predators (n=2).

Abundance Estimates

- Raptors/km were 4.6 for Oregon Basin (P_a=5.26, SE 0.15) and 1.4 (P_a=1.06, SE 0.57) for Polecat Bench.

	Canidae PTI		SD		Felidae PTI		SD	Mustelidae PTI		SD		Procyonidae PTI		SD
	SS	CS	SS	CS	SS	CS		SS	CS	SS	CS	SS	CS	
Oregon Basin														
Fork in Road	0.010	0.005	0.31	0.23	0	0	-	0.001	0	0.12		0.002	0	0.14
Gravel Pit	0.004	0.005	0.24	0.41	0.001	0	0.11	0.002	0	0.14		0	0	-
Polecat Bench														
Polecat	0.003	0.001	0.16	0.14	0	0	-	0.003	0.001	0.17	0.08	0	0	-
South	-	0.001	0.18		-	0	-	-	0.001	0.18		-	0	-

Survival Analysis

	Hen Survival	SE	95% CI	Nest Success	Var	95% CI	*dsr*	SE	95% CI
Oregon Basin	0.41	0.12	0.23, 0.75	0.39	0.03	0.07, 0.71	0.98	0.01	0.94, 0.99
Polecat Bench	0.78	0.14	0.56, 1	0.21	0.04	-0.16, 0.58	0.96	0.02	0.88, 0.99
Study Area	0.55	0.10	0.39, 0.79	0.33	0.02	0.08, 0.58	0.97	0.01	0.94, 0.99

Conclusions

We detected higher survival at PB, which has predator removal for livestock management, than at OB, where currently no removals for management occur.

- Substantial site effect (-1.96) on hen survival (PB hens 28% less likely to die, p=0.1) was detected, this is partially attributed to small sample sizes.
- No significant differences were found in *dsr* rates of nests between the two study sites (β = -0.51, 95% CI (-1.96, 0.95)).

Next Steps

- Two sites will be added to the BHB study and additional tags will be deployed with the goal of 13 VHF collars, 5 Argos packs per site.
- Predator abundance will be experimentally manipulated.
  - Coyotes will be removed from Fifteen Mile.
  - Ravens will be removed from Major Basin.
  - Both coyote and ravens will be removed from Polecat Bench.
  - No removals will occur at Oregon Basin.

This treatment-control sample survey design will be used to compare and model the effects of predator removal on sage-grouse survival and nest success.

Literature Cited

[1] Connelly, JW, AD Apa, RB Smith, KP Reese. 2000. Effects of predation and hunting on adult sage grouse *Centrocercus urophasianus* in Idaho. Wildlife Biology 6:227-232.
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Hello All,

I would like to begin by apologizing for a mistake I made while writing the last update. As I said initially, I plan to keep comments and evidence proving facts very transparent to everyone. I mentioned in the last update the 35-day post hatch survey shows 3-5% of chicks survived which should have been 35-44% of the chicks survived from the 20-35% of the total nests initiated that successfully hatched. This still shows a very low number of grouse recruited into the population. All unsuccessful nest shows evidence of predator related activity rather is was egg predation or hen predation during nesting. I will work with Beth and WS personnel before the next update to get the exact numbers for each.

At this time evidence has been documented showing predator activities have reduced our Oregon Basin birds by 60%. Of the 15 hens collared 6 remain alive today. We were able to place 6 new argos collars in this population between September 12-15th, 2011. So far they remain alive and are being monitored via satellite from my and Julie's computers. These collars were donated to the project by Fidelity Oil Company. We found evidence this last month of a coyote and an eagle had predated on a grouse a piece in the Oregon Basin area. My guess is the cured vegetation may be making sage grouse more visible lately and water sources are limiting movements and providing a better opportunities for predators. These birds have traveled very little since the last update but are beginning to show signs of movement the last few days. We are seeing evidence for an increase in the rabbit population in a few areas as well.

100% of remaining Polecat Bench birds are still located on or near heavily farmed fields but also are showing more signs of movement lately similar to the Oregon Basin birds. We were able to place 3 argso collars in the Polecat population and plan to place two more along with 3 telonics collars this week. So far we have 7 collard hens alive of the initial 10 collared in the polecat Bench area. Last week we found evidence that an eagle may have predated on PCB3, we found PCB2 dead of natural causes not related to predation earlier this summer, and we had PCB6 shed her collar due to an attachment malfunction.

Additional areas in the Washakie, Hot Springs, and Bighorn Counties have been put on hold for now due to the distance the birds are traveling from Lek to summer range. We want to be sure we collar grouse that will remain in the basin in counties where we have personnel and support for this project to keep research complete and attainable. We have decided to include the Major Basin area in Hot Springs County for sure and are discussing one other additional area that is not yet determined. We plan to collar birds in new sites this Spring. Tim Wooley of the WGFD and I will work on the permitting process that is required for the project before January to assure permits are requested and received in a more timely manner now that all requirements requested by the WGFD have been met as far as training for WS personnel. We were able to get five WS employees well trained in attaching argos collars to hen sage grouse by Haydenwing Associates and nine WS personel trained in attaching necklace collars for this project so far. As of now we have spent a lot of funds (Approximately $24,000) and went to great lengths making sure our employees and project staff have received the best training possible in

capturing and handling sage grouse using all techniques and look forward to a more productive capture season this spring. We have had zero loses due to capturing and handling using all techniques in all areas of our project. I know things happen and there is always a chance of mortality with this type of activity, but I would just like to thank all involved for their professionalism and dedication to the project thus far to assure animal safety and project success.

I really appreciate everyone's support and comments that pertaining to the project to assure we produce the best results possible for everyone's effort. Please call or e-mail with any question or ideas.

Thanks again!

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Mortality, Predation, and Space Use of Greater Sage-Grouse (*Centrocercus urophasianus*) in the Bighorn Basin

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Sage-grouse & Predators

Sage-grouse adults, nests, and chicks are depredated by terrestrial and avian predators

- Most common cause of adult sage-grouse mortality is predation.[1]
- Nest predation has been identified as the main cause of nest failures.[2,3,4,5]
- Up to 81% of chick mortality is due to predation.[5]

Sage-grouse hens are vulnerable to increased predation risk during nesting

- Hens prefer nest locations obscured from visual but not olfactory predators.[3]
- Female mortality by predators is greatest in May and June.[1]

Why remove predators for sage-grouse?

Greater sage-grouse distribution and population densities have declined across western North America where they now occupy 56% of their historic range.[6] Lethal coyote control programs are important to livestock industry and big game management, but effects on other wildlife is largely unknown.[7]

Overall Goal: To test the effects of predator removal on adult sage-grouse survival and nest success.

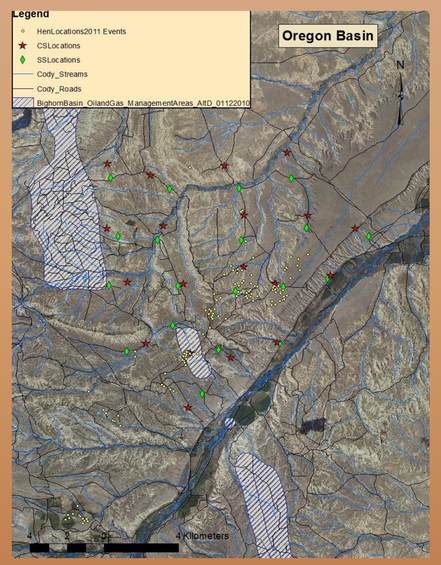
Objectives:

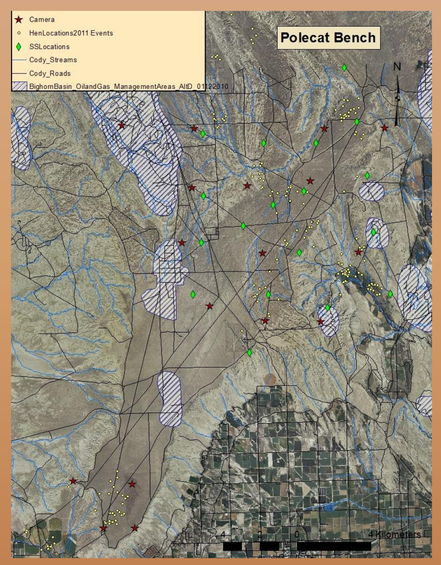
1) Obtain data on the types and impacts of predators on sage-grouse survival and nest success.
2) Compare effect of experimental predator removal treatments on sage-grouse populations.

Table 1. Summary of capture, nesting, and survival data for sage-grouse in two study sites in BHB (April – September 2011).

	Polecat Bench	Oregon Basin
# Radio-collared	10	15
# Nests	9	15**
Avg. Nest distance (km) to Lek	9.6	3.7
Nest Successes	2	6**
Nest Predations	6	7**∫
Other Losses	2*	3
Hen Mortalities	2	9
Fate Unknown	1	0
% Nest Predations	57	67
%Mortality	20	60

* One nest abandoned may also have been partially predated
** Includes two second nest attempts
∫ Includes a partial predation





Methods

Field

Study Site:

- The 2011 pilot study was on two lek complexes in the Bighorn Basin Conservation Area (BHB) in north-central Wyoming:
  - Oregon Basin (OB) & Polecat Bench (PB)

Capture and Monitoring:

- Sage-grouse hens were captured on leks with rocket nets and fitted with VHF necklace style transmitters.
- Hens were monitored every 48-72 hrs via telemetry from April – August.
- Nesting, brood movements, long-distance migration, and causes of adult mortality were documented.
- Infrared trail cameras were used to monitor and document nest predations.

Predator Surveys

- Terrestrial and avian predators surveys were conducted using average nesting distances and a 3x3 km grid-interval plot centered at each lek.
  - Scent stations (SS) were checked daily for 10 days, and consisted of a 1-m circle of sifted dirt scented with a fatty-acid scent tab in a 6-in central hole.
  - Camera trap stations (CS) were ≥ 200 m from the nearest scent station and run for 14 non-concurrent days to scent surveys.
  - Road transects were established through grid plots and sampled twice, one hour after sunrise and at mid-day.

Abundance Estimation

- Distance sampling methods and the Unmarked package in Program R were used to calculate detection probabilities, densities and raptor abundance in both complexes.
- Passive tracking indices (PTI) were estimated for scent and camera trap station surveys.[8]

Survival Analysis

- Maximum likelihood estimation (MLE) of known-fate using Cox proportional hazard models in R to estimate survival rates of adult sage-grouse.
- Nest models were used in Program MARK to obtain daily survival rates (*dsr*) and nest success, and 95% confidence intervals were calculated using the DELTA METHOD.

Data Summary

Sample Size

- 25 sage-grouse hens were captured and fitted with necklace radio collars.
- Coyotes (n=5) and ravens (n=2) were found to be the primary predators of nests.
- Coyotes (n=4) and golden eagles (n=2) were found to be the primary predators of adult sage-grouse.
- Other hen losses were attributed to badgers (n=2), bodily trauma of undetermined origin (n=1), and unknown predators (n=2).

Abundance Estimates

- Raptors/km were 4.6 for Oregon Basin (P_a=5.26, SE 0.15) and 1.4 (P_a=1.06, SE 0.57) for Polecat Bench.

	Canidae PTI		SD		Felidae PTI		SD	Mustelidae PTI		SD		Procyonidae PTI		SD
	SS	CS	SS	CS	SS	CS		SS	CS	SS	CS	SS	CS	
Oregon Basin														
Fork in Road	0.010	0.005	0.31	0.23	0	0	-	0.001	0	0.12		0.002	0	0.14
Gravel Pit	0.004	0.005	0.24	0.41	0.001	0	0.11	0.002	0	0.14		0	0	-
Polecat Bench														
Polecat	0.003	0.001	0.16	0.14	0	0	-	0.003	0.001	0.17	0.08	0	0	-
South	-	0.001	0.18		-	0	-	-	0.001	0.18		-	0	-

Survival Analysis

	Hen Survival	SE	95% CI	Nest Success	Var	95% CI	*dsr*	SE	95% CI
Oregon Basin	0.41	0.12	0.23, 0.75	0.39	0.03	0.07, 0.71	0.98	0.01	0.94, 0.99
Polecat Bench	0.78	0.14	0.56, 1	0.21	0.04	-0.16, 0.58	0.96	0.02	0.88, 0.99
Study Area	0.55	0.10	0.39, 0.79	0.33	0.02	0.08, 0.58	0.97	0.01	0.94, 0.99

Conclusions

We detected higher survival at PB, which has predator removal for livestock management, than at OB, where currently no removals for management occur.

- Substantial site effect (-1.96) on hen survival (PB hens 28% less likely to die, p=0.1) was detected, this is partially attributed to small sample sizes.
- No significant differences were found in *dsr* rates of nests between the two study sites (β = -0.51, 95% CI (-1.96, 0.95)).

Next Steps

- Two sites will be added to the BHB study and additional tags will be deployed with the goal of 13 VHF collars, 5 Argos packs per site.
- Predator abundance will be experimentally manipulated.
  - Coyotes will be removed from Fifteen Mile.
  - Ravens will be removed from Major Basin.
  - Both coyote and ravens will be removed from Polecat Bench.
  - No removals will occur at Oregon Basin.

This treatment-control sample survey design will be used to compare and model the effects of predator removal on sage-grouse survival and nest success.

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