Appendix D: OSC Project Reports

The following reports for OSC Cooperative Sage-grouse Projects were submitted in 2011.

Cooperative Sage-grouse Project Final Report

OSC Sage-grouse Project number: **2010-01**

Title: **Big Desert Road Grading and Fuel Breaks Project**

Project Proponent: **BLM**

As per your Idaho Sage-grouse Management Plan Cooperative Agreement, dated **January 12, 2011**, the final report for this project is due January 31, 2012 or upon completion of the project, whichever occurs first. Please use the following template to complete your final report.

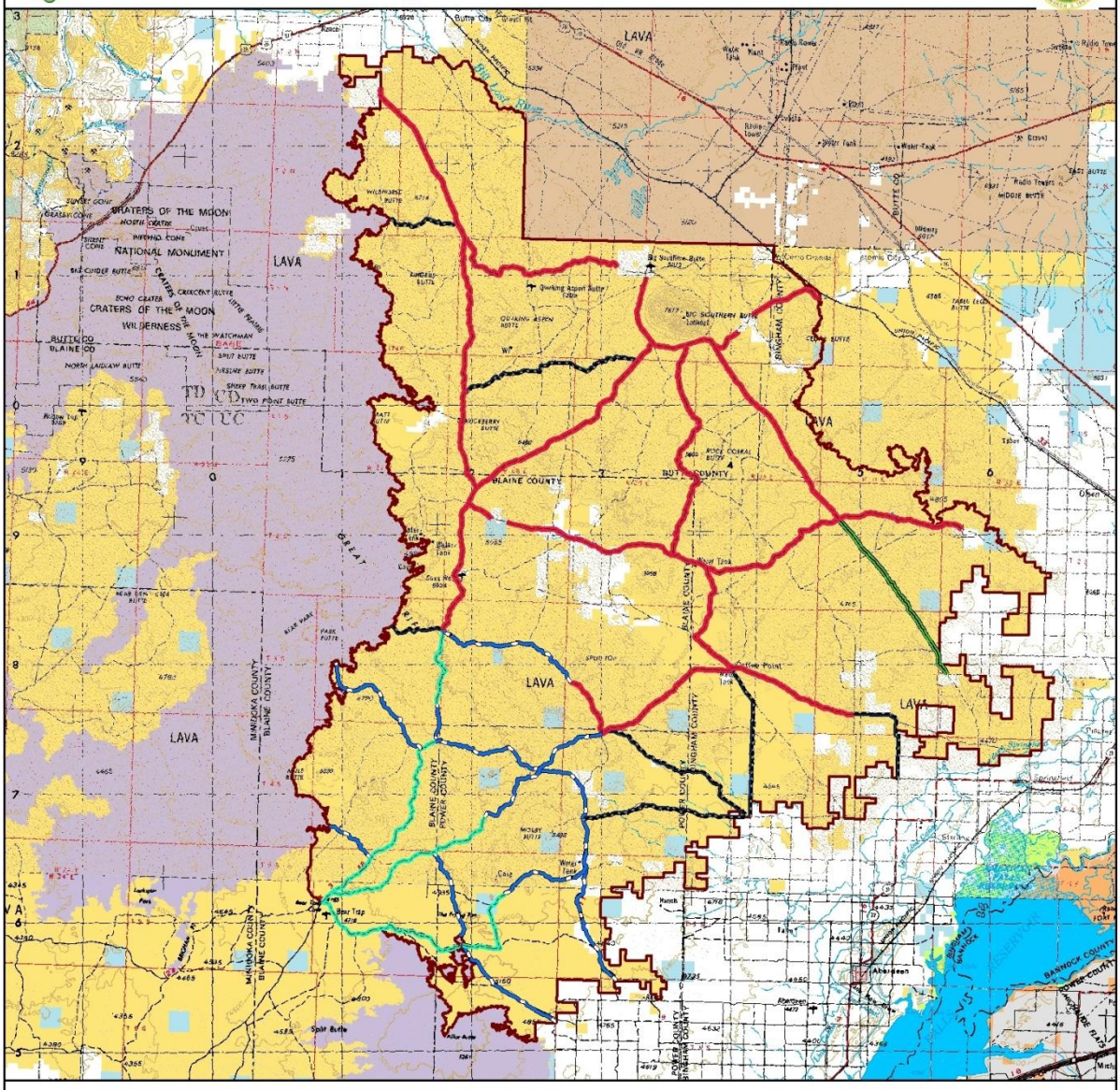
1. Project Overview.
    a. Location: *The project occurs within the Big Desert Area in southeastern Idaho. Fuel breaks will be created along existing roads (attached map).*
    b. Threat(s): What threat(s) to sage-grouse is this project addressing? *Wildfire, annual grasslands*
    c. Objectives: What were the objectives of the project? *The identified fuel break units will aid in reducing the size and severity of wildfire. Improving road conditions would also allow for quicker response to wildfires with the area. All fuel break units are designed along existing roads. Roads would be devoid of vegetation and the vegetation on each side of the road would be mowed to approximately 6 to 12 inches or sprayed to reduce canopy approximately 50%.*

2. Methodology.
    a. Methods: Describe the methods used to achieve the project objectives. Multiple types of mechanical treatments would be used to implement the Big Desert Fuel Breaks Project: 1) Grade existing roads 2) Roto-mow 150 feet buffers on the side of existing roads 3) Spraying existing vegetation min. 50 feet on each side of the existing roads.
    b. Monitoring: Describe the monitoring methods used to measure the effectiveness of the project. Annually, inspect the height of the vegetation in the road as well as the vegetation on the 50 feet spray area or 150 feet roto-mow buffer strips off each side of the road. After shrub height within the strips exceeds an average of 2 feet, the project would need maintenance in order to secure the road as a good fuel break.

3. Results. Describe the results of the project, including any difference in the planned work from the final project (e.g., change in treatment acres). Include the results of monitoring data and images of photo points (inserted into the document or as attachments), if applicable.
    An individual worked on grading the roads in the Big Desert Planning Area for two weeks in the spring of 2011. Approximately, 25 miles of roads were improved and vegetation was removed from the center portion of the roads. In addition to the road grading, approximately fifteen miles of fuel break buffer areas were treated with herbicide.

4. Discussion. Discuss how the project did or did not meet the objectives. If additional work or time is needed to determine the project's effectiveness, include a discussion of planned monitoring or adaptive management. Initial objectives for the project have been met: fuel breaks were improved through road grading and application of herbicides. A more intensive effort would have to be made in order get the Big Desert Area to a maintain status. Effectiveness of the project will be determined when the Big Desert Area experiences another wildfire. The fuel break concept in the area can adapt as new methods are tried and tested improving the effectiveness of the current fuel breaks.

Big Desert Roads



Legend

- Big Desert Roads Project Bdy

Road Treatments

- Chemical
- Chemical-Seeded
- Mechanical
- Mechanical-Chemical
- Mechanical-Seeding-Chemical

Surface Management

- Bureau of Land Management
- Bureau of Reclaimation
- Department of Energy - INL
- Indian Reservation
- Military Reservations and Corps of Engineers
- National Park Service
- National Wildlife Refuge
- Private
- State of Idaho
- US Forest Service
- Other

0 3 6 12 Miles

NATIONAL SYSTEM OF PUBLIC LANDS

No warranty is made by the Bureau of Land Management (BLM). The accuracy, reliability,or completeness of these data for individual use or aggregate use with other data is not guaranteed.

Produced: October 2011
Projection: UTM Zone 12 North NAD 1983
Location: R:\loc\Fuels\Projects\Big Desert Roads\Maps

N W E S

Location Map

Cooperative Sage-grouse Project Final Report

OSC Sage-grouse Project number: **2010-02**

Title: **Rock Corral Allotment Sagebrush Seedling Plantings**

Project Proponent: **BLM**

As per your Idaho Sage-grouse Management Plan Cooperative Agreement, dated **January 12, 2011** the final report for this project is due **JAN 31, 2012** or upon completion of the project, whichever occurs first. Please use the following template to complete your final report.

1. Project Overview.
    a. Location: *Rock Corral Allotment is located northwest of Springfield, ID in Township 3 South, Range. 31 East, Sections: 5-8.*
    b. Threat(s): What threat(s) to sage-grouse is this project addressing? *Wildfire, and annual grasslands*
    c. Objectives: What were the objectives of the project? *The planting of one year old sagebrush plants (plugs and bareroot) in those areas where sagebrush seed source is lacking and in areas adjacent to sage grouse leks. The goal for the project would be 30 to 60 percent survival rate.*

2. Methodology.
    a. Methods: Describe the methods used to achieve the project objectives. Plugs and bareroot sagebrush plants would be planted in the Rock Corral Allotment using two techniques: tractor pulled plug planter and the use of small augers.
    b. Monitoring: Describe the monitoring methods used to measure the effectiveness of the project. Setup four or five 100 foot transects within the project areas. Each transect would have 100 plugs planted. Approximately six to eight months after the plugs have been planted, the BLM would do a live/dead count on each 100 foot transect. The live/dead count would be repeated the following year at the same time.
3. Results. Describe the results of the project, including any difference in the planned work from the final project (e.g., change in treatment acres). Include the results of monitoring data and images of photo points (inserted into the document or as attachments), if applicable.
   The project was implemented in the fall of 2011. The project was initially planned for the fall of 2010 but the sagebrush plug supplier had a large amount of their inventory die over the winter. After the plugs died, the project was postponed until the fall of 2011 when sagebrush plugs would be available. In order to plant ~30,000 sagebrush plants, we had to adapt and plant some bareroot seedings in addition to the traditional plug.
4. Discussion. Discuss how the project did or did not meet the objectives. If additional work or time is needed to determine the project's effectiveness, include a discussion of planned monitoring or adaptive management. Seedling and/or plugs were planted during November 2011. Monitoring (described under 2b above) will be conducted in the summer of 2012 in order

to determine whether the Rock Corral Allotment sagebrush plug planting was successful or not. Due to past experiences, the Upper Snake Field Office sagebrush plug planting projects have adapted over the years. Monitoring data from past projects indicate that fall plantings have been more successful than spring plantings. This project tried to see if planting bareroot seedling is more successful than planting the traditional sagebrush plug. The success of planting seedlings versus plugs will be determined based on follow up monitoring.

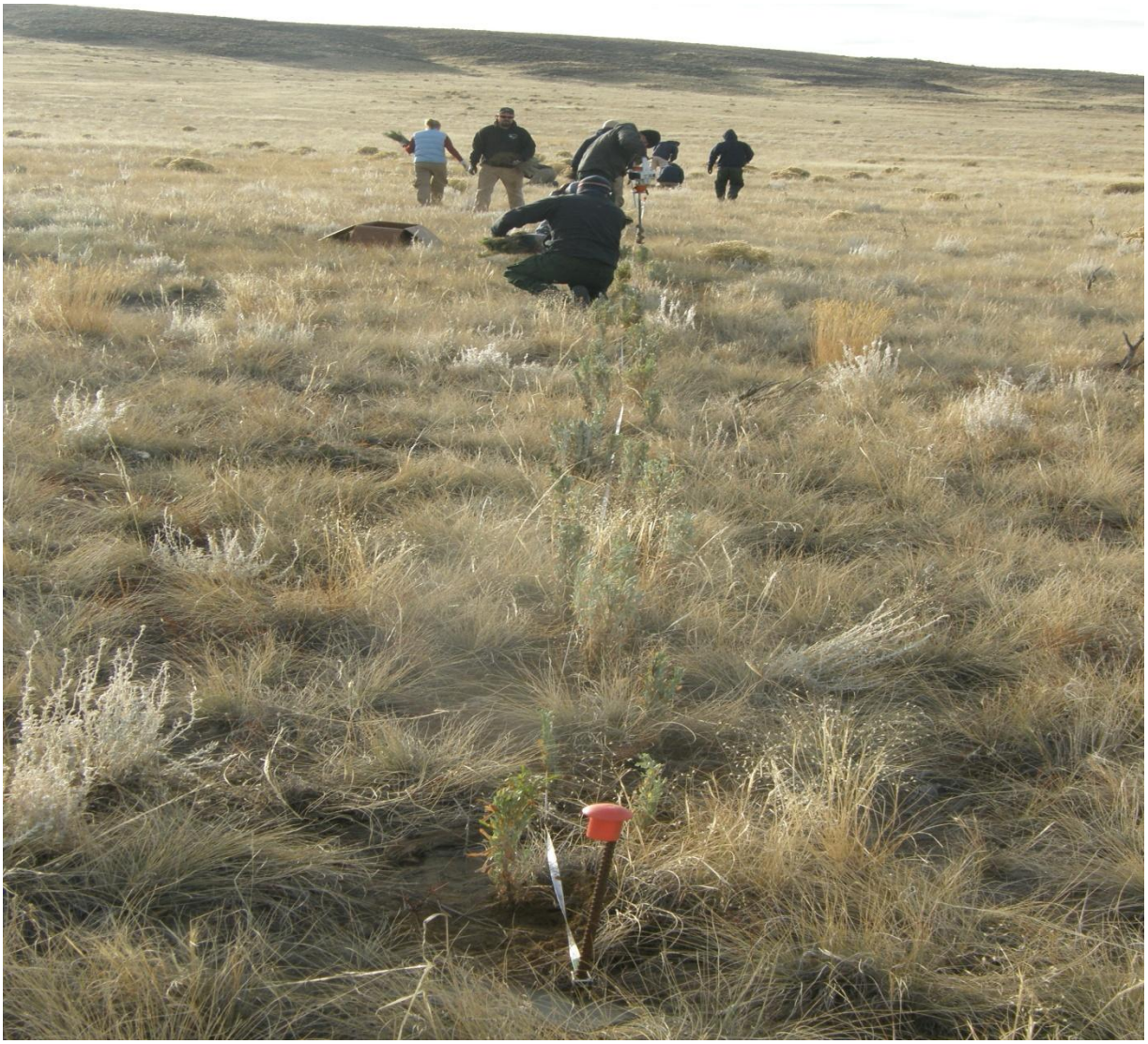
Project Area Photo: Two auger operators keep a crew of five planters hard at work.

Bareroot plants

Traditional Sagebrush Plugs

Planting operations from tractor plug planter

Tractor Plug Planter



Monitoring transect setup.

Factors Influencing the Ecology of Greater Sage-Grouse Inhabiting the Bear Lake Plateau and Valley, Idaho-Utah

2011 Progress Report

(OSC sage-grouse project 2009-12)

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Submitted to

Idaho Department of Fish and Game
Utah Division of Wildlife Resources
Bureau of Land Management
U.S. Fish and Wildlife Service
U.S. Forest Service
Idaho Department of Lands
Idaho Governor's Office of Species Conservation
East Idaho Uplands Sage-grouse Local Working Group
Rich County Coordinated Resources Management Working Group
Wyoming Department of Game and Fish
Southwest Wyoming Sage-grouse Local Working Group

January 2012

INTRODUCTION

Greater sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse), the largest grouse species in North America, was designated as a candidate species in March 2010 by the U.S. Fish and Wildlife Service (USFWS) for protection under the Endangered Species Act (ESA) of 1973 (USFWS 2010). In the 12-month finding, the USFWS determined that sage-grouse range wide warranted protection under the ESA but their listing was precluded because of higher conservation priorities.

Sage-grouse occupy sagebrush-steppe (*Artemisia* spp.) ecosystems throughout their current range (Patterson 1952, Connelly and Braun 1997). Sagebrush is important as both a source of food and cover (Patterson 1952, Connelly et al. 2000). To complete their annual life cycle they require a large expanses of sagebrush habitat (Dalke et al. 1963, Connelly et al. 1988, Leonard et al. 2000, Connelly et al. 2000). Schroeder et al. (2004) estimated that sage-grouse currently occupy about 668,412 km^2, < 60% of the presettlement range, which includes 11 states and 2 Canadian Provinces. Declines in sage-grouse populations have mainly been attributed to habitat loss and degradation of the sagebrush-steppe ecosystem (Braun 1998, Connelly et al. 2004, Knick and Connelly 2011).

Sage-grouse populations inhabiting in the Bear Lake Plateau and Valley of Idaho and Utah are included in the Wyoming Basin sage-grouse population (Connelly et al. 2004). The southwestern subpopulation includes southwestern Wyoming, northwestern Colorado, northeastern Utah, and southeastern Idaho (Miller and Eddleman 2001, Connelly et al. 2004). The Bear Lake Plateau and Valley population occurs at the edge of the Wyoming Basin in the southeastern subpopulation. Populations of sage-grouse at the edge of the range-wide distribution, such as the Bear Lake Plateau and Valley population, often depend on dispersal from connecting leks to sustain the genetic variation of these populations (Knick and Hanser 2011).

Because sage-grouse are capable of migrating considerable distances (Patterson 1952, Connelly et al. 1988), the sage-grouse inhabiting the Bear Lake Plateau and Valley are believed to use habitats in three states. Pilot research conducted in 2010 confirmed that the population uses seasonal habitats in three states, however the magnitude and importance of the interchange is uncertain (C.J. Cardinal, Utah State University, unpublished data). Obtaining this information could be paramount to the conservation of the Bear Lake Plateau and Valley sage-grouse population if the seasonal movements include multiple states where they are subjected to the jurisdiction of different state laws and management plans.

Purpose and Study Objectives

Little is known about the ecology, seasonal movements, and habitat-use patterns of the sage-grouse populations that inhabit the Bear Lake Plateau and Valley relative to existing or potential land uses for application to management. Migration information is important to delineate population dynamics (e.g., a meta-population, source-sink, and other spatial complications), identify essential habitats, and determine the potential effects of land-use on species conservation.

The purpose of this research is to describe the ecology, seasonal movements, and habitat-use patterns of sage-grouse that inhabit the Bear Lake Plateau and Valley relative to existing land-uses. Because the Bear Lake Plateau and Valley is subject to both natural and anthropogenic barriers and fragmentation, defining population vital rates, seasonal movement and habitat-use relative to land use and jurisdictional boundaries of this population will be important as the basis for management cooperation between Idaho, Utah, and Wyoming. Sage-grouse land use research will also define the

core use areas of important seasonal and temporal habitats in the Bear Lake Plateau and Valley. This could be important for targeted conservation efforts in the future.

The objectives of this study are to:

1. Document population(s) vital rates of sage-grouse that inhabitat the Bear Lake Plateau and Valley, Idaho, Utah, and Wyoming.
2. Document sage-grouse seasonal distribution and habitat-use patterns in the Bear Lake Plateau and Valley.
3. Determine if any differences observed in movement and habitat-use patterns are related to sex, age class, or land-use patterns.
4. Document how natural and anthropogenic land-use patterns and activities may contribute to habitat loss by fragmentation of sage-grouse habitats in the Bear Lake Plateau and Valley.

STUDY AREA

The Bear Lake Plateau and Valley Study Area (BLPV) consists of 207,500 ha in Bear Lake County, Idaho, Rich County, Utah, and Lincoln County, Wyoming. The elevation of the study area ranges from 1800 m to 2500 m above mean sea level. The BLPV is comprised of many different land ownership and management entities. This area is comprised mostly of private land, with some patches of public (i.e., U. S. Forest Service, USFWS, Bureau of Land Management) and state-owned land.

Vegetation is dominated by sagebrush (*Artemisia* spp.)- grassland plant communities. The main vegetation includes shrubs: *Artemisia* spp. *Chrysothamnus spp.*; grasses such as: crested wheatgrass (*Agropyron cristatum),* cheatgrass (*bromus tectorum), Poa* spp.; and forbs such as: *Pholx* spp., pale agoseris (*Agoseris glauca),* tapertip hawksbeard (*Crepis acuminate),* willow baccharis *(Baccharis salicina),* rosy pussytoes (*Antennaria rosea).* The climate of the study area is typical of intermountain highlands by cold winters and hot summers. Temperatures ranged from lows of about 14°F in January, and highs of 85°F in July. The average precipitation is 14.2 inches, and the average annual snowfall is 41.1 inches (Western Regional Climate Center).

The primary land use is for grazing by domestic livestock. Though, because of the presence of Bear Lake, the BLPV is a major seasonally recreation area, with most of the use occurring in the summer. Additional residential development is occurring at the base of Bear Lake on both the east and west sides of the study area.

METHODS

Sage-grouse were trapped on and near leks beginning in March 2010. I will continue to trap additional birds through spring of 2012. Spotlights were used to locate roosting grouse, and they were captured using a dip net, and fitted with radio-collars (Connelly et al. 2003). I plan to capture and collar up to 40 male and 40 females annually. Half the collars will be deployed in Utah and half in Idaho. I will attempt to distribute them evenly on yearling and adults using size and plumage to classify grouse (Dalke 1963). Radio-collared grouse were located using telemetry at least once a week from 1 June to 1 November and once a month from 1 November to 15 March 2011.

Radio-collared females were located on nests by approaching and observing them under the same bush for several days. Nest success was measured by monitoring nest incubation time, and locating nest remains after success or failure. Brood success was determined by walking up females and counting the number of chicks, or by using night spotlighting.

Nest and brood vegetation was recorded beginning in 2011. A Robel pole was used to measure visual cover at nests, and four 15 meter line intercept transects at 90 degree angles from the nest were used to measure vegetation cover. Along these transects herbaceous cover was measured using Daubenmire frames. The aspect and the slope of the nest location were also recorded. Brood sites were measured using the line-intercept method at four 30 meter transects at 90 degree to measure shrub cover, and Daubenmire Frames were used to measure ground cover (grass, forb, bare ground, litter, rock) at four locations along theses transects. Random vegetation points were taken for each nest and brood discovered to compare selected habitats to habitat points in the study area (Connelly et al. 2003).

Habitat fragmentation will be measured using GIS and remote sensing technology. Sage-grouse habitat use, production, and seasonal movements will be plotted relative to anthropogenic landscape features (Connelly et al. 2011). These metrics will be used to develop indices of habitat fragmentation to determine if the fragmentation observed constitutes functional habitat loss (USFWS 2010). Sage-grouse movements will also be plotted relative to natural landscape barriers to determine how habitat-use is affected in this area.

RESULTS

2011 Research Progress

Captures

In spring 2011, we trapped three leks in Idaho (2B025, 2B032, and 2B043) and two in Utah. (2B014 and 2B015). In 2011, 35 males were captured (25 adults and 10 yearlings) and 17 females (7 adults and 10 yearlings) were captured and radio-collared. In the fall of 2011, an additional 18 birds were captured and in North Eden along the Idaho-Utah Border. This included 7 females: 5 adults, 2 yearlings, and 11 males: 8 adults and3 juveniles (Table 1).

Locations

During 2011, 461 female telemetry locations were recorded among from 33 females. We also documented 529 male locations for 49 males. Over 300 unmarked sage-grouse were observed around the site during routine monitoring (Figure 2).

Small scale lek monitoring was conducted during the spring of 2011. On several mornings in April and May leks were visited and counted using standard protocols (Table 2).

Twelve hens were located on nests during 2011. Of these, 8 were unsuccessful (3 mammal depredation, 2 avian depredation, and 3 undetermined). Four hens successfully hatched nests, but only one was observed with a brood 2 weeks after hatching. Fifteen unmarked broods also were observed on the site this summer.

Mortalities

There were twelve recorded mortalities during 2011 (Table 3). In the Indian Creek area (2B043) mortalities were attributed to: 2 mammalian and 2 avian. The Eden area (2B014 and 2B015) mortalities were attributed to: 2 mammalian and 4 avian. The Bloomington area (2B025) mortalities were attributed to: 1 fence collision and 1 avian. In addition, 3 dropped collars were recovered in the Bloomington area. These were assumed to be dropped due to collaring error because there was no indication of mortality.

Future Work Plan

During Fall 2011 and Spring 2012, I will attempt to deploy 60 additional radio collars. I will continue to locate the birds two times per week in the spring and summer, once a week in the fall, and at least once a month in the winter. In spring 2012, I will attempt to determine which historical leks are still active and if there are any leks that have been undiscovered in the study area. During the spring and summer 2012, I will focus on finding nests and recording success or failure. I will take vegetation measurements for nests and brood locations. I will also take vegetation measurements at random locations to assess site selection based on vegetation structure or composition components. Finally, I will start to create a habitat fragmentation index to determine if the fragmentation observed constitutes functional habitat loss. I will use remote sensing to assess land use change over the last 30 years and classify habitat and non-habitat in the Bear Lake Plateau and Valley study area. I will use these maps along with bird locations to determine if land use may be affecting habitat use and vital rates.

MANAGEMENT IMPLICATIONS

If sage-grouse in the Bear Lake Plateau and Valley Study Area do use habitat in all three states, this study will be useful for management cooperation between Idaho, Utah, and Wyoming. If birds are documented using habitat in the three states a conservation plan similar to the California-Nevada border plan could be constructed. This research will also be important to define the core use areas of valuable habitat for sage-grouse on the BLPV. This could be important for targeted conservation efforts in the future. If possible human impact could be reduced in vital breeding or wintering habitat, to promote sustainable populations in this area. Observing birds in this area will help define timing of migration. In future monitoring, this will aid in tracking birds, and studying habitat selection at different times of the year.

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Tables and Figures

Table 1. The distribution of radio-collars deployed on greater sage-grouse in the Bear Lake Study Area during 2011.

SPRING CAPTURES				
Capture Location	Adult Male	Yearling Male	Adult Female	Yearling Female
Idaho- 2B043 Lek	7	1	5	5
Idaho- 2B025 Lek	3	4	0	2
Idaho- 2B032 Lek	6	0	0	1
Utah- 2B014 &2B015 leks	12	2	2	2

FALL CAPTURES						
Capture Location	Adult Male	Yearling Male	Juvenile Males	Adult Female	Yearling Female	Juvenile Females
IDAHO/UTAH BORDER	8	0	3	5	2	0

TOTAL CAPTURES FOR 2011						
Capture Location	Adult Male	Yearling Male	Juvenile Males	Adult Female	Yearling Female	Juvenile Females
Total for 2011=	36	7	3	12	12	0

Table 2. 2011 Lek Observations for the Bear Lake Valley and Plateau Study Area

LEK	YEAR	MONTH	DAY	TIME	MALES	FEMALES
2B025	2011	4	22	6:15	14	13
2B007	2011	4	22	7:45	0	0
2B025	2011	4	25	6:15	8	1
2B014	2011	5	6	5:45	42	3
2B015	2011	5	6	5:30	40	0
2B014	2011	5	12	6:05	33	7
2B006	2011	5	11	6:20	0	0
2B005	2011	5	11	6:29	0	0

2B012	2011	5	11	6:34	6	0
2B013	2011	5	11	6:57	0	0
2B032	2011	5	11	8:00	42	0
2B043	2011	5	18	5:45	38	3
2B025	2011	5	18	6:38	5	1

Figure 1. Distribution of sage-grouse locations for 2011. Symbol shapes correlate to the area of capture. Colors correlate to season of location

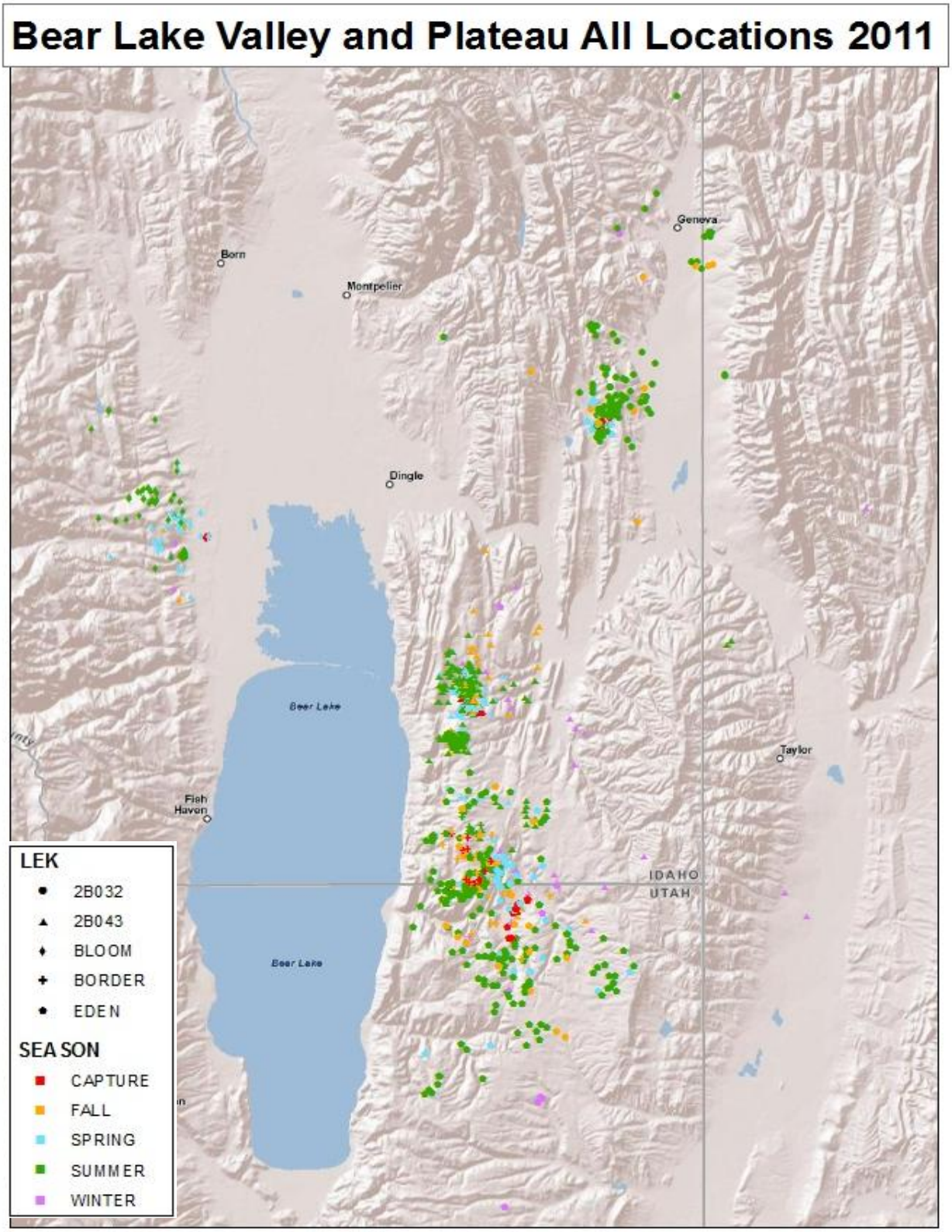
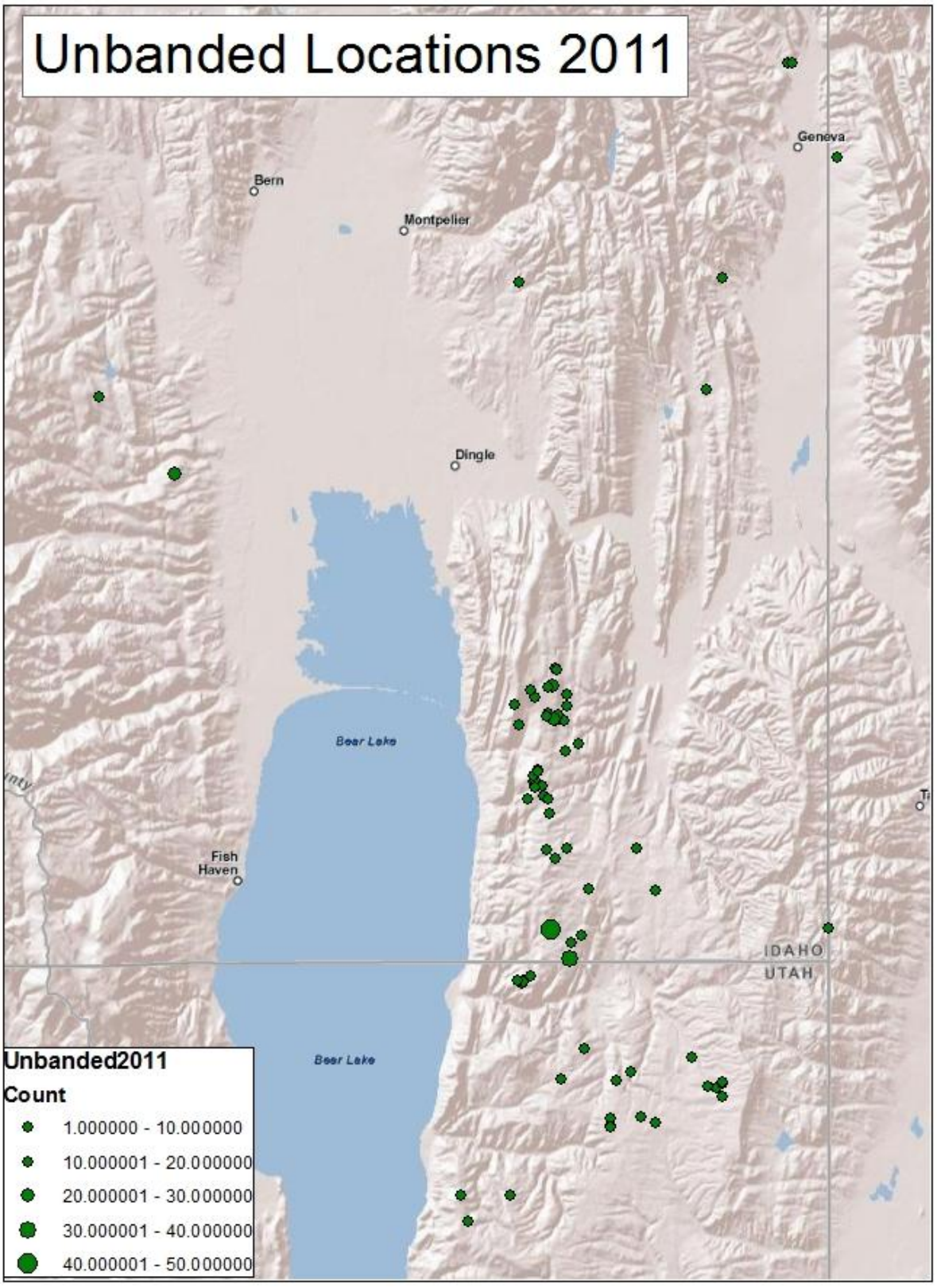


Figure 2. Recorded locations of unbanded sage-grouse for 2011.



Greater Sage-grouse (*Centrocercus urophasianus*) Lek Search

East Idaho Uplands

2011

(OSC sage-grouse project 2010-06)

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State of Idaho
Cooperative Sage-grouse Project
Project grant number 2010-06
East Idaho Uplands Sage-grouse Local Working Group
Idaho Department of Fish and Game
Idaho Office of Species Conservation

Introduction

The Idaho Sage-Grouse Conservation Plan (Idaho Sage-grouse Advisory Committee 2006) directed the state to develop local working groups to address local conditions, threats, and opportunities for conservation. The East Idaho Uplands local working group (EIULWG) identified lack of data as a high risk threat to greater sage-grouse in the planning area (East Idaho Uplands Sage-grouse Local Working Group 2011). To help address this threat, grant funding was obtained from the Idaho Office of Species Conservation (OSC) to conduct aerial lek surveys during the spring of 2011 in a portion of the EIULWG planning area.

Study Area and Methods

The focal area for the 2011 aerial survey was the Grays Lake Outlet watershed in the northcentral portion of the EIULWG planning area, from Grays Lake north to the foothills south of Ririe, Idaho (Figure 1). The total focal area was approximately 260,000 acres in size but the area included some habitats that are not likely used by sage-grouse during the lekking season (e.g. steep canyons, aspen, conifer, etc). These areas were not surveyed, as the intent of this survey was to fly areas that had the potential to have lekking sage-grouse. Locations occupied by birds during the aerial survey were not ground-truthed during the 2011 lek season.

Surveys were conducted using the Idaho Department of Fish and Game's *Aerial Lek Survey Protocol*. Observation of a displaying male was considered confirmation of an active lek but a GPS location was taken for all sage-grouse and sharp-tailed grouse (*Tympanuchus phasianellus*) observed, whether displaying or not. Aerial survey flights were conducted on April 12th, 13th, and 15th of 2011 (weather conditions precluded flying on April 14th, 16th, and 17th). Aerial surveys were conducted using a Bell 47 Soloy helicopter flying approximately 100 feet above ground level with the pilot and two trained observers. Surveys started ½ hour before sunrise and continued until two hours after sunrise. Transects were flown over likely sage-grouse habitat within the designated survey area at ½ mile intervals. All historic sage-grouse and sharp-tailed grouse leks within the area we surveyed were visited. Locations were recorded using a handheld DeLorme PN-40 GPS unit with a base topographic map overlaid with the survey area boundary and historic lek locations (basemap created in ArcGIS 9.3). Locations were mapped using DeLorme Shapefile Writer software and ArcGIS 9.3.

Results

There was still significant snowpack (approx. 120% of normal) in the southern portion of the focal area during the survey (i.e., lek habitat covered by snow) and may have caused redistribution of birds, weather conditions prevented surveying on multiple days, and the survey pilot's schedule prevented extension of the survey. Therefore, only approximately 75,000 acres, in the northern portion of the focal area, were actually surveyed (Figure 2). Greater sage-grouse were located at 8 sites during aerial surveys (Table 1, Figures 3 and 4). These 8 sightings resulted in reaffirmation of 3 historic leks (2 observations in Fall Creek Basin were 285m apart and therefore considered the same lek),

documentation of 2 new leks (2 observations in Hell Creek were 300m apart and therefore considered the same lek), and 1 observation that needs ground-truthed to determine lek status (i.e., "Unknown" status in Table 1). No new leks were located in the north portion of the area that was surveyed. No birds were observed at the one location on Tex Creek WMA that historically had sage-grouse activity (Quarter Circle O). Another historic lek near Tex Creek WMA only had one lone male (Kepp's Crossing).

Sharp-tailed grouse locations were recorded during sage-grouse lek search surveys. The details of locations and observations are included in Appendix A. The sharp-tailed grouse sightings resulted in the reaffirmation of 3 historic leks, documentation of 1 new lek, and 5 observations that need ground-truthed to determine lek status.

Discussion

Observations of greater sage-grouse during aerial surveys in early April did not necessarily result in documentation of active leks. Most birds seen during surveys flush as the helicopter approaches and likely stop displaying prior to flushing, making documentation of displaying very difficult. Therefore, lekking activity is typically not confirmed without a follow-up ground-truthing operation (i.e., visit the lek on the ground to document displaying by lekking males). Ground-truthing was not feasible during the 2011 survey due to a lack of personnel and weather conditions that severely limited ground access into the survey area. However, the documentation of these sightings is a valuable starting point for future ground-truthing operations.

The survey of the extreme northern end of the focal area (Meadow Creek to the north) resulted in no sage-grouse observations. The majority of sagebrush in this area has been removed for agriculture and most is either actively farmed or enrolled in the Conservation Reserve Program (CRP) at this time. In its current state, this part of the focal area is much better sharp-tailed grouse habitat than sage-grouse habitat, which is supported by sharp-tailed grouse lek locations and sharp-tailed grouse observations from this survey (Figure 5).

Three of the four historic sage-grouse leks within the area surveyed were reaffirmed as active leks, but 2 of those 3 had the lowest number of sage-grouse ever documented at the site. The lek at Blacktail/Ririe Reservoir (8B003) had been counted once before in 2008 and had 8 displaying males. This lek is in the middle of Blacktail Road/Lincoln Road and receives a fair amount of vehicular traffic from fisherman accessing the Reservoir. Additionally, there is a small strip of sagebrush near the lek but most of the area is actively farmed or in the CRP program. The lek at Kepp's Crossing (8B004) was also counted for the first time in 2008 and had 8 displaying males. This lek is very near the Kepp's Crossing road, a gravel road traditionally used by the few residents of the area and recreationalists. During the lekking season of 2011, there was a large volume of commercial traffic on this road hauling materials to a wind tower array that was being constructed to the east of Kepp's Crossing. This traffic may have influenced bird activity at the site. The Fall Creek Basin lek was first documented in 1988 and had 12 displaying males at that time. It was visited again in 2008 and had 5 displaying males, the same as we observed in 2011. This area is on National Forest ground, has adequate sagebrush cover, is grazed by livestock later in the season, but receives minor amounts of human disturbance during the lekking season.

Recommendations

All sage-grouse and sharp-tailed grouse observations collected during the 2011 aerial survey should be ground-truthed to verify lekking activity. In addition to verification of these observations, ground-truthing operations would likely lead to the discovery of additional leks that were not seen on this survey. Based on observations from this survey, from past surveys, and from knowledge of land use patterns throughout the Grays Lake Outlet, ground truthing operations should focus on the southern end of the area surveyed during 2011 (Hell Creek/Dan Creek). If a number of active leks in these areas are verified, a collaring effort to examine seasonal movements and survival would be very beneficial in understanding the annual ecology and habitat use of these birds.

Another aerial survey should be conducted to cover the area south of Hell Creek to Grays Lake, the area west of Grays Lake Outlet on the Bingham/Bonneville County line, and the Caribou Basin/McCoy Creek area. The area west of Grays Lake Outlet on the county line has the habitat potential to support sage-grouse and the survey pilot (Dave Savage) stated that he has seen sage-grouse in that area before. The area south of Hell Creek to Grays Lake has 2 historic leks that should be revisited and has historic and recent reports of sage-grouse activity to the immediate northwest and north of Grays Lake. The Caribou Basin area also has historic and recent reports of sage-grouse activity that should be investigated.

Initiation of a new, ground-based lek route would be extremely difficult in this area due to inclement weather preventing vehicular access during the lekking season. Once a baseline list of potential and documented sage-grouse and sharp-tailed grouse leks has been compiled (through ground-truthing and additional aerial surveys), then aerial surveys of known leks on a three to five year schedule may be advisable to monitor trends.

Acknowledgements

The funding for this project was obtained from a grant submitted by the East Idaho Uplands Local Working Group membership to the Office of Species Conservation. The grant was coordinated and administered with the help of Terry Thomas and Paul Wackenhut. Pilot Dave Savage (Savage Air Service) provided aerial survey expertise and local knowledge of the survey area. Matt Proett assisted with aerial surveys, logistics, and survey preparation. Shane Liss and Clark Shackelford assisted with aerial surveys.

Literature Cited

East Idaho Uplands Sage-grouse Local Working Group. 2011. Sage-grouse Conservation Plan.

Idaho Sage-grouse Advisory Committee. 2006. Conservation Plan for the Greater Sage-grouse in Idaho.

Table 1. Greater sage-grouse observations during 2011 aerial survey (Obs. ID is state assigned lek ID).

Obs. ID	Latitude[a]	Longitude[a]	Date	Birds Observed	Displaying Observed	Lek Status	Land Manager	General Location
8B003	43.502608	-111.780256	4/12/2011	5	No	Historic	Private	Blacktail/Ririe Res.
8B004	43.401760	-111.787318	4/12/2011	1	No	Historic	Private	Kepp's Crossing
8B002[b]	43.354422	-111.517741	4/15/2011	2	No	Historic	USFS	Fall Creek Basin
8B002[b]	43.352946	-111.520501	4/15/2011	3	No	Historic	Private	Fall Creek Basin
8B008[c]	43.331367	-111.639017	4/15/2011	10	Yes	New	Private	Hell Creek
8B008[c]	43.329487	-111.641972	4/15/2011	1	Yes	New	Private	Hell Creek
8B009	43.336747	-111.680419	4/15/2011	4	Yes	New	Private	Hell Creek
N/A	43.346750	-111.700878	4/15/2011	12	No	Unknown	Private	Hell Creek

[a] WGS84 datum

[b] observations were 285m apart, and therefore are considered the same lek in the State of Idaho lek database.

[c] observations were 300m apart, and therefore are considered the same lek in the State of Idaho lek database.

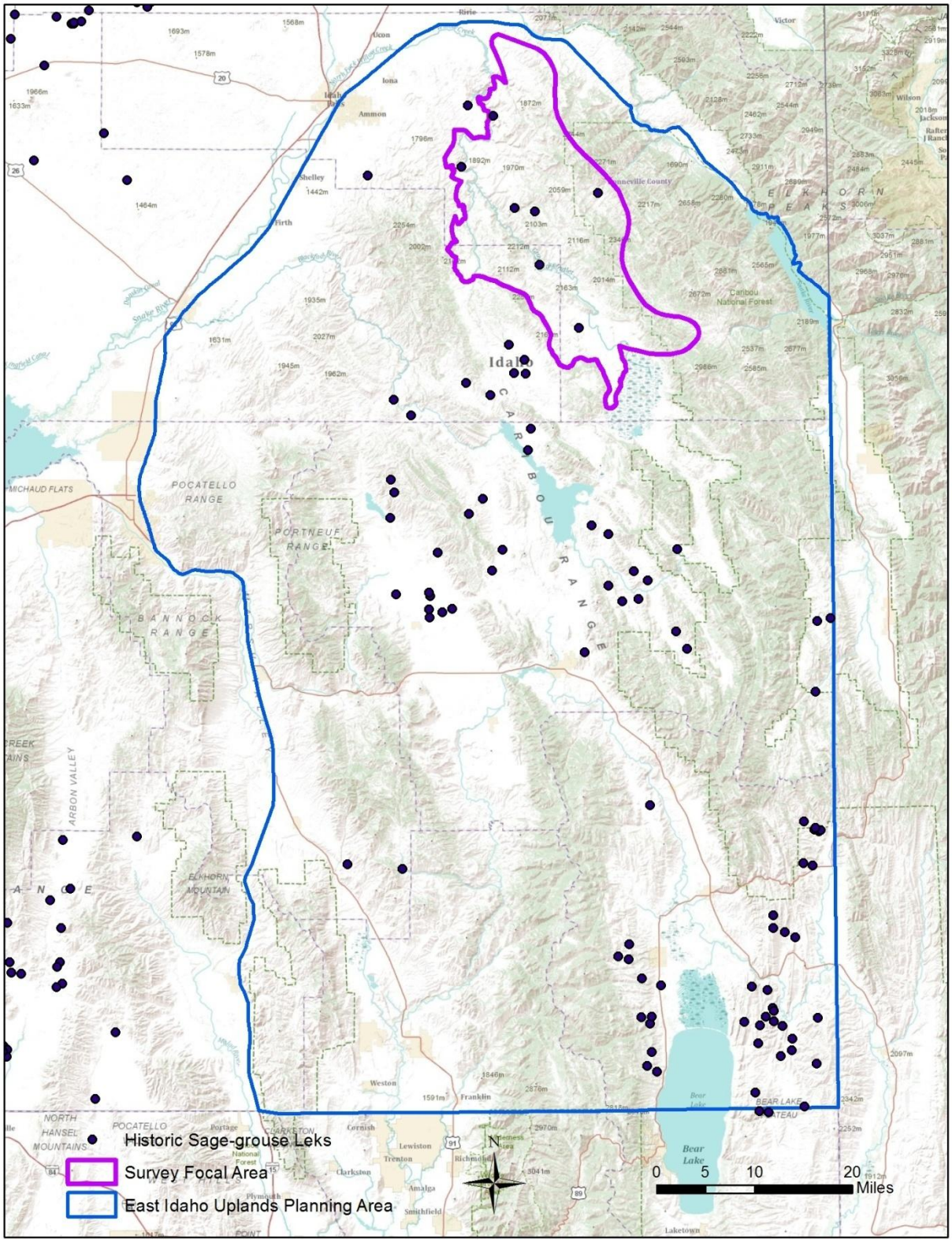

Figure 1. East Idaho Uplands Local Working Group planning area and 2011 aerial survey focal area with historic sage-grouse lek locations.

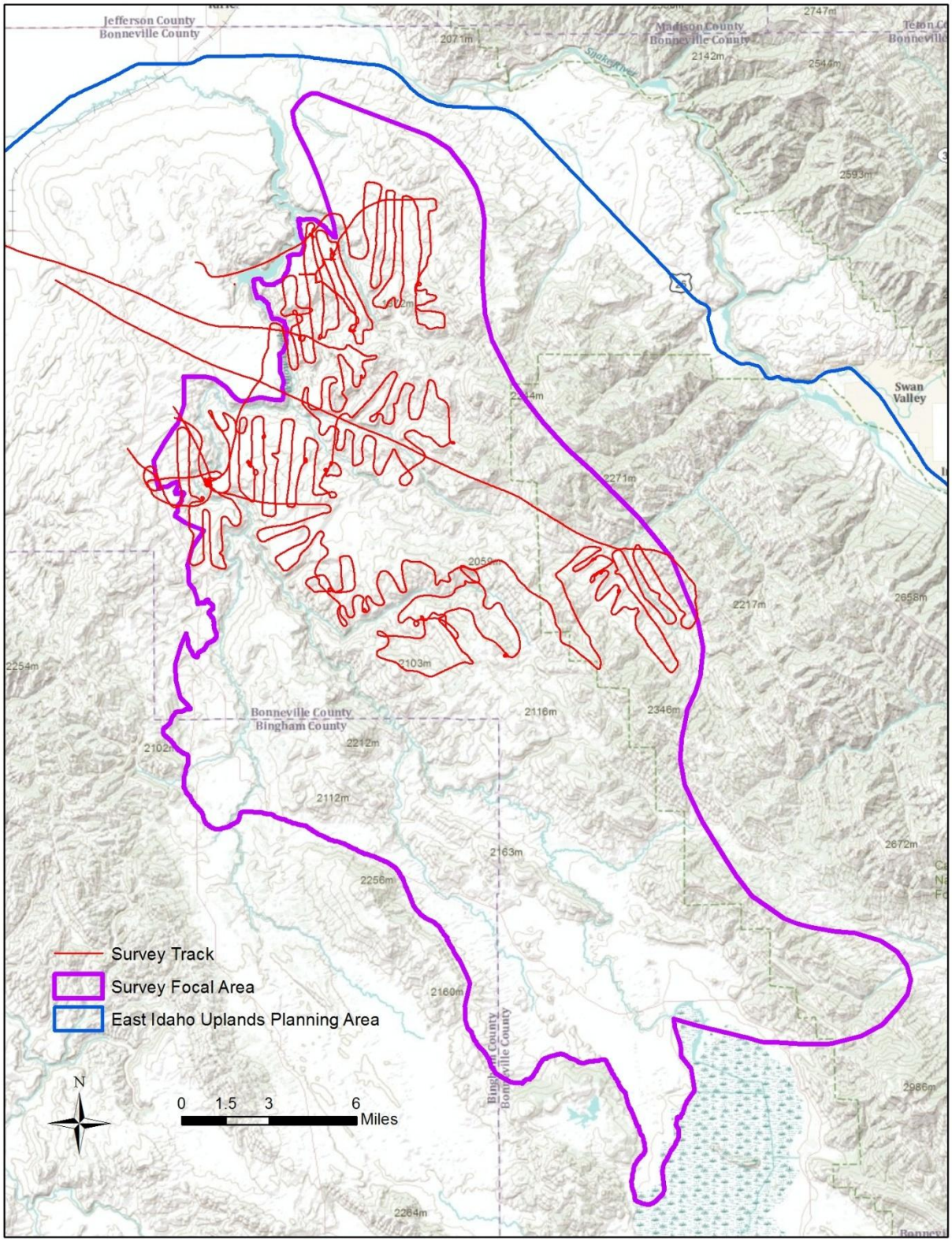

Figure 2. 2011 aerial survey focal area and track of aerial survey path.

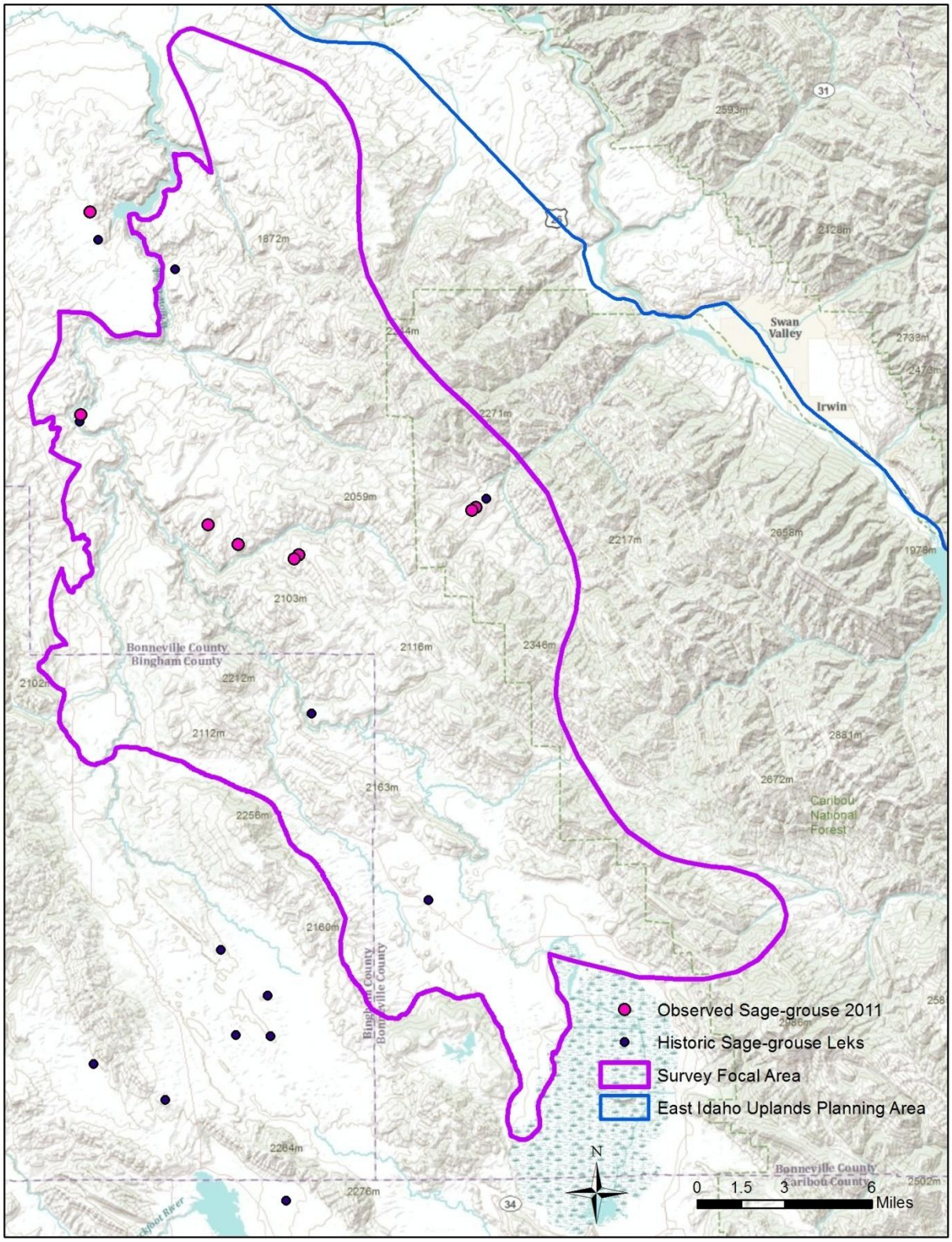

Figure 3. 2011 aerial survey focal area with sage grouse observations and historic lek locations.

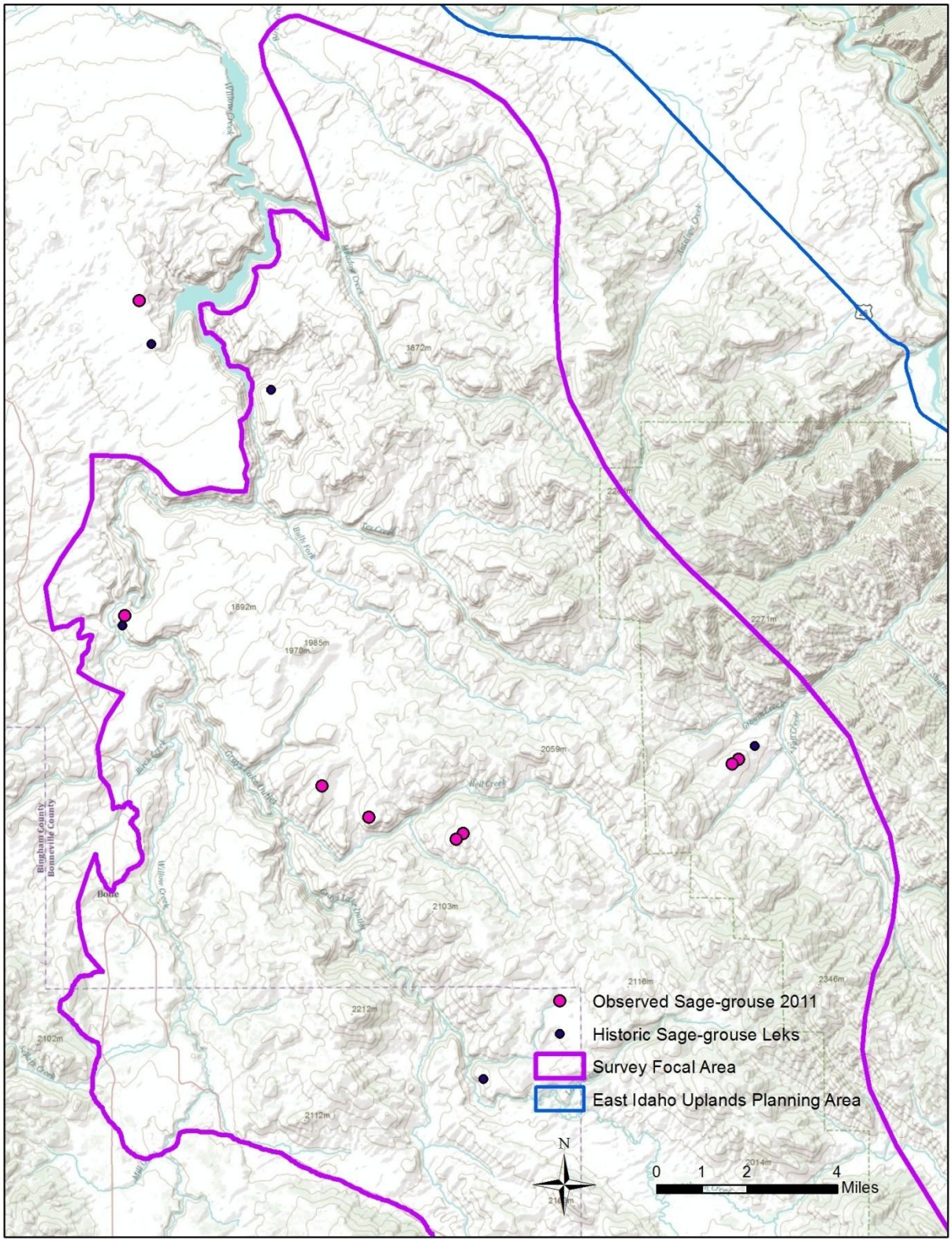

Figure 4. Northern portion of 2011 aerial survey focal area with sage grouse observations and historic lek locations.

Appendix A: Sharp-tailed Grouse Observations during 2011 Aerial Survey

(not included)

Juniper Mastication to Restore Sage-Grouse Brood Rearing Habitat

Owyhee County Sage-Grouse Working Group
Bull Basin, Juniper Mountain, Idaho

The Nature Conservancy
Arthur Ray Talsma
2011 Completion Report

Idaho Fish and Wildlife Office
FY 2010 Recovery and Candidate Conservation Implementation Project

Juniper Mastication to Restore Sage-Grouse Brood-Rearing Habitat –Bull Basin on Juniper Mountain

Abstract:

Throughout southern Idaho, sage-grouse populations are threatened by the encroachment of western juniper into sage-steppe habitat. In 2009, The Nature Conservancy, in partnership with the Owyhee Local Working Group, Idaho Department of Fish and Game, and ranchers implemented juniper mastication projects on two significant sites. These projects resulted in the restoration of approximately 526 acres of sage-grouse brood-rearing habitat. Sites 1 and 2 were selected because they are within 3 miles of historic sage grouse leks and were good brood rearing habitat adjacent to wet meadows before being encroached by western juniper. These treatments resulted in a dramatic increase in native plant diversity and abundance the following years. The cost of these mastication treatments was approximately $186 per acre at Site 1, and $245 per acre at Site 2 where larger trees and higher density were encountered. To further demonstrate the effectiveness of juniper mastication we selected a third site at Bull Basin. Site selection was again based on proximity to sage-grouse leks and productive sage-grouse brood rearing habitat. Landowners, George and Donna Bennett, were anxious to remove juniper from this area that was historically heavily used by sage-grouse. We successfully restored 484 acres in the fall of 2011. The roller-drum masticator operated cost effectively on smaller trees at $82 per acre at Bull Basin (Site 3-a). We anticipate that these mastication treatments will have a 15-20 year lifespan before treatment is again required. Many area ranchers and agency personnel participated in 4 field demonstrations. Together, these two pilots effectively improve nesting and brood rearing habitat on 1,010 acres in *Core Sage-grouse Areas.*

Project Location:

The project area is in Owyhee County, Idaho. The three sites were identified by the local sage-grouse working group to demonstrate the effectiveness of juniper mastication to benefit sage-grouse habitat. Figure 1 shows the location of all 3 sites that are being monitored from the ground and using remote images (note the GPS track log in red). The specific location of the Bull Basin Site 3 is located off the Mud Flat road at:
9S, 2W, in Section 31.

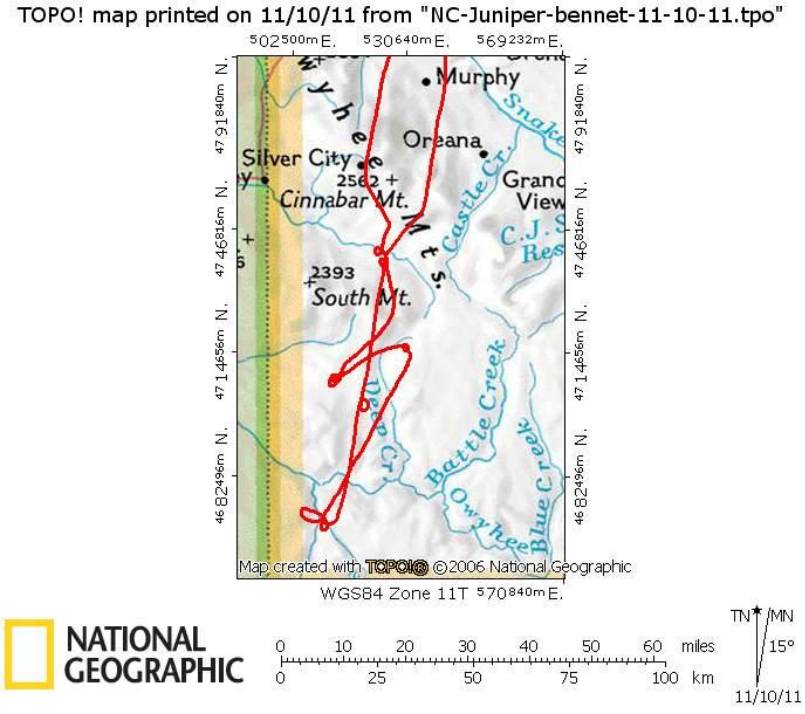

Figure 1

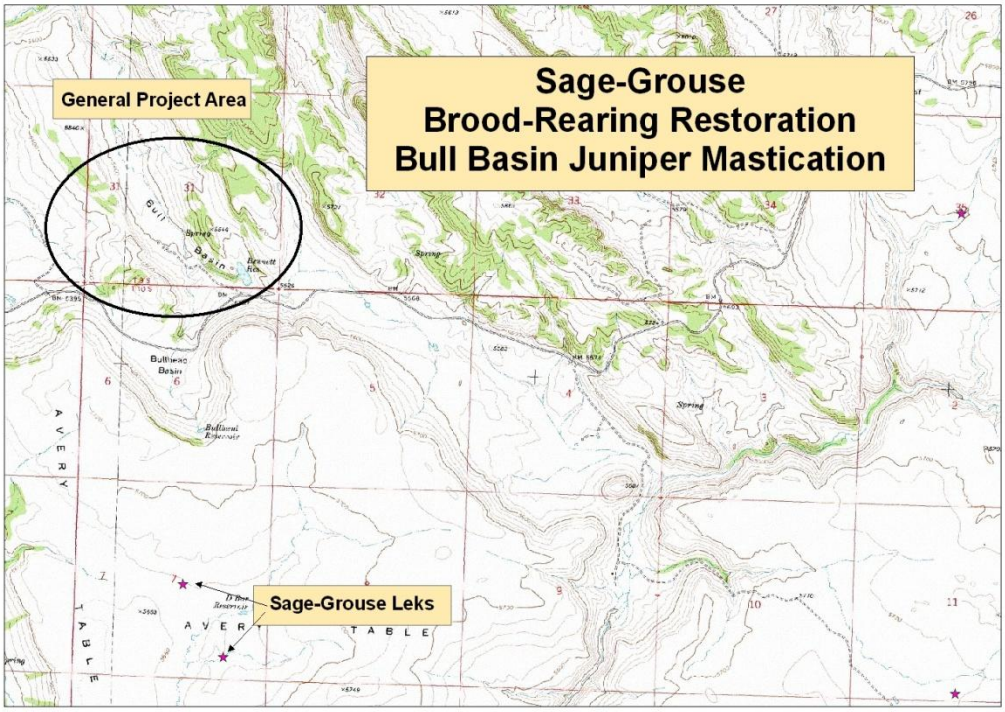

Figure 2

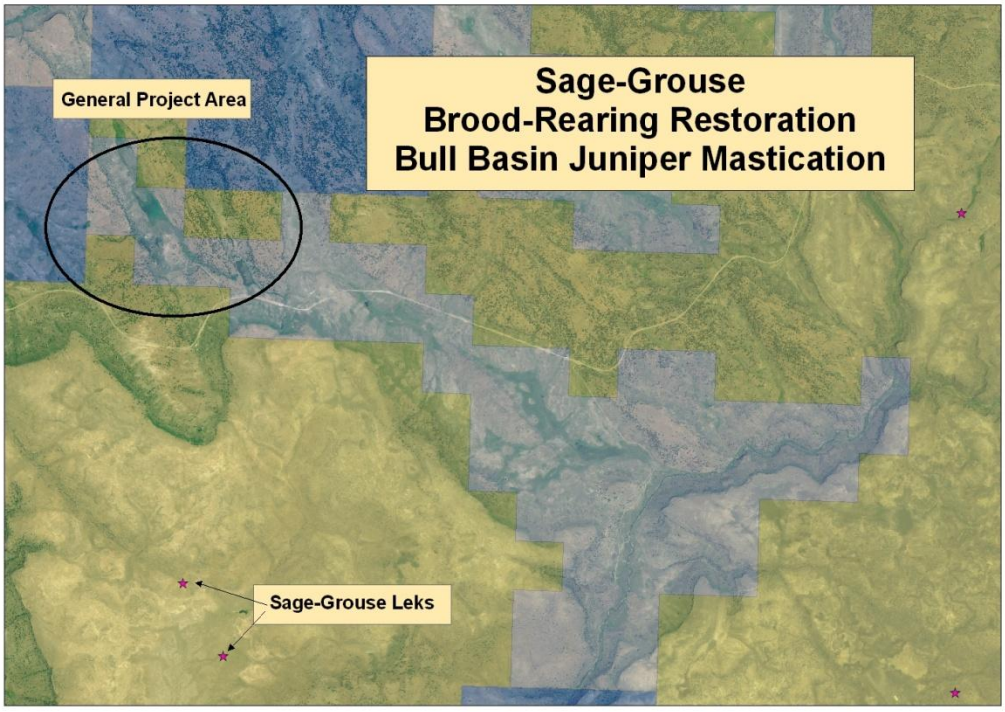

Figure 3

Introduction:

Western sage-steppe communities are habitat for over 200 wildlife species including the greater sage-grouse, which has recently been listed as "warranting protection under the ESA, but precluded by other species needs" by the USFWS. Habitat fragmentation and destruction across much of the sage-grouse range has contributed to significant declines in the bird's population over the past century. If current trends persist, many local populations may disappear in the next few decades, with the remaining fragmented population more vulnerable to extinction.

The vast majority of arable sage-grouse habitat has been converted to agricultural production. In southwest Idaho and southeast Oregon, much of the remaining sage-steppe is also undergoing change as a result of unnatural fire, invasive annual grasses, and juniper encroachment. These habitat changes result in the loss of suitable sagebrush to meet sage-grouse requirements for food, cover, and nesting[i]. An estimated 75% of the remaining birds exist within only 27% of this remaining range[ii].

Historically, Idaho's Owyhee Uplands were productive sage-grouse range. This ecologically unique area is the core of sage-grouse abundance within the western half of the species range. Maintaining grouse populations in high priority *core areas* including the Owyhee's is critical to the persistence of the species. We anticipate that success in this area will be readily translated throughout the entire region where western juniper is encroaching into sage-grouse habitat.

Figure 4. Juniper mastication using a large excavator at Site 1, October 2009

Drought tolerant species including western juniper (*Juniperus occidentalis)* are rapidly expanding into sage-grouse habitat throughout much of the bird's range. In the Owyhee Mountains, western juniper has increased in aerial extent 3-5 fold in the last 50 years. Rowland[iii] and other researchers in Oregon suggest that, within sagebrush communities, intensive management through removal of younger western juniper, while retaining pre-settlement trees, may be prudent. They have demonstrated that juniper removal in combination with brush-beating to reduce shrub height resulted in a doubling in the number of male sage grouse counted on treatment leks 2 and 3 years post-treatment. Building on this research, TNC-ID has been instrumental in demonstrating the effectiveness, and documenting the

Figure 5. Restored open meadow with native sage and bunch-grass plant community following juniper mastication

costs, of mechanical treatment (mastication) of juniper within Idaho's sagebrush ecosystems. Our experience with these efforts has been that the herbaceous community recovers quite rapidly following restoration, improving both production for livestock and sage-grouse habitat. As a result of our work with others, mechanical treatment (mastication) is now listed as an "approved" rangeland management action by the NRCS, enabling landowners to apply for federal assistance for juniper control.

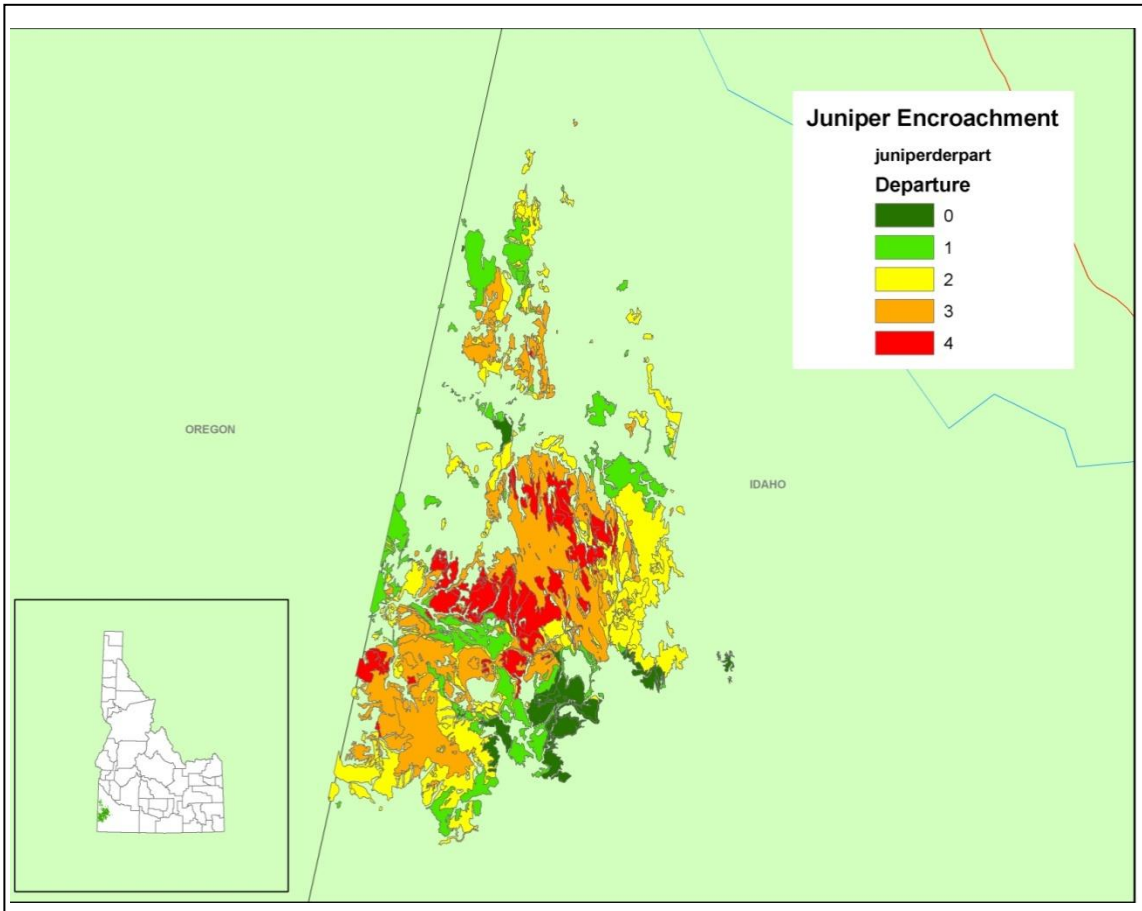

Figure 6. Departure of Western juniper abundance in the Juniper Mountain region of Owyhee County[iv]. The values represent either a value of Western Juniper above site potential (positive); no change or below site potential (0). In current Western juniper woodland sites, positive departure values indicate increases in juniper extent; describing areas of potential juniper expansion/encroachment into other ecological site types (e.g., sagebrush steppe sites).

1 = Less than 25% WJ excess
2 = 26-50% WJ excess
3 = 51-75% WJ excess
4 = Greater than 75% WJ excess

Project Description:

The purpose of this project was to restore key sage-grouse habitat by removing young (5-20') western juniper. All three project sites are near known active sage-grouse leks. The first site, Bull Basin, is located on George and Donna Bennett's property. This project targeted upland and riparian habitat enhancement for sage-grouse brood-rearing areas. The Bennett's report that, prior to juniper encroachment; the project area was extensively used by sage-grouse broods during the late summer and early fall. Over the past 2 decades, juniper has continued to encroach into a large wet meadow complex and now this area has very limited sage grouse use despite two active leks in the vicinity (Figure 3). Restoration of the riparian communities and adjacent sage steppe more than doubled the area of suitable habitat (484 acres) for sage-grouse. As a secondary benefit, aspen stands were opened to sunlight to benefit wildlife species associated with both aspen stands and wet meadows. A variety of species from elk to Columbia spotted frogs have been reported in the greater area and on adjacent properties. Increased functionality of the riparian areas following restoration is expected to result in increased habitat suitability for a variety of wildlife species.

Figure 7. Rare aspen stand, Site 3

Figure 8. Bull Basin (Site 3) visit to estimate mastication equipment needs for size and density of juniper located approximately 1.8 miles north of sage-grouse leks.

Bull Basin Site 3 Project Description: We used a roller-drum masticator for juniper control during the summer and fall of 2011. This technique was proven to be successful in other projects and the equipment is typically more mobile than the excavator masticator (Figure 4) used during 2009. The use of this type of mastication equipment enabled us to determine and compare the efficiencies of two types of equipment when working in younger juniper stands. The restored area will be rested from livestock use to encourage spring growth of native sage and grasses. This will optimize sage-grouse nest selection and nesting success in 2012 and future years as sage-grouse select nest sites in early spring.

Figure 9. Roller-drum masticator at Bull Basin, Site 3

Figure 10. Aerial monitoring of Bull Basin showing completed mastication and a much larger nesting and brood rearing area 1.8 miles north of known sage-grouse leks. Photograph taken on November 2011 by Art Talsma and Bob Unnasch in survey flight with Owyhee Air.

Figure 11. Bull Basin Homestead Site- showing juniper mastication to open up sage country and aspen that will benefit sage-grouse and a variety of other wildlife.

Mastication Cost Analysis:

The Sage-grouse Management Plan for Owyhee County lists juniper encroachment among the top three threats to sage-grouse recruitment. Juniper mastication was not used in the county prior to 2009 because of the remote landscape and cost of operating early mastication machinery. The local Sage-grouse Working Group felt it was especially important to demonstrate both the ecological and cost effectiveness of this alternative juniper control method to landowners and land managers. Both cutting and prescribed fire have been used for juniper management in the Owyhee's. However many landowners know these conservation practices put their property at risk of fire, weeds and most importantly, expansion of cheatgrass and medusahead. We also wanted to test two types of mastication equipment given that some sites are encroached by older age (stage II) juniper vs. other areas are in early stages (stage I) of invasion. Therefore all sites were purposely contracted at an operator hour rate ($145/hour) so we could test the cost per acre rates for mastication of various ages and densities of juniper stands.

We found that the roller-drum masticator operated most effectively in young scattered juniper stands that were encroaching wet meadows. In contrast the larger trees up to 20 inch dbh and over 20 feet tall were most effectively masticated by the excavator

machinery. Mobilization costs were similar. Both types of equipment were very light on the land with less than 6 psi track weights. Experienced operators walked the equipment around and over sage in route to juniper trees with very little soil disturbance.

Table 1. Stage I and II juniper mastication cost per acre at 3 sites in the Owyhee's.

	Cost Per Acre*	Acres Masticated	Meadows & Openings	Total Area Restored
Site 1 Nickel Creek Stage I & II juniper	$186	151 acres	165 acres	316 acres
Site 2 Josephine Creek Stage II juniper	$245	124 acres	86 acres	210 acres
Site 3-a Bull Basin Meadow Pasture Stage I juniper	$82	210 acres	164 acres	374 acres
Site 3-b Bull Basin Aspen Pasture Stage II juniper	$169	90 acres	20 acres	110 acres
Totals		575 acres	435 acres	1,010 acres

- Average mastication cost for all 3 sites was $139 per acre of stage I and II juniper.

Partner Collaboration:

Figure 12 George and Donna Bennett at Bull Basin

Partners included:

- Art Talsma with The Nature Conservancy as project manager
- Landowners- George and Donna Bennett
- State lands managed by Idaho Department of Lands.
- Owyhee Country NRC administered the sage-grouse funds from IDFG and OSC and contracted the mastication at all 3 sites.
- Many ranchers, hunters and land managers in the Sage-Grouse Local Working Group helped with the demonstrations, photography, weed control and sharing the story of conservation in the Owyhee's.

- The NRCS Marsing office offered assistance to area landowners and the Jordan Valley CWMA provided weed inspection of equipment plus weekly monitoring of the experienced operators.
- The USFWS provided both funding for the monitoring and technical advice regards projects to improve sage-grouse habitat.
- Idaho Department of Fish and Game and BLM provided sage-grouse lek survey data on maps as well as hunter collected sage-grouse age ratio wing data.

Figure 13. Partners gather for a photograph during one of the 2011 field demonstrations.

Monitoring:

The Nature Conservancy (TNC) collected both pre-treatment and post-treatment vegetation data. TNC utilizes paired infrared and natural light cameras to collect ground cover data. Analysis of these images provides information on green vegetation cover, bare ground, and species composition (as needed). NRCS staff was also involved in monitoring improvements in range conditions.

Figure 14. Aerial view of juniper mastication one week following treatment. The light brown areas are masticated juniper.

Figure 15. Dual mounted cameras taking IR and natural light photographs before and after mastication treatments

Figure 16. Monitoring included 11 transects per site with 20 photographs per transect resulting in 210 photographs/year to monitor response in native plnat community over time.

Figure 17. Robust growth in native forbs and grasses along with sagebrush 2 growing seasons after treatments.

Outreach and Communication:

Project Site 1 and 3 are located in an area easily accessible from the Mud Flat Road. These are excellent demonstration sites to engage other ranchers and agency land managers as we monitor restoration of sage-grouse habitat in the future. These demonstrations will increase awareness of sage-grouse conservation and the associated threats. They provide opportunities for other producers and professionals to witness the benefits of on-the-ground juniper encroachment site restoration. We also expanded the outreach through several articles written for the Statewide Sage-grouse Newsletter and in publications of The Nature Conservancy. We presented the projects to joint agency meetings and professional (TWS and SAC) conferences. We maintain an Owyhee Forum on a Spatial Interest site owned and managed by Dennis Murphy. Mountain Visions in Boise produced on site videos and panoramic photography that is being shared on Web browsers in TNC sites, YouTube and Google Earth (see attached DVD provided to the USFWS in Boise). Information is shared with universities and BLM, NRCS, USFS and USFWS regards the cost of mastication as a conservation practice for ranchers, contractors and land managers.

Figure 18. Project demonstration with video and panoramic photographs that were shared on web sites.

References:

[i] Connelly, J.W. et al. 2010. Conservation of Greater Sage-grouse: A synthesis of current trends and future management. In: Marti, C.D., ed. 2010. Ecology and Conservation of Greater Sage-Grouse: A landscape species and it habits. Univ. of CA Press.

[ii] Doherty, K.E., J.D. Tack, J.S. Evans, and D.E. Naugle. 2010. Mapping breeding densities of greater sage-grouse: A tool for range-wide conservation planning. Bureau of Land Management White Paper

[iii] Rowland, M.H., L.H. Suring, L.H., R.J. Tausch, S. Geer, and M.J. Wisdom. 2008. Characteristics of western juniper encroachment into sagebrush communities in central Oregon. USDA Forest Service and range Sciences Laboratory, La Grande, Oregon 97850, USA. 23pp.

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MOVEMENTS, HABITAT USE, AND VITAL RATES OF GREATER SAGE-GROUSE (*CENTROCERCUS UROPHASIANUS*) IN AN ISOLATED POPULATION OF WEST-CENTRAL IDAHO

Update for 2008–2011 and
Cumulative Report for 2005–2011

Prepared By:
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IDAHO DEPARTMENT OF FISH AND GAME

Virgil Moore, Director

600 South Walnut Street
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November 30, 2011

Findings in this report are preliminary in nature and not for publication without permission of the Director of the Idaho Department of Fish and Game.

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ABSTRACT

During 2008–2011 we continued a study initiated in 2005 of movements, habitat use, and vital rates of greater sage-grouse (*Centrocercus urophasianus*) in Idaho's West Central Sage-grouse Planning Area. We trapped birds at night in spring and fall, marked them with leg bands, and deployed radio collars. We followed birds year-round and marked locations of all sage-grouse, including uncollared sage-grouse encountered opportunistically, with a Global Positioning System (GPS). We used line intercepts and Daubenmire frames to characterize fine-scale vegetation, and examined sage-grouse occurrence relative to land ownership and the statewide sage-grouse habitat planning map at a broad scale. We used results of lek surveys from 2008–2010 to maximize our trapping and as the context for interpreting the health of the population from which our radio-collared birds came. Peak female lek attendance was shorter in duration than males and occurred prior to the statewide protocol period. We added 68 sage-grouse and 700 observations to the study during 2008–2011. Of 11 nesting opportunities for 9 hens, 2 nests hatched, 3 nests were lost to predators, and on 4–6 occasions no nests were initiated. Across all years of the study we tracked sage-grouse an average of 272 days, with no difference between females and males. Survival beyond the first year of being radio-collared ranged 36–76% for males and 33–83% for females. Two of 5 birds collected dead were confirmed positive for West Nile Virus. Sage-grouse overlapped geographically with birds from other nearby leks, generally after the breeding season. On 3 occasions males were present at 2 leks during a single breeding season. We identified the Hells Canyon breaks as a long-distance wintering area, with birds from 4 leks traveling there. The greatest distance from a lek to a seasonal-use area was 54 km. One of our hens crossed the Snake River to winter in Oregon, and an Oregon hen wintered on the Idaho side at least 1 year. 89% (n = 3495) of sage-grouse locations occurred in key habitat, compared with 35% of the planning area occurring in this class. The greatest threat to the west-central Idaho sage-grouse population is human encroachment. Data generated from this study on habitat use and important seasonal areas occupied by sage-grouse will be used by local governments, utilities, and federal agencies as they consider land-use changes. Individual landowner participation in the Candidate Conservation Agreement with Assurances holds the best prospect for sage-grouse. Our information on sage-grouse seasonal-use areas and site-specific vulnerabilities will contribute to the effectiveness of these plans.

ACKNOWLEDGMENTS

This study could not have been conducted without the assistance, input, and encouragement of the landowners of Washington and Adams counties, Idaho. Their dedication to the western way of life, their love of the land they cherish, and their unselfish commitment to protect wildlife made this study possible. Gratitude is also given to the members of the West Central Sage-grouse Local Working Group. M. Commons Kemner implemented the first year of the study and continued to provide biological expertise. W. Green, P. Bond, B. Wagner, J. Rohlman, C. Mack, A. Moser, G. Burak, R. Bronson, J. Bronson, D. Gray, M. Sands, J. Pyron, P. Mamer, M. Cambier, J. Rebholtz, and S. Allen assisted with trapping. C. N. Kinney assisted field efforts. M. Scott, W. Green, M. Sands, D. Neider, G. Duke, E. Potter, R. Winton, and A. Owsiak conducted lek counts. Idaho Power donated the use of telemetry equipment and purchased transmitters. The West Central Highlands Resource Conservation and Development Area purchased transmitters and provided additional funding. Regional Soil Conservation Districts provided outreach in their newsletters. This study was funded by the State of Idaho Cooperative Sage-grouse Project administered by the Office of Species Conservation. Lek surveys were funded in part by a Challenge Cost Share Agreement with the Bureau of Land Management.

INTRODUCTION

This report updates a study of movements, habitat use, and vital rates of greater sage-grouse (*Centrocercus urophasianus*) in Idaho's West Central Sage-grouse Planning Area (SGPA). The study began in March 2005 and two previous progress reports covered activities through 31 December 2007 (Gray and Commons Kemner 2006, Gray and Evans Mack 2009). This report covers the ensuing 42 months, through summer 2011.

The West Central Sage-Grouse Local Working Group (LWG) was formed in June 2004 and represents 1 of 12 planning areas in the state. LWGs are advisory groups supported by the Idaho Department of Fish and Game (IDFG) to promote collaborative sage-grouse conservation throughout its range (Idaho Sage-grouse Advisory Committee 2006). The West Central LWG is comprised of local landowners, state and federal agency staff, non-governmental organizations, interested citizens, and other local resource users. Interest in managing sage-grouse has increased among private landowners, and they are becoming more actively involved in local planning efforts to help maintain or enhance sage-grouse populations. A programmatic Candidate Conservation Agreement with Assurances (CCAA) was signed on 12 February 2010. This CCAA serves as the West Central SGPA management plan as required by the Conservation Plan for the Greater Sage-grouse in Idaho (Idaho Sage-grouse Advisory Committee 2006) and is the umbrella document for site-specific management plans by individual landowners.

The greater sage-grouse once occupied 13 western states and 3 Canadian provinces. Large-scale eradication and alteration of sagebrush (*Artemisia* spp.*)* habitats, upon which sage-grouse depend for survival, have reduced the range to 10 states and 2 Canadian provinces (Connelly and Braun 1997, Connelly et al. 2004, Idaho Sage-grouse Advisory Committee 2006). Continued declines in sage-grouse across their range through the mid 1990s prompted multiple petitions to list the species as threatened or endangered under the U. S. Endangered Species Act (USDI 2005). In early 2010 the U.S. Fish and Wildlife Service listed the greater sage-grouse as a candidate species under the Act.

The West Central sage-grouse population occupies sagebrush habitat in portions of Washington, Adams, Gem, and Payette counties in western Idaho on the Idaho/Oregon border. This area is unique relative to other sage-grouse areas in the state. The West Central SGPA supports the largest proportion of private land compared with the other SGPAs in Idaho, and much of the remaining sage-grouse habitat occurs on these private lands. The sage-grouse population was thought to be geographically isolated from other populations of sage-grouse in Idaho and Oregon. Several leks occur on winter livestock feed lots and within 100 m of fences, roads, occupied residences, and barns. The area is dominated by large stands of introduced perennial grasses such as bulbous bluegrass (*Poa bulbosa*), crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass (*Thinopyrum intermedium*), and native perennial grasses with scattered sagebrush and abundant forbs. There has been no sage-grouse hunting season since 1984.

The purpose of this project was to continue to identify seasonal habitat use, movements, and vital rates of sage-grouse in west-central Idaho. Landowners active in the West Central LWG expressed a strong desire to see baseline information established from which to evaluate progress in improving habitat or sustaining populations. Little was known about population movements of the greater

sage-grouse in the West Central SGPA prior to February 2005. Local opinion was that elements of the population were not migratory. A lack of detailed information on lek data, distribution, habitat use, and numbers in the West Central SGPA hampered the West Central LWG's ability to effectively participate in broader (e.g., statewide) conservation efforts, specifically to identify threats and opportunities to initiate habitat enhancements on the ground.

STUDY AREA

The West Central SGPA consists of sagebrush steppe habitat from the Oregon border to a few miles east of the North Crane road, north to Cambridge/Indian Valley, and south to the Washington/ Payette/Gem county line. The study area is approximately 3,747 km². Ownership is made up of 64% private, 20% federal, and 5% state (Fig. 1). Elevations range from 640 m at the Snake River near Brownlee Reservoir to over 1,219 m at Sugarloaf Peak and the southern Payette National Forest boundary. Most of the area and the occupied habitat lie between 762 m and 1,067 m.

Climate is characterized by cold, wet winters and hot, dry summers. Mean annual precipitation is 28 cm at lower elevations near Weiser but rises quickly with elevation to over 50 cm over much of the SGPA. Of this, 29% falls during April through September. In 2 years out of 10, rainfall during this period is less than 13 cm (USDA 2001).

The West Central SPGA is characterized by valley farmlands surrounded by extensive rolling hills of sagebrush, grassland, and mountain foothills. The valley bottom is dominated by irrigated hay meadows and some dry land wheat production. Livestock grazing is the major agriculture practice in the sagebrush uplands. Much of the historic dry land wheat has been converted to perennial grass made up primarily of intermediate wheatgrass and bulbous bluegrass. The dominant native shrubs are big sagebrush (*A. tridentata* ssp. *xericensis*), low sagebrush (*A. arbuscula*), mountain big sagebrush (*A. t.* ssp. *vaseyana*), stiff sagebrush (*A. rigida*), antelope bitterbrush (*Purshia tridentata*), black hawthorn (*Crataegus douglassii*), and yellow rabbitbrush (*Chrysothamnus viscidiflorus*). Dominant native grasses are bluebunch wheatgrass (*Pseudoroegneria spicata*) and Idaho fescue (*Festuca idahoensis*). Common forbs are balsamroot (*Balsamorhiza* spp.), mules-ears (*Wyethia amplexicaulis*), tapertip onion (*Allium acuminatum*), buckwheat (*Eriogonum* spp.), desertparsley (*Lomatium* spp.), prickly lettuce (*Lactuca serriola*), largehead clover (*Trifolium macrocephalum),* and curleycup gumweed (*Grindelia squarrosa*).

METHODS

Lek Counts

Leks were the focal point of this telemetry study, as most birds were captured on or near leks during the breeding season. Thus, numbers of birds and timing of lek attendance directly influenced our capture effort. In the late 1990s, 4 lek routes encompassing 14 leks were established in what is now the West Central SGPA. These routes were monitored annually by IDFG to index sage-grouse population trends. The lek monitoring protocol in Idaho requires at least 4 visits during 25 March through 30 April (Connelly et al. 2003). In 2005 we were alerted by rancher Steve Sutton that males were on leks earlier in the West Central SGPA. Our observations suggested peak hen attendance, and possible peak male counts, occurred prior to this protocol period. Beginning in 2008, we worked with Mike Scott, IDFG coordinator of the West Central lek surveys, to add visits to leks

during late February through 25 March. Lek counts otherwise followed established protocols for time of day, weather, and routes. Peak counts were tallied by individual lek and by route for males and females separately. We used results of lek surveys from 2008–2010 to maximize our trapping efforts (i.e., when to trap which leks) and as the context for interpreting the health of the population from which our radio-collared birds came.

Telemetry

Capture and telemetry followed the methods established in 2005 (Gray and Commons Kemner 2006). Sage-grouse were trapped at leks and adjoining areas, which were selected based on: (1) an adequate number of displaying males to attract females, (2) geographic separation, (3) a mix of private and federal lands, and (4) a range of habitats within 5 km of the lek. Additional trapping occurred away from leks during late summer and fall by tracking radio-marked sage-grouse to other unmarked birds grouped with them.

Sage-grouse were captured at night using a spotlighting technique and large landing net (Giesen et al. 1982). We equipped captured sage-grouse with radio collars (Advanced Telemetry Systems, Inc., Isanti, MN) and a numbered leg band. Sage-grouse leg bands had the alpha prefix SGM (sage-grouse male) or SGF (female) followed by a number. Radio transmitters had a mortality switch. Bird age was determined by assessing the shape of the outer 2 primary feathers. Radio-marked birds were monitored every 2 to 3 weeks from March through August and once each month from October through February with an R-1000 Telemetry Receiver (Communications Specialists, Inc., Orange, CA) and a hand-held Yagi antenna. Most telemetry work was conducted from the ground on foot or with an ATV. The ATV was equipped with a 1.5 m antenna. Aerial flights (fixed-wing aircraft) were conducted when birds could not be found from the ground. We also used specific vantage points (e.g., Riley Butte, Ant Butte) to scan for missing birds. We got visual confirmation from telemetry locations whenever feasible to describe spring and summer habitats of males and non-nesting females, nest and brood-rearing habitats of females, fall habitats of all birds, and movements to wintering areas. Radio transmitters detected on mortality mode were retrieved as quickly as possible to investigate cause of death.

Locations of all birds, including uncollared sage-grouse encountered opportunistically, were marked with a Global Positioning System (GPS). These ‘hits’ formed the basis for land ownership and vegetation associations and were defined as a field contact with ≥1 sage-grouse in 1 occurrence. Thus, a group was counted as 1 hit regardless of group size.

Sage-grouse movements among seasonal activity areas were measured in ArcGIS v9.3. Summer generally was defined as June–August, fall as September–November, winter as December–February, and spring as March–May. However, some locations were assigned to a season based on their geographic clumping with other locations rather than strictly by date. For example, a location in late August that was far from other summer records and clumped with later fall records was considered ‘fall’. Males were on or near leks for the spring period. The farthest lek-to-summer distance was measured from the lek to the summer location that was farthest away. Average lek-to-summer distance was an average of the measurements from the lek to each individual summer location. Summer-to-fall distance was measured between the last summer location and the first fall location. Fall-to-winter distance was between the last fall location and the first winter location. The farthest distance from winter to lek was measured from the winter location most distant from the

lek. Measures of female sage-grouse movements were similar to males except we added a lek-to-nest (if nested) or lek-to-spring (if no nest) measure and replaced the lek-to-summer with a nest- or spring-to-summer measure. Sage-grouse that disappeared or perished within 2-3 months of capture were not included in movement calculations. Measuring distances was subjective; thus, we reanalyzed 2005–2007 data using the same methods and software used for 2008–2011 data.

Vegetation

We developed a list of plants associated with sage-grouse observations to describe general habitat by cover type. We recorded plant species that occurred within 50 m of each sage-grouse contact (observation in the field), including marked birds and those encountered opportunistically, during 2005–2011. From these data we determined which months of the year a plant species was recorded at any observation. Plants associated with any sage-grouse location in only 1 month during the year were assigned a '1'. A '12' indicated a plant species was recorded at sage-grouse locations throughout the year. Species names generally followed the PLANTS database (USDA 2011); some older names also were listed for consistency with previous reports.

We measured vegetation characteristics at nest, brood, and random locations during 2006–2011, and at male seasonal locations in 2008. We used line intercepts (Canfield 1941) to measure sagebrush and other shrub canopy cover. Grass and forb height and canopy cover were measured with Daubenmire (1959) frames.

At the broad scale, we examined where sage-grouse locations occurred relative to the statewide sage-grouse habitat planning map (Idaho Sage-grouse Advisory Committee 2006) as updated through 2008 (Bureau of Land Management 2008, unpublished data). We also examined locations relative to land ownership. We buffered sage-grouse locations by 1 m to create a polygon layer, then intersected this layer with the habitat classification layer and with a general ownership layer in ArcMAP v9.3. Land ownership was confirmed from spatial data in ArcGIS v9.2 as part of the development of the West Central LWG CCAA (J. Hatton, Artemis Technologies, LLC, personal communication).

RESULTS

Lek Monitoring

In 2008 IDFG coordinated 4 early visits to each of 4 lek routes prior to the March 25 protocol period, with the earliest on 22 February along the Soulen Center route. In 2009–2010 1–3 early visits per route were completed, beginning 7 and 11 March, respectively. The following summary was provided by Mike Scott, IDFG. Males had a relatively stable and extended peak period spanning 49 days. Across the 3 years, the earliest peak male count was 10 March 2009 on the Midvale route; the latest was 27 April 2009 on the Crane Creek route (Fig. 2). Of the 12 peak counts (4 lek routes X 3 years), 75% fell within the prescribed 25 March–30 April survey period. However, in roughly 8% of the surveys (1 out of 12), that time period may be too late to detect the peak count. Counts starting 5 to 10 days earlier could reduce that problem, although counts should still extend though 30 April.

Female lek attendance was quite different from males. Female attendance peaked in mid- to late-March (Fig. 3). This was earlier and shorter in duration (15 days) than males. All of the female peak

attendance occurred between 10 March and 24 March, prior to the statewide protocol period. Counts before and after that time period were usually ≤50% of the peak. Peak hen attendance was earliest along the Midvale lek route in 2 of the 3 years and latest along the Monday Gulch route.

Looking back 10 years, the maximum number of males counted on lek routes (maximum count on each lek independently summed across the 3–5 leks per route) dropped substantially in 2007 (Fig. 4). This decline coincided with high reported cases of West Nile Virus (WNV) in humans and horses the previous 2 years in Adams and Washington counties (Idaho Department of Health and Welfare 2008). No WNV cases were reported in these counties in 2010 and 2011 (U.S. Geological Survey 2011).

Telemetry Study

We entered the 2008–2011 study period with 6 previously marked male sage-grouse. During March and April 2008 we captured another 17 males from 6 leks (Table 1). Two of these males (SGF3254 and SGF3255) were mistakenly fitted with female leg bands. Thirteen of the 17 birds captured in 2008 survived into 2009, a relatively high first-collar-year persistence (76%) for this study.

In 2009 we attempted to capture only female sage-grouse. We caught 5 birds (3 hens, 2 males) from 4 leks, although 1 male was banded only (Table 1). Capturing female sage-grouse in the West Central SGPA was difficult because peak lek attendance was early and snow was still present on the ground, making a stealth approach challenging. The single radio-collared male was captured on the Farm to Market lek, the first bird from this lek since the study began in 2005. By the end of 2009, 2 hens remained on the air.

In spring 2010 another 19 males and 3 females were captured from 7 leks (Table 1). An additional 3 females were captured in October <2 km southeast of the Cinnabar lek. Of these 2010 captures, 12 birds (8 males, 4 hens) survived into 2011. Our last trapping effort occurred in spring 2011, with 4 males marked from 3 leks. The 3 hens captured in fall 2010 were still alive by mid-summer 2011, and all 4 of the birds trapped in spring 2011 were still confirmed or presumed alive by mid-summer.

During 2008–2011 most contacts with radioed sage-grouse occurred on private land (83%), compared with 16% on federal land and 1% on state land. These percentages follow land ownership across the West Central SGPA (64% private, 30% federal, and 5% state). A total of 700 observations of marked and unmarked birds were made during 2008–2011. Field personnel made 686 contacts with 57 radio-marked birds during this period, including 1 female from Oregon that wintered in Idaho.

The 9 hens captured in 2009 and 2010 collectively had 11 nesting opportunities, as 2 hens survived through 2 nesting seasons. Of these 11 opportunities, 2 nests hatched but 1 brood was lost and the fate of the other brood was unknown, 3 nests were lost to predators, and on at least 4 and possibly 6 occasions no nests were initiated (Table 2). These hens were captured from 5 leks (Craig, Soulen Center, Cinnabar, Shoepeg, and Fourmile) and from a fall seasonal location southeast of Cinnabar. SGF3201 from the Soulen Center lek, a non-nesting hen in 2009, was observed on several occasions with other sage-grouse that year, including 2 broods of 6 and 7 chicks, respectively, in early August. No hens were captured in 2008, but 4 broods were observed in the study area during May–August that year.

2005-2011 CUMULATIVE RESULTS

Population Statistics

From the beginning of the study in spring 2005, we made 101 captures of 100 sage-grouse. Of these, 71 males and 21 females were fitted with radio transmitters. The total male captures included 1 male, SGM3893, which was first caught in 2005 and banded only, then recaptured in 2007 and collared. Another 8 males were banded only. Sage-grouse were captured on 12 leks (Fig. 1), although more than half (56%) of the captures were from 5 leks (Soulen Center, Craig, Fourmile, Wiley, and Shoepeg; Table 3).

Of the 92 sage-grouse fitted with transmitters, 78 were included in an analysis of 'tracking days', or the length of time a bird was on the air from capture until death or disappearance. Excluded from this analysis were birds still alive as of July 2011 (n = 7), birds whose transmitters dropped or failed prematurely (n = 5), and birds lost from contact shortly after capture (n = 2). On average, sage-grouse in our study area were tracked 272 days, with no difference between females (278.2 tracking days) and males (270.8 tracking days; $t_{25} = 2.06$, $P = 0.88$). The longest period of time that a single sage-grouse was tracked was 610 days (Table 4). This was female SGF3201 trapped near the Soulen Center lek and followed from 18 March 2009 through 18 November 2010. Female SGF3297 (Lower Knob Hill) and male SGM3811 (Fourmile) had the next longest durations on the air, 593 and 586 days, respectively. Thirty-three birds (28 males, 5 females) were followed through portions of 2 consecutive lek-attendence seasons.

During 2005–2011, 55 of 92 (60%) radio-marked sage-grouse were found or presumed dead (Table 4). Another 24 birds 'disappeared' and transmitters were not recovered, in some cases because the birds outlived the transmitter battery life but in other cases because the birds likely died. Based on known mortalities and the missing birds presumed dead, males from Lower Knob Hill, Sagebrush Flat, and Fourmile leks generally fared the best, while those from Craig, Wiley, County Line, and Crane Creek Reservoir had the highest loss (Table 5). In contrast, females from Craig fared the best and those from Wiley and Fourmile fared poorly, although sample sizes were much smaller for females (Table 5). Survival beyond the first calendar year of being radio-collared varied across the 7 years of the study, and the year of highest apparent survival was different for males and females (Table 6). Apparent survival for males ranged 36–76%, females 33–83%.

Through the 2005–2011 study period 5 sage-grouse were examined for WNV by IDFG's Wildlife Health Laboratory. An unmarked delirious bird was collected 2.7 km northwest of the Lower Knob Hill lek on 8 August 2006 and diagnosed with fungal pneumonitis and airsaculitis but tested brain and lung positive for WNV. WNV was not considered to be the direct cause of death. A male trapped on the Monday Gulch II lek in spring 2008 was found alone and sickly on the night of 24 August 2009 1.3 km east of the Wiley lek. He was picked up dead the next morning and transported to the Wildlife Health Lab. WNV was the cause of death. The remaining 3 birds tested negative for WNV.

Locations and Lek-based Seasonal Movements

We detected sage-grouse from 666 m to 1,450 m elevation. Median elevation was 1,025 m. The Shoepeg, Sagebrush Flat, and Lower Knob Hill leks near Midvale occurred at the lower range of recorded elevations, from 806–834 m. The other 9 leks east of the Midvale area were >950 m, with

the highest at 1,072 m. SGM3829, marked on the Sagebrush Flat lek (834 m), was located at the highest elevation recorded, the Hells Canyon breaks (1,450 m), during January 2009.

Leks generally defined the home ranges of sage-grouse on the landscape (Fig. 5). Sage-grouse associated with particular leks often overlapped geographically with birds from other leks, although this happened most often outside of the breeding season and generally followed proximity (i.e., interactions with nearest neighbors; Fig. 5). For example, the Wiley and Monday Gulch II leks were close, ~2 km apart, and males from both leks were observed together and with other unmarked birds on numerous occasions once birds moved away from the leks in late spring. Similar overlap occurred between Crane Creek Dam and Farm to Market and between Soulen Center and Cinnabar. In contrast, no birds from other leks were observed near Lower Knob Hill in any season.

We saw variation not only in individual movements, as expected, but also in the way birds from particular leks used the landscape. For example, birds trapped at the Craig lek dispersed the most compared to other leks (Fig. 5). A non-nesting female summered ~11 km west in the hills north of Little Crane Creek Reservoir near a male from Crane Creek Dam lek and in the same vicinity where males from Farm to Market lek were observed several years later. One Craig male summered east above Sheep Creek where birds from Fourmile lek were observed in other years, and 2 other Craig males went south to settle west of the Fourmile lek. Two males made long-distance movements to wintering locations: 1 ~18 km south to the Almaden Mine area, the other 54 km west to Hells Canyon breaks. In contrast to Craig lek birds, Soulen Center birds generally stayed close to the lek year round. The farthest distance any Soulen Center bird traveled was 7.6 km, a winter movement to the adjacent Cinnabar area. In another example of lek-specific patterns, birds trapped from the Shoepeg lek tended to exhibit long-distance movements to a shared wintering area.

We documented 3 instances of males appearing at leks other than their capture lek during the breeding season. SGM3806, captured on the Wiley lek in April 2007, returned to this lek in March 2008, but was located on the Fourmile lek, 21.5 km away, on 10 April 2008. He was back near Wiley by 5 May 2008, where he was found dead. SGM3821, captured on the Wiley lek in spring 2007, was near the Farm to Market lek, 13 km away, in February 2008. He died east of the Farm to Market lek by 3 March 2008. SGM3851 was captured at the Craig lek in March 2010. He returned to Craig in March 2011, but moved to near the Fourmile lek, 10.5 km away, where he was found dead on 15 April 2011.

On average, females nested 3.5 km from their breeding lek (Table 7), but 3 nests were >5 km from the lek. Both males and females generally traveled farthest to reach wintering sites. Three males and 3 females wintered >30 km from their leks. On average, the distance between lek and farthest winter location for males (12.2 km) was not statistically different from that of females (16.1 km; $t_{12} = 2.18$, $P = 0.56$).

During the study 9 birds wintered near Hells Canyon in the western portion of the planning area. Most of these birds were associated with the Shoepeg lek, but this group also included 1 bird each from Lower Knob Hill, Sagebrush Flat, and Craig leks (Fig. 6). During the winter of 2006/2007, 2 females and a male were discovered near the Hells Canyon breaks on both sides of the Snake River. One female was from Shoepeg and wintered near Huntington, Oregon (see below). The second female, from the Lower Knob Hill lek, was found west of Rock Creek Road on the Idaho side in

December 2006. She returned to the same location the next winter, the only one of our radio-collared birds known to be on the breaks that winter. The male, from the Craig lek, was located to the north above Rock Creek in December 2006. He perished at this site. His travel to this wintering location was the greatest distance any bird moved from any lek in any season (54 km).

During the winter of 2008/2009, only 1 bird was located in the Hells Canyon area, a male from Sagebrush Flat. In contrast, 5 birds were in the area during the winter of 2010/2011. All were from the Shoepeg lek except an Oregon bird that crossed the river (see below). All 5 of the birds occurred within a 5-km radius circle. The 3 males in this group had been located together several months earlier in mid-August northwest of the Shoepeg lek.

One of our study females from the Shoepeg lek crossed the Snake River to winter near Huntingon, Oregon in 2006/07, ~47 km from the lek. Four years later, a female from a lek east of Baker City, Oregon, was discovered on the Idaho side near the Payette National Forest boundary in November 2010 (James Rebholz, U.S. Fish & Wildlife Service, personal communication). This was ~51 km from her Oregon summer range. She later moved farther south to the Hog Creek area and ultimately returned to her Oregon lek in spring 2011. This could have been her second winter in Idaho, as she was missing from her usual Oregon haunts in late 2009/early 2010 (Nick Myatt, Oregon Department of Fish and Wildlife, personal communication). Travels of these 2 females became known as the 'Or-Ida Connection'.

Habitat Associations

Roughly 35% of the West Central SGPA is key sage-grouse habitat, as defined and mapped statewide, yet 89% (n = 3495) of the sage-grouse locations we recorded, excluding leks, occurred in this habitat class. For males, >80% of locations occurred in key habitat each season, with highest occurrence in spring (Fig. 7). Most female locations also occurred in key habitat, with the greatest number in winter. Females were recorded in R1 habitat (perennial native and non-native grasslands with high restoration potential) more than males, and females and males were rarely recorded in R2 habitat (annual grass dominated areas, shrubland or grassland, with low restoration potential).

In all, 90 plant species were recorded across all sage-grouse locations combined in our study area at least 1 month of the year (Table 8). Most forbs and grasses in the West Central SGPA were desiccated by early to mid-July. Plant species recorded at sage-grouse locations across most of the year (at least 8 months) included:

- chokecherry (*Prunus virginiana*)
- prairie sagewort (*A. frigida*)
- basin big sagebrush (*A. t.* ssp. *tridentata*)
- antelope bitterbrush
- curleycup gumweed
- Idaho fescue
- alfalfa (*Medicago* spp.)
- low sagebrush
- stiff sagebrush
- xerix big sagebrush
- buckwheat
- wheatgrass
- bulbous bluegrass

Sage-grouse were found in alfalfa and pasturage fields and often observed grazing in winter livestock feeding areas among livestock. During harsh winters with deep snow they were often observed on southeast- and southwest-facing slopes where wind had blown the snow off the ridge

faces. Those ridges usually contained mixes of bitterbrush, stiff sagebrush, and big sagebrush. In summer and fall sage-grouse often were found near man-made ponds and natural springs. Several birds used CRP lands, particularly in mid-summer to fall.

Prior to 2008 no data were available to characterize male sage-grouse habitat associations at a fine scale. From 2 June through 12 December 2008 field personnel completed 38 Daubenmire frames and line-intercept transects in the West Central SGPA (Table 9). Sagebrush cover and overall shrub cover was slightly higher at late fall locations. Changes in forb and grass cover and heights across months likely reflected the progressive drying of vegetation through the summer into fall (Table 9). To examine female habitat use, we completed Daubenmire frames and line-intercept transects at 10 nests, 17 brood locations, and 6 random sites during 2006–2010. Hens were found nesting in greater overall shrub, forb and grass cover, and taller shrubs, forbs, and grasses compared to random sites (Table 10). Brood sites generally were similar to nest sites for the vegetation parameters we measured. One exception was perennial grass cover, which averaged 60% lower than nest sites. Broods were most often located in areas with greater forb cover compared to random sites and compared with where males were located during July.

DISCUSSION

This 6-year telemetry study was the first intensive look at sage-grouse year-round seasonal habitat use and population dynamics in this region of Idaho. When Idaho's sage-grouse conservation plan was developed in 2006 (Idaho Sage-grouse Advisory Committee 2006), the West Central SGPA was considered unique because of its isolation from other populations in the state and the high proportion of private property relative to other planning areas. In fact, for these same reasons the West Central population was given the highest risk of extirpation by a science panel convened to evaluate geographic areas in Idaho (Idaho Sage-grouse Advisory Committee 2006). The 'Or-Ida Connection' we found near the Hells Canyon breaks demonstrated that the Snake River was not a geographic barrier for Idaho and Oregon birds. However, we don't know how or if overlap on wintering areas ultimately could lead to genetic exchange during the breeding season. A possible scenario would be an Oregon bird lingering in Idaho, traveling to a lek with, or following, Idaho birds, and successfully breeding (A. Moser, IDFG, personal communication).

Based on spring lek route data, sage-grouse numbers were relatively high (for this SGPA) at the beginning of the study in 2005, dropped in 2007 and 2008, appeared to increase slightly after 2008, only to drop again by the last year of the study. These fluctuations influenced our trapping success. Given that the trapping technique we used has been implemented across the west for years (Connelly et al. 2003), we assumed our activity would not have a detrimental effect on sage-grouse. Our presence at night roaming on foot across leks did not appear to deter birds from displaying on those same leks the next morning. We didn't test this directly, but there were numerous occasions when a lek was monitored on the morning following trapping, with no apparent drop in numbers. Whether we had any ultimate effect on sage-grouse fitness is unknown.

We saw 2 leks (Monday Gulch and Crane Creek Reservoir) become inactive during the 6 years of this study. Lower Knob Hill lek also had a dramatic decline in attendance, from >30 birds in the early 2000s to 15 in 2007 to 0 in 2011. Combined with the counts from lek surveys, this was a disturbing trend. The location of several other leks appeared somewhat fluid in the West Central

SGPA over time. No birds had been recorded at Sagebrush Ridge lek during 2007–2010, but in 2011 3 males were observed displaying north of the lek on 1 occasion. These could have been males displaced temporarily from Fourmile lek. Two homes were built north and east of the Fourmile lek during the study, and sage-grouse attendance at this lek was inconsistent during our trapping efforts. Infrastructural changes also occurred at the Wiley lek. A home was built at the north end of the lek and a 2.5-km power line installed along Bedrock Flat Road. Numbers declined at Wiley to the point that we may have captured the last remaining male in spring 2011. Predators and other factors also caused variation in lek attendance.

The duration of the study illuminated patterns that would not have been apparent in a shorter time frame. For example, after the first 2 years of following radio-collared birds we concluded that many males remained within 5 km of their lek (Gray and Commons Kemner 2006). We subsequently learned that both males and females traveled substantial distances, particularly in winter, and there was individual and annual variation in these movements. The distances we documented did not exceed what was reported elsewhere in Idaho (>75 km between seasonal ranges; citations in Connelly et al. 2000). Despite these movements, we also saw fidelity to leks, nest sites, and other seasonal ranges, as expected from other sage-grouse populations (Fischer et al. 1993 in Connelly et al. 2000). Venturing to another lek during the breeding season was a costly decision for the 3 males that did so in our study. All 3 died, 2 in the vicinity of their new leks and the other very shortly after returning to his original lek.

Annual survival for males for the first year during which radio collars were deployed was more variable than the 46-54% rate reported in the literature for males in Idaho (Connelly et al. 2000). Our female survival rate was lower than the 68-85% reported for females. Of the known causes of mortality we documented, avian predators accounted for the greatest loss. Avian predators, such as ravens, crows, hawks, and eagles, are common in the West Central SGPA. Coyotes also accounted for mortality. However, many birds recovered dead had an unknown cause of death, and a similar number of sage-grouse disappeared with no opportunity to determine fate. The impact of WNV on this sage-grouse population can be assessed only indirectly from the 2 birds known to have contracted the disease and from the correspondence of low sage-grouse numbers on leks the year following peak West Nile cases in humans and horses. Interestingly, we saw our highest first-collar-year survival of males in 2007 and 2008, when the rest of the West Central sage-grouse population appeared to be dropping substantially.

Food preference, determined from collecting sage-grouse and examining the contents of their crops, was not part of this study. Nevertheless, many of the plant species present where sage-grouse were detected have been identified as important food plants from studies of juvenile and adult sage-grouse in Idaho and Wyoming where crop analyses were conducted (Patterson 1952, Klebenow and Gray 1968). At a finer scale, canopy cover and heights of sagebrush and forbs were similar to results reported across the range of greater sage-grouse (Fisher 1994, Gregg et al. 1994, Haustleitner 2003, Lyon and Anderson 2003, Holloran and Anderson 2005).

MANAGEMENT IMPLICATIONS

Results of this telemetry study and associated lek monitoring provide a foundation for management direction in the West Central SGPA and raise questions for additional exploration.

To maintain the utility and validity of lek routes for assessing regional population trend, lek monitoring needs to occur earlier in the West Central SGPA. Broadening the survey window to begin as early as 1 March but still extend through 30 April also would require a greater number of visits and adequate distribution of visits to catch both peak hen and peak male presence.

From this study we created a database of >1,000 sage-grouse locations. There are a number of additional analyses that could build from this resource to improve management for sage-grouse. One priority is to examine habitat selection at a finer scale when suitable vegetation data are made available. For example, the NWGAP (University of Idaho 2008) vegetation classes might provide a suitable base layer for analyses. The West Central SGPA, with its high percentage of private land and predominance of perennial grasslands, provides a unique contrast to other planning areas. Another priority is to examine habitat at a broad scale to assess fragmentation and other landscape metrics.

Currently the greatest threats to the west-central sage-grouse population are human encroachment through infrastructure development, wildfire, and the presence of annual grasslands. Data generated from this study on habitat use and important seasonal areas occupied by sage-grouse have already been used by local and county governments as they consider exurban development. Likewise, the data have been important for utilities, such as Idaho Power, and federal agencies as they plan for infrastructure and assess energy development proposals. Continuing to provide sound data on the sage-grouse population and its use of the landscape will help ensure that the needs of this species are considered during human population expansion.

The programmatic CCAA for the West Central SGPA was signed in 2010. To date, no site-specific management plans have been completed, yet individual landowner participation in the CCAA currently holds the best prospect for sage-grouse while also retaining working ranches in this rural landscape. Site-specific plans under the programmatic CCAA have the potential to improve or increase habitat through livestock management at leks and nesting areas and through measures to improve sagebrush cover. Our information on sage-grouse seasonal-use areas and site-specific vulnerabilities will contribute to the effectiveness of these plans.

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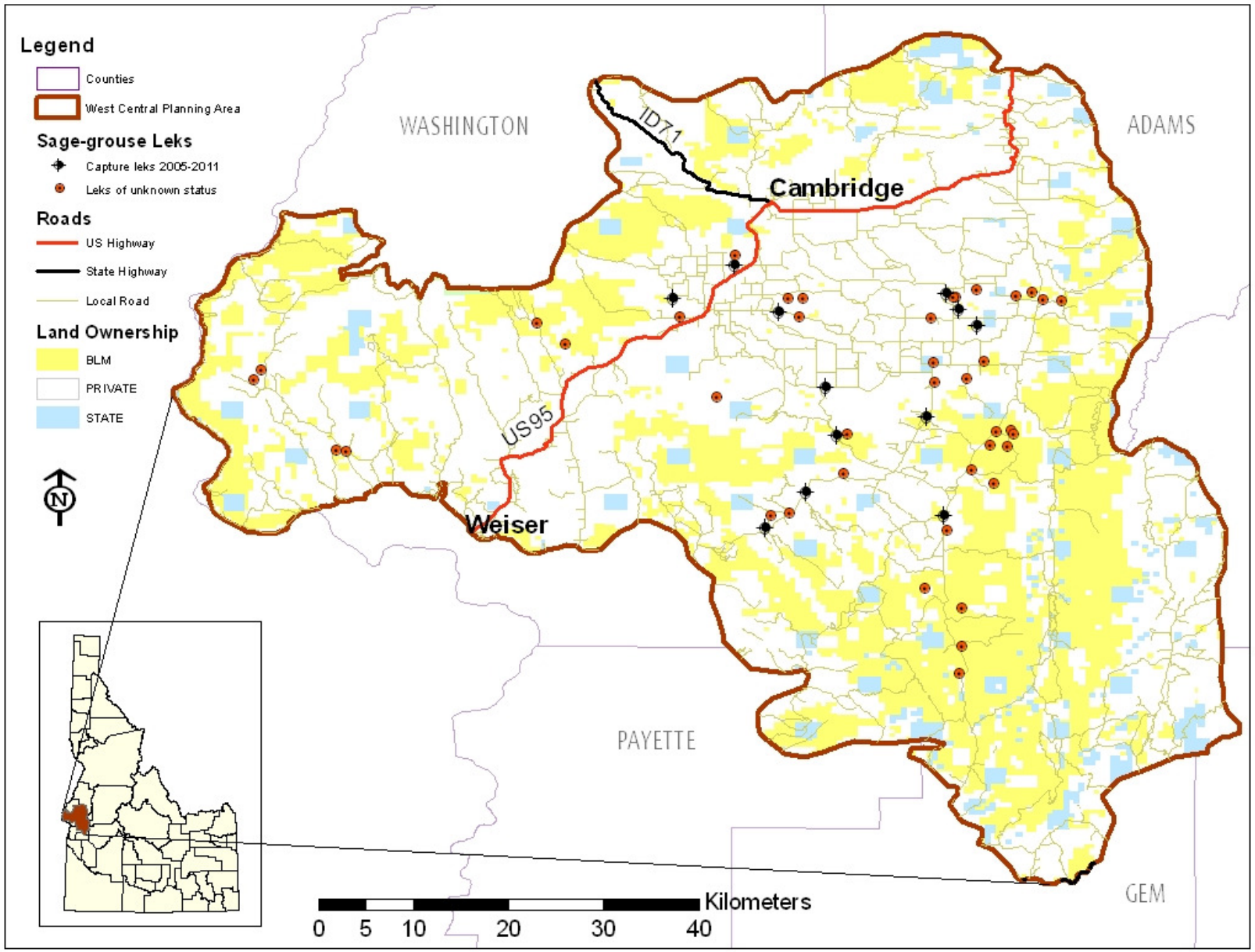


Figure 1. West Central Sage-grouse Planning Area and telemetry study area, Idaho.

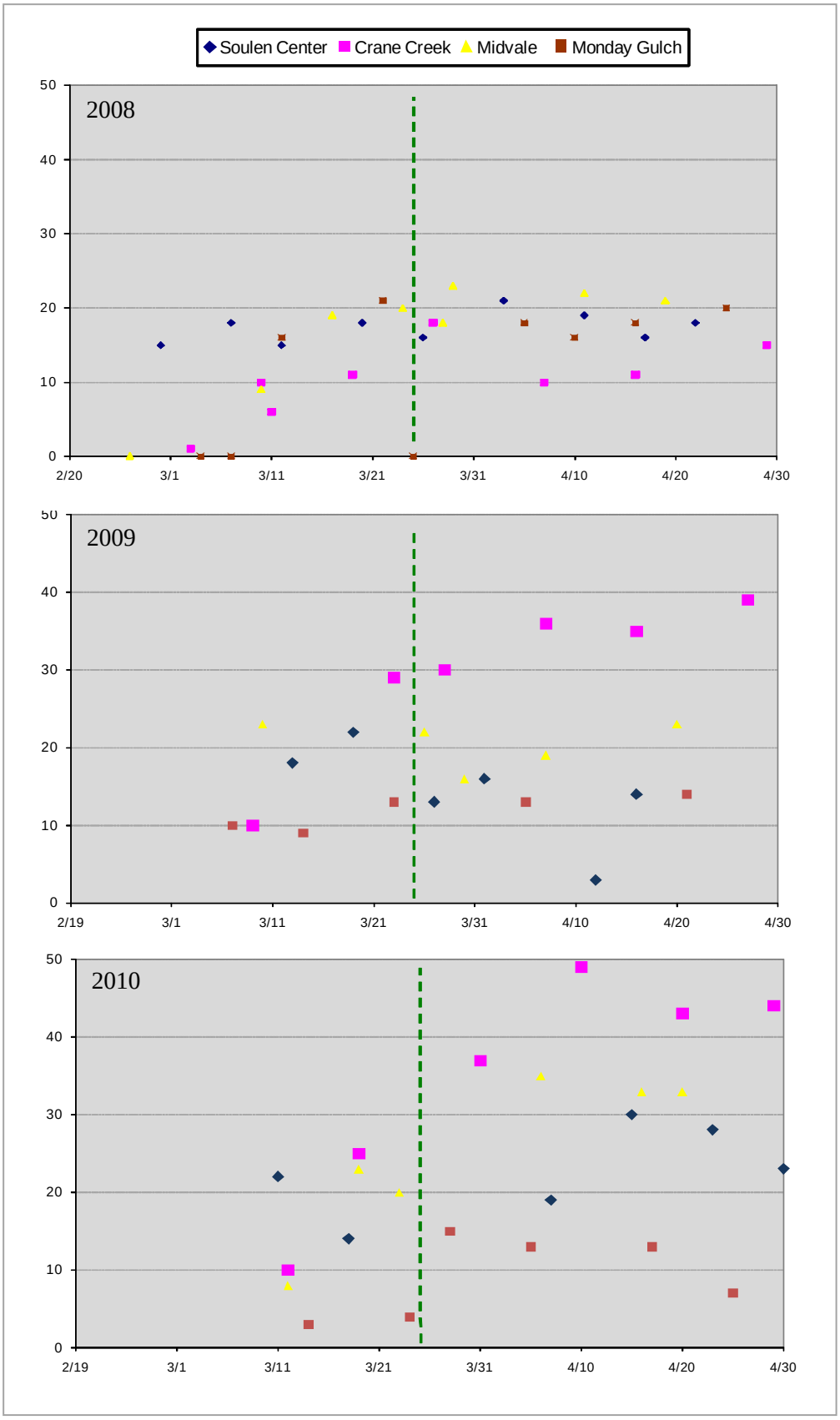


Figure 2. Counts of male sage-grouse on four lek routes in West Central Sage-grouse Planning Area, Idaho, 2008–2010. Green vertical line marks 25 March, beginning of protocol period.

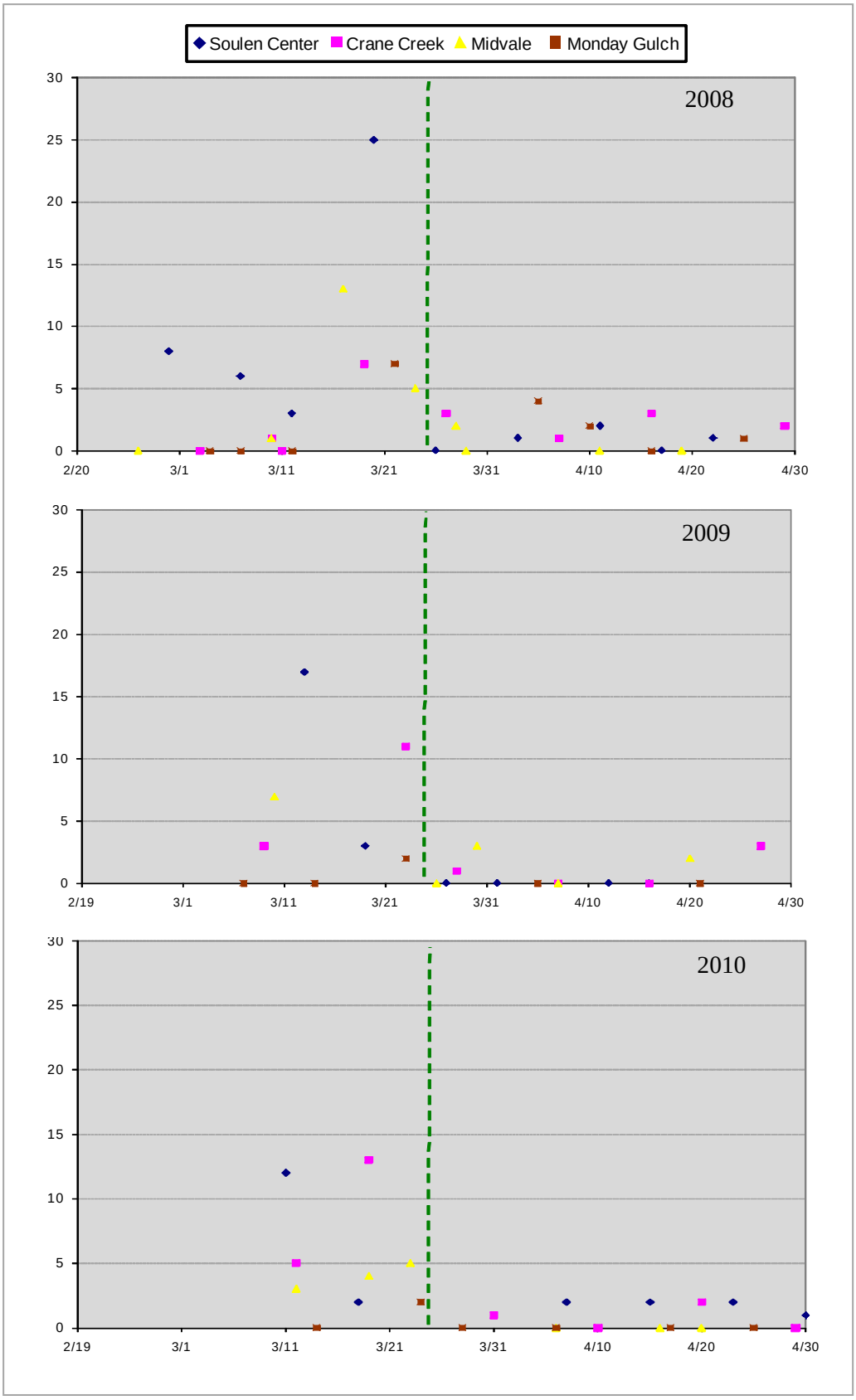


Figure 3. Counts of female sage-grouse on four lek routes in West Central Sage-grouse Planning Area, Idaho, 2008–2010. Green vertical line marks 25 March, beginning of protocol period.

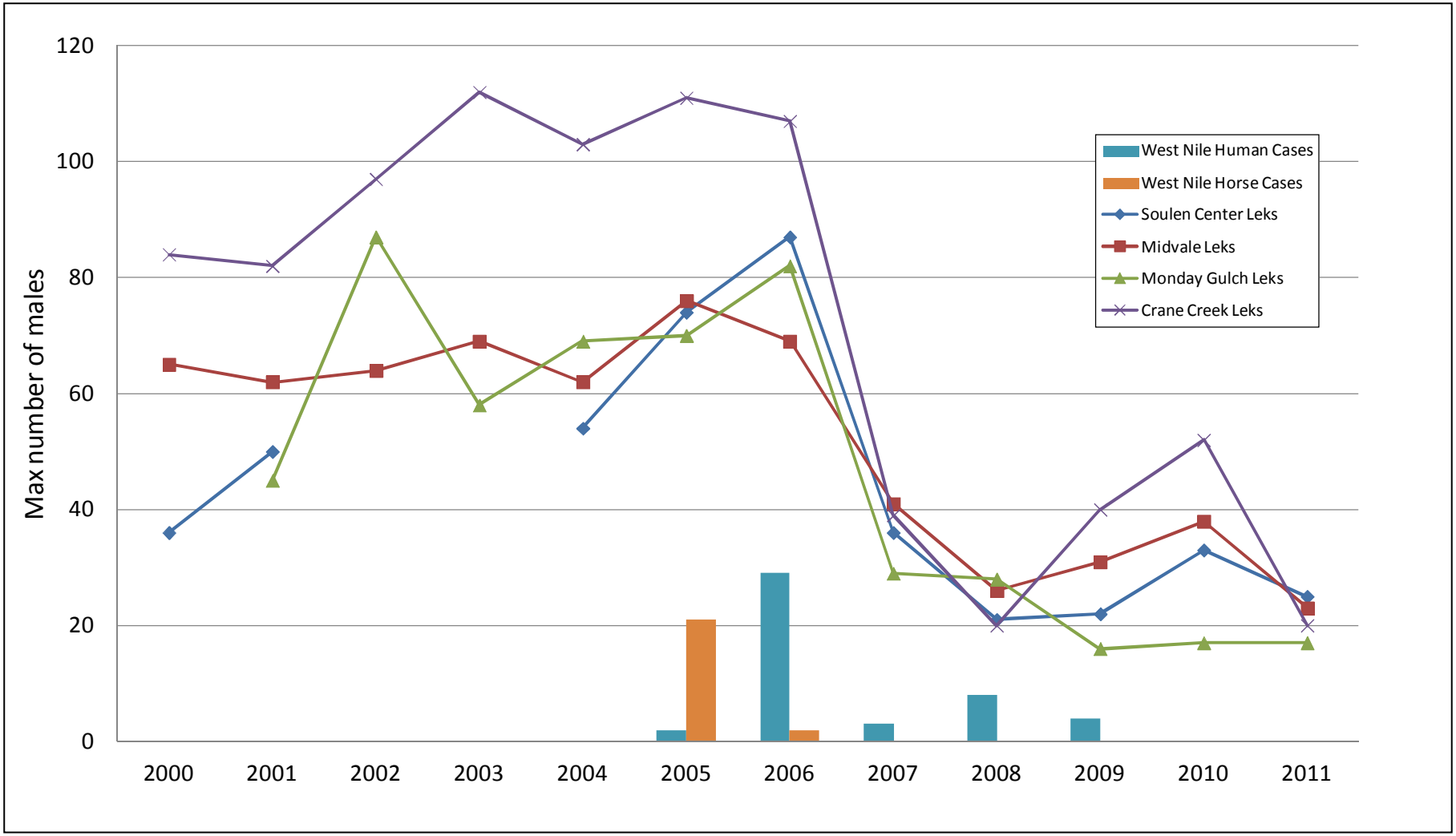


Figure 4. Peak male sage-grouse counts (maximum count on each lek; 3–5 leks per route) on lek routes in West Central Sage-grouse Planning Area, 2000–2011, and West Nile Virus cases in Adams and Washington counties, Idaho, 2005–2011.

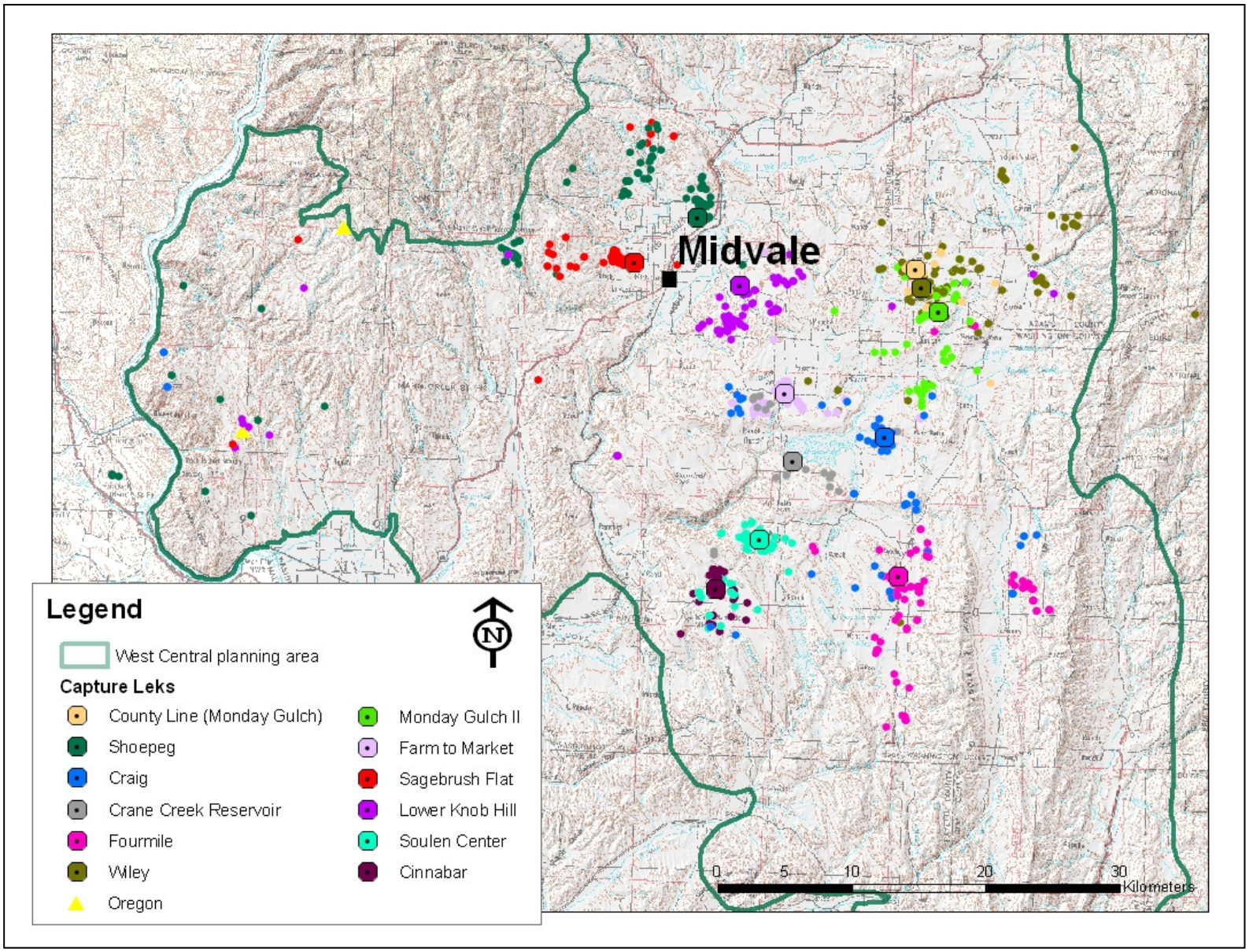


Figure 5. Greater sage-grouse telemetry locations color-coded by lek where captured, 2005–2011, West Central Sage-grouse Planning Area, Idaho.

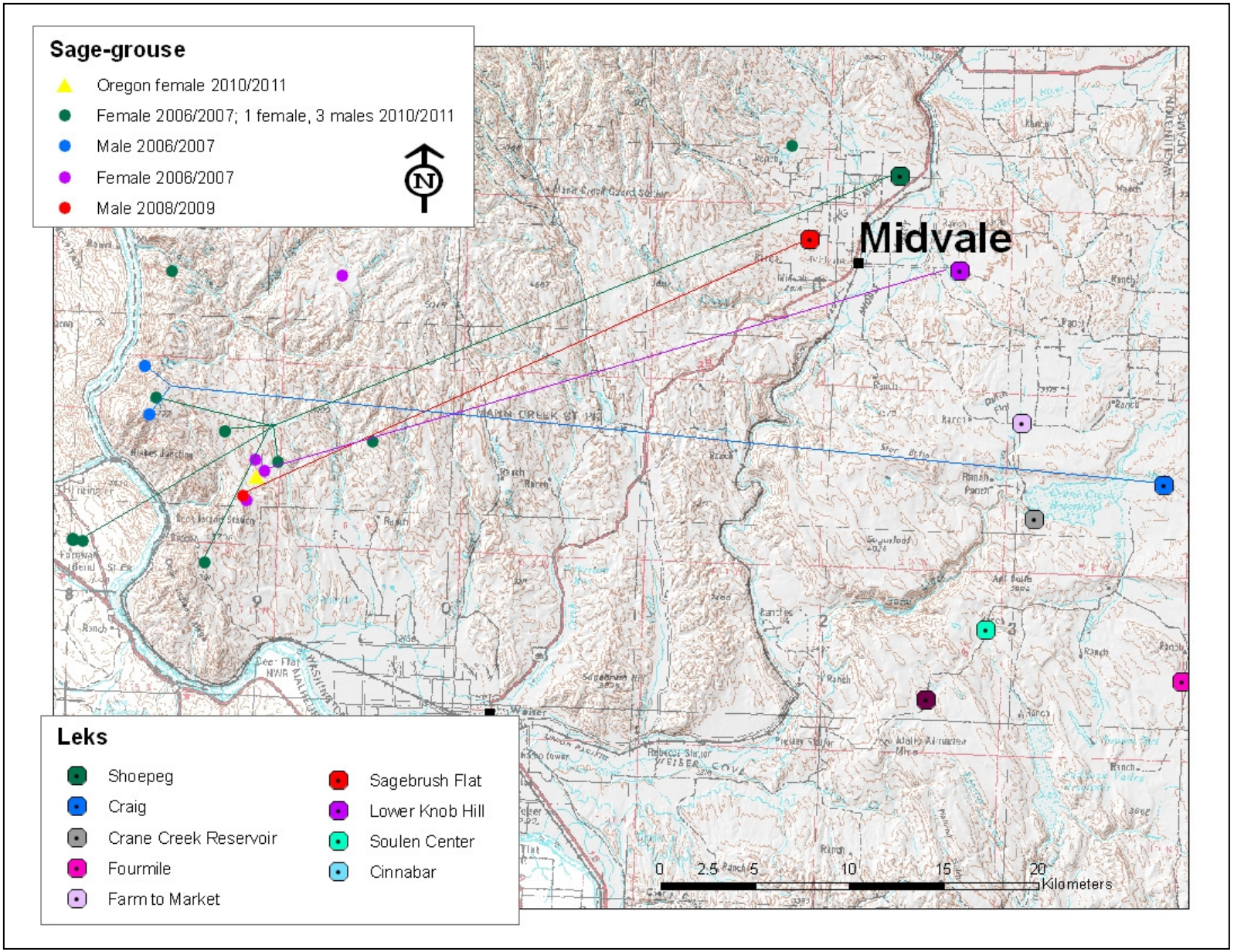


Figure 6. Greater sage-grouse long-distance movements to Hells Canyon breaks wintering areas from lek of origin, West Central Sage-grouse Planning Area, Idaho.

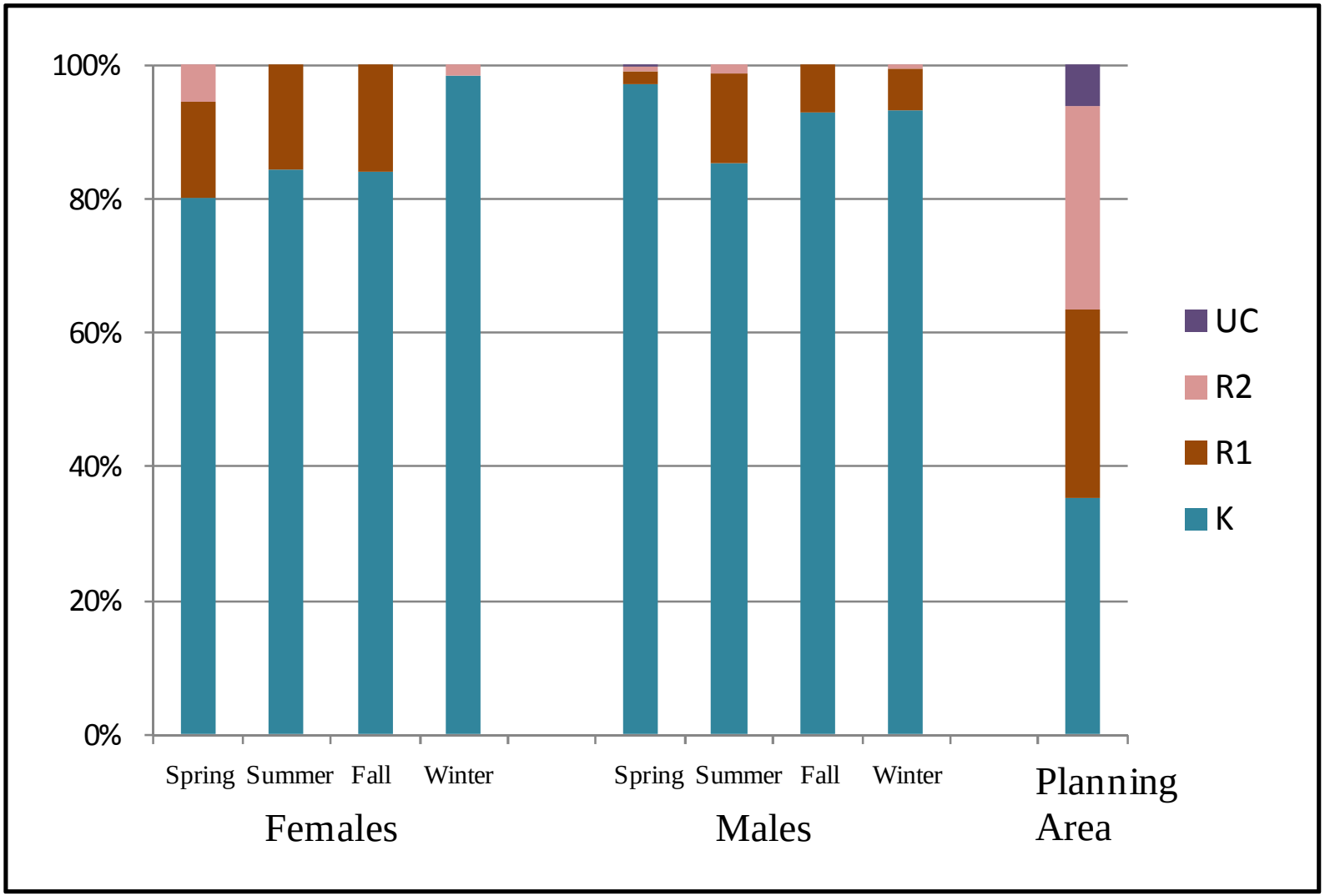


Figure 7. Percentage of sage-grouse telemetry locations and incidental observations from 2005–2011, weighted by group size, within sage-grouse habitat classes; and percentage of each habitat class within the West Central Sage-grouse Planning Area, Idaho. K=key sage-grouse habitat, R1= perennial native and non-native grasslands with high restoration potential, R2= annual grass dominated areas (either shrubland or grassland) with low restoration potential, UC=unclassified. Habitat basemap: Idaho statewide habitat v.2008.

Table 1. Greater sage-grouse captured, collared, and tracked in the West Central Sage-grouse Planning Area, Idaho, 2008–2011.

Date	Band	Sex	Age	Lek
Marked in 2008				
25-Mar-08	SGF3254[a,b]	M	A	Wiley Feed Lot
25-Mar-08	SGF3255[a,b]	M	A	Wiley Feed Lot
25-Mar-08	SGM3839	M	A	Wiley Feed Lot
25-Mar-08	SGM3840	M	A	Wiley Feed Lot
25-Mar-08	SGM3841[a]	M	J	Wiley Feed Lot
2-Apr-08	SGM3838[a]	M	J	Sagebrush Flat
4-Apr-08	SGM3834[a]	M	J	Monday Gulch II
4-Apr-08	SGM3835[a]	M	J	Monday Gulch II
4-Apr-08	SGM3836[a]	M	J	Monday Gulch II
4-Apr-08	SGM3837[a]	M	J	Monday Gulch II
5-Apr-08	SGM3833[a]	M	A	Lower Knob Hill
8-Apr-08	SGM3832	M	J	Four Mile
10-Apr-08	SGM3831[a]	M	A	Shoepeg
24-Apr-08	SGM3828[a]	M	A	Sagebrush Flat
24-Apr-08	SGM3829[a]	M	A	Sagebrush Flat
24-Apr-08	SGM3830[a]	M	J	Sagebrush Flat
27-Apr-08	SGM3827	M	A	Four Mile
2007 Carry Over to 2008				
4-Apr-07	SGM3806	M	A	Wiley Feed Lot
4-Apr-07	SGM3809	M	A	Four Mile
4-Apr-07	SGM3811	M	A	Four Mile
5-Apr-07	SGM3812	M	A	Sagebrush Flat
10-Apr-07	SGM3819	M	A	Lower Knob Hill
24-Apr-07	SGM3821	M	J	Wiley Feed Lot
Marked in 2009				
17-Mar-09	SGF1330[a]	F	A	Cinnabar
18-Mar-09	SGF3201[a]	F	Y	Soulen Center Ranch
28-Mar-09	SGF1329	F	Y	Four Mile
22-Apr-09	SGM3824	M	Y	Farm To Market

Date	Band	Sex	Age	Lek
Marked in 2010				
6-Mar-10	SGM3844	M	J	Soulen Center Ranch
6-Mar-10	SGM3845[a]	M	J	Soulen Center Ranch
6-Mar-10	SGM3846	M	J	Soulen Center Ranch
7-Mar-10	SGM3847	M	J	Four Mile
11-Mar-10	SGM3848	M	J	Shoepeg
11-Mar-10	SGM3849[a]	M	J	Shoepeg
11-Mar-10	SGM3850	M	A	Shoepeg
15-Mar-10	SGF3216	F	J	Shoepeg
17-Mar-10	SGF3217	F	J	Craig
17-Mar-10	SGM3851[a]	M	A	Craig
17-Mar-10	SGM3985	M		Four Mile
19-Mar-10	SGF1331[a]	F		Soulen Center Ranch
19-Mar-10	SGM3984[a]	M	A	Four Mile
20-Mar-10	SGM3983[a]	M	A	Sagebrush Flat
21-Mar-10	SGM3852	M	A	Sagebrush Flat
21-Mar-10	SGM3853	M	A	Sagebrush Flat
7-Apr-10	SGM3854	M	J	Monday Gulch II
14-Apr-10	SGM3855[a]	M	J	Shoepeg
14-Apr-10	SGM3856[a]	M	A	Shoepeg
14-Apr-10	SGM3857	M	J	Shoepeg
17-Apr-10	SGM3858[a]	M	A	Farm to Market
17-Apr-10	SGM3859	M	A	Farm to Market
11-Oct-10	SGF3218[a]	F	J	
11-Oct-10	SGF3219[a]	F	J	
11-Oct-10	SGF3220[a]	F	A	
Marked in 2011				
5-Apr-11	SGM3860	M	A	Farm to Market
5-Apr-11	SGM3861	M	A	Farm to Market
8-Apr-11	SGM3862	M	J	Monday Gulch II
8-Apr-11	SGM3863	M	A	Wiley Feed Lot

[a] Still active as of January following bird's capture year.
[b] Male fitted with female leg band.

Table 2. Outcome of nesting opportunities of radio-marked greater sage-grouse hens, 2009–2011, West Central Sage-grouse Planning Area, Idaho.

Band	Year	Lek to nest (km)	# Eggs	Nest Fate	Brood Fate	Date Fate	Nest Cover
SGF1329	2009	1.4	7	Hatch	Lost	20-Jul-09	xeric sagebrush
SGF1330	2009						
SGF3201	2009						
SGF3201	2010	1.1	9	Predated		25-May-10	big sagebrush
SGF1331	2010	1.1	3	Predated		5-May-10	xeric sagebrush
SGF1331	2011						
SGF3216	2010						
SGF3217	2010	5.3	7	Hatch	Unknown[a]	10-Jun-10	
SGF3218	2011	1.5	7	Predated		24-May-11	xeric sagebrush
SGF3219	2011						
SGF3220	2011						
Average		2.1	6.6				

[a] Hen dropped transmitter; 5 chicks observed on previous contact.

Table 3. Greater sage-grouse captures by lek, 2005–2011, West Central Sage-grouse Planning Area, Idaho.

Lek	F	M	Total
Soulen Center	2	11	13
Craig	2	10	12
Wiley Feed Lot	2	10	12
Four Mile	1	9	10
Shoepeg	2	8	10
Lower Knob Hill	3	6	9
Sagebrush Flat		9	9
Monday Gulch II		7	7
Farm to Market		5	5
Crane Creek Reservoir	1	2	3
County Line		2	2
Cinnabar area	1	1	2
No Lek (summer/fall)	7		7
Total	21	80	101

Table 4. Duration radio-collared greater sage-grouse were monitored in West Central Sage-grouse Planning Area, Idaho, 2005–2011.

Band	Capture Date	Mortality Date	Last Contact	Tracking Days
SGM3801	30-Mar-05	6-Jul-05		98
SGM3899	30-Mar-05	14-Aug-06		502
SGF3299	1-Apr-05	28-Apr-06		392
SGM3896	2-Apr-05	12-May-05		40
SGM3897	2-Apr-05	12-May-05		40
SGM3898	2-Apr-05	28-Apr-05		26
SGM3894	3-Apr-05	11-May-05		38
SGM3895	3-Apr-05	21-Jun-05		79
SGM3889	9-Apr-05	19-Jun-06		436
SGM3890	9-Apr-05	20-Jun-06		437
SGF3298	10-Apr-05		10-Oct-05	183
SGM3887	10-Apr-05	25-Apr-06		380
SGM3888	10-Apr-05	5-Dec-05		239
SGF3202	24-Aug-05	28-Nov-05		95
SGF3203	25-Aug-05		21-Jun-06	300
SGF3204	26-Aug-05	10-Oct-05		45
SGF3205	29-Aug-05	28-Nov-05		91
SGM3883	21-Mar-06	11-Jul-06		112
SGF3240	22-Mar-06	19-Sep-06		181
SGM3882	22-Mar-06		26-Jan-07	310
SGF3229	23-Mar-06	3-Jan-07		286
SGM3881	23-Mar-06		11-May-06	48
SGF3222	26-Mar-06		16-Aug-07	508
SGF3235	26-Mar-06		21-Jul-06	117
SGM3880	26-Mar-06		30-Aug-06	157
SGF3296	12-Apr-06	30-Aug-06		140
SGF3297	12-Apr-06	26-Nov-07		593
SGM3806	4-Apr-07	5-May-08		397
SGM3809	4-Apr-07		16-May-08	408
SGM3811	4-Apr-07		10-Nov-08	586
SGM3812	5-Apr-07		2-Jun-08	424
SGM3814	7-Apr-07	13-Sep-07		159
SGM3815	9-Apr-07	4-Sep-07		148
SGM3817	9-Apr-07	23-Aug-07		136
SGM3893	9-Apr-07	16-Oct-07		190
SGM3818	10-Apr-07	15-Aug-07		127
SGM3819	10-Apr-07		5-Jun-08	422
SGM3820	11-Apr-07	29-Oct-07		201
SGM3821	24-Apr-07	12-May-08		384
SGF3254[a]	25-Mar-08	6-Mar-09		346
SGF3255[a]	25-Mar-08	17-Aug-09		510

Table 4, con't. Duration radio-collared greater sage-grouse were monitored in West Central Sage-grouse Planning Area, Idaho, 2005–2011.

Band	Capture Date	Mortality Date	Last Contact	Tracking Days
SGM3840	25-Mar-08	4-May-08		40
SGM3841	25-Mar-08	12-Mar-09		352
SGM3839	31-Mar-08	18-Nov-08		232
SGM3838	2-Apr-08	27-Mar-09		359
SGM3834	4-Apr-08	6-May-09		397
SGM3835	4-Apr-08	25-Aug-09		508
SGM3836	4-Apr-08		21-Oct-09	565
SGM3837	4-Apr-08	6-Mar-09		336
SGM3833	5-Apr-08	3-Feb-09		304
SGM3832	8-Apr-08	24-May-08		46
SGM3831	10-Apr-08		16-Sep-09	524
SGM3828	24-Apr-08		20-Aug-09	483
SGM3829	24-Apr-08		20-Aug-09	483
SGM3830	24-Apr-08		21-Oct-09	545
SGM3827	27-Apr-08	2-May-08		5
SGF1330	17-Mar-09		15-Feb-10	335
SGF3201	18-Mar-09		18-Nov-10	610
SGF1329	28-Mar-09	14-Sep-09		170
SGM3824	22-Apr-09		20-Nov-09	212
SGM3845	6-Mar-10		7-Feb-11	338
SGM3846	6-Mar-10	23-Apr-10		48
SGM3847	7-Mar-10		6-Aug-10	152
SGM3848	11-Mar-10	30-Mar-10		19
SGM3849	11-Mar-10	29-Apr-11		414
SGM3850	11-Mar-10	17-Aug-10		159
SGF3216	15-Mar-10		17-Dec-10	277
SGM3851	17-Mar-10	15-Apr-11		394
SGM3985	17-Mar-10	23-Apr-10		37
SGF1331	19-Mar-10		29-Apr-11	406
SGM3983	20-Mar-10	17-May-11		422
SGM3852	21-Mar-10	21-May-10		61
SGM3854	7-Apr-10	22-Sep-10		168
SGM3855	14-Apr-10	15-Apr-11		366
SGM3856	14-Apr-10	11-Mar-11		331
SGM3857	14-Apr-10	17-Dec-10		247
SGM3858	17-Apr-10	29-Apr-11		377
SGM3859	17-Apr-10		18-Nov-10	215
Average	Female **278.2**	Male **270.8**	$t_{05[25]} = 2.06$, $P = 0.88$	

[a] Males with female leg bands.

Table 5. Proportion of confirmed mortalities and 'missing' greater sage-grouse by lek of capture, West Central Sage-grouse Planning Area, Idaho, 2005–2011.

	Males				Females			
	Known Mortality	Missing	# Radioed	% Loss	Known Mortality	Missing	# Radioed	% Loss
Cinnabar						1	1	100
County Line	2		2	100				
Crane Creek Dam	2		2	100	1		1	100
Craig	7		7	100	1		2	50
Wiley Feed Lot	8	1	10	90	1	1	2	100
Shoepeg	6	1	8	88		1	2	50
Soulen Center	5	1	8	75			2	
Farm to Market	1	2	5	60				
Monday Gulch II	4		7	57				
Four Mile	5		9	56	1		1	100
Sagebrush Flat	4	1	9	56				
Lower Knob Hill	2		4	50	2		3	67
No lek					3	1	7	57

Table 6. First-collar-year survival[a] of marked greater sage-grouse in the West Central Sage-grouse Planning Area, Idaho, 2005–2011.

Year collared	# Birds collared		Mortality or loss[b]		% Survival	
	F	M	F	M	F	M
2005	6	11	4	7	33	36
2006	6	5	3	4	50	20
2007	0	14	---	6	---	57
2008	0	17	---	4	---	76
2009	3	1	1	1	66	0
2010	6	19	1	9	83	53
2011	0	4	---	0[c]	---	100[c]

[a] Survival beyond the first calendar year of collaring.
[b] Excludes slipped collar or failed transmitter.
[c] As of July 2011.

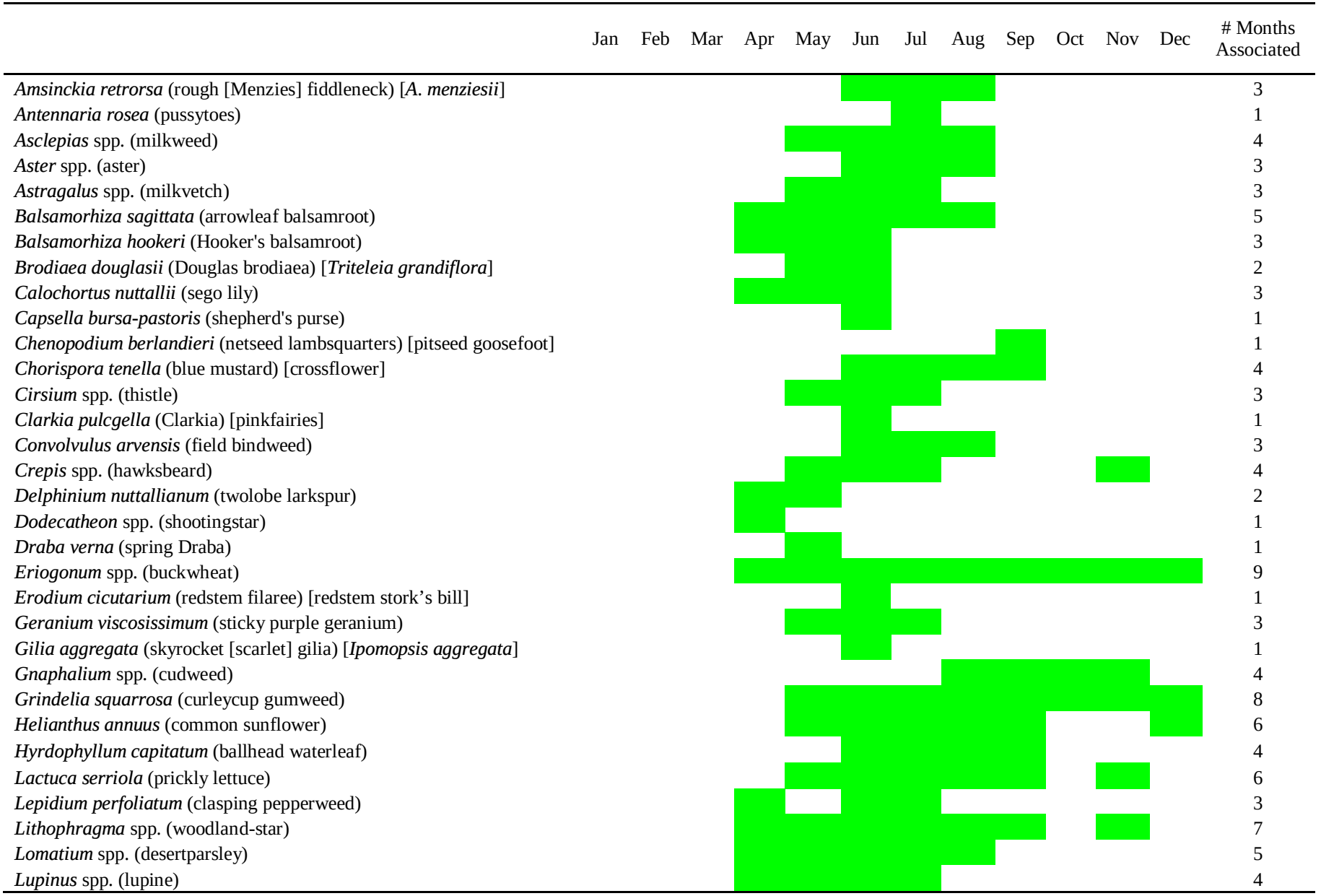
Table 7. Movements (km) to seasonal-use areas by greater sage-grouse in West Central Sage-grouse Planning Area, Idaho, 2005–2011.

	Females				Males			
	Min	Max	Mean	*n*	Min	Max	Mean	*n*
Farthest Distance Lek to Nest[a]	0.4	14.5	3.5	14				
Farthest Distance Lek to Spring[a]	0.8	14.1	4.7	8				
Average Distance Nest or Spring to Summer[b]	0.3	9.0	1.7	21				
Farthest Distance From Lek to Summer[c]					0.7	15.0	5.7	60
Average Distance Lek to Summer[d]					0.6	13.1	4.5	60
Summer to Fall[e]	0.0	8.0	2.8	12	0.0	10.5	1.9	41
Fall to Winter[f]	0.8	43.4	17.6	12	0.1	53.6	12.3	30
Farthest Distance Lek to Winter[g]	1.6	47.4	16.1	10	1.2	53.9	12.2	31

[a] Measured from lek to nest site or lek to most distant spring location if didn't nest.
[b] Average of the distances from nest to each summer location or average of distances from last spring to each summer location if didn't nest.
[c] Measured from lek to most distant summer location.
[d] Average of the distances from lek to each summer location.
[e] Distance between last summer and first fall location.
[f] Distance between last fall and first winter location.
[g] Greatest single distance between lek and any wintering location for each bird.

Table 8. Plant species recorded at greater sage-grouse observations in the West Central Sage-grouse Planning Area, Idaho, 2005–2011.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	# Months Associated
TREE LIKE													
Alnus spp. (alder)													1
Crataegus douglassii (black hawthorn)													6
Prunus virginiana (chokecherry)													8
Salix spp. (willow)													1
Sambucus cerulea (blue elderberry) [*S. nigra* ssp. *cerulea*][a]													3
SHRUBS													
Amelanchier spp. (serviceberry)													2
Artemisia arbuscula (low [little] sagebrush)													10
Artemisia cana (silver sagebrush)													1
Artemisia frigida (fringed [prairie] sagewort)													9
Artemisia rigida (stiff [scabland] sagebrush)													10
Artemisia tridentata ssp. *tridentata* (basin big sagebrush)													12
Artemisia tridentata ssp. *wyomingensis* (Wyoming big sagebrush)													1
Artemisia tridentata ssp. *xericensis* (xeric big sagebrush)													12
Ceanothus velutinus (snowbrush ceanothus)													4
Chrysothamnus nauseosus (rubber rabbitbrush) [*Ericameria nauseosus*]													7
Chrysothamnus viscidiflorus (yellow rabbitbrush)													5
Purshia tridentata (antelope bitterbrush)													12
Ribes spp. (currant)													4
Rosa woodsii (Woods' rose)													4
FORBS													
Alfalfa field (with mixed wild forbs and grasses)													12
Achillea millefolium (common yarrow)													5
Allium acuminatum (tapertip onion)													4
Amaranthus spp. (pigweed)													1


Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Months Associated
Amsinckia retrorsa (rough [Menzies] fiddleneck) [*A. menziesii*] 3
Antennaria rosea (pussytoes) 1
Asclepias spp. (milkweed) 4
Aster spp. (aster) 3
Astragalus spp. (milkvetch) 3
Balsamorhiza sagittata (arrowleaf balsamroot) 5
Balsamorhiza hookeri (Hooker's balsamroot) 3
Brodiaea douglasii (Douglas brodiaea) [*Triteleia grandiflora*] 2
Calochortus nuttallii (sego lily) 3
Capsella bursa-pastoris (shepherd's purse) 1
Chenopodium berlandieri (netseed lambsquarters) [pitseed goosefoot] 1
Chorispora tenella (blue mustard) [crossflower] 4
Cirsium spp. (thistle) 3
Clarkia pulcgella (Clarkia) [pinkfairies] 1
Convolvulus arvensis (field bindweed) 3
Crepis spp. (hawksbeard) 4
Delphinium nuttallianum (twolobe larkspur) 2
Dodecatheon spp. (shootingstar) 1
Draba verna (spring Draba) 1
Eriogonum spp. (buckwheat) 9
Erodium cicutarium (redstem filaree) [redstem stork's bill] 1
Geranium viscosissimum (sticky purple geranium) 3
Gilia aggregata (skyrocket [scarlet] gilia) [*Ipomopsis aggregata*] 1
Gnaphalium spp. (cudweed) 4
Grindelia squarrosa (curleycup gumweed) 8
Helianthus annuus (common sunflower) 6
Hyrdophyllum capitatum (ballhead waterleaf) 4
Lactuca serriola (prickly lettuce) 6
Lepidium perfoliatum (clasping pepperweed) 3
Lithophragma spp. (woodland-star) 7
Lomatium spp. (desertparsley) 5
Lupinus spp. (lupine) 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	# Months Associated
Lygodesmia juncea (rush skeletonplant)													5
Madia glomerata (cluster [mountain] tarweed)													4
Matricaria matricarioides (pineapple-weed) [*M. discoidea*]													2
Melilotus officinalis (yellow sweetclover)													3
Mertensia oblongifolia (oblongleaf bluebells)													1
Navarretia spp. (Navarretia)													1
Onopordum acanthium (scotch thistle) [scotch cottonthistle]													2
Penstemon spp. (Penstemon)													3
Phlox spp. (Phlox)													4
Plantago major (broadleaf [common] plantain)													1
Polygonum spp. (knotweed)													4
Potentilla spp. (cinquefoil)													1
Rumex spp. (dock)													3
Senecio spp. (groundsel) [ragwort]													2
Taraxacum officinale (common dandelion)													7
Tragopogan dubius (yellow salsify)													5
Trifolium macrocephalum (bighead [largehead] clover)													3
Trifolium spp. (clover)													3
Valeriana spp. (valerian)													5
Verbascum thapsus (common mullein)													1
Viola purpurea (goosefoot violet)													5
Wyethia amplexicaulis (mules-ears)													4
Zigadenus paniculatus (foothill deathcamas)													4
GRASSES													
Agropyron spp. (wheatgrass)													9
Bromus brizaeformis (rattlesnake grass)													3
Bromus tectorum (cheatgrass)													2
Elymus cinereus (basin wildrye) [*Leymus cinereus*]													5
Festuca idahoensis (Idaho fesque)													8
Poa bulbosa (bulbous bluegrass)													8
Poa pratensis (Kentucky bluegrass)													2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	# Months Associated
Stipa comata (needle and thread grass) [*Hesperostipa comata*]													1
Sitanion hystrix (squirreltail) [*Elymus elymoides*]													4
Taeniatherum asperum (medusahead wildrye) [*T. caput-medusae*]													6
GRASS LIKE													
Carex spp. (sedge)													3
Equisetum spp. (horsetail)													1
ROCKS (MAJOR LANDSCAPE)													8
HAY FIELD (Machine Harvestable)													4

[a] [ ] = current PLANTS Database nomenclature, USDA Natural Resources Conservation Service.

Table 9. Canopy cover and heights recorded from line intercepts and Daubenmire frames at male greater sage-grouse seasonal locations, 2008, West Central Sage-grouse Planning Area, Idaho.

	Mean					
	Jun (n = 14)	Jul (n = 13)	Aug (n = 8)	Sep-Dec (n = 3)	Overall Mean	Range
Sagebrush canopy cover (%)	7.20	14.82	10.64	15.73	11.2	0.00 – 26.90
Sagebrush avg ht (cm)	36.16	48.68	54.00	38.15	44.36	0.00 – 77.83
Shrub canopy cover (%)	9.47	19.83	14.73	20.30	14.98	3.90 – 32.60
Perennial forb canopy cover (%)	8.53	3.43	0.61	0.00	4.44	0.00 – 31.91
Annual forb canopy cover (%)	2.67	2.47	0.46	0.03	1.93	
Total forb canopy cover (%)	11.13	5.90	1.07	0.03	6.35	
Perennial forb avg ht (cm)	25.31	31.77	31.19	0.00	26.76	0.00 – 49.96
Perennial grass canopy cover (%)	9.75	3.21	1.36	1.89	5.13	0.00 – 21.06
Annual grass canopy cover (%)	4.61	2.47	0.02	2.25	2.73	
Perennial grass avg ht (cm)	27.11	55.55	17.61	0.85	32.77	0.00 – 142.24
Perennial grass and forb avg ht (cm)	25.55	38.12	32.59	0.85	29.38	

Table 10. Canopy cover and heights recorded from line intercepts and Daubenmire frames at greater sage-grouse nest, brood, and random locations, 2006–2011, West Central Sage-grouse Planning Area, Idaho.

	Nest (*n* = 10)		Brood (*n* = 17)		Random (*n* = 6)	
	Mean	Range	Mean	Range	Mean	Range
Sagebrush canopy cover (%)	11.1	2.0 – 20.5	10.2	0.0 – 28.6	4.9	1.0 – 10.0
Sagebrush avg ht (cm)	57.5	24.1 – 90.8	47.3	0.0 – 77.4	44.0	25.3 – 60.5
All shrubs canopy cover (%)	12.2	2.6 – 20.5	12.3	0.0 – 30.3	5.4	2.0 – 10.0
Perennial forb canopy cover (%)	8.1	1.1 – 20.3	9.7	0.1 – 27.9	6.1	0.8-11.6
Annual forb canopy cover (%)	1.5	0.0 – 5.5	1.7	0.0 – 9.1	0.3	0.03 – 0.58
Total forb canopy cover (%)	8.6	1.1 – 20.5	11.4	4.3 – 30.4	6.2	0.9 – 11.6
Perennial forb avg ht (cm)	20.5	8.6 – 34.1	22.0	15.6 – 35.1	18.0	8.4 – 24.4
Perennial grass canopy cover (%)	11.5	2.2 – 25.2	4.5	0.0 – 10.7	11.5	3.3 – 18.6
Annual grass canopy cover (%)	4.1	0.0 – 14.8	1.1	0.0 – 3.6		
Perennial grass avg ht (cm)	33.0	19.3 – 59.4	27.4	0.0 – 50.5	26.3	17.1 – 32.7
Perennial grass and forb avg ht (cm)	26.8	15.5 – 43.1	28.4	16.7 – 58.5		

Appendix

Table A-1. Greater sage-grouse live-trapped and marked in the West Central Sage-grouse Planning Area, Idaho, 2005–2011.

Band	Gender	Capture Date	Mortality Date	Last Contact	Radio	Fate	Lek
SGM3801	M	30-Mar-05	6-Jul-05		150.445	Mortality	Crane Creek Rsvr
SGM3899	M	30-Mar-05	14-Aug-06		150.824	Mortality	Crane Creek Rsvr
SGF3299	F	1-Apr-05		28-Apr-06	150.566	Mortality	Crane Creek Rsvr
SGM3810[a]	M	2-Apr-05		2-Apr-05		Unknown - banded only	Craig
SGM3896	M	2-Apr-05	12-May-05		150.986	Mortality	Craig
SGM3897	M	2-Apr-05	12-May-05		151.397	Mortality	Craig
SGM3898	M	2-Apr-05	28-Apr-05		150.325	Mortality	Craig
SGM3894	M	3-Apr-05	11-May-05		150.666	Mortality	Soulen Center
SGM3895	M	3-Apr-05	21-Jun-05		150.186	Mortality	Soulen Center
SGM3893[a,b]	M	5-Apr-05					Craig
SGM3891[a]	M	6-Apr-05		6-Apr-05		Unknown - banded only	Soulen Center
SGM3892[a]	M	6-Apr-05		6-Apr-05		Unknown - banded only	Soulen Center
SGM3889	M	9-Apr-05	19-Jun-06		150.464	Mortality	Four Mile
SGM3890	M	9-Apr-05	20-Jun-06		150.506	Mortality	Four Mile
SGF3298	F	10-Apr-05		10-Oct-05	151.415	Unrecovered	Wiley Feed Lot
SGM3887	M	10-Apr-05	25-Apr-06		150.225	Mortality	County Line
SGM3888	M	10-Apr-05	5-Dec-05		150.404	Mortality	County Line
SGF3202	F	24-Aug-05	28-Nov-05		150.324	Mortality	No lek - fall capture
SGF3203	F	25-Aug-05		21-Jun-06	150.184	Unrecovered	No lek - fall capture
SGF3204	F	26-Aug-05	10-Oct-05		150.604	Mortality	No lek - fall capture
SGM3802[a]	M	26-Aug-05		26-Aug-05		Unknown - banded only	Cinnabar area
SGF3205	F	29-Aug-05	28-Nov-05		150.545	Mortality	No lek - fall capture
SGM3883	M	21-Mar-06	11-Jul-06		151.265	Mortality	Soulen Center
SGF3240	F	22-Mar-06	19-Sep-06		150.906	Mortality	Craig
SGM3882	M	22-Mar-06		26-Jan-07	150.403	Mortality	Craig
SGF3229	F	23-Mar-06	3-Jan-07		151.184	Mortality	Wiley Feed Lot
SGM3881	M	23-Mar-06		11-May-06	150.665	Unrecovered	Wiley Feed Lot

Band	Gender	Capture Date	Mortality Date	Last Contact	Radio	Fate	Lek
SGF3222	F	26-Mar-06		16-Aug-07	150.344	Unrecovered	Shoepeg
SGF3235	F	26-Mar-06		21-Jul-06	151.397	Unrecovered	Lower Knob Hill
SGM3880	M	26-Mar-06		30-Aug-06	150.385	Unrecovered	Shoepeg
SGM3805[a]	M	27-Mar-06		27-Mar-06		Unknown - banded only	Craig
SGM3877[a]	M	27-Mar-06		27-Mar-06		Unknown - banded only	Lower Knob Hill
SGM3878	M	27-Mar-06		27-Mar-06	150.545	Unrecovered	Lower Knob Hill
SGM3879[a]	M	27-Mar-06		27-Mar-06		Unknown - banded only	Lower Knob Hill
SGF3296	F	12-Apr-06	30-Aug-06		150.815	Mortality	Lower Knob Hill
SGF3297	F	12-Apr-06	26-Nov-07		150.985	Mortality	Lower Knob Hill
SGM3806	M	4-Apr-07	5-May-08		151.263	Mortality	Wiley Feed Lot
SGM3809	M	4-Apr-07		16-May-08	150.463	Unrecovered	Four Mile
SGM3811	M	4-Apr-07		10-Nov-08	150.314	Unrecovered	Four Mile
SGM3812	M	5-Apr-07		2-Jun-08	150.493	Unrecovered	Sagebrush Flat
SGM3813	M	6-Apr-07		4-May-07	150.423	Lost collar	Monday Gulch II
SGM3814	M	7-Apr-07	13-Sep-07		150.873	Mortality	Wiley Feed Lot
SGM3815	M	9-Apr-07	4-Sep-07		150.394	Mortality	Soulen Center
SGM3817	M	9-Apr-07	23-Aug-07		150.133	Mortality	Craig
SGM3893	M	9-Apr-07	16-Oct-07		150.722	Mortality	Craig
SGM3816	M	10-Apr-07		10-Apr-07	150.525	Unrecovered	Soulen Center
SGM3818	M	10-Apr-07	15-Aug-07		150.233	Mortality	Lower Knob Hill
SGM3819	M	10-Apr-07		5-Jun-08	150.474	Unrecovered	Lower Knob Hill
SGM3820	M	11-Apr-07	29-Oct-07		150.563	Mortality	Sagebrush Flat
SGM3821	M	24-Apr-07	12-May-08		150.372	Mortality	Wiley Feed Lot
SGF3254[c]	M	25-Mar-08	6-Mar-09		150.053	Mortality	Wiley Feed Lot
SGF3255[c]	M	25-Mar-08	17-Aug-09		151.144	Mortality	Wiley Feed Lot
SGM3840	M	25-Mar-08	4-May-08		151.463	Mortality	Wiley Feed Lot
SGM3841	M	25-Mar-08	12-Mar-09		150.924	Mortality	Wiley Feed Lot
SGM3839	M	31-Mar-08	18-Nov-08		151.763	Mortality	Wiley Feed Lot
SGM3838	M	2-Apr-08	27-Mar-09		150.192	Mortality	Sagebrush Flat
SGM3834	M	4-Apr-08	6-May-09		150.893	Mortality	Monday Gulch II

Band	Gender	Capture Date	Mortality Date	Last Contact	Radio	Fate	Lek
SGM3835	M	4-Apr-08	25-Aug-09		151.863	Mortality	Monday Gulch II
SGM3836	M	4-Apr-08		21-Oct-09	150.583	Unrecovered	Monday Gulch II
SGM3837	M	4-Apr-08	6-Mar-09		150.654	Mortality	Monday Gulch II
SGM3833	M	5-Apr-08	3-Feb-09		151.887	Mortality	Lower Knob Hill
SGM3832	M	8-Apr-08	24-May-08		150.254	Mortality	Four Mile
SGM3831	M	10-Apr-08		16-Sep-09	151.054	Unrecovered	Shoepeg
SGM3828	M	24-Apr-08		20-Aug-09	151.626	Unrecovered	Sagebrush Flat
SGM3829	M	24-Apr-08		20-Aug-09	151.636	Unrecovered	Sagebrush Flat
SGM3830	M	24-Apr-08		21-Oct-09	151.645	Unrecovered	Sagebrush Flat
SGM3827	M	27-Apr-08	2-May-08		151.516	Mortality	Four Mile
SGF1330	F	17-Mar-09		15-Feb-10	150.8129	Unrecovered	Cinnabar
SGF3201	F	18-Mar-09		18-Nov-10	150.9731	Unrecovered	Soulen Center
SGM3981[a]	M	18-Mar-09		18-Mar-09		Unknown - banded only	Soulen Center
SGF1329	F	28-Mar-09	14-Sep-09		150.534	Mortality	Four Mile
SGM3824	M	22-Apr-09		20-Nov-09	150.743	Unrecovered	Farm to Market
SGM3844	M	6-Mar-10		17-Jun-10	151.272	Lost collar	Soulen Center
SGM3845	M	6-Mar-10		7-Feb-11	151.304	Unrecovered	Soulen Center
SGM3846	M	6-Mar-10	23-Apr-10		152.132	Mortality	Soulen Center
SGM3847	M	7-Mar-10		6-Aug-10	151.676	Unrecovered	Four Mile
SGM3848	M	11-Mar-10	30-Mar-10		152.072	Mortality	Shoepeg
SGM3849	M	11-Mar-10	29-Apr-11		152.252	Mortality	Shoepeg
SGM3850	M	11-Mar-10	17-Aug-10		152.241	Mortality	Shoepeg
SGF3216	F	15-Mar-10		17-Dec-10	150.224	Unrecovered	Shoepeg
SGF3217	F	17-Mar-10		2-Jul-10	150.214	Lost collar	Craig
SGM3851	M	17-Mar-10	15-Apr-11		152.202	Mortality	Craig
SGM3985	M	17-Mar-10	23-Apr-10		152.062	Mortality	Four Mile
SGF1331	F	19-Mar-10		29-Apr-11	152.123	Lost collar	Soulen Center
SGM3984	M	19-Mar-10	11-Jan-11		152.162	Lost collar	Four Mile
SGM3983	M	20-Mar-10	17-May-11		152.223	Mortality	Sagebrush Flat
SGM3852	M	21-Mar-10	21-May-10		150.064	Mortality	Sagebrush Flat

Band	Gender	Capture Date	Mortality Date	Last Contact	Radio	Fate	Lek
SGM3853	M	21-Mar-10		29-Oct-10	150.323	Transmitter failed	Sagebrush Flat
SGM3854	M	7-Apr-10	22-Sep-10		151.587	Mortality	Monday Gulch II
SGM3855	M	14-Apr-10	15-Apr-11		152.072	Mortality	Shoepeg
SGM3856	M	14-Apr-10	11-Mar-11		150.073	Mortality	Shoepeg
SGM3857	M	14-Apr-10	17-Dec-10		150.832	Mortality	Shoepeg
SGM3858	M	17-Apr-10	29-Apr-11		150.334	Mortality	Farm to Market
SGM3859	M	17-Apr-10		18-Nov-10	150.773	Unrecovered	Farm to Market
SGF3218	F	11-Oct-10		12-Aug-11	149.372	Alive	No lek - fall capture
SGF3219	F	11-Oct-10		12-Aug-11	149.312	Alive	No lek - fall capture
SGF3220	F	11-Oct-10		12-Aug-11	149.357	Alive	No lek - fall capture
SGM3860	M	5-Apr-11		8-Aug-11	150.273	Alive	Farm to Market
SGM3861	M	5-Apr-11		10-Jul-11	149.333	Alive	Farm to Market
SGM3862	M	8-Apr-11		10-Jul-11	149.181	Alive	Monday Gulch II
SGM3863	M	8-Apr-11		9-Jun-11	152.241	Alive	Wiley Feed Lot

[a] Banded only.

[b] Recaptured in 2007 and collared.

[c] Males with female leg bands.