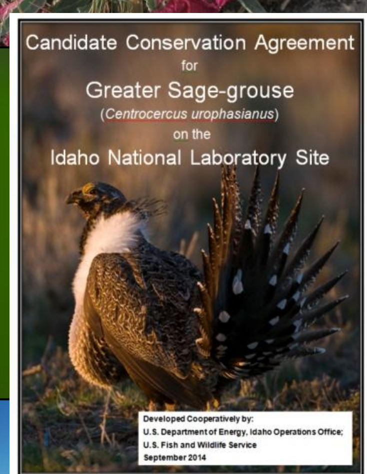
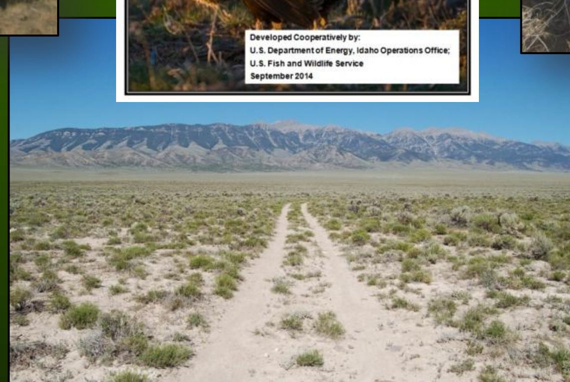
Implementing the Candidate Conservation Agreement for Greater Sage-Grouse on the Idaho National Laboratory Site:

2015 Full Report



Candidate Conservation Agreement
for
Greater Sage-grouse
(*Centrocercus urophasianus*)
on the
Idaho National Laboratory Site

Developed Cooperatively by:
U.S. Department of Energy, Idaho Operations Office;
U.S. Fish and Wildlife Service
September 2014



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Implementation of the Candidate Conservation Agreement for Greater Sage-Grouse on the Idaho National Laboratory Site: 2015 Full Report

February 2016

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ACRONYMS

AMWTP	Advanced Mixed Waste Treatment Project
ATR	Advanced Test Reactor
BEA	Battelle Energy Alliance
CCA	Candidate Conservation Agreement
CFA	Central Facilities Area
CITRC	Critical Infrastructure Test Range Complex
DOE	U.S. Department of Energy, Idaho Operations Office
ESER	Environmental Surveillance, Education, and Research
GIS	Geographic Information System
GPS	Global Positioning System
IDFG	Idaho Department of Fish and Game
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
LTV	Long-Term Vegetation
MFC	Materials & Fuel Complex
NAIP	National Agricultural Imaging Program
NOAA	National Oceanic and Atmospheric Association
NRF	Naval Reactors Facility
RWMC	Radioactive Waste Management Complex
SGCA	Sage-grouse Conservation Area
USFWS	U.S. Fish and Wildlife Service

EXECUTIVE SUMMARY

This document satisfies the reporting requirement of the *Candidate Conservation Agreement* [CCA] *for Greater Sage-grouse (Centrocercus urophasianus) on the Idaho National Laboratory* [INL] *Site*, entered into by the U.S. Department of Energy, Idaho Operations Office (DOE) and the U.S. Fish and Wildlife Service (USFWS) in 2014. The primary purposes of this report are to (1) document DOE's 2015 inventory and monitoring activities and results in support of the CCA, (2) address sage-grouse population and habitat regulatory triggers in the context of those results, and (3) document progress toward achieving CCA objectives associated with the conservation measures. This summary highlights key results and conclusions as they relate to population and habitat triggers, threat monitoring, and implementation of conservation measures.

Population Monitoring

The population baseline on the INL Site is 316 males, which was the number of males counted in 2011 during peak male attendance on 27 active leks within the Sage-grouse Conservation Area (SGCA). The population trigger would be tripped if the three-year average of males on those 27 leks decreased by ≥ 20% (i.e. ≤253 males). In 2015, we surveyed the 27 baseline leks (20 of which are currently active), three Idaho Department of Fish and Game survey routes, and all other active leks on the INL Site. Key results from population monitoring are as follows:

- The 3-year average peak male attendance (2013–2015) on the 27 baseline leks was 340 (134% of trigger value), the same as last year's average.
- Peak male attendance at all known active leks on the INL Site was 589 males, down 9% from last year (647 males), but 6% higher than 2013 (556 males).
- The number of leks classified as active on the INL Site increased from 45 in 2014 to 46 in 2015.

Habitat Monitoring

The baseline value of the habitat trigger is equivalent to the amount of area within the SGCA that was characterized as sagebrush-dominated habitat at the beginning of 2013. This habitat trigger will trip if more than 15,701 ha (38,798 ac) of sagebrush habitat within the SGCA are converted to a non-sagebrush-dominated vegetation class. To monitor the extent and condition of sagebrush-dominated lands and areas recovering from wildland fire, we surveyed 125 vegetation plots distributed across both habitat types. We also updated the boundary of the 2010 Jefferson fire to obtain a more precise estimate of the amount of remaining sagebrush habitat. The following is a summary of wildland fire activity and principle results from habitat monitoring tasks:

- No wildland fires burned in the SGCA, but two fires outside the SGCA burned an estimated 1.6 ha (4 ac). It is unclear how much sagebrush habitat was impacted by those two fires.
- We made final mapping updates to the 2010 Jefferson Fire and adjusted the SGCA sagebrush habitat baseline to 78,504 ha (193,988 ac), an increase of 113 ha (279 ac). No losses in sagebrush habitat have been mapped since monitoring was initiated.
- In polygons currently identified as sagebrush habitat, mean sagebrush cover and height were within suggested optimal ranges for breeding and brood-rearing habitat.
- Perennial herbaceous height was at the lower end of its suggested range and perennial herbaceous cover was below guideline recommendations. Low herbaceous cover values, relative

to habitat guidelines, do not appear to be a result of poor ecological condition, but rather the effect of soils and climate on the local ecosystem.

Threats Monitoring

The CCA identifies eight threats that potentially impact sage-grouse and its habitats on the INL Site. Three of these – raven predation, annual grasslands, and infrastructure development – require baseline inventory and monitoring information to support associated conservation measures. In 2015, we searched infrastructure for active raven nests (raven predation), surveyed selected areas for cheatgrass (annual grasslands), and updated the INL roads layer and sagebrush habitat distribution map to establish baselines for monitoring unauthorized infrastructure expansion (infrastructure development). Key results and conclusions from threat monitoring tasks are listed below:

Raven Predation

- Thirty-nine active raven nests were observed on INL Site infrastructure, which is slightly higher than in 2014. However, it is still too early to determine whether increasing observations of raven nests in the past two years is due to a real trend or inter-annual variation.
- DOE will encourage responsible parties to take advantage of low-cost opportunities to deter raven nesting at perennial nest sites on towers and within facilities that are in or near the SGCA. Highest priority locations are at two National Oceanic and Atmospheric Association towers and specific sites within Advanced Mixed Waste Treatment Project, Test Area North, Advanced Test Reactor Complex, and Naval Reactors Facility.

Annual Grasslands

- Nineteen new locations dominated by cheatgrass or other non-native annual species were identified and mapped, including two areas totaling 17.1 ha (69 ac) and 17 points of less than 400 m^2 each.

Infrastructure Development

- We added 505.5 km (314.1 mi) of previously unmapped two-track features to the INL Site roads data layer. Currently, 3,593.3 km (2,232.8 mi) of two-track and paved road features are on the INL Site, representing the baseline data that future monitoring will be compared against.
- We removed 66.2 ha (163.5 ac) from the sagebrush habitat layer, because our analysis showed these areas were affected by facility and gravel pit expansion between the time of the last mapping effort and the signing of the CCA.

Implementation of Conservation Measures and Adaptive Management

DOE and INL Site contractors began to implement all 13 conservation measures in 2015. They fully completed conservation measure 11, which included aims to produce training modules and teach employees to eliminate food subsidies for ravens and other wildlife. In support of conservation measure 1, employees with the ESER program coordinated the planting of 5,000 sagebrush seedlings during fall 2015 and mapped the locations of about 15% of them to facilitate survivorship monitoring in the future.

Synthesis and Conclusions

Results from lek surveys and other monitoring provide no evidence that the local sage-grouse population is in decline or that threats are increasing. Only 2 ha (5 ac) have burned on the INL Site in the past three years. However, we recognize that wildland fire remains the greatest threat to sage-grouse and its habitats because a single large fire can remove tens of thousands of acres of sagebrush habitat and can significantly impact local sage-grouse abundance within one or two years following the fire. Because wildland fire activity has been low, and because natural habitat changes occur slowly, the habitat baseline remains unchanged. We have no expectation that either the population or habitat triggers will be tripped in the near term unless a large fire burns sagebrush habitat.

1. BACKGROUND AND PURPOSE

In October 2014, The U.S. Department of Energy, Idaho Operations Office (DOE) and the U.S. Fish and Wildlife Service (USFWS) entered into a Candidate Conservation Agreement (CCA) for Greater Sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse) on the Idaho National Laboratory (INL) Site (DOE and USFWS 2014). The CCA stipulates that DOE submit a report annually summarizing results from eight monitoring tasks (Section 11), updating the USFWS on DOE's progress toward achieving stated conservation objectives (Section 10), and providing other relevant information prior to an annual meeting between the two agencies. This report summarizes results from the 2015 inventory and monitoring tasks completed by DOE's Environmental Surveillance, Education, and Research (ESER) Program, and provides other information in support of sage-grouse conservation and the CCA.

The primary purpose of this report is to provide data and information necessary to enable DOE and USFWS to track population and habitat trends relative to adaptive regulatory triggers outlined in the CCA. On the INL Site, the two triggers and criteria that would have to be demonstrated to initiate an automatic response by both agencies are:

- <u>Population Trigger</u>: Peak male attendance, averaged over three years on the 27 leks within the Sage-grouse Conservation Area (SGCA), decreases by 20% or more (i.e., ≤ 253 males) compared with the 2011 baseline (*n*=316 males);
- <u>Habitat Trigger</u>: Total area designated as sagebrush habitat within the SGCA is reduced by 20% or more (i.e. ≥15,701 ha [38,798]) of the 2013 baseline (78,504 ha [193,988 ac]).

Information provided here will inform a dialogue between DOE and USFWS as the two agencies cooperate to achieve CCA objectives for sage-grouse conservation on the INL Site. Consistent re-evaluation and analysis of new information will ensure that the CCA continues to benefit sage-grouse on the INL Site, is continuously grounded in the best available science, and retains its value to both signatories.

This document groups related inventory and monitoring task reports into three chapters: Population Trigger Monitoring (Chapter 2), Habitat Trigger Monitoring (Chapter 3), and Threat Monitoring (Chapter 4). Each chapter summarizes results of pertinent monitoring tasks outlined in section 11.1 of the CCA. Chapter 5 documents how DOE and its contractors implemented the 13 conservation measures listed in the CCA during 2015. Chapter 6 summarizes the status of population and habitat triggers in a synthesis that combines information obtained from the eight monitoring tasks and the conservation measures. Finally, Chapter 7 succinctly outlines ESER's work plan for the upcoming year, especially highlighting changes that will be made to the past year's activities.

2. POPULATION TRIGGER MONITORING

In 2013, DOE initiated the following three monitoring tasks designed to track the number of male sage-grouse at active leks and document additional active leks on the INL Site (DOE and USFWS 2014):

1) Lek Surveys – Surveys of all active leks on the INL Site. These include leks that are located in and out of the SGCA and leks on the three Idaho Department of Fish and Game (IDFG) survey routes;
2) Historical Lek Surveys – Surveys of historical leks on the INL Site to determine if grouse still use those areas;
3) Systematic Lek Discovery Surveys – Surveys of poorly sampled regions of the INL Site to discover additional active leks, especially in the SGCA.

Task 1 produces an index of peak male attendance across the 27 leks in the SGCA that were used to establish the baseline value of the population trigger (DOE and USFWS 2014). Task 1 also provides information about abundance trends across the three IDFG lek routes and all other active leks on the INL Site (DOE and USFWS 2014). The purpose of Tasks 2 and 3 is to identify unknown active leks on the INL Site. Our goal is to use information from the three tasks to establish new, permanent lek routes on the INL Site before the 2017 lek season (DOE and USFWS 2014).

2.1 Task 1 – Lek Surveys

2.1.1 Introduction

Task 1 consists of surveying all known active leks on the INL Site, including (1) the 27 baseline leks located in the SGCA, (2) leks on three IDFG survey routes (15 of these were used to calculate the baseline), and (3) all other known active leks on the INL Site (DOE and USFWS 2014).

The primary purpose of Task 1 is to provide information to track male attendance trends on the 27 baseline leks within the SGCA, which is crucial for evaluating the population trigger. The baseline value for the population trigger is 316 males, which is the summation of peak male attendance on the 27 leks in the SGCA that were active during 2011 (Figure 2-1; DOE and USFWS 2014; some of the 27 leks are no longer classified as active). The trigger would be tripped if the three-year average of peak male attendance at these 27 leks decreases by 20% or more (i.e., ≤ 253 males) relative to the 2011 baseline (DOE and USFWS 2014).

Three lek routes (Tractor Flats, Radioactive Waste Management Complex [RWMC], and Lower Birch Creek) were established on the INL Site by the IDFG in the 1990s and have been monitored annually since 1999 (Figure 2-1). Many of these leks are included in the suite of 27 baseline leks. Data from these lek routes are valuable as they add an historical perspective to current trends in sage-grouse abundance (Garton et al. 2011, DOE and USFWS 2014). Counts of peak male attendance on lek routes represent a minimum number of breeding males in a local area (Connelly et al. 2003, Garton et al. 2011) and are useful for evaluating abundance trends over time.

In 2015, ESER biologists surveyed 23 active leks on the INL Site in addition to the SGCA baseline leks (Figure 2-1). These leks were not included in the 2011 baseline value because they were either not within the SGCA (including some leks on IDFG routes), not discovered until after 2011, or they were not sampled every year from 2011 to 2013. Now that all active leks on the INL Site are surveyed each year, there is a broad context by which to evaluate sage-grouse abundance trends and establish new lek routes (DOE and USFWS 2014).

2.1.2 Methods

We surveyed all leks from 23 March to 30 April following methods used in past years (Shurtliff et al. 2015). The winter of 2014-2015 was uncharacteristically warm, so as a precaution we conducted two to four unofficial surveys per route during February and early March, 2015. The extra data allowed us to evaluate whether peak male attendance occurred during the official survey period.

2.1.3 Results and Discussion

SGCA Baseline Leks

We surveyed each of the 27 SGCA baseline leks 3–7 times ($\bar{x}$ = 4.6 surveys, *SD* = 1.5; Figure 2-1). The sum of peak male attendance counts across the 27 leks was 335, and the three-year mean (2013-2015) was 340. This mean is identical to the 2014 mean (Figure 2-2), and remains at 134% of the trigger point (i.e. 253 males). Because the number of males observed on the baseline leks has increased since 2011 and is well above the trigger point, it is unnecessary for DOE and the USFWS to conduct a special review of sage-grouse population management on the INL Site during the upcoming year, as stipulated in the CCA.

Following the 2015 field season, 20 leks remained classified as active (two were reclassified as inactive). In each of the past three years, two or three baseline leks per year have been reclassified as inactive as the improving data set provides a more accurate classification for each lek. These results should not be interpreted as evidence that seven leks have been abandoned in the past three years but rather that five years of data have accumulated for most leks, allowing for more precise lek classifications (Whiting et al. 2014).

Other Active Leks

We surveyed 23 additional active leks 2–6 times each ($\bar{x}$ = 3.3, SD = 1.1) (Figure 2-1). The sum of males at peak attendance on those 23 leks was 244. In comparison, we counted 264 males on 20 active, non-baseline leks in 2014.

IDFG Lek Routes

Active leks on IDFG lek routes include some counted as baseline leks, some counted as “other active leks” (see above), and two that are outside the INL Site boundaries. We surveyed each of the IDFG lek routes five times during the official survey period (Figure 2-1). The summed peak male attendance from each lek route was 254, which is slightly lower than the 2014 peak of 260 males, but still higher than any of the other years since the 2010 Jefferson Fire. Both the Lower Birch Creek and the Tractor Flats routes had higher numbers of males in 2015 than in recent years (*n* = 82 and 76, respectively)(Figure 2-3). The Lower Birch Creek count was higher than any year since 2007, and Tractor Flats count was the highest documented since the Jefferson Fire. Peak male attendance on the RWMC route was 96 males, a moderate decrease following two consecutive years of increased attendance.

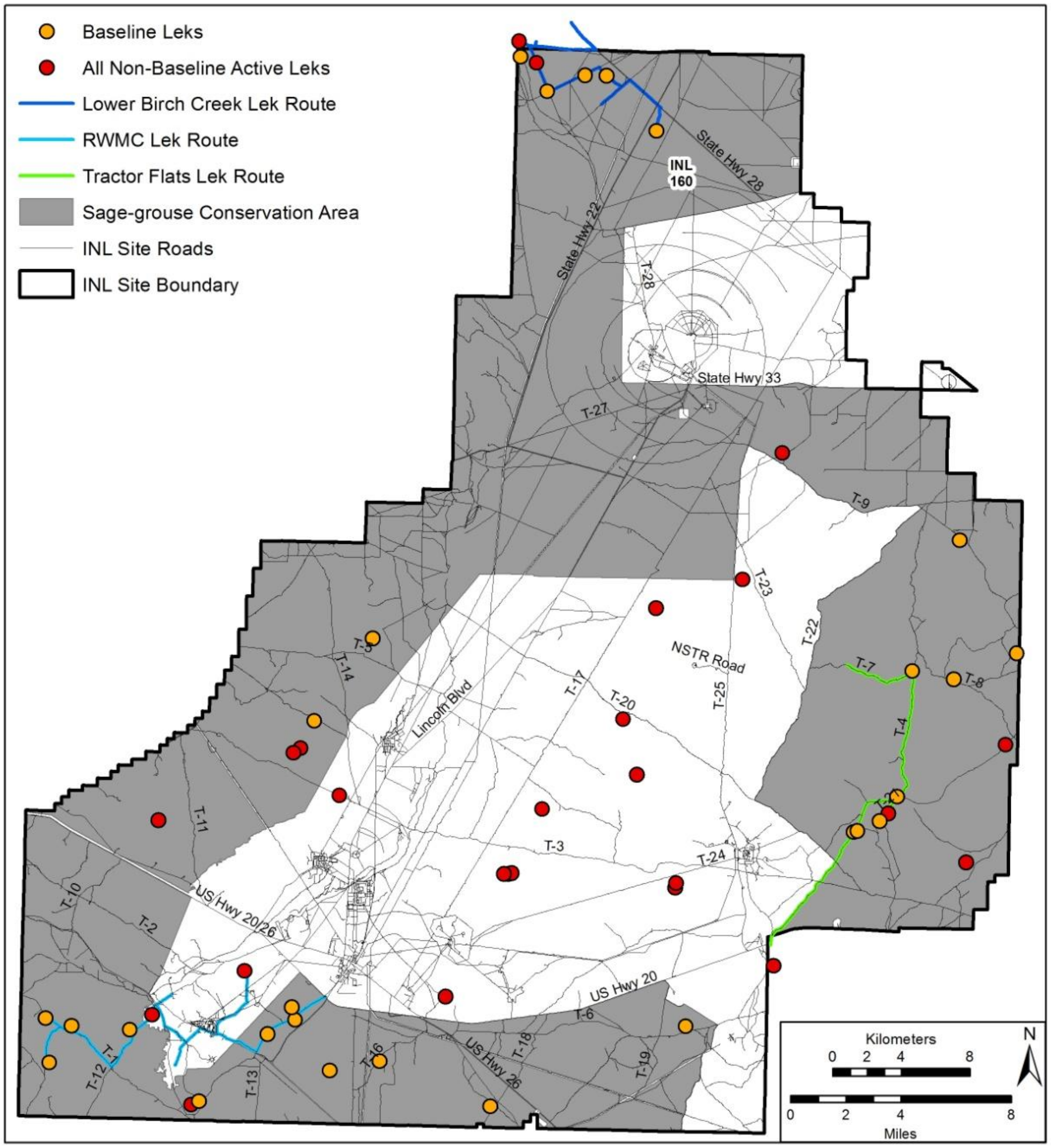


Figure 2-1. Leks surveyed on and near the INL Site in 2015. Twenty-two baseline leks (orange dots) and all non-baseline leks (red dots) were classified as active at the beginning of the survey period. Two baseline leks were subsequently reclassified as inactive following the surveys. A new active lek discovered in 2015 (INL160) is also shown.

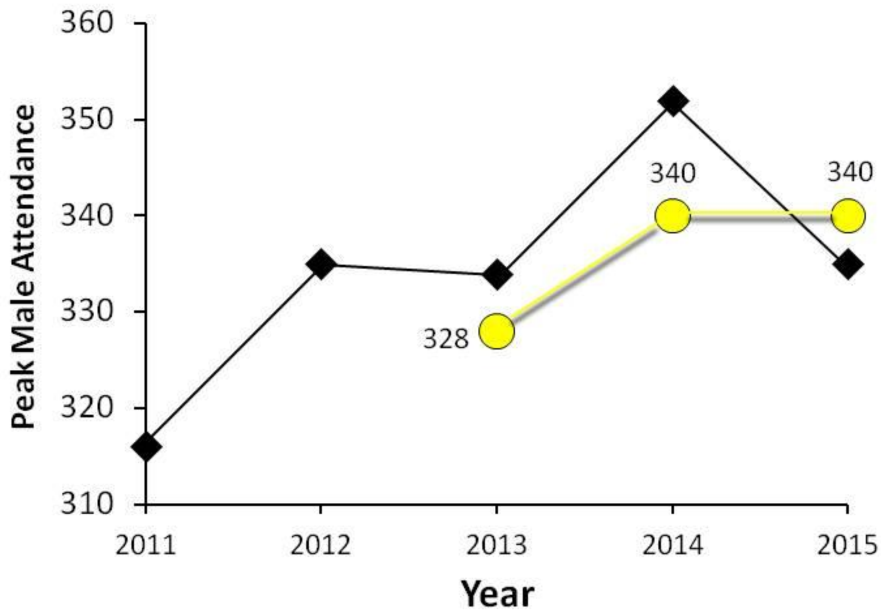


Figure 2-2. Peak male attendance on 27 leks in the SGCA used to calculate the original baseline value. Black squares are annual counts, and yellow dots represent the 3-year running average.

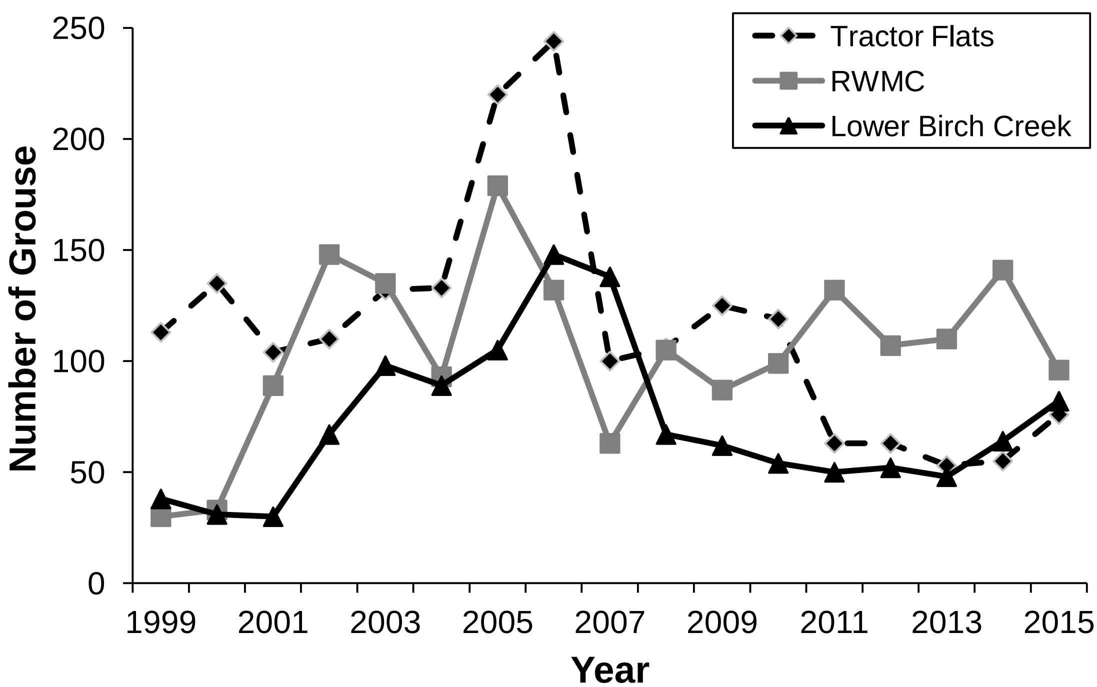


Figure 2-3. Number of male sage-grouse observed at peak attendance across three lek routes on the INL Site from 1999 to 2015. From 1999 – 2007, the number of leks surveyed increased from 12 to 21. Since 2008, the number of leks surveyed has increased to 24.

2.2 Task 2 – Historical Lek Surveys

2.2.1 Introduction

During the past several decades, many leks have been documented on the INL Site as a result of surveys and opportunistic observations of displaying sage-grouse (Whiting and Bybee 2011). Prior to 2009, many of these historical lek sites had not been surveyed for nearly 30 years. Since 2009, ESER biologists have revisited a subset of historical leks each spring to determine if they remain active based on current criteria (DOE and USFWS 2014). The objective of Task 2 is to determine which historical leks are active before establishing new lek routes prior to the 2017 lek season (DOE and USFWS 2014).

2.2.2 Methods

Survey methods and criteria used to designate a historical lek as active or inactive are described elsewhere (Shurtliff et al. 2015, Whiting et al. 2014, Research Procedure 6, 2014). In 2015, we surveyed historical lek sites from 23 March to 5 May (Figure 2-4).

2.2.3 Results and Discussion

We surveyed 15 historical leks in the SGCA an average of 2.2 times (range=2 to 3 surveys), and 11 historical leks outside the SGCA an average of 2.3 times (range=2 to 3 surveys). Across those 26 potential lek sites, we observed males displaying on one lek (INL 144) on two separate visits (three males during one visit and one male during another visit) and four males displaying on another lek during a single visit (INL 117)(Figure 2-4). Consequently, these two leks were reclassified as active.

After an historical lek has been surveyed for five years without at least two years of observed breeding activity, it is reclassified as inactive (Whiting et al. 2014). Following the 2015 survey season, ten leks were reclassified as inactive. Fourteen leks remain classified as historical and will be surveyed again in 2016.

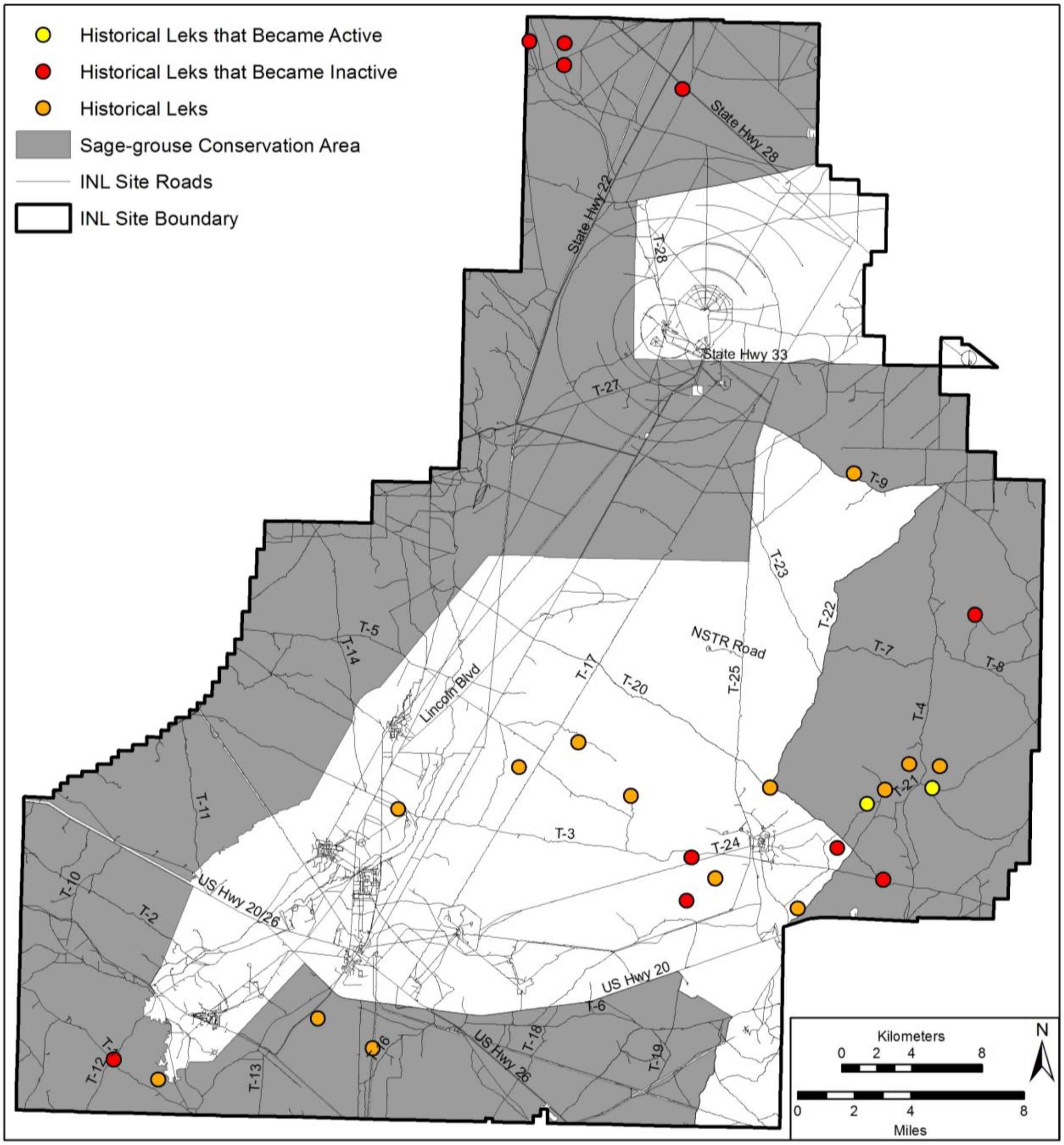


Figure 2-4. Historical leks surveyed on the INL Site in 2015. Leks reclassified as active or inactive following the field season are indicated.

2.3 Task 3 – Systematic Lek Discovery Surveys

2.3.1 Introduction

Known lek sites are few or absent across large portions of the SGCA (Figure 2-1), even though habitat in these areas often appears to be adequate to support sage-grouse breeding and nesting activities (DOE and USFWS 2014). Since 2013, ESER has systematically searched for unknown lek sites each spring in areas where few or no leks are known. The objective of this task is to continue to search for active lek sites in an effort to find as many as possible before new lek routes are established (DOE and USFWS 2014).

2.3.2 Methods

Prior to the field season, we designated road- and remote-survey locations in a Geographic Information System (GIS) to which we would drive or hike (Shurtliff et al. 2015). At each point, we listened for lekking sage-grouse using a parabolic microphone as described elsewhere (Shurtliff et al. 2015; Research Procedure 6, 2014).

2.3.3 Results and Discussion

Between 25 March and 6 May, 2015, we completed 74 surveys (29 road, 45 remote) within the northeastern section of the INL Site (Figure 2-5). As a result, we discovered one sage-grouse lek (N160). We counted two males on one visit to N160 and three males on a second visit, and on both occasions we observed 4 – 14 others of unknown gender.

Since surveys began in 2013, we have discovered four previously unknown leks through Task 3 monitoring.

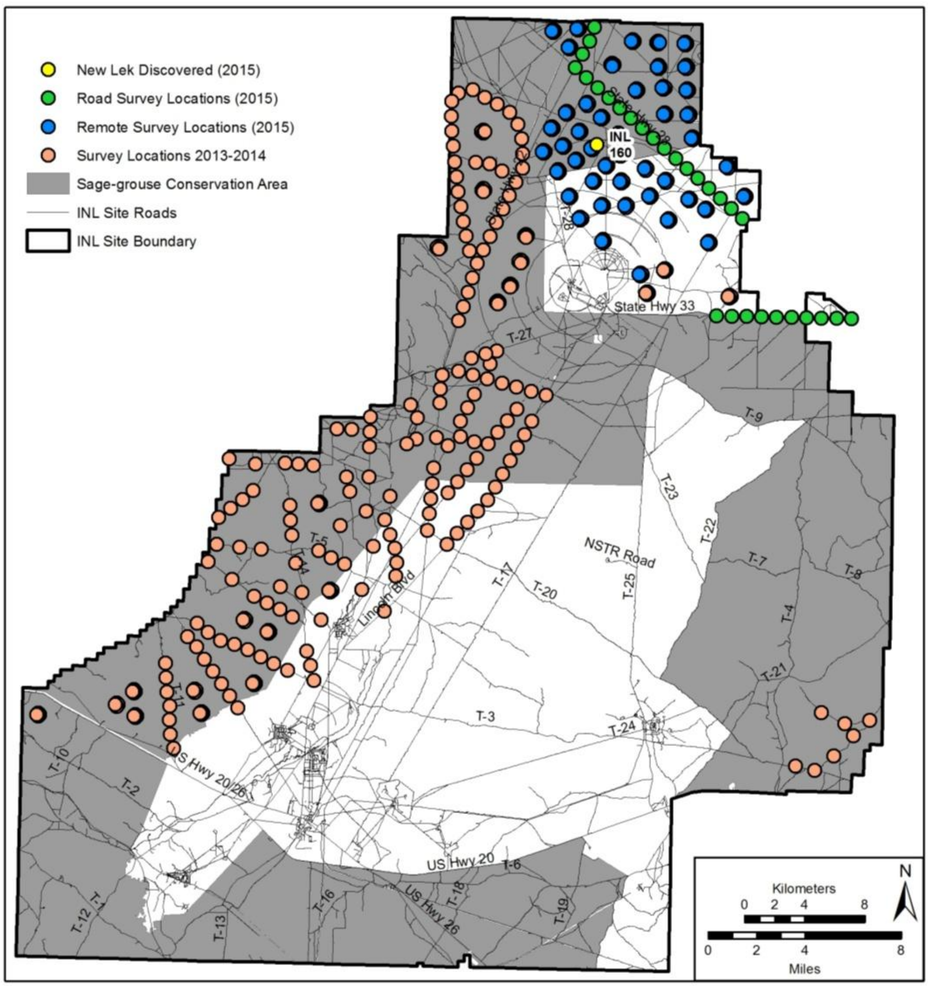


Figure 2-5. Locations where ESER biologists performed acoustic and visual surveys for sage-grouse since 2013.

2.4 Summary of Known Active Leks

Prior to the start of the 2015 field season, 47 leks were classified as active on or near the INL Site, including two just outside the Site boundaries that are part of the IDFG survey routes. With the addition of 2015 data, we reclassified two active lek sites as inactive. However, we added three new active leks to the list (two confirmed during historical lek surveys and one documented during the lek discovery surveys), increasing the total number of known active leks on or near the INL Site to 48 (Figure 2-6).

Peak male attendance in 2015 across all leks on the INL Site was 589. This count represents the summed counts from SGCA baseline leks (*n*=335), all other active INL Site leks recognized as such at the beginning of the field season (*n*=244), the two historical leks reclassified as active in 2015 (*n*=7), and the newly discovered lek (*n*=3).

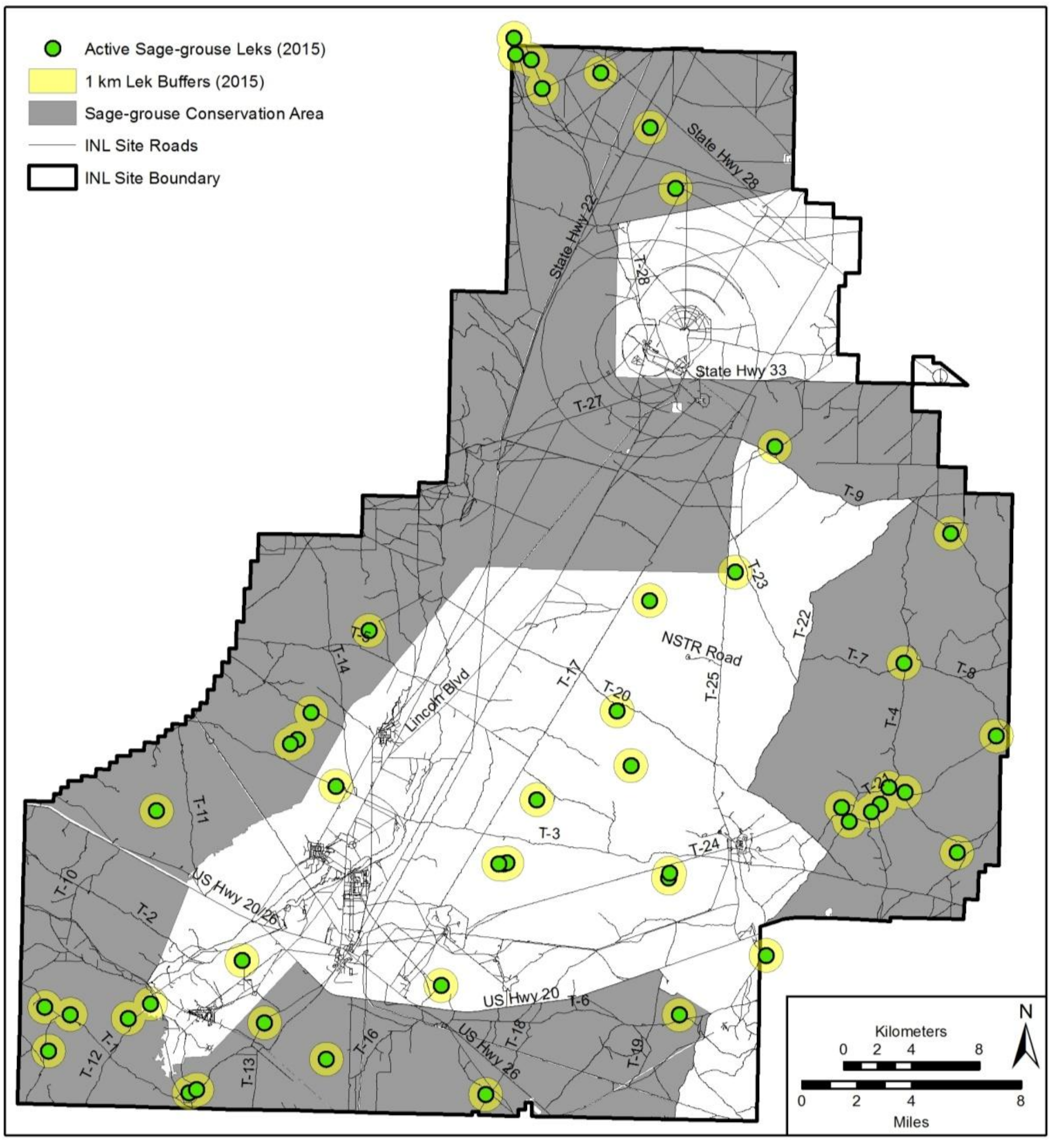


Figure 2-6. The 48 leks classified as active on or near the INL Site following the 2015 field season.

2.5 Literature Cited

Connelly, J. W., K. P. Reese, and M. A. Schroeder. 2003. Monitoring of Greater sage-grouse habitats and populations. College of Natural Resources Experiment Station publication No. 979, University of Idaho, Moscow, Idaho, 49 pp.

Department of Energy, Idaho Operations Office, and U.S. Fish and Wildlife Service. 2014. Candidate conservation agreement for greater sage-grouse (*Centrocercus urophasianus*) on the Idaho National Laboratory Site. DOE/ID-11514, U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho.

Garton, E. O., J. W. Connelly, C. A. Hagen, J. S. Horne, A. Moser, and M. A. Schroeder. 2011. Greater Sage-Grouse population dynamics and probability of persistence. Pp. 293-381 in Greater Sage-Grouse: Ecology and Conservation of a Landscape Species and Its Habitats (S. T. Knick, and J. W. Connelly, eds.). University of California Press, Berkeley, California.

Research Procedure 6. 2014. Sage-grouse historical lek and lek discovery surveys. ESER Research Procedure 6, Gonzales-Stoller Surveillance, LLC., Idaho Falls, ID, 12 pp.

Shurtliff, Q.R., A.D. Forman, J.C. Whiting, J.P. Shive, J.R. Hafla, K.T. Edwards, R.D. Blew. 2015. 2014 monitoring report in support of the candidate conservation agreement for greater sage-grouse on the Idaho National Laboratory Site. DOE/ID-11527. Gonzales-Stoller Surveillance, LLC, Idaho Falls, ID. January 2015.

Whiting, J. C. and B. Bybee. 2011. Annual report of surveys for historic sage-grouse leks on the Idaho National Laboratory Site. Environmental Surveillance, Education, and Research Program Report, Gonzales-Stoller Surveillance, LLC., Idaho Falls, ID. GSS-ESER-141; http://www.gsseser.com/Publications.htm.

Whiting, J. C., Q. R. Shurtliff, K. B. Howe, and B. F. Bybee. 2014. Greater sage-grouse monitoring and management on the Idaho National Laboratory Site. Environmental Surveillance, Education, and Research Program Report, Gonzales-Stoller Surveillance, LLC., Idaho Falls, ID. GSS-ESER-161; http://www.gsseser.com/Publications.htm.

3. HABITAT TRIGGER MONITORING

All vegetation-based estimates for sagebrush habitat for the CCA were initially determined using a vegetation map completed in 2010 (Shive et al. 2011). Sagebrush habitat was designated by selecting all map polygons assigned to stand-alone big sagebrush or low sagebrush classes, and all map class complexes where one of the two classes is either a big sagebrush or low sagebrush class. The spatial extent of sagebrush habitat is dynamic and will reflect changes in plant communities or vegetation classes. Areas designated as sagebrush habitat will change through time based on gradual changes in vegetation composition and also from abrupt changes caused by wildland fire.

The current baseline value of the habitat trigger is defined as the total area designated as sagebrush habitat within the SGCA at the beginning of 2013. The trigger will trip if there is a 20% reduction in sagebrush habitat within the SGCA. In 2015, we analyzed new data and updated the habitat trigger baseline value to 78,504 ha (193,988 acres), 359 ha (887 acres) more than was estimated last year (see section 3.2, this document). If a net of >15,701 ha (38,798 acres) of sagebrush habitat is lost in the future, the USFWS will conduct an evaluation of current habitat management on the INL Site and arrange a meeting with DOE to discuss plans for maintaining compliance with the CCA.

Two monitoring tasks identify vegetation changes across the landscape and assist in maintaining an accurate record of the quantity and distribution of sagebrush habitat within the SGCA to annually evaluate the habitat trigger:

Task 5: Sagebrush Habitat Condition Trends - The sagebrush habitat quality data will document gains in habitat as non-sagebrush map polygons transition back into sagebrush classes, or when compositional changes occur (e.g. non-native grass density) within existing sagebrush polygons that may require a change in the assigned map class. This task also allows for ongoing assessment of habitat quality, or condition, within polygons mapped as sagebrush habitat, which facilitates comparisons between sagebrush habitat on the INL Site and sage-grouse habitat guidelines (e.g. Connelly et al. 2000).

Task 6: Monitoring to Determine Changes in Sagebrush Habitat Amount and Distribution - The sagebrush habitat quantity monitoring task is intended to provide an update to the current sagebrush habitat distribution, and deals with losses to sagebrush habitat following events that alter vegetation communities. As updates are made to the map classes and/or vegetation polygon boundaries, the total area of sagebrush habitat available will be compared to the baseline value established for the habitat trigger to determine status with respect to the habitat threshold.

Together, these two monitoring tasks reflect the original mapping process and provide the basis for maintaining an accurate map and estimate of quality and quantity of sagebrush habitat on the INL Site. For example, if imagery from burned areas suggests there have been changes in vegetation classes or distribution of those classes several years post-burn, sagebrush cover will be assessed using habitat condition monitoring data from plots located within a burned area. Once substantial increases in big sagebrush cover have been identified from either the plot data or the imagery, a dichotomous key to vegetation classes will be used at numerous locations within the polygon to determine whether it has enough big sagebrush cover over a substantial enough area to redefine the polygon as a big sagebrush class or complex, or whether re-delineating smaller sagebrush-dominated polygons within the burn area is appropriate.

3.1 Task 5 – Sagebrush Habitat Condition Trends

3.1.1 Introduction

Characterization and monitoring of sagebrush habitat quality, or condition, was identified as an integrated component of the CCA monitoring plan to address conservation efforts for sage-grouse on the INL Site. Annual monitoring of sagebrush habitat is necessary to track trends in the condition of habitat available for sage-grouse and to understand the potential for declines in habitat quality associated with threats. Two threats, wildland fire and infrastructure development, were ranked as "high "in the CCA threats assessment. The potential threat from annual grasses and other weeds, livestock, and seeded perennial grasses were also important, with each receiving a "medium" ranking. These five threats are thought to affect sage-grouse populations partially or wholly through their effects on habitat. Therefore, the habitat condition monitoring task was developed to allow biologists to characterize broad-scale trends in habitat condition over time as well as to identify annual changes in condition associated with post-fire recovery, surface disturbance, livestock operations, and spread of introduced herbaceous species.

3.1.2 Methods

Study Design

The habitat condition monitoring task was specifically designed to:

- characterize habitat condition each year,
- relate vegetative characteristics of habitat on the INL Site to conservation goals and/or management guidelines,
- track trends in habitat decline and/or recovery,
- interpret changes to habitat condition within the context of regional vegetation and weather patterns,
- continue to assess progress toward recovery in areas that were lost from current habitat status due to wildland fire or other disturbances,
- understand the effects of various threats on habitat condition,
- provide a link between areas mapped as habitat and the vegetative characteristics of the plant communities in those polygons, and
- inform the process used to update the estimate of sagebrush habitat distribution.

A total of 225 plots have been established for the purpose of monitoring sage-grouse habitat condition. All plot locations were selected using a stratified random sampling design (Appendix B). A subset of 75 of the habitat condition monitoring plots are surveyed annually; about two-thirds of the plots are located in polygons designated as current sagebrush habitat and the remaining plots are located in fire scars where the plant community prior to the wildland fire was thought to include sagebrush habitat. An additional 150 plots are surveyed on a rotational basis with a subset of 50 plots sampled each of three years over the span of five years. The rotational plots are located so as to increase sample sizes in fire scars, grazing allotments, and areas likely to be impacted by non-native plants.

The data metrics collected at each of the habitat monitoring plots were selected for two purposes. The first is to support basic description and assessment of sage-grouse habitat quality (e.g. Connelly 2000, Table

3). The second is to track trends which allow for characterization of compositional change in vegetation through time, and with respect to potential threats. The habitat data sampled at each plot include: vegetation cover by species, vegetation height for shrubs and herbaceous species, sagebrush density, frequency of juvenile sagebrush occurrence, comprehensive species lists, photographic documentation, sign of use by sage-grouse, indicators of anthropogenic disturbance, and documentation of the current local plant community. A complete description of sample site selection and plot sampling methodology can be found in the study plan and sample protocol for this monitoring project (Appendix B).

Data Analyses

Plots that are sampled annually will be used to track trends in general habitat condition across the INL Site, while rotational plots will be used to address specific threats or concerns related to more localized areas (fire scars, grazing allotments, etc.). Formal trend analysis on data collected from the annual plots will begin when data are available for at least five years, after enough temporal variability has been captured to make those analyses meaningful.

Data collected in 2015 were used to update habitat summary statistics from 2013 and 2014. These summary statistics will eventually form the basis for trend analyses. They will also allow for updated comparisons between vegetative characteristics of polygons currently designated as sage-grouse habitat on the INL Site and those recommended for optimal sage-grouse habitat in guidance documents. Analysis of the 2015 data includes an overview of precipitation and the potential effects of precipitation patterns on the 2015 habitat condition monitoring data. The 2015 summary data were informally compared to the summary data from the previous two years, which will help biologists develop an understanding of the potential annual variability of sage-grouse habitat on the INL Site.

3.1.3 Results and Discussion

Data were collected on a total of 125 plots between June and August of 2015; sampling was completed on all 75 annual plots and 50 of the rotational plots (Figure 3-1). For this report, we focus on data from the annual plots, as discussed previously. With respect to the annual plots, 48 are located in polygons currently designated as sagebrush habitat (referred to as sagebrush habitat plots hereafter), and 27 are located in polygons where habitat status is currently non-sagebrush dominated (referred to as non-sagebrush plots hereafter). All of the non-sagebrush plots are located in polygons that have burned at least once since 1994 and were thought to have been dominated by sagebrush prior to fire. The sagebrush habitat plots are located in polygons that have not burned in at least the last 20 years, and many of them have likely not burned for at least a few centuries (Forman et al. 2013).

Forty-six of the 48 annual sagebrush habitat plots were assigned to communities characterized by sagebrush dominance in 2015 (Table 3-1a.). The remaining two plots were assigned to communities characterized by the dominance of green rabbitbrush. Results from 2015 were comparable to 2013 results, with the majority of plots assigned to Wyoming big sagebrush communities and a substantial number of plots assigned to communities where big sagebrush subspecies are mixed and/or hybridized. Notable differences between 2014 and 2015 include a shift back to keying more plots as being dominated by mixed and/or hybridized big sagebrush subspecies rather than being dominated specifically by Wyoming big sagebrush.

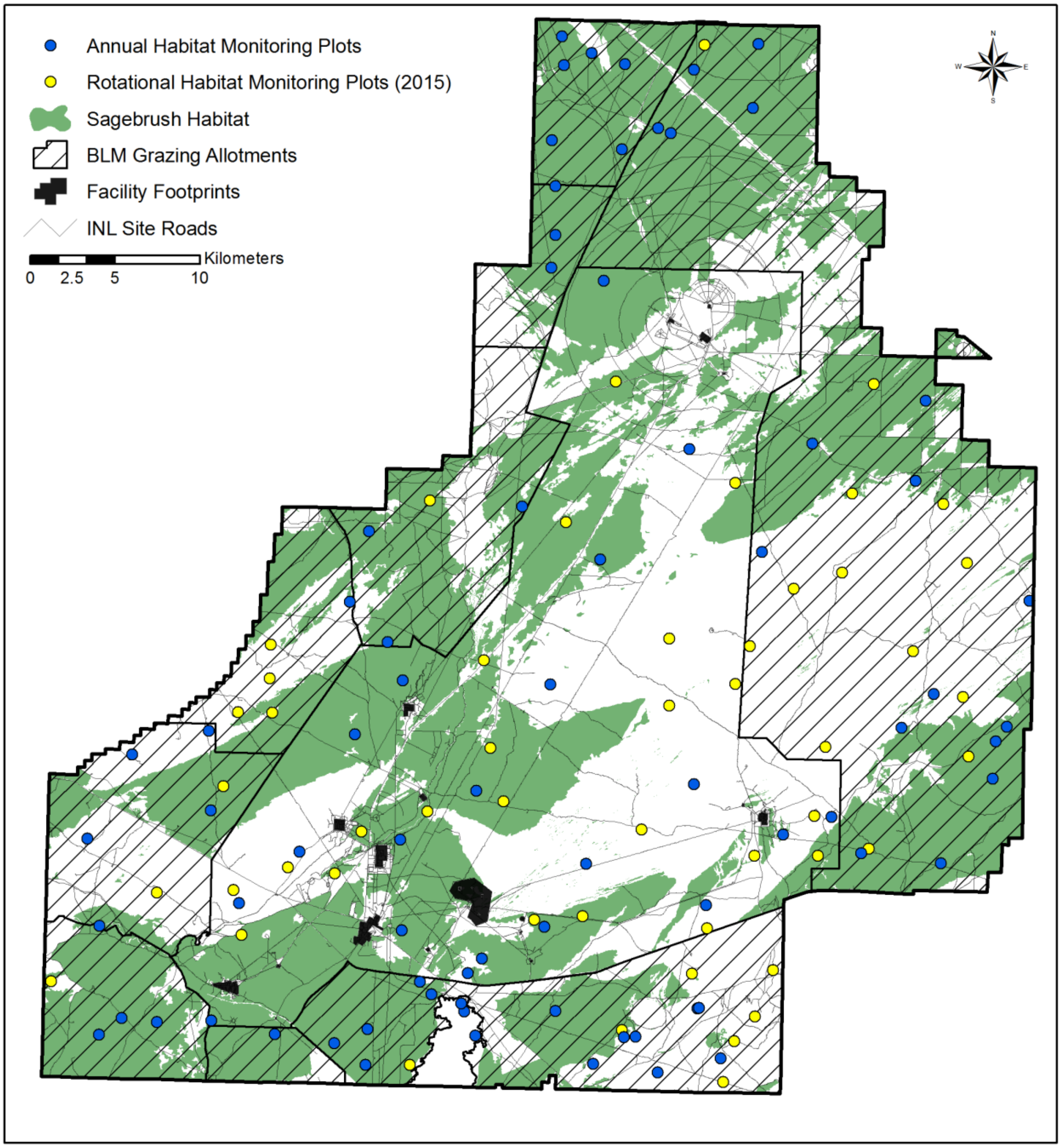


Figure 3-1. CCA sage-grouse habitat condition monitoring plots sampled in 2015 on the INL Site.

Table 3-1a. Results of a dichotomous plant community key (Shive et al . 2011) for 48 sage-grouse habitat condition monitoring plots sampled in 2013, 2014, and 2015 on the INL Site.

Plant Community	Number of Plots 2015	Number of Plots 2014	Number of Plots 2013
Wyoming Big Sagebrush Shrubland	19	39	25
Big Sagebrush Shrubland (mixed subspecies)	15	0	11
Low Sagebrush Dwarf Shrubland	5	3	3
Black Sagebrush/Sandberg Bluegrass Dwarf-shrub Herbaceous Vegetation	3	2	2
Three-tip Sagebrush Shrubland	3	2	3
Green Rabbitbrush – Winterfat Shrubland	2	0	0
Basin Big Sagebrush Shrubland	1	0	4
Green Rabbitbrush Shrubland	0	2	0

Of the 27 annual non-sagebrush plots, eight were assigned to shrublands or shrub herbaceous communities and the remaining 19 were assigned to communities which were dominated entirely by herbaceous vegetation during the 2015 sample period (Table 3-1b). With the exception of one plot, green rabbitbrush dominance characterized the plant communities in non-sagebrush habitat plots that were assigned to shrublands or shrub herbaceous communities. The remaining shrubland plot was assigned to a shadscale-dominated plant community. Of the 19 plots assigned to herbaceous vegetation communities, 11 were dominated by native, perennial grasses, and the other eight were dominated or co-dominated by introduced grasses in 2015. In general, more non-sagebrush plots keyed to herbaceous-dominated communities and fewer keyed to green rabbitbrush-dominated communities in 2015 than in 2014. Fewer plots keyed to green rabbitbrush than herbaceous-dominated communities between the 2013 and 2014 sample periods as well. The number of plots keying to communities dominated by cheatgrass increased from three in 2013 and 2014 to seven in 2015.

Through the first three years of data collection, most of the sagebrush habitat plots keyed to sagebrush-dominated communities and non-sagebrush plots keyed to non-sagebrush dominated shrublands or communities dominated by herbaceous species. Most of the differences among the three field seasons for the sagebrush habitat plots were from the amount of certainty a field crew had in assigning a plant community to dominance by a specific big sagebrush subspecies. Some crews appeared to have a greater confidence in selecting a dominant subspecies than others, and the phenology of big sagebrush may have also been quite different from one year to the next. Given the probability of morphological hybrids across the INL Site (Shive et al. 2011), this result is not unreasonable. Overall, there was a greater shift among sample years for assigned communities among the non-sagebrush plots. This result reflects the tendency for herbaceous communities to be more immediately responsive to seasonal weather conditions than sagebrush communities.

Table 3-1b. Results of a dichotomous plant community key (Shive et al . 2011) for 27 non-sagebrush habitat condition monitoring plots sampled in 2013, 2014, and 2015 on the INL Site.

Plant Community	Number of Plots 2015	Number of Plots 2014	Number of Plots 2013
Cheatgrass Semi-natural Herbaceous Vegetation	7	3	3
Indian Ricegrass Herbaceous Vegetation	5	0	1
Green Rabbitbrush Shrubland	4	5	6
Bluebunch Wheatgrass – Sandberg Bluegrass Herbaceous Vegetation	3	10	2
Green Rabbitbrush/Bluebunch Wheatgrass Shrub Herbaceous Vegetation	2	3	3
Western Wheatgrass Herbaceous Vegetation	2	0	1
Crested Wheatgrass Semi-natural Herbaceous Vegetation	1	0	2
Green Rabbitbrush/Streambank Wheatgrass (Western Wheatgrass) Shrub Herbaceous Vegetation	1	2	4
Needle and Thread Herbaceous Vegetation	1	1	1
Sandberg Bluegrass Herbaceous Vegetation		1	1
Shadscale Dwarf Shrubland	1	1	0
Green Rabbitbrush – Winterfat Shrubland	0	0	1
Tall Tumblemustard – Cheatgrass Semi-natural Herbaceous Vegetation	0	1	1
Wyoming Big Sagebrush Shrubland	0	0	1

Several other qualitative variables were collected at each plot to help describe plot context in terms of potential use by sage-grouse and to document any notable anthropogenic impacts, especially as they relate to the threats identified in the CCA. These qualitative data show that in 2015 sage-grouse sign (scat) was present on 12 of the 48 annual sagebrush habitat plots and none of the scat appeared to be from the current year. Sage-grouse scat, all from previous seasons, was noted on only one of the 27 non-sagebrush plots. Scat was noted on 27 of the sagebrush plots and four of the non-sagebrush plots in 2013 and on 21 of the sagebrush plots and two of the non-sagebrush plots in 2014. Scat was present on fewer than half of the plots in 2015 when compared to 2013 on both sagebrush habitat and non-sagebrush plots. However, plots in polygons designated as sagebrush habitat have still experienced more past use than plots in polygons designated as non-habitat. In 2015, a quarter of the plots representing sagebrush habitat contained sage-grouse sign, and more than 90% of sage-grouse sign documented in 2015 occurred in plots that are located in polygons designated as current sagebrush habitat.

Active ant mound counts were added to the sample protocol in 2014, so there are no 2013 data available for this metric. In 2015, 34 of the 75 annual habitat condition monitoring plots had active ant mounds at the time of sampling. The maximum number of mounds counted in a single 20m x 20m plot was three. Of the 34 plots with active ant mounds, 20 were sagebrush habitat plots and 14 were non-sagebrush plots. Thatch mounds ($\bar{x}$ = 0.29) were less abundant than crater mounds ($\bar{x}$ = 1.29) in non-sagebrush plots. The pattern was similar for sagebrush habitat plots where thatch mound ($\bar{x}$ = 0.15) and crater mound ($\bar{x}$ = 1.00) abundance values approximated those of non-sagebrush plots. Compared with 2014, ant mounds were detected in more plots and the mean abundance of thatch mounds was slightly lower, while the mean abundance of crater mounds was slightly higher in those plots. After two years of data collection for this metric, there doesn't appear to be a specific pattern in occurrence of ant mounds. The annual stability of this estimate and the relationship between it and other biotic and abiotic factors are unknown and can only be elucidated after several years of data are available.

Anthropogenic influence was noted on 15 (20%) of the annual habitat condition monitoring plots in 2015. Livestock manure was present in 9 of the 15 plots, and livestock trails were identified in seven of the plots (two plots contained both manure and trails). Tire tracks were identified as the source of disturbance in one plot. Thirteen plots with documented anthropogenic influence are located within allotment boundaries. Trails were noted as the disturbance type on both plots located outside of allotment boundaries. One of the plots was located within close proximity to an allotment boundary and sheep were seen in the area for several consecutive years prior to this survey. The remaining plot was located in the interior of the INL near a facility that may provide a water source for native ungulates, which would suggest the trails noted during the survey were game trails rather than livestock trails; although, the game trails were likely a consequence an anthropogenic feature. Overall, about 25% of the plots sampled within allotments and about 9% of plots sampled outside of allotments were noted to have been disturbed. Twelve of the 15 total plots were located in areas currently designated as habitat.

In 2015, absolute cover from sagebrush species averaged 21% across the annual sagebrush habitat monitoring plots (Table 3-2a), which is nearly unchanged from 2013 (Table 3-2c) and 2014 (Table 3-2b) sagebrush cover values. In non-sagebrush monitoring plots, absolute sagebrush cover averaged approximately 0.3% during 2015 and contributed very little to total vegetative cover over the past three years. The few sagebrush individuals that were present in those plots during all three sample years were shorter, on average, than sagebrush individuals in sagebrush habitat plots (Tables 3-2a, 3-2b, and 3-2c). Conversely, average cover and height of perennial grasses and forbs were greater in non-sagebrush plots than in sagebrush habitat plots from 2013 through 2015. Sagebrush density estimated across the annual sagebrush habitat plots was higher in 2015 than in 2014 (Tables 3-2a and 3-2b), and was consistent with the range of density estimates from big sagebrush stands previously sampled to support characterization of sagebrush demography on the INL Site (Forman et al. 2013) as well as density estimates from the Long-Term Vegetation (LTV) Transects (unpublished data).

Table 3-2a. Summary of selected vegetation measurements for characterization of condition of sagebrush habitat monitoring plots and non-sagebrush monitoring plots on the INL Site in 2015.

	Mean Cover (%)	Mean Height (cm)	Mean Density (individuals/m^2)
Sagebrush Habitat Plots (n = 48)			
Sagebrush	21.14	47.68	2.28
Perennial Grass/Forbs	9.28	19.99	
Non-sagebrush Plots (n = 27)			
Sagebrush	0.30	33.61	0.04
Perennial Grass/Forbs	22.31	35.27	

Table 3-2b. Summary of selected vegetation measurements for characterization of condition of sagebrush habitat monitoring plots and non-sagebrush monitoring plots on the INL Site in 2014.

	Mean Cover (%)	Mean Height (cm)	Mean Density (individuals/m2)
Sagebrush Habitat Plots (n = 48)			
Sagebrush	20.47	46.70	1.98
Perennial Grass/Forbs	3.02	12.10	n/a
Non-sagebrush Plots (n = 27)			
Sagebrush	0.15	29.11	0.05
Perennial Grass/Forbs	12.14	21.96	n/a

Table 3-2c. Summary of selected vegetation measurements for characterization of condition of sagebrush habitat monitoring plots and non-sagebrush monitoring plots on the INL Site in 2013.

	Mean Cover (%)	Mean Height (cm)	Mean Density (individuals/m2)
Sagebrush Habitat Plots (n = 48)			
Sagebrush	20.69	44.87	3.24
Perennial Grass/Forbs	8.08	14.37	n/a
Non-sagebrush Plots (n = 27)			
Sagebrush	0.08	29.81	0.05
Perennial Grass/Forbs	18.47	19.41	n/a

Absolute cover averaged across sagebrush habitat plots was about 8% higher in 2015 than in 2014 (Table 3-3a). About 70% of the total vegetation cover was from shrubs, and more than two thirds of the shrub cover was from *Artemisia* species. Overall sagebrush contributed about half of the total vegetation cover on sagebrush habitat plots. Big sagebrush was the most abundant and widespread sagebrush species; however, threetip, black, and low sagebrush were locally abundant on the limited number of plots where they each occurred. Mean shrub cover in the sagebrush habitat plots was similar across all three sample years, but native perennial grasses were much more abundant in both 2013 and 2015 than in 2014. Indian ricegrass (*Achnatherum hymenoides*) was the most abundant perennial grass across the sagebrush habitat plots in 2014 and in 2015; Sandberg bluegrass (*Poa secunda*) was the most abundant perennial grass in 2013. Total cover from introduced species on sagebrush habitat plots was less than 1% in 2014 and a little more than 3% in 2015. Cheatgrass cover was undetectable in 2014 and was about a third of a percent in 2015.

Table 3-3a. Mean absolute cover by species for 48 sagebrush habitat monitoring plots on the INL Site in 2013, 2014, and 2015. * indicates that this species was undetectable using the current sampling methodology in a given sample year.

Plant Species	Absolute Cover (%) 2015	Absolute Cover (%) 2014	Absolute Cover (%) 2013
Native			
Shrubs			
Artemisia tridentata	17.06	17.28	16.75
Chrysothamnus viscidiflorus	6.02	6.67	8.59
Artemisia tripartita	1.71	1.70	2.33
Artemisia nova	1.37	0.57	0.77
Artemisia arbuscula	1.00	0.92	0.84
Atriplex confertifolia	0.99	0.77	0.70
Krascheninnikovia lanata	0.96	0.50	0.45
Linanthus pungens	0.15	0.22	0.37
Eriogonum microthecum	0.09	0.08	0.12
Others (n = 3, 2, 4)	0.10	0.06	0.09
Total Native Shrub Cover	**29.45**	**28.78**	**31.00**
Succulents			
Opuntia polyacantha	**0.09**	**0.10**	**0.11**
Perennial Graminoids			
Achnatherum hymenoides	1.78	0.80	1.30
Elymus elymoides	1.58	0.15	0.86
Poa secunda	1.19	0.57	2.04
Pseudoroegneria spicata	0.95	0.56	1.57
Elymus lanceolatus	0.84	0.13	0.74
Hesperostipa comata	0.61	0.14	0.35
Pascopyrum smithii	0.16	*	0.02
Others (n = 1, 0, 2)	0.03	*	0.09
Total Native Perennial Graminoid Cover	**7.14**	**2.35**	**6.95**
Perennial Forbs			
Phlox hoodii	0.36	0.57	0.73
Sphaeralcea munroana	0.16	*	*
Schoenocrambe linifolia	0.14	0.00	0.01
Others (n = 11, 6, 15)	0.11	0.10	0.39
Total Native Perennial Forb Cover	**0.77**	**0.68**	**1.13**
Annuals and Biennials			

Plant Species	Absolute Cover (%) 2015	Absolute Cover (%) 2014	Absolute Cover (%) 2013
Chenopodium leptophyllum	0.14	*	0.01
Descurainia pinnata	0.14	*	*
Lappula occidentalis	0.14	*	*
Others (n = 2, 0, 0)	0.01	*	*
Total Annual and Biennial Forb Cover	**0.44**	**0.00**	**0.01**
Total Native Cover	**37.88**	**31.91**	**39.20**
Introduced			
Perennial Grasses			
Agropyron cristatum	**1.37**	**0.66**	**1.23**
Annuals and Biennials			
Halogeton glomeratus	1.02	0.18	0.41
Alyssum desertorum	0.51	*	0.13
Bromus tectorum	0.37	*	0.21
Others (n = 1, 0, #)	0.01	*	
Total Introduced Annual and Biennial Cover	**1.91**	**0.18**	**0.75**
Total Introduced Cover	**3.28**	**0.84**	**1.99**
Total Vascular Plant Cover	**41.16**	**32.74**	**41.19**

In the non-sagebrush plots, only about 20% of total vascular plant cover was from shrubs in 2015 and green rabbitbrush provided more than 90% of the cover from shrubs. Perennial grasses and forbs were responsible for about 65% of the cover from native species on non-sagebrush plots in 2015. Native herbaceous species were only slightly more abundant than non-native herbaceous species. Bluebunch wheatgrass (*Pseudoroegneria spicata*) was the most abundant native herbaceous species in all three sample years with about 5% absolute cover. Average absolute cover from native, perennial grasses on non-habitat plots was nearly triple that on sagebrush habitat plots, and cover from introduced herbaceous species was about six times greater on non-habitat plots (Table 3-3b). Cheatgrass was much more abundant on non-habitat plots than on sagebrush habitat plots in all three sample years. In 2015, cheatgrass cover was particularly high on non-sagebrush plots when compared to the same subset of plots from previous years (Table 3-3b). Crested wheatgrass was abundant enough to be represented in the cover data of only two of the non-habitat plots, but it was dominant or co-dominant where it occurred.

Table 3-3b. Mean absolute cover by species for 27 non-sagebrush monitoring plots on the INL Site in 2013, 2014, and 2015. * indicates that this species was undetectable using the current sampling methodology in a given sample year.

Plant Species	Absolute Cover (%) 2015	Absolute Cover (%) 2014	Absolute Cover (%) 2013
Native			
Shrubs			
Chrysothamnus viscidiflorus	10.06	10.52	9.92
Atriplex confertifolia	0.33	0.41	0.21
Artemisia tridentata	0.29	0.15	0.07
Tetradymia canescens	0.11	0.25	0.26
Eriogonum microthecum	0.07	0.07	0.06
Ericameria nana	0.05	0.04	0.02
Others (n = 4, 1, 2)	0.08	0.03	0.05
Total Native Shrub Cover	**10.99**	**11.47**	**10.59**
Succulents			
Opuntia polyacantha	**0.13**	**0.06**	**0.05**
Perennial Graminoids			
Pseudoroegneria spicata	5.13	4.93	4.70
Hesperostipa comata	3.14	1.31	2.13
Achnatherum hymenoides	2.92	1.13	1.33
Elymus lanceolatus	2.66	0.63	2.11
Poa secunda	1.67	2.63	3.86
Elymus elymoides	1.55	0.67	0.91
Pascopyrum smithii	1.35	*	0.63
Leymus flavescens	1.10	*	*
Carex douglasii	0.07	*	*
Others (n = 1, 1, 1)	0.00	0.07	0.03
Total Native Perennial Graminoid Cover	**19.60**	**11.37**	**15.70**
Perennial Forbs			
Sphaeralcea munroana	0.54	0.01	0.02
Phlox hoodii	0.28	0.52	0.51
Machaeranthera canescens	0.15	0.02	0.07
Schoenocrambe linifolia	0.14	*	0.03
Erigeron pumilus	0.10	0.08	0.18
Crepis acuminata	0.09	0.12	0.91
Antennaria microphylla	0.06	*	*

Plant Species	Absolute Cover (%) 2015	Absolute Cover (%) 2014	Absolute Cover (%) 2013
Psoralidium lanceolatum	0.05	*	*
Others (n = 8, 2, 14)	0.64	0.01	1.06
Total Native Perennial Forb Cover	**2.04**	**0.77**	**2.77**
Annuals and Biennials			
Lappula occidentalis	0.29	*	*
Others (n = 2, 2, 5)	0.05	0.09	0.24
Total Native Annual and Biennial Cover	**0.34**	**0.09**	**0.24**
Total Native Cover	**33.10**	**23.76**	**29.35**
Introduced			
Perennial Grasses			
Agropyron cristatum	**0.66**	**0.44**	**0.35**
Perennial Forbs			
Others (n = 1, 0, 0)	**0.01**	*	*
Annuals and Biennials			
Bromus tectorum	13.77	2.68	5.41
Salsola kali	4.24	1.20	1.12
Halogeton glomeratus	1.16	0.75	1.31
Sisymbrium altissimum	0.25	*	0.14
Alyssum desertorum	0.08	*	0.32
Lappula squarrosa	0.05	*	*
Others (n = 1, 0, 2)	0.02	*	0.13
Total Introduced Annual and Biennial Cover	**19.57**	**4.63**	**8.42**
Total Introduced Cover	**20.24**	**5.07**	**8.77**
Total Vascular Plant Cover	**53.34**	**28.83**	**38.12**

Vegetation height was summarized by functional group to provide a more complete assessment of vertical structure on the habitat condition monitoring plots (Tables 3-4a and 3-4b). In sagebrush habitat plots, shrub height estimates were from sagebrush species about 70% of the time and sagebrush was the tallest functional group. On non-sagebrush plots shrub height estimates were from other species, primarily green rabbitbrush, more than 90% of the time. It is notable that many non-sagebrush plots did have a substantial shrub component which provides more vertical structure than herbaceous plant communities that lack shrubs entirely. Because cover from annual species was relatively low on sagebrush habitat plots, most of the herbaceous height in those plots was from perennial grasses, which tend to be taller than annuals. A greater proportion of the herbaceous height estimate (37%) in non-sagebrush plots is from shorter-statured annual species. For both sagebrush habitat plots and non-sagebrush plots, height estimates from annuals were primarily from introduced species in 2015. Overall, mean height for shrubs in both sagebrush habitat and non-sagebrush plots was slightly higher in 2015 than in 2014, and mean height of herbaceous species, was considerably higher in 2015, particularly in non-sagebrush plots.

Table 3-4a. Vegetation height by functional group for 48 sagebrush habitat monitoring plots on the INL Site in 2013, 2014, and 2015.

	2015		2014		2013	
	Mean Height (cm)	Proportion of Sample	Mean Height (cm)	Proportion of Sample	Mean Height (cm)	Proportion of Sample
Shrubs						
Sagebrush Species	47.68	0.71	46.70	0.69	44.87	0.82
Other Species	25.52	0.29	23.48	0.31	26.20	0.18
Herbaceous Species						
Perennial Grasses	21.31	0.71	14.31	0.72	15.69	0.76
Perennial Forbs	9.54	0.09	4.53	0.21	7.24	0.14
Annual Grasses	21.92	0.03	*	0.00	7.60	0.04
Annual Forbs	11.61	0.17	4.01	0.07	3.61	0.06

Table 3-4b. Vegetation height by functional group for 27 non-sagebrush monitoring plots on the INL Site in 2013, 2014, and 2015.

	2015		2014		2013	
	Mean Height (cm)	Proportion of Sample	Mean Height (cm)	Proportion of Sample	Mean Height (cm)	Proportion of Sample
Shrubs						
Sagebrush Species	33.61	0.08	29.11	0.07	29.81	0.08
Other Species	27.11	0.92	23.70	0.93	24.85	0.92
Herbaceous Species						
Perennial Grasses	37.30	0.58	22.98	0.74	21.15	0.52
Perennial Forbs	11.73	0.05	6.85	0.05	10.97	0.11
Annual Grasses	19.50	0.23	14.87	0.10	9.62	0.19
Annual Forbs	13.67	0.14	5.66	0.12	9.00	0.19

In 2015, sagebrush density ranged from approximately one individual per two square meters to approximately eight individuals per square meter in the sagebrush habitat plots (Table 3-5a). In the non-sagebrush plots, sagebrush density ranged from zero to a maximum of about one individual per five square meters. Juvenile sagebrush frequency is a proportion of the eight density transects in each plot that contain juvenile shrubs. Averaged across all sagebrush habitat plots, juvenile shrubs were present in about one out of every two sample transects. In non-habitat plots, the average falls to about one out of every 100 transects. Compared with 2013 and 2014 (Table 3-5c and 3-5b), mean sagebrush density and juvenile frequency values in 2015 were mostly unchanged in non-sagebrush plots. In sagebrush habitat plots, mean density increased slightly, and mean juvenile frequency remained about the same. The number of sagebrush habitat plots with juveniles has increased from 2013 through 2015; juveniles were recorded in at least one transect of 34 out of the 48 sagebrush habitat plots in 2013, in at least one transects of 41 out of the 48 sagebrush habitat plots in 2014, and in at least one transect of 44 out of 48 plots in 2015.

Sagebrush density and juvenile frequency metrics were specifically collected to facilitate monitoring the health and population status of sagebrush stands sampled by sagebrush habitat plots. Between 2013 and

2015, sagebrush density changed more than would be expected for a relatively stable woody species. However, sagebrush density becomes a little easier to understand when interpreted within the context of cover. Because sagebrush cover was unchanged among the three sample periods, it is likely that seedlings drove annual variability, but established individuals changed very little. Future monitoring data will be very useful in characterizing the annual variability associated with the sagebrush density and juvenile frequency metrics and will form the basis for understand the difference between stochasticity and ecologically meaningful change.

Table 3-5a. Sagebrush density and juvenile frequency from sagebrush habitat monitoring plots (n = 48) and non-sagebrush monitoring plots (n = 27) on the INL Site in 2015.

	Sagebrush	Non-sagebrush
Mean Density (individuals/m^2)	2.28	0.04
Minimum Density (individuals/m^2)	0.43	0.00
Maximum Density (individuals/m^2)	8.53	0.20
Mean Juvenile Frequency	0.48	0.01

Table 3-5b. Sagebrush density and juvenile frequency from sagebrush habitat monitoring plots (n = 48) and non-sagebrush monitoring plots (n = 27) on the INL Site in 2014.

	Sagebrush	Non-sagebrush
Mean Density (individuals/m^2)	1.98	0.05
Minimum Density (individuals/m^2)	0.28	0.00
Maximum Density (individuals/m^2)	6.73	0.43
Mean Juvenile Frequency	0.46	0.03

Table 3-5c. Sagebrush density and juvenile frequency from sagebrush habitat monitoring plots (n = 48) and non-sagebrush monitoring plots (n = 27) on the INL Site in 2013.

	Sagebrush	Non-sagebrush
Mean Density (individuals/m^2)	3.24	0.05
Minimum Density (individuals/m^2)	0.35	0.00
Maximum Density (individuals/m^2)	16.08	0.33
Mean Juvenile Frequency	0.27	0.02

Total annual precipitation for 2015 was below average (Figure 3-2). As with 2014, the timing of precipitation in 2015 deviated markedly from historical patterns (Figure 3-3). Almost half of the total precipitation from 2014 fell in August. Mean August precipitation, calculated from the 64-year Central Facilities Area (CFA) record, is about 14 mm; total August precipitation from 2014 was 102 mm. In 2015, May was abnormally wet, with a total of nearly 60 mm, which is twice the historical monthly average. The three years prior to the 2014 sample effort were below average in terms of total annual precipitation, and 2013 was the driest year on record with only about ¼ of average annual precipitation. Much of the sampling in 2014 was completed prior to August precipitation, therefore, vegetation on the INL Site experienced drought conditions through most of the 2014 growing season and associated sampling effort. The extreme precipitation events in

August 2014, as well as the abnormally wet May of 2015, were likely reflected in the habitat condition vegetation data collected in 2015.

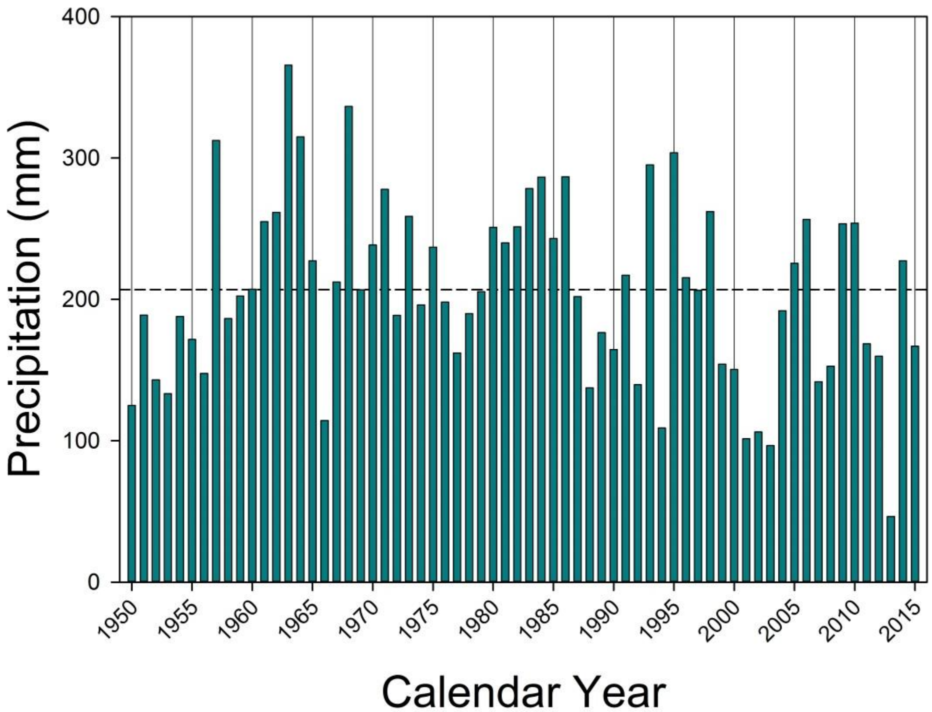


Figure 3-2. Total annual precipitation from 1950 through 2015 at the CFA, INL Site. The dashed line represents mean annual precipitation.

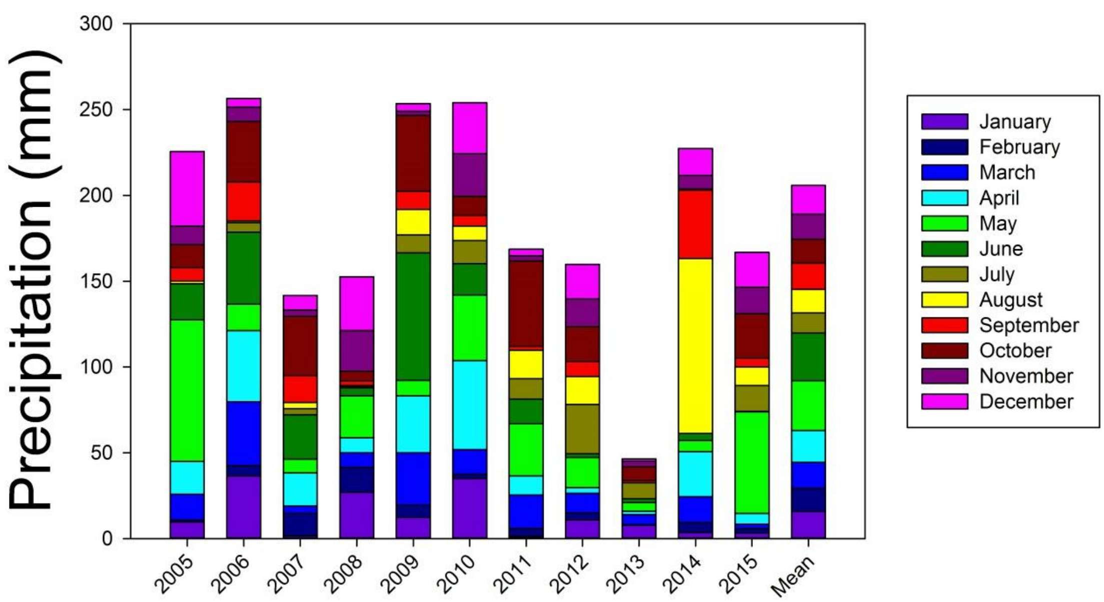


Figure 3-3. Annual precipitation by month from the CFA, INL Site. Mean monthly precipitation includes data from 1950 through 2015.

3.1.4 Summary of Habitat Condition

Mean sagebrush cover from annual sagebrush habitat plots, and for the sagebrush habitat polygons they represent, is in the middle of the range suggested for optimal breeding and brood-rearing habitat in arid sites (Connelly et al. 2000). Mean sagebrush height is within, but at the lower end of the suggested optimal range. This result is to be expected, as most INL Site sagebrush communities are dominated by Wyoming big sagebrush or even shorter statured species. Perennial grass/forb mean height values were also at the lower end of the range recommended in current sage-grouse habitat guidelines (Connelly et al. 2000). Average perennial grass/forb cover on sagebrush habitat plots was about 6% lower in 2015 than specified for breeding and brood-rearing habitat, but was much higher than it was on the same plots in 2014. It is difficult to directly compare herbaceous cover values for this monitoring effort to long-term averages across the INL Site because this monitoring effort measures canopy cover, while the LTV effort measures basal cover. Overall trends in herbaceous cover on the LTV plots though, indicate that perennial grass and forb cover in good-condition sagebrush step on the INL Site is probably always below sage-grouse habitat guidelines, except possibly following a series of years with abnormally high precipitation (Forman et al. 2013). Low herbaceous cover values, relative to habitat guidelines, do not appear to be a result of poor ecological condition, but rather the effect of soils and climate on the local ecosystem (Forman et al. 2013).

Herbaceous functional groups are highly influenced by precipitation, and precipitation for three years prior to and up through most of the 2014 growing season was far below average. Although annual precipitation approximated annual averages in 2014 and 2015, a few abnormally wet months at the end of summer in 2014 and at the end of spring in 2015 affected vegetation on the INL Site during the 2015 growing season. As with perennial herbaceous species, mean cheatgrass cover and cover from all annual species were probably uncharacteristically low in 2014 and were probably much higher than normal in 2015. The increases in cheatgrass and Russian thistle (*Salsola kali*) between 2014 and 2015 are notable, particularly in the non-sagebrush plots.

Continued monitoring will be required to determine whether or not cover and height of herbaceous species on sagebrush habitat plots are comparable to optimal suggested ranges for habitat or whether normal INL Site values are a little more site-specific. Additionally, consistent monitoring will facilitate characterizing the amount of annual variability to be expected in various functional groups, especially those which appear to be particularly sensitive to weather, like introduced annuals. Several years of monitoring, through a range of precipitation scenarios, will also allow biologists to establish a reasonable “baseline” for herbaceous species across both habitat and non-habitat plots. Characterizing trends in relative species composition will also be an important component of identifying changes in both sagebrush and non-sagebrush habitat, as those changes may reflect responses to stressors and/or the threats identified in the CCA. Increases in introduced annuals, decreases in native perennial forb diversity, increases in crested wheatgrass, and decreases in native, perennial grasses are all trends indicating decreases in habitat condition. All of these compositional changes have the potential to affect the use of an area as habitat and may eventually affect total habitat distribution.

3.2 Task 6 – Monitoring to Determine Changes in Sagebrush Habitat Amount and Distribution

3.2.1 Introduction

Loss of sagebrush dominated habitat has been implicated as one of the primary causes of decline in sage-grouse populations (ISAC 2006, USFWS 2013). Direct loss of sagebrush habitat has occurred through several mechanisms including infrastructure development and wildland fire. In the future, we expect the total area and extent of sagebrush habitat to change following wildland fires, as new facilities are developed on the INL Site, and as lands are naturally restored or recover following decommissioning of existing facilities. These changes in land cover can be determined using airborne or satellite imagery that is readily available at little or no cost. ESER GIS analysts will compare new imagery as it becomes available with existing land cover data from the recently completed vegetation classification and mapping project to document changes in the distribution of sagebrush habitat. Ground-based point surveys and changes in species cover and composition documented through the sagebrush habitat condition monitoring data will also provide spatial information to assist with periodic map updates needed to monitor the habitat trigger in the CCA.

A 20% loss of sagebrush habitat from the 2013 baseline has been identified as a conservation trigger in the CCA (DOE-ID and USFWS 2014). The goal of this monitoring task is to maintain an updated INL Site vegetation map to accurately document changes in sagebrush habitat area and distribution. This task is designed to document changes in sagebrush habitat following losses due to wildland fire or other disturbances, which remove or significantly alter vegetation across the landscape. In addition to documenting losses of sagebrush habitat, this monitoring task will also document additional sagebrush habitat by providing updates to the vegetation map when sagebrush cover increases and warrants a new map class designation, or to refine existing boundaries of vegetation classes when changes in species cover and composition are documented through the sagebrush habitat quality monitoring data. Lastly, this task will conduct post-fire mapping when the fire extent is unknown and will also allow for modifying existing wildland fire boundaries and unburned patches when errors on the ground are observed.

The process of updating the INL Site vegetation map is a two-step process. The first step is to verify, update, or edit existing wildland fire boundaries using a GIS and remote sensing imagery. Wildland fire boundaries are produced by different contractors or agencies (e.g. Bureau of Land Management) using a variety of methods such as collecting GPS data on the ground or via helicopter, or through manual delineations using digital imagery. The quality and accuracy of wildland fire boundaries can vary considerably depending on the method used to delineate the boundary. During the development of the most recent INL Site vegetation map (Shive et al. 2011), older wildland fire GIS layers were disregarded and the actual fire edge was digitized from high resolution imagery to maintain spatial consistency across the map. Before new vegetation class delineations are produced inside the fire boundary, recent mapped boundaries need to be updated or created at the same mapping scale (i.e. 1:12,000) as the original vegetation map. The burned areas represent outdated holes in the vegetation map where new post-fire vegetation boundaries have not been delineated nor have map classes been assigned.

The second step requires an adequate number of growing seasons for vegetation communities to reestablish before recently burned areas are updated with new, remapped vegetation class delineations representative of the post-fire vegetation classes present. All new wildland fires will be sampled to identify the vegetation classes present across the burned area. It can be difficult to assess the vegetation classes that establish immediately after a fire, especially during drought years. We intend to allow for at least two growing seasons, and possibly longer if the years following fire were excessively dry and hindered normal reestablishment of vegetation communities. Field surveys may also commence when a particular map polygon or burned area begins to show sign (i.e. via habitat quality monitoring data) that the current vegetation class may have changed to another class and warrants reassignment. When high resolution imagery becomes available, either through the National Agricultural Imaging Program (NAIP) or from INL Site specific acquisitions, it will be used as the source data layer to delineate new vegetation class boundaries within recent wildland fire boundaries.

The work accomplished on this monitoring task in 2015 included updating the wildland fire boundary and internal unburned patches of vegetation within the 2010 Jefferson Fire and collecting field data at plots distributed within the Jefferson Fire to assist with mapping the reestablished vegetation classes. The mapped boundaries for the Jefferson Fire were completed the fall immediately after the fire, however the existing ground conditions made it difficult to map and further mapping was originally planned. Within some regions of the fire, there was dark charring and partially burned vegetation which made it difficult to accurately delineate (Figure 3-4). The 2010 delineations used GeoEye-1 high resolution satellite imagery as the basemap imagery, and there is a slight spatial offset compared to the 2013 Idaho NAIP imagery (Figure 3-5). All other wildland fires from 2010-2015 that have been recently mapped to support the CCA used the 2013 Idaho NAIP as basemap imagery (Shurtliff et al. 2015) and the same mapping methods. Updating the wildland fire boundary and unburned vegetation patch boundaries within the Jefferson Fire, completes the mapping process for all recent INL Site fires.

Vegetation plots were sampled throughout the extent of the Jefferson Fire to provide ground information to assist with the delineation of new vegetation classes within the burned area. There have been five growing seasons since the Jefferson Fire burned in 2010, and native vegetation has had ample time to reestablish within the fire boundary. Before new vegetation community boundaries can be delineated, it is typically helpful to collect some field data representative of the diversity of vegetation communities naturally establishing after wildland fire. Those field data serve as training information to help the GIS analyst visually associate patterns in the imagery with vegetation class presence on the ground.

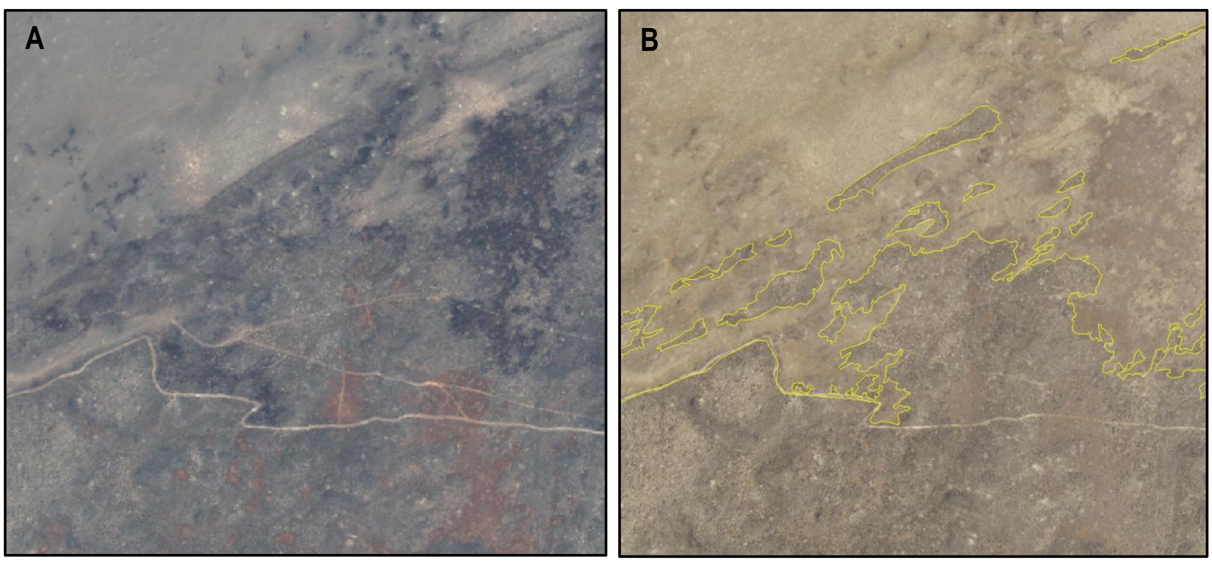


Figure 3-4. A) The image subset shows a region within the Jefferson Fire as it appeared in the 2010 GeoEye-1 imagery. The unburned vegetation patches are difficult to distinguish. B) The same area showing the region as it appeared in the 2013 Idaho NAIP imagery. The unburned patches are more easily detected and the yellow polygons show example delineations produced in 2015.

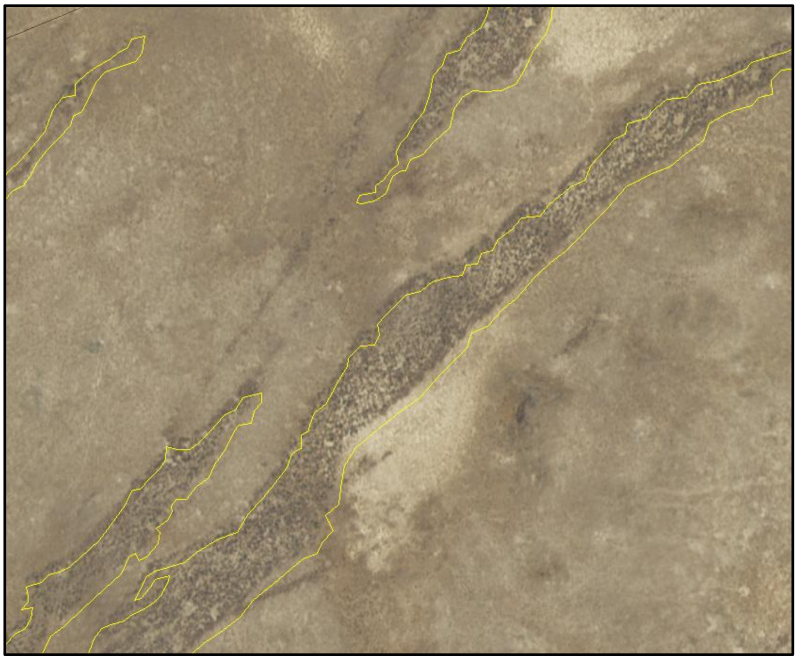


Figure 3-5. The yellow polygons were originally produced in the fall of 2010 using the 2010 GeoEye-1 basemap imagery. They are plotted here on the 2013 Idaho NAIP imagery and the slight offset to the southeast between the delineated edge and the vegetation patch edge is evident.

3.2.2 Methods

Digital Imagery

The 2013 Idaho NAIP high resolution color-infrared imagery served as the basemap for all delineations. For additional details about the digital imagery, see page 3-21 in Shurtliff et al. 2015.

Delineation Process

Wildland fire boundaries were manually digitized in a GIS at a 1:12,000 mapping scale. Once the outer fire boundary was complete, all identifiable unburned patches of vegetation were delineated at a finer spatial scale. Unburned vegetation patches were digitized at a 1:2,000 mapping scale, and at times up to 1:1,000 for smaller distinct isolated patches. For additional details about delineation methods, see page 3-21 in Shurtliff et al. 2015.

Jefferson Fire Field Sampling

The goal of this subtask is to document the current presence and distribution of vegetation classes within the Jefferson fire and to collect representative field data to develop a visual library within the fire to build a link between the image pixel response and the vegetation classes present on the ground. Because there will not be any statistical summaries or inference drawn from the field data, selecting sites in a random fashion is not appropriate for this monitoring task. Specific sampling locations were manually selected using a GIS to direct field sampling to particular areas within the fire boundary that encompassed the range of variability visible in the imagery. Sampling locations were selected to provide ground data throughout the fire where the imagery showed differential response (i.e. color, texture, etc.). In most cases, there are numerous vegetation classes that were previously mapped within recent wildland fire boundaries. Previously mapped polygons were visited to identify which vegetation classes are reestablishing. We suspect that the post-fire classes present will be a reflection of the pre-fire classes with less sagebrush and other shrubs initially.

At each sampling location we used a plot array design to document which vegetation class or classes are present within a localized region. The sampling plot array consists of five subplots; a focal plot and four peripheral plots each separated by 50 m in the four cardinal directions (Figure 3-6). Each subplot is circular with an 8 m radius representing about 200 m^2. The sampling array is an attempt to collect vegetation class information across an extent that more closely represents the spatial scale communities are being delineated from digital imagery. The same plot array was used to validate and conduct an error assessment of the INL Site vegetation map (Shive et al. 2011).

Each subplot was assigned to a vegetation class using the class key developed during the INL Site vegetation mapping project (Shive et al. 2011, Appendix A). While assigning each subplot to a vegetation class, we also recorded if the class designation was in agreement with the key. The dichotomous key developed after the original vegetation classification was generated from the statistical analysis of plot data collected in 2008. Occasionally there are unique vegetation communities which do not 'fit' the key well because they are isolated and/or in low abundance across the INL Site, and were not accounted for in the key. Or over the past seven years, some new vegetation community types may be beginning to emerge possibly following disturbance coupled with atypical temperature and precipitation patterns.

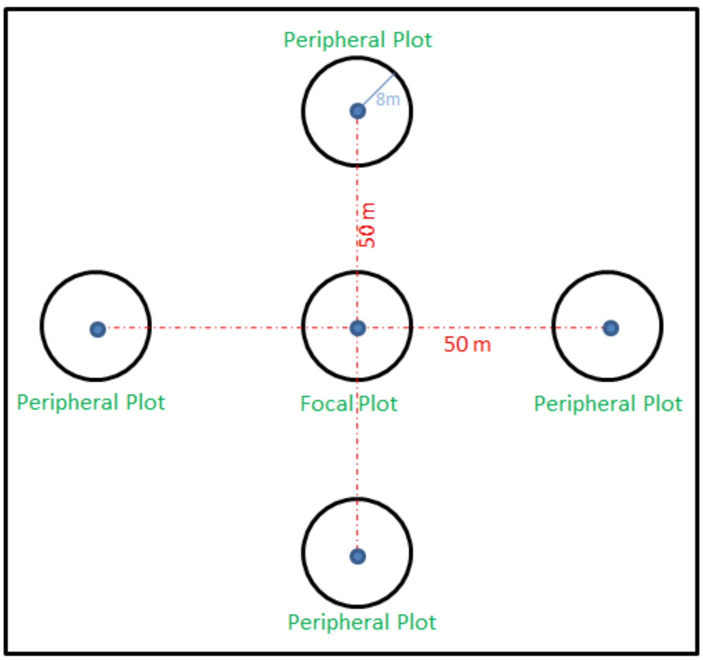


Figure 3-6. A schematic of the field plot array used to sample the vegetation within the Jefferson Fire.

3.2.3 Results

Jefferson Fire Mapping Updates

There has been five growing seasons since the Jefferson Fire burned in 2010. The area within the fire boundary has stabilized and primarily native grasses and shrubs have begun to reestablish naturally. There have been areas within the Jefferson Fire that burned up to three times in the past, and field observations showed that native vegetation communities persist and are most common throughout the burned area.

Large undisturbed stands of big sagebrush were common before the Jefferson Fire burned, and following the fire a number of unburned sagebrush patches remained.

The fire boundary was updated slightly resulting in 31,498 ha (77,832 acres) of area burned excluding unburned patches (Figure 3-7). A total of 4,488 polygons of unburned vegetation patches were delineated within the Jefferson Fire, representing 1,168 ha (2,887 acres). The unburned vegetation patch total area includes polygons that are not big sagebrush classes and represented other native grassland or shrubland vegetation classes. The exported sagebrush habitat layer contained 2,168 polygons representing 561 ha (1,386 acres; Figure 3-7).

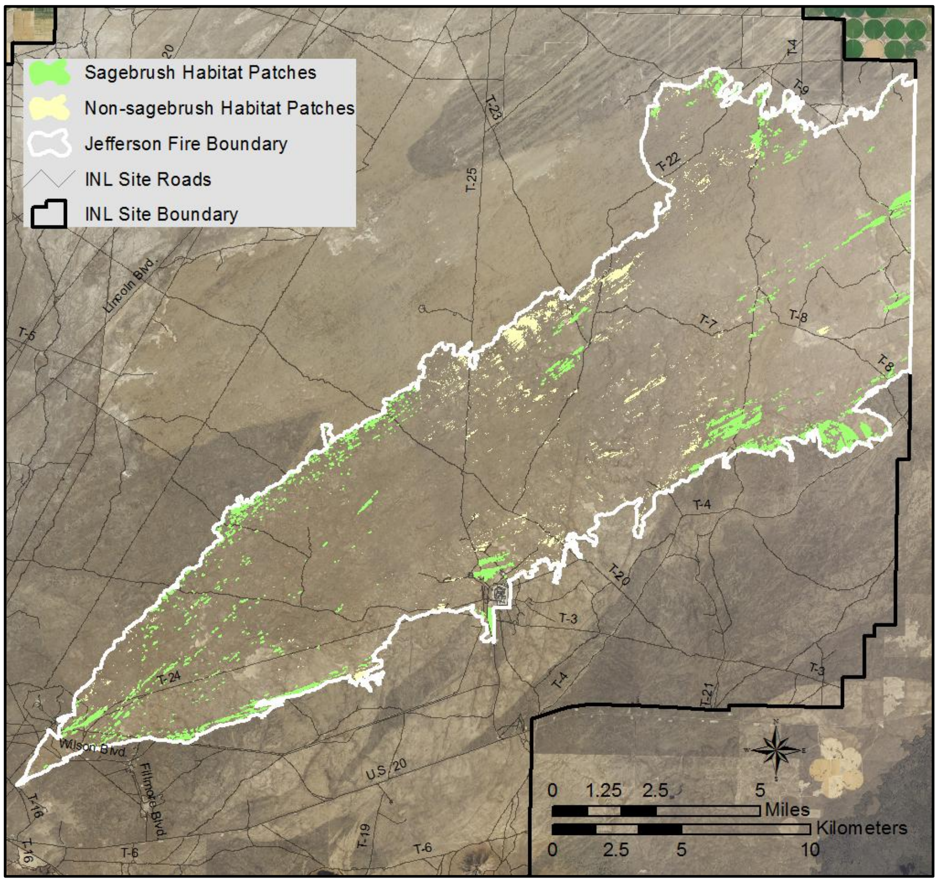


Figure 3-7. The mapped 2010 Jefferson Fire on the Idaho National Laboratory Site showing the distribution of unburned vegetation patches within the fire boundary. The fire boundary was manually digitized at a 1:12,000 scale and the unburned patches of vegetation were mapped at scales up to 1:1,000.

Sagebrush Habitat Update

The 2015 updated SGCA sagebrush habitat baseline value increased 113 ha (279 acres) from the reported amount in 2014 to 78,570 ha (194,151 acres). Although the updated sagebrush habitat total area is only a minimal adjustment, the current distribution is more accurate and provides a finer scale mapping of potentially important unburned sagebrush habitat patches.

There were also 66.2 ha (163.5 acres) of sagebrush habitat removed from infrastructure expansion (see Section 4.3 for more information). When this amount is subtracted from the updated baseline area presented above, the new sagebrush habitat baseline is 78,503.8 ha (193,987.5 acres). These results are the most accurate and up-to-date estimation of sagebrush habitat available for the INL Site representing ground conditions as of the beginning of 2013. Now that all of the recent large fires have been consistently mapped and updated, we do not anticipate making any additional adjustment to the 2013 sagebrush habitat baseline area.

Jefferson Fire Field Sampling

Anecdotal observations from within the Jefferson Fire found substantial native vegetation regrowth throughout the burned area. There were numerous regions where the native grasses were waist high and appeared to be flourishing with very little weeds present. There were also localized areas where non-native vegetation (e.g. Russian thistle [*Salsola kali*]) was abundant and dominated areas such as low-lying playa basins. We sampled 101 field plots throughout the Jefferson Fire burned area (Figure 3-8) which resulted in 505 individual subplot points of information. The plots were distributed near two-track roads to facilitate access to remote regions within the fire.

As expected based on previous observations of post-fire vegetation communities on the INL Site, the vegetation communities reestablishing in the Jefferson Fire were most commonly native communities which tend to exhibit considerable variability across small spatial extents. Many of the same species are typically present and individual abundances vary within a matrix of community types across the landscape. The continuous mixing of species even within the localized extent of a plot array resulted in 15 of the 101 plot arrays sampled (14.9%) where no class had a majority and each subplot keyed to either a different vegetation class or did not have more than two of the same classes within the plot array.

Any subplot within the plot array where the dichotomous key did not work well was marked with the ‘No’ option. Occasionally, a vegetation community has a composition that was not well characterized by the plots sampled in 2008 to support the vegetation statistical classification. There were 16 plots (15.8%) were there was at least one subplot within the plot array where the vegetation class key was noted to not key appropriately.

The vegetation class recorded the most at plot arrays was the Green Rabbitbrush/Streambank Wheatgrass (Western Wheatgrass) Shrub Herbaceous Vegetation class which was documented at 113 (22.4%) subplots. The second most abundant class was the Green Rabbitbrush/Desert Alyssum Shrub Herbaceous Vegetation class recorded at 92 (18.2%) subplots. The most common non-native vegetation class recorded was the Cheatgrass Semi-natural Herbaceous Vegetation class at 75 (14.9%) subplots. However it is important to note that 15 of the Cheatgrass Semi-natural Herbaceous Vegetation subplots were assigned to that class, but were also marked as not agreeing with the key. This means that those areas were likely weedy with a few cheatgrass individuals present but not enough to confidently assign it to an appropriate class.

There were 13 plots (12.9%) where all five subplots keyed to the same vegetation class, suggesting the area around the plot was more homogenous. However, three of those plots identified ‘No’ as the key agreement at all five subplots. This means each subplot was assigned to a class, but the selection of that class could be considered a subjective best fit as the dichotomy choices at some nodes in the key did not apply to the observed species presence and abundance on the ground. There were 23 plots (22.8%) where four of the subplots keyed to the same vegetation class representing a fairly homogenous plot. Three of those plots identified a ‘No’ as the key agreement which contributed to the majority.

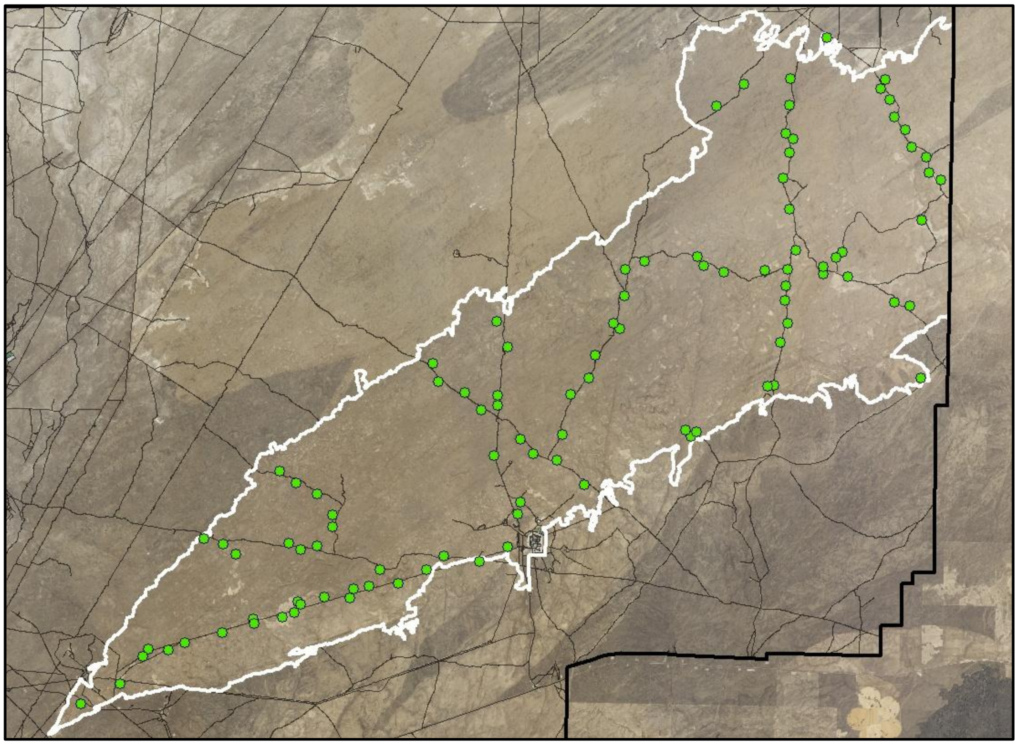


Figure 3-8. The distribution of 2015 field plot arrays sampled within the 2010 Jefferson Fire on the Idaho National Laboratory Site.

3.2.4 Discussion

Maintaining an up-to-date amount and distribution of sagebrush habitat on the INL Site is important to support the CCA (DOE-ID and USFWS 2014). Sagebrush habitat is one of the adaptive regulatory thresholds that will be monitored annually and serves to identify when modification to conservation actions might be required or mitigation is necessary. Therefore, it is important that the established baseline amount of sagebrush habitat and subsequent changes (increases and decreases) are documented accurately and regularly.

When a wildland fire boundary is produced by different methods and is then used to clip the existing vegetation map, the localized spatial accuracy becomes different for that fire. To maintain the accuracy and quality of the original map, it is imperative to make any edits or updates to the dataset using the same methods and mapping scales. This allows the vegetation map to be a dynamic dataset which is updated continuously through time, rather than a static map product that can become outdated very quickly when there are changes across the landscape. It is easier and more cost effective to make minor incremental updates, rather than waiting until there are enough changes to warrant the development of an entirely new map which can take a significant amount of time and funding.

Understanding the current distribution of unburned sagebrush patches at a much finer scale allows for a more accurate estimation of total sagebrush habitat on the INL Site, and can assist with other conservation efforts. Knowing where unburned sagebrush patches are distributed across the landscape may help with selecting future restoration sites where planting seedlings in strategic gaps could effectively connect habitat islands and create larger contiguous patches of functional habitat.

Similar to what was documented in the INL Site vegetation community classification and mapping report, we observed considerable variability in vegetation composition and class distribution within recently burned areas. The field data from this year showed that vegetation classes are spatially variable and it is not unusual to see multiple classes present within a small localized area. When the plot array was used to validate the INL Site vegetation map, we described majority rules to assign the entire plot array to either a single vegetation class or a two-class complex (Shive et al. 2011). The purpose of the plot arrays was to calculate map accuracy statistics, but for this monitoring task the field data will be used differently. It is less of a concern when plot arrays show multiple vegetation classes because maybe there is a real class boundary that splits the plot and is detectable in the imagery. The plot array data will be used to help identify if the spectral response in the imagery can be used to predict and map the boundaries of vegetation classes within the entire burned area. These plots are a subsampling of the burned area and the information gained from each plot will be used to extrapolate to potentially map class boundaries in other areas of the Jefferson Fire.

Some of the more weedy areas tended to be located in specific topographic features, such as relatively flat basins, where Russian thistle and Halogeton (*Halogeton glomeratus*) were commonly dominant. This information will assist with the delineation process where a Digital Elevation Model (DEM) can be utilized to delineate topographic boundaries which may be coincident with vegetation class boundaries or as transitions between adjacent classes.

The field data from this summer have been imported to a GIS and plotted on the 2013 NAIP imagery for initial review. It is important to note that the patterns and spectral response in the 2013 NAIP imagery is now outdated and not reflective of current ground conditions. Consequently, we would not expect to see definitive relationships between the field data and image data. There was new Idaho NAIP imagery collected this year, which was acquired during the same timeframe our field sampling was being conducted. As soon as the new NAIP imagery is made available to the public, we will download and import the imagery to the GIS project for further evaluation of the field data. Comparing field results to the newer imagery will be more a direct comparison as the imagery will capture the same ground conditions that we observed in the field.

3.3 Literature Cited

Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28:967-985.

Beck, J. L., J. W, Connelly, and K. P. Reese. 2009. Recovery of Greater sage-grouse habitat features in Wyoming big sagebrush following prescribed fire. Restoration Ecology 17:393-403.

Blew, R. D., and A. D. Forman. 2010 Tin Cup fire recovery report. STOLLER-ESER-143, Environmental Surveillance, Education, and Research Program, Idaho Falls, ID.

Colket, E. C. 2003. Long-term vegetation dynamics and post-fire establishment patterns of sagebrush steppe. MS Thesis, University of Idaho, Moscow. 154 pg.

Colket, E. C., and S. C. Bunting. 2003. Long-term vegetation dynamics and fire effects at the Idaho National Engineering and Environmental Laboratory. Department of Rangeland Ecology and Management, University of Idaho, Moscow, ID.

Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28:967-985.

Connelly, J. W., W. L. Wakkinen, A. D. Apa, and K. P. Reese. 1991. Sage grouse use of nest sites in southeastern Idaho. Journal of Wildlife Management 55:521–524.

Department of Energy, Idaho Operations Office (DOE), and U.S. Fish and Wildlife Service (USFWS). 2014. Candidate conservation agreement for greater sage-grouse (Centrocercus urophasianus) on the Idaho National Laboratory Site. DOE/ID-11514, U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho.

Forman, A. D., J. R. Hafla, and R. D. Blew. 2013. The Idaho National Laboratory Site long-term vegetation transects: understanding change in sagebrush steppe. Environmental Surveillance, Education, and Research Program, Gonzales-Stoller Surveillance, LLC, Idaho Falls, ID. GSS-ESER-163.

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

Klebenow, D. A., & Gray, G. M. 1968. Food habits of juvenile sage grouse. Journal of Range Management 80-83.

Nelle, P. J., Reese, K. P., & Connelly, J. W. 2000 . Long-term effects of fire on sage grouse habitat. Journal of Range Management 586-591.

Rhodes, E.C., J.D. Bates, R.N. Sharp, and K.W. Davies. 2010. Fire effects on cover and dietary resources of sage-grouse habitat. The Journal of Wildlife Management. 74:755-764.

Shive, J. P., A. D. Forman, K. Aho, J. R. Hafla, R. D. Blew, and K. T. Edwards. 2011. Vegetation community classification and mapping of the Idaho National Laboratory Site. Environmental Surveillance, Education, and Research Program Report, Gonzales-Stoller Surveillance LLC., Idaho Falls, ID. Report GSS-ESER-144.

Shumar, M. L., and J. E. Anderson. 1986. Gradient analysis of vegetation dominated by two subspecies of big sagebrush. Journal of Range Management 39:156-160.

Shurtliff, Q.R., A.D. Forman, J.C. Whiting, J.P. Shive, J.R. Hafla, K.T. Edwards, R.D. Blew. 2015. 2014 monitoring report in support of the candidate conservation agreement for greater sage-grouse on the Idaho National Laboratory Site. DOE/ID-11527. Gonzales-Stoller Surveillance, LLC, Idaho Falls, ID. January 2015.

U.S. Fish and Wildlife Service. 2013. Greater Sage-grouse (*Centrocercus urophasianus*) Conservation Objectives: Final Report. U.S. Fish and Wildlife Service. Denver, CO. February 2013.

4. THREAT MONITORING

The CCA identifies and rates eight threats that impact sage-grouse and its habitats on the INL Site, either directly or indirectly. All threats are addressed to some extent by the 13 conservation measures that DOE is striving to implement (see Chapter 5). However, some measures developed for three threats – raven predation, annual grasslands, and infrastructure development – require baseline inventory and monitoring information to support associated conservation measures. The following sections report on Tasks 4, 7, and 8, and over time will provide information needed by DOE to make decisions about how to implement threat reduction measures.

4.1 Task 4 – Raven Nest Surveys

4.1.1 Introduction

The common raven (*Corvus corax*, hereafter raven) is native to Idaho and historically constructed nests on natural substrates such as rock ledges and juniper trees. In many areas of the INL Site, these substrates are limited and ravens likely compete with raptors for some of them. Today, most raven breeding pairs on the INL Site nest on anthropogenic structures, primarily power transmission structures (Howe et al. 2014). Research suggests that these nesting pairs (rather than unmated, non-territorial individuals) may be responsible for the majority of sage-grouse nest depredation (Bui et al. 2010).

In the CCA, DOE committed to support research aimed at developing methods for deterring raven nesting on utility structures (*Conservation Measure 10*; DOE and USFWS 2014). To do so, DOE must first know the spatial distribution of raven nests and in what areas they tend to build nests each year. DOE must also obtain baseline nest numbers so that continued monitoring following deterrent installation can address whether actions had an impact on the number of raven nests on transmission structures.

The objective of Task 4 is to annually survey all anthropogenic structures on the INL Site that could potentially be used by ravens as nesting substrates and document the number and location of active nest sites. These data will allow DOE to determine the trend of raven nesting (whether increasing, stable, or decreasing), which will be useful when deciding how and when to install nest deterrents.

4.1.2 Methods

We systematically surveyed all power lines, towers, raptor nesting platforms and facilities on the INL Site that could feasibly support a raven nest, following methods described elsewhere (Shurtliff et al. 2015). Surveys occurred between 31 March and 3 June, 2015. To evaluate the type of power line structures preferred by ravens, we collected information about each structure that supported an active nest by taking pictures and recording other pertinent information.

4.1.3 Results

We observed 39 active raven nests on anthropogenic structures (Figure 4-2, Table 4-2), 31 of which (79%) were on power line structures. We were unable to confirm nesting activity at 20 nests, though we visited them multiple times throughout the survey period. Most of these were probably unoccupied this year, though it is possible that we failed to detect nest activity, especially if birds attended and then abandoned the nest early in the season.

Facilities

We surveyed eleven facilities one to three times each between 1 April and 14 May, 2015. (Table 4-1). The Advanced Mixed Waste Treatment Project (AMWTP) was the only facility surveyed just once. Most available nesting substrates at AMWTP are visible from RWMC, and as a result, we have not secured an escort for AMWTP in the past and have never entered the facility. In 2015, we observed a raven nest inside the fence at AMWTP during a survey of RWMC, so we made arrangements to enter, record the exact location of the nest, and survey the remainder of the facility.

We observed six active raven nests at facilities and no more than a single nest at any one facility. Horizontal platforms attached to buildings and effluent stacks were the primary substrates of choice, though one nest was in an ornamental tree. Great-horned owls were also common nesters within facilities (Table 4-2).

Towers

We surveyed 11 towers between 2 April and 29 April, 2015, nine of which we surveyed twice. We assumed that if ravens had not yet commenced building a nest on a tower by the end of April, that they would not do so in the current year. Although we officially surveyed two towers only once and neither were used as nest substrates, both are next to paved roads that we often traveled. Thus, if ravens had used them for nesting, we would have observed it serendipitously.

We observed active raven nests on two towers, both of which were identical 15.2 m (50 ft) National Oceanic and Atmospheric Association (NOAA) towers located within the SGCA in remote regions of the INL Site (Figures 4-1 and 4-2; Table 4-2).

Figure 4-1. Raven nest on one of the two NOAA towers.

Power Lines

We surveyed nearly all transmission and distribution lines four times. The first two surveys occurred between 31 March – 30 April, and the second two occurring from 4 May – 3 June, 2015. The only line that was not surveyed four times was a 3-arm distribution line that angles northwest from CFA to the western INL Site boundary (Figure 4-2). We surveyed that line on the first two surveys and part of the line on the fourth survey. A gun range safety fan intersects the line, so it is often difficult to gain permission to survey the full line. Though we intended to survey the line four times if possible, the arms supporting the three phases may not be wide enough to support a raven or raptor nest, as no nest has been observed on that line during our surveys (2013-2015) nor during surveys conducted by other researchers (2007-2009; unpublished data). We also did not complete a fourth survey of a short section (~ 6 km) of distribution line west of CFA because it consists of single poles without cross arms. Following the third survey of that line, we determined that it would be impossible for those structures to support a nest.

Twenty (65%) of the 31 active raven nests on power lines were outside the SGCA. Mean density of non-SGCA raven nests on power lines was 9.66 km/nest (*n*=20), and mean density within the SGCA was 11.3 km/nest (*n*=11).

All but two active raven nests associated with power lines were on transmission line structures. Fourteen nests were on transmission structures we refer to as “Sloped H”, fourteen were on “Closed H-Cable” transmission structures, and one was on an “Open H” transmission structure (Figure. 4-3). On distribution lines, one nest was supported by a single pole that had a double cross-arm, and the other was on a single pole with a single cross arm. We only observed the latter nest once before it fell to the ground.

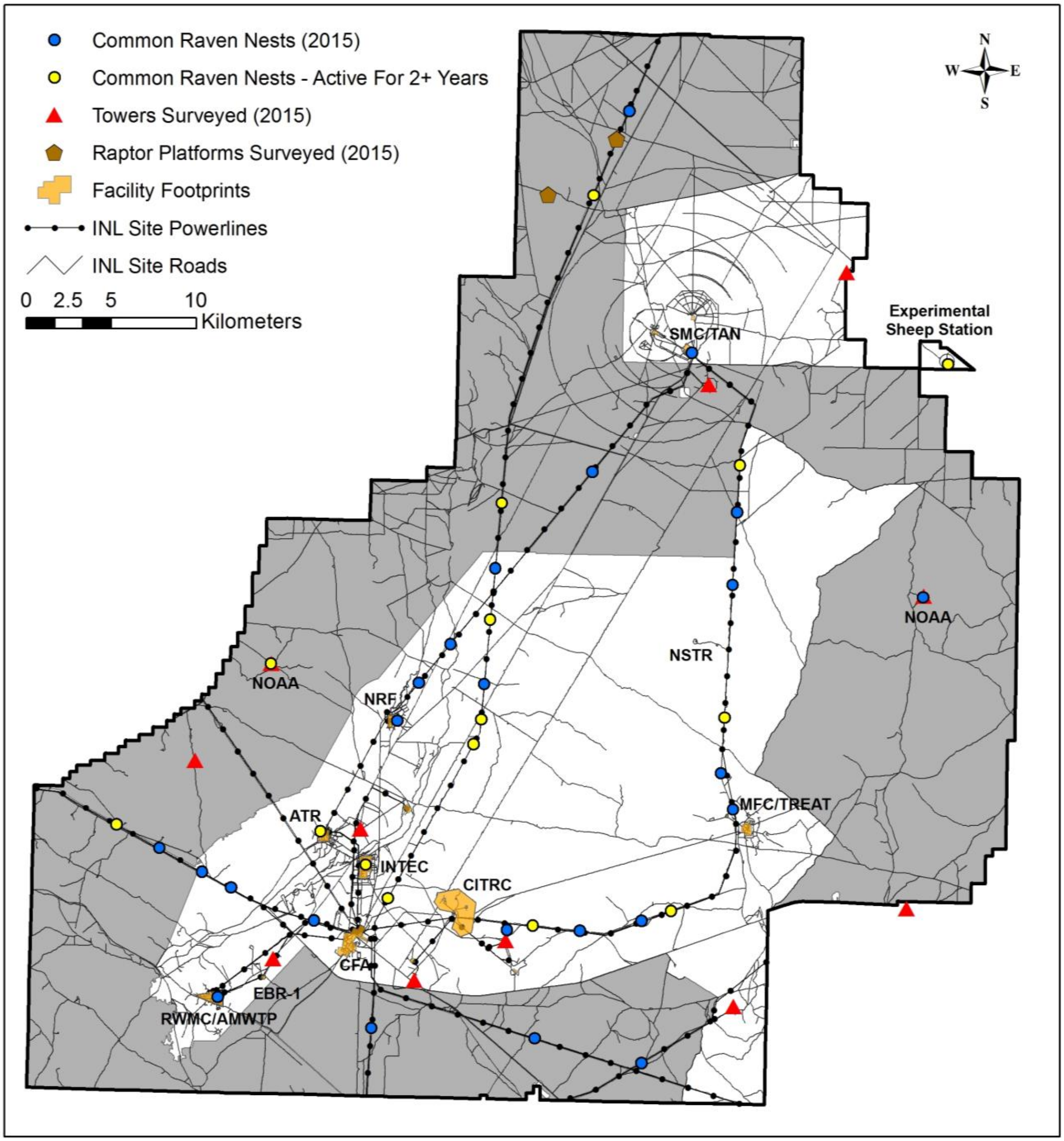


Figure 4-2. Results of 2015 raven nest surveys. Yellow dots represent active raven nests in 2015 that were also active in 2013, 2014, or both years.

Table 4-1. Facilities surveyed for raven nests in 2015. The number of days between surveys is indicated, though individual nests with unconfirmed activity statuses were sometimes revisited more frequently.

Facility	# Times Surveyed	Days Between Surveys	Active Raven Nest Confirmed	Substrate Supporting Active Nest
Advanced Mixed Waste Treatment Project (AMWTP)	1*	N/A	Yes	Building Platform
Advanced Test Reactor (ATR) Complex	2	22	Yes	Effluent Stack
Central Facilities Area (CFA)	2	14	No	N/A
Critical Infrastructure Test Range Complex (CITRC)	2	15	No	N/A
Idaho Nuclear Technology and Engineering Center (INTEC)	2	13	Yes	Effluent Stack
Experimental Breeder Reactor I (EBR-I)	2	20	No	N/A
Experimental Sheep Station	3	21, 12	Yes	Building Platform
Materials & Fuel Complex (MFC)/Transient Reactor Test Facility (TREAT)	2	15	No	N/A
Naval Reactors Facility (NRF)	3	20, 15	Yes	Building Platform
Radioactive Waste Management Complex (RWMC)	2	20	No	N/A
Specific Manufacturing Capability (SMC)/Test Area North(TAN)	2	14	Yes	Ornamental Tree

*Most of AMWTP was surveyed more than once during the RWMC surveys. However, only later in the season did we find an escort at AMWTP so we could enter the property and complete a full survey.

Table 4-2. Active raven, hawk, and owl nests observed on anthropogenic features during 2015 surveys.

Species	# Active Nests	Substrate	Within SGCA	Outside SGCA
Common Raven	31	Power Line	11	20
	3	Building Platform	0	3
	2	Stack	0	2
	2	Tower	2	0
	1	Ornamental Tree		1
Total Common Raven	**39**		**13**	**26**
Red-tailed Hawk	3	Power Line	1	2
Swainson's Hawk	2	Power Line	0	2
	2	Ornamental Tree	0	2
Ferruginous Hawk	1	Raptor Platform	1	0
Unidentified *Buteo* Hawk	1	Power Line	0	1
Great-horned Owl	1	Ornamental Tree	0	1
	2	Building Platform	0	2
	1	Other	0	1
Total Hawks and Owls	**13**		**2**	**11**

Figure 4-3. Transmission pole structures used as nest substrates by ravens in 2015. From Left to Right: Sloped H, Closed H-Cable, and Open H.

4.1.4 Discussion

Results from three years of surveys (2013-2015) confirm that ravens prefer to nest on transmission line structures over other anthropogenic substrates. However, it is still too soon to determine whether raven nesting is increasing on INL Site infrastructure. We observed 32 active raven nests in 2013, 37 in 2014, and 39 in 2015. Though this appears to be an upward trend, the differences may be partly reflective of increased survey effort and effectiveness. In 2014, we started surveys a month earlier than in 2013 (DOE and USFWS 2014), though in 2015, our search effort was comparable to 2014 (however, we took weeks more to complete the same surveys). The number of raven nests on power lines in and out of the SGCA was exactly the same in 2014 and 2015. The two additional nests observed this year were on a tower and in an ornamental tree near a facility. Because of the difficulty in observing the nest in the ornamental tree, it is possible that nest was active but missed in 2014. Thus, with only three years of data, and only two that are fully comparable, we do not yet observe convincing evidence that the number of raven pairs nesting on anthropogenic structures is increasing on the INL Site.

This year was the first in which we recorded information about the construction style of power pole structures that ravens nested upon (Figure 4-3). What we now lack is knowledge of the relative availability of each structure type so that we may analyze whether the structures raven occupy are used more often than would be expected based on availability. We are working to collect and analyze that information, and will have a completed data set by the end of 2016. If ravens exhibit a preference for a specific structure, DOE and its power management contractor may find there are other steps that can be taken to reduce the attractiveness of transmission structures for nesting.

Potential Impacts of Towers

In 2014, we reported that a remote NOAA tower on the west side of the INL Site was occupied by ravens. In 2015, the same tower was used by ravens, and in addition, we observed that an identical tower in a remote region on the east side of the INL Site was also occupied by ravens (Figure 4-2). Though we do not know to what extent these breeding pairs impact sage-grouse on the INL Site, the presence of these towers provides an opportunity for ravens to nest in areas that may otherwise be unsuitable because of a lack of anthropogenic substrates. The nearest transmission lines are 7.5 km (4.7 mi) from the western tower and 11.3 km (7.0 mi) from the eastern tower. These towers occur in areas that have some of the lowest probability of raven occurrence based on resource selection analyses (Coates et al. 2014). If ravens are deterred from nesting on these two towers, sage-grouse nest predation risk may decrease in these areas.

Areas of Highest Potential Predation Risk

Raven breeding pairs maintain a territory year round (Webb et al. 2012) and the same nest site is often used year after year (but it may not be the same pair). Though we are unable to distinguish individual birds and therefore cannot address the degree of site fidelity among mated pairs on the INL Site, we note that 11 of the 39 active nest sites in 2015 were used in either 2013 or 2014, and four others were occupied each of the past three years. Thus, 38% (*n* = 15) of nest sites that were active in 2015 had been used by ravens at least twice in the past three years. This renesting value may underestimate actual site fidelity, because ravens returning to old nesting areas on transmission lines may select different, nearby power line structures from year to year, especially if the previous year's nest blew down (which is often the case).

During 2014 and 2015, we frequently observed nests on transmission structures that were only one or two structures removed from the structure that supported a nest the previous year. We suspect that in many of these cases, a breeding pair has returned to nest in the same part of its territory, though not necessarily on the same pole. With regard to local sage-grouse, predation risk would be unchanged from year to year, regardless of which structure ravens nested on. Currently, our data collection focuses on documenting the exact site where a nest occurs, and noting sites where repeat nesting has been observed (Figure 4-2). Given the potential site fidelity of ravens on the INL Site that we suspect, but cannot yet fully quantify, we believe it would be beneficial in the future to shift our focus to highlighting general nesting areas rather than site-specific locations. By so doing, we will be able to better highlight stretches of transmission lines that would be best suited for installing nest deterrents.

Management Implications and Recommendations

Conservation Measure 10 in the CCA specifically identifies utility structures as the target for nest deterrent experiments, which is appropriate because most raven nests on anthropogenic structures are on power transmission structures, and most other infrastructure is outside of the SGCA. However, in light of data collected during the past three years, DOE will also promote opportunities to deter raven nesting on non-utility structures (i.e. towers, facilities) where the cost to do so would be minimal. Such actions would be most important for nests that are in or near the SGCA. Non-utility nest sites of highest priority are (1) the two NOAA towers occupied in 2015 (both are in the SGCA), (2) sites at AMWTP and TAN (within 1.8 km and 0.7 km, respectively, from the SGCA), and (3) nests at the Advanced Test Reactor (ATR) Complex and Naval Reactors Facility (NRF) (both are within 2.8 km of the SGCA and both have supported raven nests for three consecutive years).

To address the highest priority sites, an ESER biologist met with local NOAA staff in summer 2015 and developed a plan for deterring nesting on the two towers that supported raven nests this year (See Table 5-1 for more details). Although this action may successfully deter nesting on these towers, the raven pairs could simply move to the nearest power line or find a juniper tree in the vicinity. It is beyond the scope of this task to determine what happens to displaced ravens or to attempt to deter ravens from nesting on natural substrates. However, if the ravens move to the nearest suitable anthropogenic structures (transmission structures), they would have to move several kilometers and would no longer be within the SGCA. Thus, deterring nesting from these towers would be consistent with the central aims of the CCA.

Though we cannot yet make a definitive statement about whether ravens are increasingly making use of anthropogenic nesting structures on the INL Site, the data are sufficient to allow us to begin to define those areas within the SGCA where sage-grouse probably experience the greatest amount of predation risk from territory-holding ravens. The transmission line that runs NW from CFA along Highway 20/26 is one area within the SGCA where raven nesting density is relatively high. Other areas in the north may also be worth considering. If DOE decides to proceed with installing nest deterrents, finer-scale analyses could be conducted to support the action.

4.2 Task 7 – Inventory and Monitoring of Sage-Grouse Habitat for Areas Dominated by Non-Native Annual Grasses

4.2.1 Introduction

The loss of habitat due to dominance by non-native grasses, primarily cheatgrass, is a substantial threat to sage-grouse across its range and was identified as a threat to sage-grouse in the CCA. Domination by annual grasses generally follows the loss of native herbaceous species, often due to soil disturbance associated with land use activities. Cheatgrass alters the fire regime by increasing fire frequency, which further reinforces cheatgrass dominance. Increased fire frequency also means that big sagebrush recovery following fire is unlikely, essentially making this loss of sage-grouse habitat permanent. Native perennial grasses and forbs are also unlikely to recover in cheatgrass-dominated areas.

Understanding the status of cheatgrass on the INL Site is an important aspect of tracking this threat. The vegetation map provides a guide to larger areas that are presently in vegetation class types or complexes of class types that are dominated or co-dominated by non-native annual grasses. However, there are additional areas smaller than the minimum mapping unit size that don't show up in the vegetation map, but are points from which annual grass invasions may expand.

Smaller areas of invasion have experienced some form of vegetation or soil disturbance that has caused the loss of native perennial plants. This disturbance may have been due to livestock management activities, road construction, firefighting, environmental remediation, or similar activities. Although the surveys will begin in areas that are presumed nesting habitat for sage-grouse, they will expand into burned areas that are likely to become nesting habitat in the future.

The goals of this inventory are to better understand the extent of annual grasses and other invasive plants on the INL Site associated with sage-grouse habitat and to provide information on areas that may require additional management attention. The objectives of this task are to identify those areas that have been substantially affected by cheatgrass and attempt to identify the stressor that allows cheatgrass to continue to dominate. The results will be used to gain a better understanding of the extent of this threat on the INL Site and the actions that may be required to reduce that threat.

4.2.2 Methods

Identifying Survey Areas

In 2014, we focused our initial search in areas most likely used by sage-grouse for nesting, including areas with sagebrush habitat and within 5 km of active leks where probability of nesting would be higher. A GIS was used to identify potential survey areas (47 total linear disturbances and 78 points). Because the GIS process didn't yield a high percentage of annual grass areas, for the 2015 field work, we chose to revisit those areas marked from the 2014 surveys and to systematically ground truth areas of known disturbances across the SGCA.

Data Collection

Field crews visited known and suspected areas of disturbance (based on imagery), such as sheep camps, gravel pits, livestock feeding/bedding areas, and drove roads included in the RWMC and Tractor Flats lek routes (Figure 4-4). These surveys were conducted primarily within, but not limited to, the SGCA and focused first on nesting habitat within 5 km of leks. We added roads that were not surveyed previously and tried to cover more ground in general than what the imagery indicated could be disturbed. Once an area was located that was dominated by cheatgrass or other annual weeds, an attempt was made to identify the stressor that resulted in the loss of native perennials.

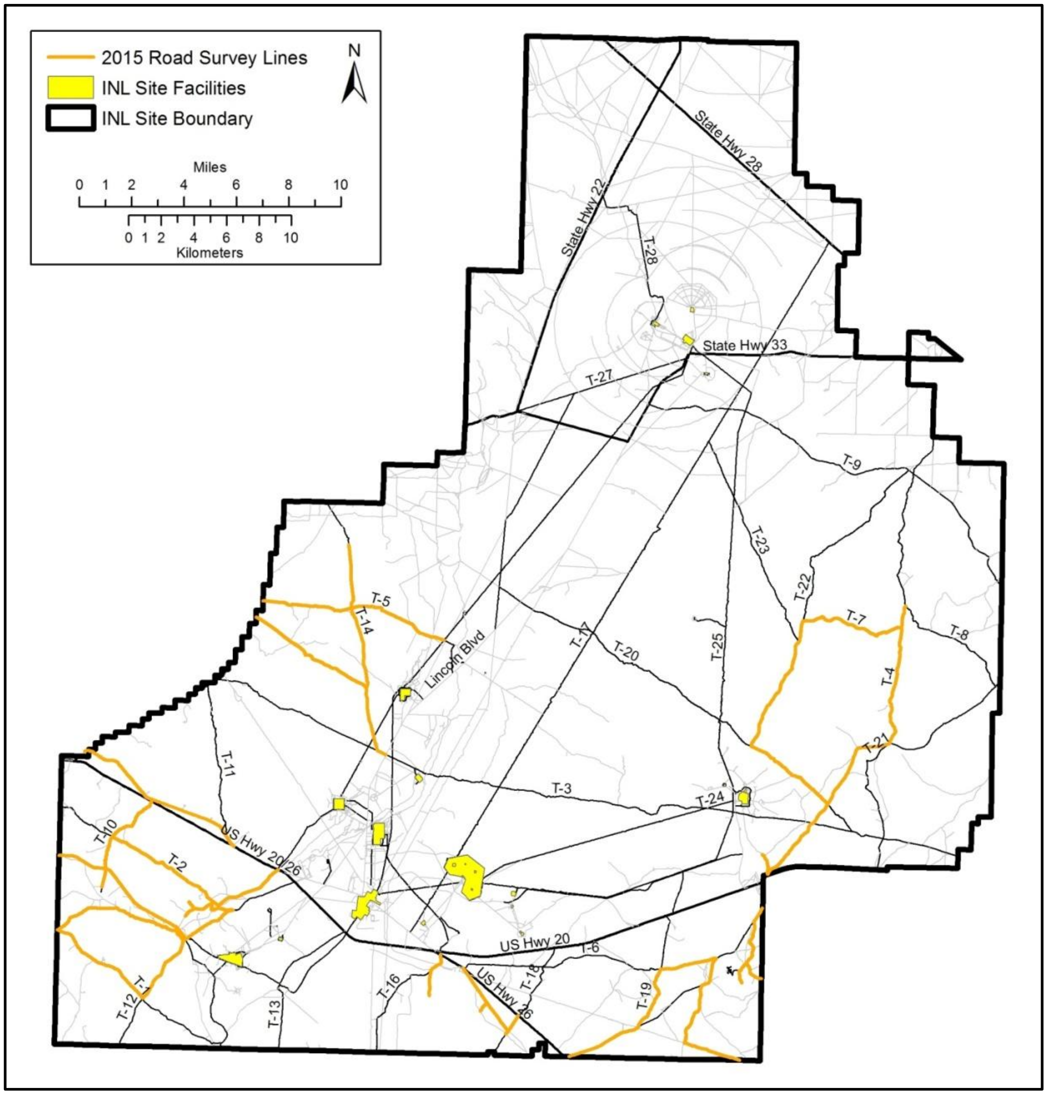


Figure 4-4. Extent of road surveys across the INL Site in search of cheatgrass and other non-native annual species.

Field crews recorded a point feature for areas less than approximately 400 m^2 (20 m x 20 m). Field crews walked the perimeter and recorded a polygon feature for areas larger than 400 m^2. A track line feature was recorded when navigating to points of interest to record the effort of the field crews. Field crews also conducted opportunistic surveys for Idaho Noxious Weeds.

Field crews recorded the following information at each of the point, line, and polygon features:

- Date: The date an infestation is located. Generated automatically when a point feature is created on the GPS unit.
- Easting: Easting coordinate at an area dominated or co-dominated by cheatgrass or other annual weeds. UTM zone 12, NAD83. Generated automatically when a point feature is created on the GPS unit.
- Northing: Northing coordinate at an area dominated or co-dominated by cheatgrass or other annual weeds. UTM zone 12, NAD83. Generated automatically when a point feature is created on the GPS unit.
- Observer: Initials of person collecting data.
- Species 1:
    - Species Code
    - Abundance (Dominant, Co-dominant or Present)
- Species 2:
    - Species Code
    - Abundance (Dominant, Co-dominant or Present)
- Species 3:
    - Species Code
    - Abundance (Dominant, Co-dominant or Present)
- Disturbance Type or Evidence: (Firefighting, Livestock Water, Livestock Salt, Livestock Bedding, Livestock Feeding, Animal Trail, Environmental Remediation, Roadside, Old Field, Playa, Outcrop, Other).
    - Comment Field for Other Disturbance Type
- Stressor Still Present: Yes or No.

The species category was included in the data dictionary to differentiate between areas dominated by cheatgrass or some other annual/weedy species. The code designates the plant specifically and the abundance indicates the level of dominance at the location. Often times, the weedy species is co-dominating with a native plant and this list allows us to separate those areas that are partially weedy from those that are a monoculture of invasive plants.

After the species-specific questions were answered, we tried to determine the type of disturbance. It was extremely difficult to know exactly what had caused the disturbance while in the field unless we were in a known location, such as a containment line or standing next to a livestock water trough.

Data Management

The GPS data collected in the field were downloaded, post-processed, and stored on the ESER GIS Archive each week. All GPS data were reviewed by a GIS Analyst and evaluated for accuracy and errors.

4.2.3 Results

In 2014, mapped disturbance areas that were dominated by cheatgrass or some combination of weedy species included the following designations: six livestock related, three animal use, two water related, one fire, and 12 unknown. In 2015, we revisited eight points and five areas from 2014 and confirmed that they were still dominated by cheatgrass. We also added two new areas (3.6 ha [8.9 ac] and 3.3 ha [8.1 ac) and 17 more point locations. Points were areas less than about 400 m^2, so a total acreage is not available for point locations. No line features were mapped in 2015.

In 2015, we further expanded our search into areas across the INL Site that have known disturbances or cheatgrass dominated areas, while staying mostly within the SGCA. While we did manage to locate some additional annual grass dominated locations, they were not as abundant as we had expected them to be (Figure 4-5).

4.2.4 Discussion

The summer of 2014 experienced abnormal weather and precipitation. After being one of the driest years on record, late summer rainfall in August and September turned the desert into spring like conditions. A summer with nearly no annual species suddenly became a fall of full bloom flowers and late production from other perennial species that had already given up producing seed for the year. Annual grasses, primarily cheatgrass, are straw-colored after they senesce. This normally makes it easy to find on the ground amid perennial species. Unfortunately, the late precipitation in 2014 changed the search from dry straw-colored grass to bright green, amid a sea of more green. After checking a number of mapped locations from the GIS activities, it became clear that finding cheatgrass may be more a matter of luck as opposed to prior knowledge and pre-digitized disturbance locations. Weather patterns in 2015 were more normal and we did not have the abundance of "green" and were now looking for a more typical "light yellow."

Because of the odd weather patterns experienced in 2014, we planned to resurvey all the areas visited during that field season. We double checked these areas during the 2015 field season to see what exactly was growing during a more typical year. The current precipitation data for 2015 indicates total precipitation below normal, but more normally distributed across the year with the highest precipitation occurring in May.

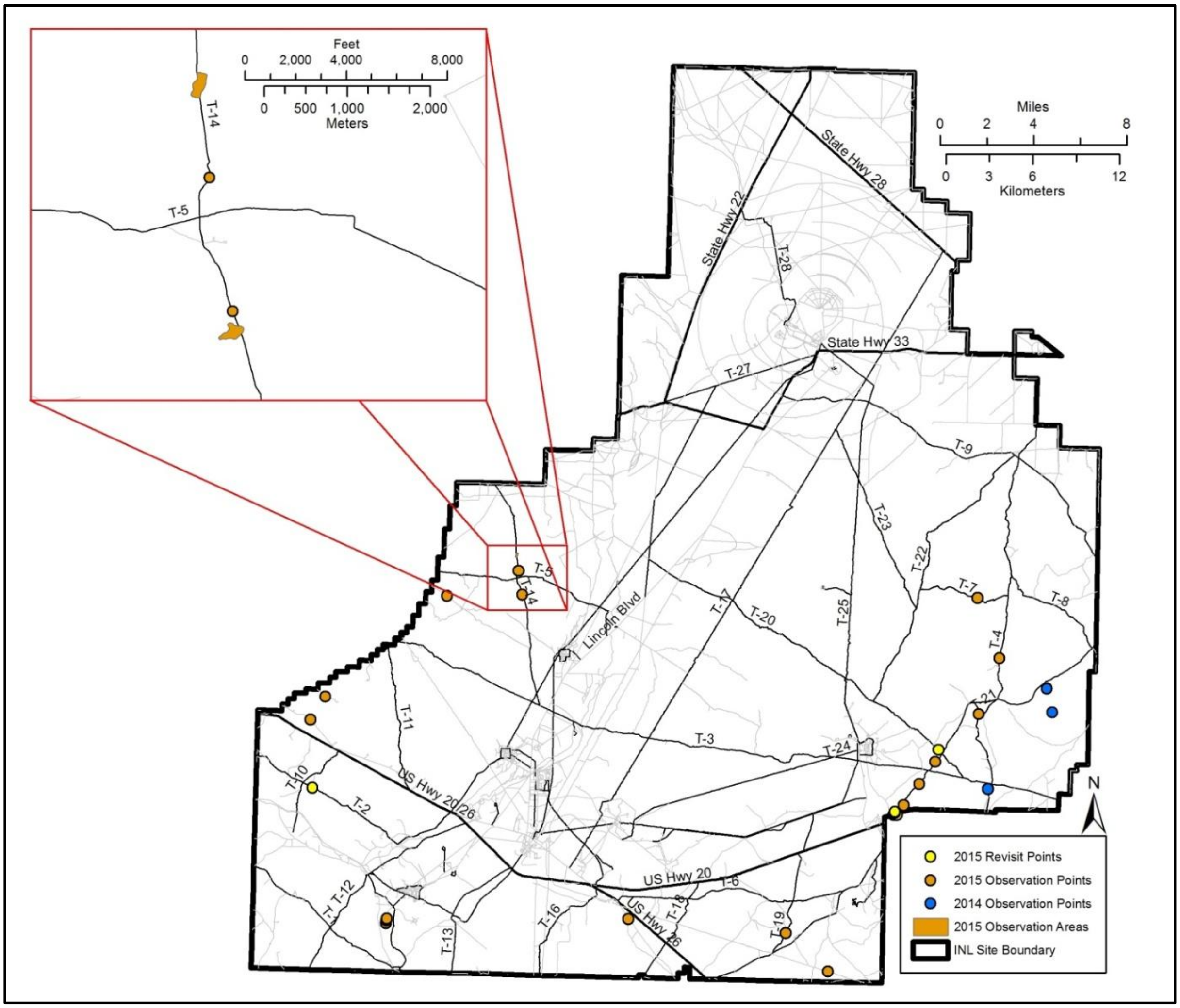


Figure 4-5. Results from field surveys. Areas of non-notive annual grass smaller than 20 m X 20 m are mapped as points and areas larger thean 20 m X 20 m are mapped as areas. Linear areas of non-native annual grass are mapped as lines.

4.3 Task 8 - Monitor Unauthorized Expansion of the Infrastructure Footprint within the SGCA and Other Areas Dominated by Big Sagebrush

4.3.1 Introduction

Infrastructure development is one of the two top threats to sage-grouse on the INL Site (see Table 3 in the CCA). Infrastructure promotes habitat fragmentation, and construction of new infrastructure nearly always disturbs soil. If proper controls are not in place, soil disturbance can facilitate the introduction and spread of invasive weeds, which in turn can increase the risk of wildland fire. Weeds may also replace native plants and reduce plant diversity in localized areas.

Prior to the start of an INL Site construction project that may affect undeveloped land, a NEPA analysis is conducted on the portion of land slated for the project. Evidence from remotely sensed images of the INL Site spanning a decade suggests that sometimes infrastructure footprints expand beyond what was originally authorized in the Environmental Assessment. Thus, there is a possibility that an unauthorized impact to sagebrush habitat and other native plant communities could occur.

Inappropriate vehicle use associated with livestock grazing management may also cause habitat degradation in localized areas. Remote sensing imagery shows that the number of roads within grazing allotments on the INL Site continues to increase (unpublished data). It is likely that most of these roads were established by permittees to strategically distribute water troughs and mineral salt stations, create shortcuts between roads, and avoid areas with deep ruts that might be impassable under wet conditions. Once a two-track trail appears, other drivers may follow it, further establishing the route. Although many named two-track roads are marked with small signs on the INL Site, no official road map has been developed to unambiguously identify authorized roads.

Occasionally, mitigation following the completion of a construction project fails to meet its objectives. For example, if no overarching plan for mitigation is developed, infrastructure requirements may continue to expand as a project moves forward, without new structures and disturbances being taken into account. For this and reasons described above, DOE supports using GIS capabilities to monitor for unauthorized expansion of the infrastructure footprint, especially within the SGCA and other areas dominated by big sagebrush.

The goal of this task is to update sagebrush habitat distribution by identifying where unauthorized expansion of infrastructure has occurred and/or removed sagebrush habitat. In some cases, there has been authorized expansion at some facilities (e.g. new MFC ponds) that was not present when the INL Site vegetation map was originally being completed (Shive et al. 2011). And because the estimated amount of sagebrush habitat is generated from the vegetation map by cross-walking all classes dominated by sagebrush, there are regions currently mapped as sagebrush habitat which are not reflective of recent ground conditions.

4.3.2 Methods

The processing and analysis workflow for this task included selecting a basemap image dataset, reviewing the entire INL Site for potential unauthorized expansion, and delineating all linear features and modifying sagebrush habitat polygons using a GIS. After all of the GIS edits were made, summary statistics were calculated for total distance of new two-track roads and area of sagebrush habitat lost to facility expansion or from new project footprints.

The 2013 Idaho NAIP high resolution imagery was used as the basemap dataset for all new road delineations and sagebrush habitat polygon editing. The 2013 Idaho NAIP color-infrared imagery was collected at a higher spatial resolution of 0.5 m compared to previous NAIP imagery datasets, and represents the highest resolution imagery available for the entire INL Site (see page 3-21 in DOE and UDFWS 2014 for additional NAIP imagery details). We also used a time series of Idaho NAIP color-infrared imagery collected in 2004, 2009, and 2011 to help understand when digitized features were created on the landscape.

One GIS Analyst systematically zoomed into regions of the INL Site and looked for evidence of undocumented surface disturbance throughout the SGCA and also within sagebrush habitat outside of the SGCA. Areas of surface disturbance are most commonly linear features created by the presence of new two-track roads. Anytime a potential location was identified, it was marked for secondary review. A second GIS Analyst then reviewed each potential marked location, and determined if the feature warranted delineation. Occasionally the image properties were adjusted to accentuate pixels in an area of interest or add more contrast to help with feature identification. When an area of disturbance was identified, additional imagery from previous years was reviewed to determine if the disturbed ground is something new or has been there for a number of years. We relied on visual cues to help determine if the linear disturbance was anthropogenic and caused by a vehicle with two distinct parallel tracks, or if the disturbance could be attributed to livestock and game trails which tend to braid (Figure 4-6). There are an abundance of old linear features (e.g. canals and bladed fire containment lines) across the INL Site landscape which can resemble roads; however in most cases the width of the line can be used to infer whether it is a two-track road or another feature (Figure 4-7). Sometimes portions of new two- track roads are observed in regions of the landscape, but then the road becomes indiscernible in the imagery and only the visible segments of roads have been mapped.

We also visually scanned the areas around facilities and project areas in the imagery to investigate whether the infrastructure footprint has expanded and now overlaps areas previously mapped as sagebrush habitat. The sagebrush habitat layer was plotted on the imagery basemap, and each facility, borrow source/gravel pit, and known project areas were reviewed for expansion into existing mapped sagebrush habitat. All outdated sagebrush habitat polygons were manually updated using GIS editing tools which also maintained topology with adjacent polygon boundaries.

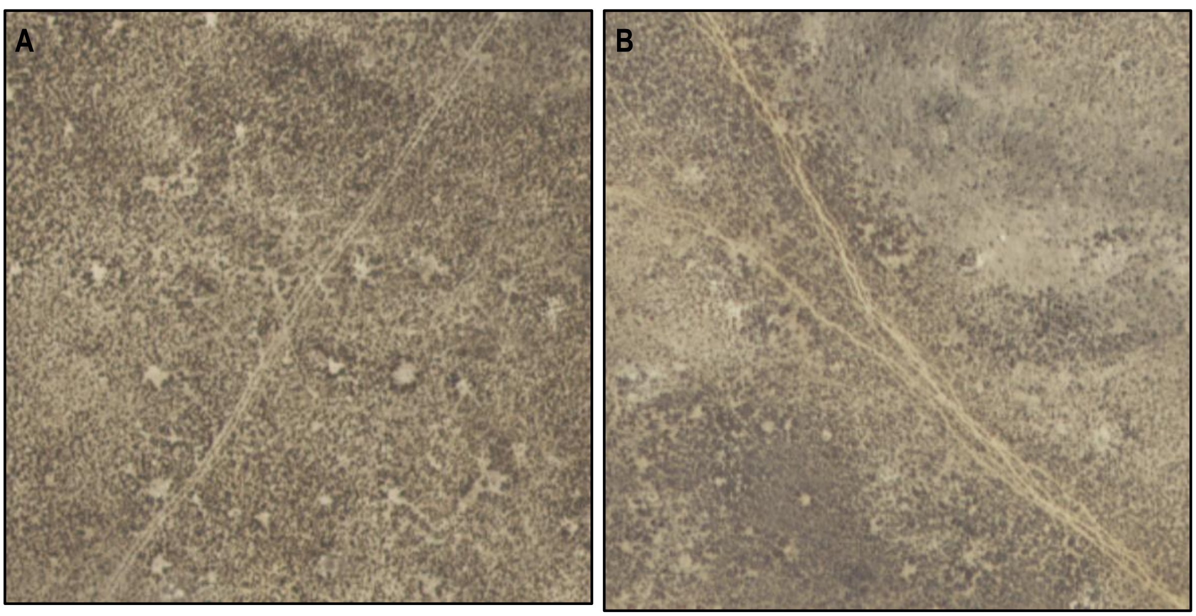


Figure 4-6. Panel A shows an example of a previously unmapped two-track road on the INL Site. As a visual comparison, Panel B shows an example of ungulate and/or livestock trails on the INL Site with characteristic braiding.

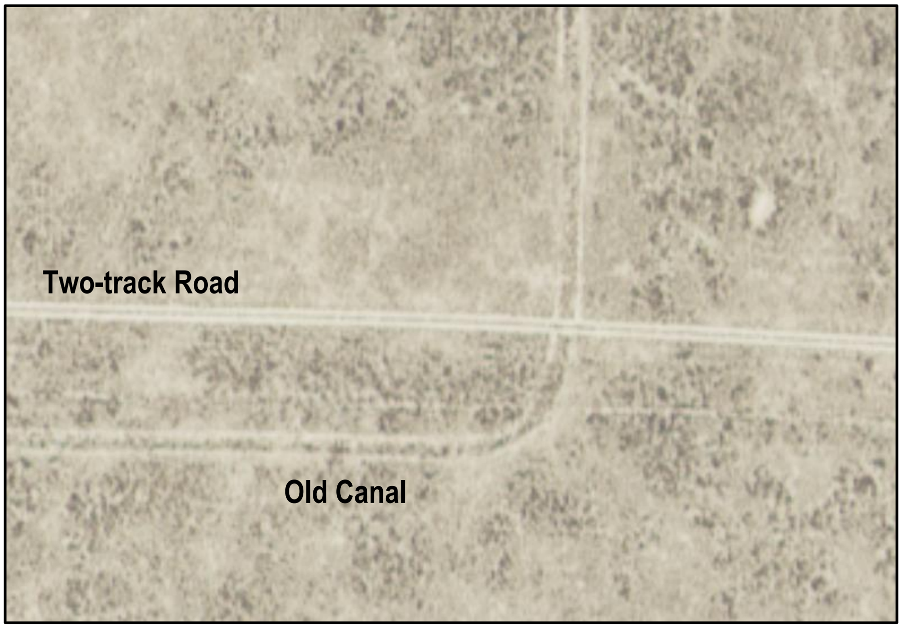


Figure 4-7. An example image subset showing two different linear disturbance features on the INL Site. The width of the features can be used to distinguish two-track roads from other features.

4.3.3 Results

We digitized 505.5 km (314.1 mi) of linear disturbance features that were not included in the most recent roads data layer (Figure 4-8). Many of these features have been visible in imagery for a number of years, however they were intentionally not added to the existing roads data layer during the 2014 update process because they appeared to have been used only a few times or were assumed to be unauthorized and the continued use of those roads did not want to be promoted. Currently, 3,593.3 km (2,232.8 mi) of two-track and paved road features are on the INL Site.

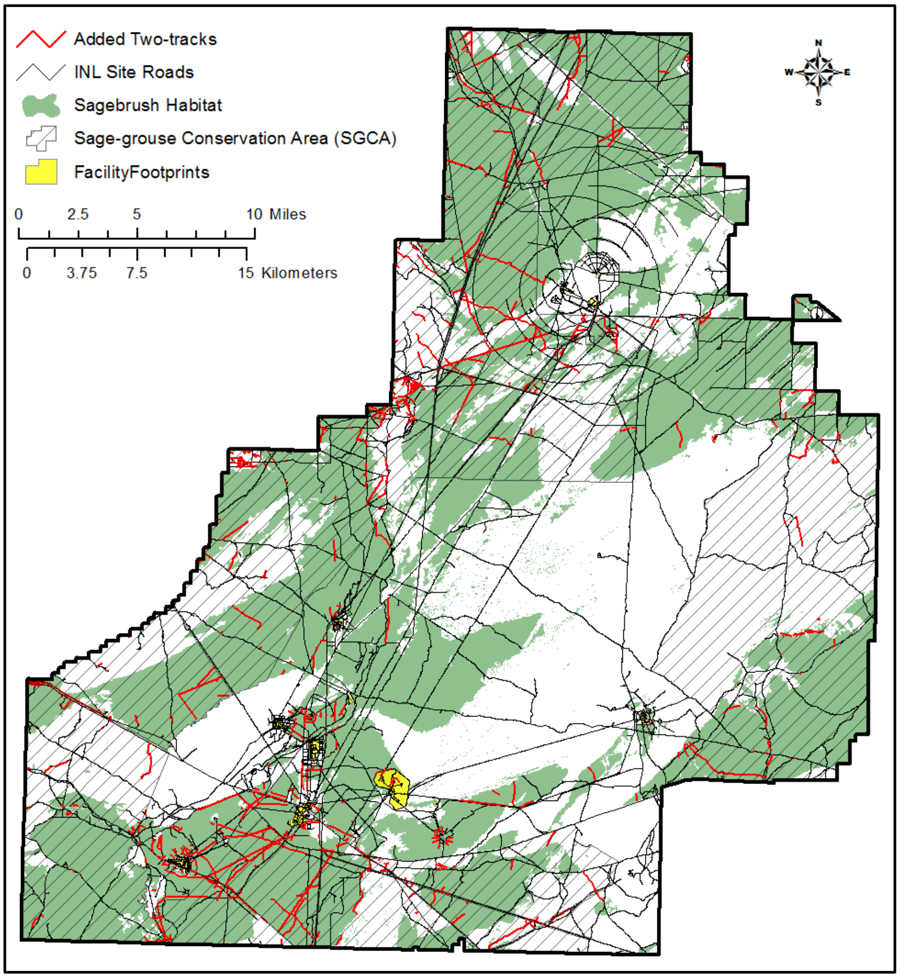


Figure 4-8. All of the mapped roads on the INL Site including two-track updates made in 2015 to support the CCA.

Sixteen polygons were delineated to document losses in sagebrush habitat. The total area of sagebrush removed from the sagebrush habitat layer was 66.2 ha (163.5 acres). The majority of the area removed was from excavated expansion at gravel pits and borrow sources (Figure 4-9). There was also sewage ponds developed since the completion of the INL Site vegetation map at both MFC and NRF facilities (Figure 4-10).

Figure 4-9. The light green overlay in both images represents sagebrush habitat as defined in the CCA. A) The subset image shows the T-12 gravel pit in 2011. B) The same area showing the expansion of the gravel pit in 2013, and the yellow polygon indicates the area of sagebrush habitat removed.

Figure 4-10. The light green overlay in both images represents sagebrush habitat as defined in the CCA. A) Image subset shows a portion of the NRF facility in 2009 prior to the construction of new ponds. B) The same are showing the newly constructed ponds in 2013 and the yellow polygon indicates the area of sagebrush habitat removed.

4.3.4 Discussion

Linear disturbance features delineated for this monitoring task are all considered two-track roads for the sake of this report, however it is important to recognize that a vehicle track left from a single or a few minimal uses may not be considered an actual permanently established road. In fact, many of the faint roads delineated may be difficult to see on the ground and further use would be unexpected. There are also examples of old roads that have presumably seen very little traffic, and natural vegetation regrowth is starting to fill-in the two-track footprint. We anticipate that if these roads see no further use, they may become indistinguishable in imagery and appear similar to the natural undisturbed landscape.

The INL Site does not have an authorized roads layer to document which are considered official roads, and which roads were created from unauthorized activities. There was an effort by Battelle Energy Alliance (BEA) in 2012 to update the INL Site roads layer to include many of the recent changes to that dataset. Then in 2014, CH2M-WG Idaho made a more comprehensive road layer update by adding additional roads and also adjusting the road lines to more accurately align with the basemap imagery. We have chosen to start with the most recently updated road layer from CH2M-WG Idaho as the baseline dataset to document further changes. It is difficult to know definitively who created the new two-track roads unless someone was caught in the act of driving off established roads. And because the origin of most new roads on the INL Site is unknown, it is hard to hold anybody accountable for past unauthorized expansion. Moving forward with this monitoring task, all new two-track roads mapped under this task in 2015 will be considered the 2013 ground condition baseline from which further expansion will be documented.

In many cases, project footprints may only be provided as a written description in NEPA documents and no spatial boundary (e.g. CAD or GIS) exists to help determine if observed expansion is unauthorized. So, rather than assuming or proposing an expansion was unauthorized, all facility or project expansion documented under this task is considered authorized until further reviewed by someone with the authority or project understanding to know whether those activities had prior approval.

The higher spatial resolution of the 2013 Idaho NAIP may have enabled the detection of two-track roads which were previously more difficult to see in other Idaho NAIP imagery. The 0.5 m pixels represent a four-fold increase in resolution compared to the standard 1 m spatial resolution of all other Idaho NAIP datasets. It is fortunate that higher resolution imagery was available for the initiation of this monitoring task, because it provides a more comprehensive documentation of infrastructure footprint which will be the source data to determine future expansion. The 2015 Idaho NAIP was collected this year and once those data are processed, they will be made available to the public sometime during spring of 2016. This new dataset will capture any changes to the infrastructure footprint that may have occurred since the collection of the 2013 imagery and the establishment of this baseline dataset.

4.4 Literature Cited

Bui, T. V. D., J. M. Marzluff and B. Bedrosian. 2010. Common raven activity in relation to land use in western Wyoming: implications for greater sage-grouse reproductive success. Condor 112:65-78.

Coates, P. S., K. B. Howe, M. L. Casazza, and D. J. Delehanty. 2014. Common raven occurrence in relation to energy transmission line corridors transiting human-altered sagebrush steppe. Journal of Arid Environments 111:68-78.

Department of Energy, Idaho Operations Office (DOE), and U.S. Fish and Wildlife Service (USFWS). 2014. Candidate conservation agreement for greater sage-grouse (Centrocercus urophasianus) on the Idaho National Laboratory Site. DOE/ID-11514, U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho.

Holloran, M. J., and S. H. Anderson. 2005. Spatial distribution of greater sage-grouse nests in relatively contiguous sagebrush habitats. The Condor 107:742-752.

Howe, K. B., P. S. Coates and D. J. Delehanty. 2014. Selection of anthropogenic features and vegetation characteristics by nesting Common Ravens in the sagebrush ecosystem. The Condor 116:35-49.

Shive, J. P., A. D. Forman, K. Aho, J. R. Hafla, R. D. Blew, and K. T. Edwards. 2011. Vegetation community classification and mapping of the Idaho National Laboratory site. Environmental Surveillance, Education, and Research Program Report, Gonzales-Stoller Surveillance LLC., Idaho Falls, ID. GSS-ESER-144.

Shurtliff, Q.R., A.D. Forman, J.C. Whiting, J.P. Shive, J.R. Hafla, K.T. Edwards, R.D. Blew. 2015. 2014 monitoring report in support of the candidate conservation agreement for greater sage-grouse on the Idaho National Laboratory Site. DOE/ID-11527. Gonzales-Stoller Surveillance, LLC, Idaho Falls, ID. January 2015.

Webb, W.C., J.M. Marzluff, and J. Hepinstall-Cymerman. 2012. Differences in Space Use by Common Ravens in Relation to Sex, Breeding Status, and Kinship. The Condor 114:584-594.

Whiting, J. C. and B. F. Bybee. 2013. 2012 Breeding Bird Surveys on the Idaho National Laboratory Site. Environmental Surveillance, Education, and Research Program Report, Gonzales-Stoller Surveillance, LLC., Idaho Falls, ID. GSS-ESER-169.

5. IMPLEMENTATION OF CONSERVATION MEASURES

5.1 Summary of 2015 Implementation Progress

Section 10 of the CCA describes eight threats to sage-grouse and its habitats on the INL Site. DOE is committed to implementing conservation measures that mitigate and reduce these threats where possible. In 2015, DOE began to implement several conservation measures intended to ameliorate threats. Table 5-1 summarizes DOE's accomplishments and other relevant events occurring during the past year.

Table 5-1. Conservation measures listed in the CCA that were designed to ameliorate threats to sage-grouse and its habitats on the INL Site (adapted from Table 5 in the CCA).

Threat:	Wildland Fire
Objective:	Minimize the impact of habitat loss due to wildland fire and firefighting activities.
Conservation Measures:	1) Prepare an assessment for the need to restore the burned area. Based on that assessment, DOE would prepare an approach for hastening sagebrush reestablishment in burned areas and reduce the impact of wildland fires > 40 ha (99 acres).
Conservation Measure 1 – Accomplishments in 2015: **1-1.** WILDLAND FIRE COMMITTEE ACTION – On 6/30/2015, the Wildland Fire Committee (including the INL Site fire chief, GSS, DOE, and BEA) met with BEA finance officials and developed an action plan that would be followed after a 40+ ha fire. To summarize, an immediate assessment would be made that looks at emergency stabilization actions. A proposed budget would be submitted, giving BEA finance officials a notice for potential needs the next year. It would not be until the next spring that imagery would be obtained to see what the green-up looks like. Then the actual costs of revegetation (if any) could be determined. **1-2.** LARGE FIRES – Two wildland fires occurred on the INL Site in 2015. Both were human-caused and total acreage burned was estimated at 4 acres (Unpublished wildland fire statistics summary for 2015; Eric Gosswiller, INL Fire Chief). Neither fire occurred within the SGCA, and it is unclear whether any sagebrush habitat was impacted. Because no fire was >40 ha, no burned area assessment was prepared. **Associated Conservation Actions that Address the Wildland Fire Threat:** **1-3.** NOTE TO INL SITE EMPLOYEES – In June, 2015, Eric Gosswiller, INL fire chief, sent a note (via i-note) to all INL Site employees regarding the upcoming fire season. Highlights of the note included an explanation that: • Fire danger was raised to moderate on June 13 and would be high in the near future. • Employees should maintain situational awareness of wildland fire danger associated with their work. • Seasonal Stage 1 fire restrictions are in effect (included a detailed explanation on what that means). **1-4.** SAGEBRUSH PLANTINGS – ESER planted 5,000 sagebrush seedlings in a priority restoration area (See Section 5.2).	
Threat:	Infrastructure Development

Objective:	Avoid new infrastructure development within the SGCA and 1 km of active leks, and minimize the impact of infrastructure development on all other seasonal and potential habitats on the INL Site.
Conservation Measures:	2) Adopt BMPs outside facility footprints for new infrastructure development. 3) Infrastructure development within the SGCA or within 1 km (0.6 mi) of an active lek will be avoided unless there are no feasible alternatives.

Conservation Measure 2 – Accomplishments in 2015:

2-1. CRITICAL INFRASTRUCTURE RANGE COMPLEX (CITRC) POWER GRID UPGRADE PROJECT – In 2015, Homeland Security proposed to install new power poles and lines near CITRC, which is outside the SGCA. One of the best management practices (BMPs) described in the CCA states that new vertical structures "should be designed to minimize the opportunity for perching and nesting by ravens or raptors." However, a new study (unpublished; Sherry Liguori, Pacificorp, Pers. Comm.) suggests that perch deterrents may increase the risk of raptors being electrocuted. Because DOE is bound to comply with both the CCA and the Migratory Bird Treaty Act, a biologist in DOE's ESER program (Quinn Shurtliff) recommended that Homeland Security only install nest deterrents on dead-end and corner poles, which are double cross-arm structures, and that they do not install any nest or perch deterrents on other poles (which are all single cross-arm structures). Furthermore, DOE asked whether the wording about minimizing perching in the CCA should be removed as a BMP, in light of this new information.

The USFWS provided a two-part response on April 22, 2015:

"1. We have read the CCA conservation measure 'Towers, utility poles.....**should** be designed to minimize......perching and nesting by ravens and raptors...' We support the proposal that Quinn describes to deter nesting opportunities on power poles by raven and raptors. This meets with the conservation measure to protect grouse near the power poles from nesting avian predators that may not have occurred there without the power poles in place (i.e., overly inflating the predator population threat). Regarding the word 'perching' in the measure, I note that the word **'should'** is used. It does not say shall, will, or must. As you may know, It is well known that deterring perching on power poles is difficult and sometimes impossible. We should have noted this in the CCA so that it is understood that you **should** consider perching issues but may not be able to address it. Regardless, I would like to leave the word in there because we encourage you to embrace new technologies in the future that may address this issue....you **'should'** consider whether you can deter perching just as you consider whether you can deter nesting, which you can and are doing. So from the perspective of CCA compliance we support that your measures to minimize nesting are sufficient and you have considered whether you can deter perching and have come to the conclusion that it may require substantial effort and may not be practicable.

" 2. The threat of electrocution for ravens and raptors (MBTA protected species) is still a threat at this site and with the new powerlines proposed the threat is expanded. If you are not already planning for this, we recommend that you build the new power poles/lines to meet with the APLIC standards. Additionally, if the existing structures are not built to APLIC standards we also recommend that you retrofit them to do so. Please note that building to APLIC standards only protects avian species from electrocution. Efforts to deter nesting, as discussed above, will also need to be applied to new and retrofitted poles."

2-2. CITRC POWER LINES AND NEAREST LEKS – Prior to commencing work on the CITRC power line project, an environmental checklist (INL-15-068, INL Smart Grid Test Bed) was approved with conditions and project specific instructions included. Contractors checked to see where the nearest leks were, but found none nearby (Pers. Comm., Jennifer Nordstrom and John Irving, INL Environmental Support & Services; October 2015).

2-3. MOWING DELAYED – Some mowing near CITRC was delayed because the proposed area to mow would have doubled the buffer around buildings, which

would have required cutting into sagebrush (Pers. Comm., Jennifer Nordstrom, INL Environmental Support & Services; October 2015). **2-4.** WIRELESS TEST BED FIBER OPTIC CABLE INSTALLATION - In 2015, approximately 12 miles of fiber optic cable were installed from Gate 1 to CITRC to CFA to EBR-1 Cell Site (all areas outside the SGCA) (Pers. Comm., Wayne Ridgeway, Test Range Director, National & Homeland Security; November 2015). The installation utilized existing power poles and underground raceway and avoided new disturbances as much as possible (environmental checklist INL-14-070). **Conservation Measure 3 – Accomplishments in 2015:** **3-1.** INSTALLATION OF MONITORING WELLS– The United States Geological Survey installed two new monitoring wells outside facility fences in 2015. Both were within the SGCA, though neither were within 1 km of a lek. One was on the west side of the INL Site, approximately 1.8 mi east of the boundary. The other was six miles northeast of MFC within the 2010 Jefferson Fire scar. In both instances, the USGS deliberately altered its original plans and shifted well sites into previously-burned areas to avoid mowing sagebrush (Pers. Comm., Roy Bartholomay, USGS INL Project Chief, Idaho Falls; Nov. 9, 2015).	
Threat:	Annual Grasslands
Objective:	Maintain and restore healthy, native sagebrush plant communities.
Conservation Measures:	4) Inventory areas dominated or co-dominated by non-native annual grasses, work cooperatively with other agencies as necessary to identify the actions or stressors that facilitate annual grass domination, and develop options for eliminating or minimizing those actions or stressors.
Conservation Measure 4 – Accomplishments in 2015: **4-1.** INVENTORY – Details of accomplishments are reported under the CCA monitoring Task 7 (Section 4.2) of this report.	
Threat:	Livestock
Objective:	Limit direct disturbance of sage-grouse on leks by livestock operations and promote healthy sagebrush and native perennial grass and forb communities within grazing allotments.
Conservation Measures:	5) Encourage BLM to seek voluntary commitments from allotment permittees and to add stipulations during the permit renewal process to keep livestock at least 1 km away from active leks until after May 15 of each year. Regularly provide updated information to BLM on lek locations and status to assist in this effort. 6) Communicate and collaborate with BLM to ensure that the herbaceous understory on the INL Site is adequately maintained to promote sage-grouse reproductive success and rangeland improvements follow guidelines in the 2006 State Plan and the current agreement.

Conservation Measure 5 – Accomplishments in 2015:

5-1. INVOLVEMENT DURING PERMIT RENEWAL PROCESS – No allotment permits that overlap the INL Site were renewed in 2015, as none expired this year. (Bret Herres, BLM, Idaho Falls office; Nov. 12, 2015).

5-2. KEEPING LIVESTOCK OFF LEKS - On 1 May, 2015, an ESER biologist reported evidence that sheep had been on lek INL128, which is approximately 700 m west of the eastern INL Site boundary near road T-8 (see Figure 2-6). Evidence included large numbers of sheep tracks and tire tracks in a clearing within 50 m of the lek.

5-3. UPDATED INFORMATION TO BLM – ESER provided updated lek maps to the BLM by Feb. 1, 2015.

Conservation Measure 6 – Accomplishments in 2015:

6-1. COMMUNICATION WITH BLM – In an effort to promote and maintain goodwill with the BLM, which will facilitate implementation of Conservation Measure 6, the following efforts occurred:

- DOE and ESER met with local BLM officials in spring 2015 to discuss habitat data collection and how DOE might share data collected on the INL Site with the BLM.
- ESER ecologists visited the field with two BLM officials during summer 2015 to talk about post-fire revegetation strategies for improving sage-grouse habitat.

Associated Conservation Actions that Address the Livestock Threat:

5-4. ALLOTMENT PERMITS RELINQUISHED – Sheep permits on the Howe Peak and Deadman allotments (Figure 10 in the CCA) were relinquished by permittees after the National Wildlife Federation paid permit holders. The BLM is unable to provide assurances that it will not put sheep back on these allotments, but because of concerns for the health of the local bighorn sheep population, it is unlikely that domestic sheep will be re-permitted in the near term. However, the BLM could add cow permits to those allotments to replace the sheep permits, but that course of action is undecided (Pers. Comm., Bret Herres, BLM, Idaho Falls office; Sept. 2015).

Threat:	Seeded Perennial Grasses
Objective:	Maintain the integrity of native plant communities by limiting the spread of crested wheatgrass.
Conservation Measures:	7) Cultivate partnerships with other agencies to investigate the mechanisms of crested wheatgrass invasion so that effective control strategies can be developed.

Conservation Measure 7 – Accomplishments in 2015:

7-1. ESER staff have communicated with individuals who would be interested in investigating mechanisms of crested wheatgrass invasion, but no funding has been secured for such a project.

Threat:	Landfills and Borrow Sources

Objective:	Minimize the impact of borrow source and landfill activities and development on sage-grouse and sagebrush habitat.
Conservation Measures:	8) Eliminate human disturbance of sage-grouse that use borrow sources as leks (measure applies only to activities from 6 p.m. to 9 a.m., March 15 – May 15, within 1 km of active leks). 9) Ensure that no net loss of sagebrush habitat occurs due to new borrow pit or landfill development. DOE accomplishes this measure by: • avoiding new borrow pit and landfill development in undisturbed sagebrush habitat, especially within the SGCA; • ensuring reclamation plans incorporate appropriate seed mix and seeding technology; • implementing adequate weed control measures throughout the life of an active borrow source or landfill.

Conservation Measure 8 – Accomplishments in 2015:

8-1. ELIMINATE HUMAN DISTURBANCE – Restrictions to protect the sage grouse that use the T-12, Adams Blvd., and Ryegrass Flats borrow pits have been implemented since 2008. Based on feedback from Roger Blew in 2008, activities in the pits have been restricted to daylight hours between 9am and 6:30pm, March 15 - May 15, from 2008 - 2015. All users in these pits are informed of the seasonal time of day restrictions through Form 450.AP01 (Gravel/Borrow Source Request), which must be completed before any work begins in the pits. In addition, in early March of each year, an email notification has been sent to all approved users in the pits to inform them of the restrictions. In 2015, the email notification was reviewed by Jackie Hafla before it was sent to all approved users on March 3, 2015. BEA Roads and Grounds conducted periodic monitoring of compliance to the restrictions throughout the restricted period and observed no violations. (Pers. Comm., Brenda Pace, INL Borrow Source Coordinator; 10/15/2015)

Conservation Measure 9 – Accomplishments in 2015:

9-1. NO NET LOSS OF SAGEBRUSH AT BORROW PITS AND LANDFILLS – No new borrow pits or landfills were developed at INL in 2015.

Expansion of existing borrow pits in 2015 was restricted to footprint boundaries that are defined in Environmental Checklist (EC) INL-14-045, which requires DOE-ID ecological contractor review of any proposed expansion. In late May of 2015, a small, ~1/2 acre expansion of the T-12 gravel pit was reviewed and approved by Jackie Hafla per the EC. Much of this area had been cleared of vegetation in 2014, so net loss of individual sagebrush was negligible. Ecological reviews of future expansions will ensure a full accounting of any loss of sagebrush habitat as well as necessary mitigation per the CCA.

Expansion within the landfill in 2015 was also restricted to the INL Landfill Complex footprint. Within this footprint, approximately 50 acres within a vegetation community of primarily crested wheatgrass were cleared of vegetation in 2015. Net loss of sagebrush was negligible. Under full implementation of the CCA in 2016, we will maintain a stricter accounting of net sagebrush loss at the landfill. No reclamation was completed at active borrow pits or the landfill in 2015. Per the requirements of our ECs, recommendations on seed mixes and seeding technology will be obtained from DOE-ID's ecological contractor for any future reclamation. All INL borrow sources and the landfill are included in an active weed control program per PLN-611: Site-wide Noxious Weed Management Plan. Finally, throughout the year, we conducted periodic monitoring of borrow pits and at the landfill to evaluate weeds and check for unauthorized activities and observed no issues. (Pers. Comm., Brenda Pace, INL Borrow Source Coordinator; 11/18/2015).

Threat:	Raven Predation
Objective:	Reduce food and nesting subsidies for ravens on the INL Site.

Conservation Measures:	10) Support research that aims to develop methods for deterring raven nesting on utility structures. 11) Instruct the INL to include an informational component in its annual Environment, Safety, and Health training module by January 2015 that teaches the importance of eliminating food subsidies to ravens and other wildlife near facilities.

Conservation Measure 10 – Accomplishments in 2015:

10-1. SUPPORTING RESEARCH – No research proposals have been submitted to DOE because the first priority is to establish a baseline of raven nesting activity on the INL Site so that raven reaction to nesting deterrents can be analyzed in proper context. However, the following related actions will occur over the next year as a direct result of information obtained from raven nest surveys:

- Dr. Bret Taylor, director of the Sheep Experiment Station, indicated in September 2015 that he will have his staff knock down the raven nest on a grain silo and will attempt to keep the ravens from coming back in the spring. The Sheep Experiment Station occupies land that is technically part of the INL Site near Mud Lake.
- Dr. Kirk Clawson, Director of the National Oceanic and Atmospheric Administration Air Resources Laboratory, will have his staff install nest deterrent devises on two 50' towers in remote locations on the INL Site in an effort to prevent ravens from nesting there in 2016. Both towers were occupied by ravens in 2015. If the design is effective, NOAA will use it on other towers in the region that raven nest on.
- INL Power Management installed a commercial nest deterrent on a single-pole distribution structure near CITRC in late summer, 2015. This structure supported a raven nest in 2013 and 2014, and a red-tailed hawk nest in 2015. The structure is particularly attractive for nesting because it has two pair of double-cross arms (a typical structure has either a single cross arm or one pair of double cross arms).

Conservation Measure 11 – Accomplishments in 2015:

11-1. EMPLOYEE TRAINING – The INL was unable to meet the January 2015 deadline to have the training described in Conservation Measure 11 included in its annual training refresher course (ES&H Site-Specific Training). Therefore, DOE-ID and its contractors took initiative to individually train their employees in 2015. Those efforts are described below. By September, 2015, INL had completed a new learning objective and included it in the ES&H Site-Specific Training that will be disseminated in 2016. The learning objective is that employees will understand the link between sage-grouse conservation and DOE's ability to pursue its mission. The instruction summarizes some of the recommendations provided in the training videos produced in 2014 including: (1) don't throw cigarette butts out car windows or park a vehicle over dry vegetation, (2) eliminate food subsidies to ravens near facilities, (3) keep outdoor garbage bins closed so as to reduce subsidies for ravens.

2015 training provided by DOE-ID and its contractors:

- DOE-ID sent a note to its employees (in "News From the Office of Public Affairs") informing them about the CCA and the three recommendations listed above. It also included a link to the two minute video produced last year.
- One of DOE-ID's contractors (ICP) sent a message to all employees September 2015 in its daily "ICliPs" newsletter that informed employees about the CCA and the three recommendations listed above. It also included a link to the two minute video produced last year (https://www.youtube.com/watch?v=LIJcEDeG_g8&list=PLX2nBoWRisnUz6o-vcRZo0LplJBaO232M&index=2).
- In the fall of 2015, ITG developed a brief awareness component that published as a Project Notes feature. This feature provided all employees a very brief introduction to the CCA requirement and a link to a 3-slide power point that basically goes over the talking points featured in the training videos described

above (Pers. Comm., Kendall Coughlan, Senior Environmental Engineer; 10/23/15)

Because the ES&H Site-Specific Training will be perpetually delivered as part of the annual refresher course, beginning in 2016, Conservation Measure 11 is now complete.

Threat:	Human Disturbance
Objective:	Minimize human disturbance of sage-grouse courtship behavior on leks and nesting females within the SGCA and 1 km Lek Buffers.
Conservation Measures:	12) Seasonal guidelines (March 15 –May 15) for human-related activities within 1 km Lek Buffers both in and out of the SGCA (exemptions apply – see section 10.9.3): • Avoid erecting portable or temporary towers, including Meteorological, SODAR, and cellular towers. • UAVs flights conducted before 9 a.m. and after 6 p.m. will be programmed so that flights conducted at altitudes < 305 m (1,000 ft) will not pass over land within 1 km of a lek. • Detonation of explosives > 1,225 kg (2,700 lbs) will only occur at the National Security Test Range from 9 a.m. – 9 p.m. • No non-emergency disruptive activities allowed within Lek Buffers March 15 – May 15. 13) Seasonal guidelines (April 1 – June 30) for human-related activities within the SGCA (exemptions apply – see section 10.9.3): • Avoid non-emergency disruptive activities within the SGCA. • Avoid erecting mobile cell towers in the SGCA, especially within sagebrush-dominated plant communities.

Conservation Measure 12 – Accomplishments in 2015:

12-1. TOWERS - No meteorological, SODAR, or cellular (portable or permanent) towers were erected in the SGCA or within 1 km of leks during 2015 (Pers. Comm., Robert A. Montgomery, Program Environmental Lead for R&D; 10/19/2015).

12-2. UNMANNED ARIAL VEHICLES - During early summer, 2015, UAV procedures were updated to comply with seasonal restrictions on vertical distances (305 m) above leks (Pers. Comm., Robert A. Montgomery, 10/20/15).

12-3. EXPLOSIVES – No explosives >1,225 kg were detonated in 2015 (Pers. Comm., Robert A. Montgomery, 10/26/15).

12-4. AVOID NON-EMERGENCY DISRUPTIVE ACTIVITIES:

- BEA National and Homeland Security is unaware of any activity in 2015 that did not comply with the disruptive activity avoidance clause (Pers. Comm., Robert A. Montgomery, 11/10/15).
- The INL Roads and Grounds organization is unaware of any activity in 2015 that did not comply with the disruptive activity avoidance clause (Pers. Comm., Norman [Kip] Winter, 11/18/15).

12-5. EXEMPTED ACTIVITY - GROUNDWATER WELL DRILLING AND MONITORING

- USGS field staff were instructed not to start any well drilling work before 9 a.m. when their well sites are near leks.
- Recently, USGS began monitoring wells once per year. Wells near leks were moved on the schedule so that they would be visited in October rather than April (Pers. Comm., Roy Bartholomay, USGS INL Project Chief, Idaho Falls; Nov. 9, 2015).
- At the request of USGS (Neil Maimer), DOE instructed ESER to begin sending the USGS an updated GIS layer each year that displays all active leks on

the INL Site. The USGS wants to ensure that it always takes appropriate precautions if wells are within 1 km of a lek.

Conservation Measure 13 – Accomplishments in 2015:

13-1. TOWERS – No meteorological, SODAR, or cellular (portable or permanent) towers were erected in the SGCA or within 1 km of leks during 2015 (Pers. Comm., Robert A. Montgomery, Program Environmental Lead for R&D; 10/19/2015).

13-2. AVOID NON-EMERGENCY DISRUPTIVE ACTIVITIES:

- BEA National and Homeland Security is unaware of any activity in 2015 that did not comply with the disruptive activity avoidance clause (Pers. Comm., Robert A. Montgomery, 11/10/15).
- The INL Roads and Grounds organization is unaware of any activity in 2015 that did not comply with the disruptive activity avoidance clause (Pers. Comm., Norman [Kip] Winter, 11/18/15).

5.2 Reports on Projects Associated with Conservation Measures

5.2.1 Conservation Measure #1 – Sagebrush Seedling Planting for Habitat Restoration on the INL Site

Goals and Objectives

In 2014, DOE funded a task to collect sagebrush seeds from the INL Site and grow seedlings for planting in fall 2015. Although there were no wildland fires >40 ha (99 acres) on the INL Site in 2014 or 2015, planting sagebrush seedlings will hasten the reestablishment of sage-grouse habitat lost during past fires, which is the intent of the objective associated with Conservation Measure 1.

The overarching goal of this conservation measure is to re-establish habitat for sage-grouse in areas where big sagebrush has been lost due to fire and are currently dominated by native perennial grasses and/or green rabbitbrush. These community types were chosen for restoration because they are in high ecological condition and require only the addition of sagebrush to the community to restore habitat suitable for sage-grouse.

Two approaches to the planting design were considered for this measure. Planting at full stocking rates (400 sagebrush plants per acre), assuming a survival rate of 50% percent, 800 seedlings would have to be planted per acre. Five thousand total seedlings would ultimately equal about 2.5 hectares (6.25 acres) each year at this planting rate verses a modified stocking rate of 80 plants per acre with coverage of 25 ha (62.5 acres). Our objective is to continue to plant 5,000 seedlings each year, up to five years. At the end of five years, based on this year's stocking rate, this should provide a start on habitat restoration of 157.8 hectares (390 acres).

Seed Collection

Sagebrush seed was collected in 2014 across a wide area of the INL site to ensure we captured a broad representation of big sagebrush genotypes. We collected enough seed to provide sufficient container stock for planting efforts over the next five years plus some extra that can be grown for other INL projects if needed. For details on seed collection, see Shurtliff et al. (2015).

Planting Site Selection – Although the CCA designates certain areas on the INL Site as Priority Restoration Areas (Figure 5-1) based on lack of sagebrush, proximity to sage grouse leks, low cultural resource impacts, and potential for success: we modified our final selection based on some additional criteria, such as ease of access and proximity to the seedling storage location at CFA.

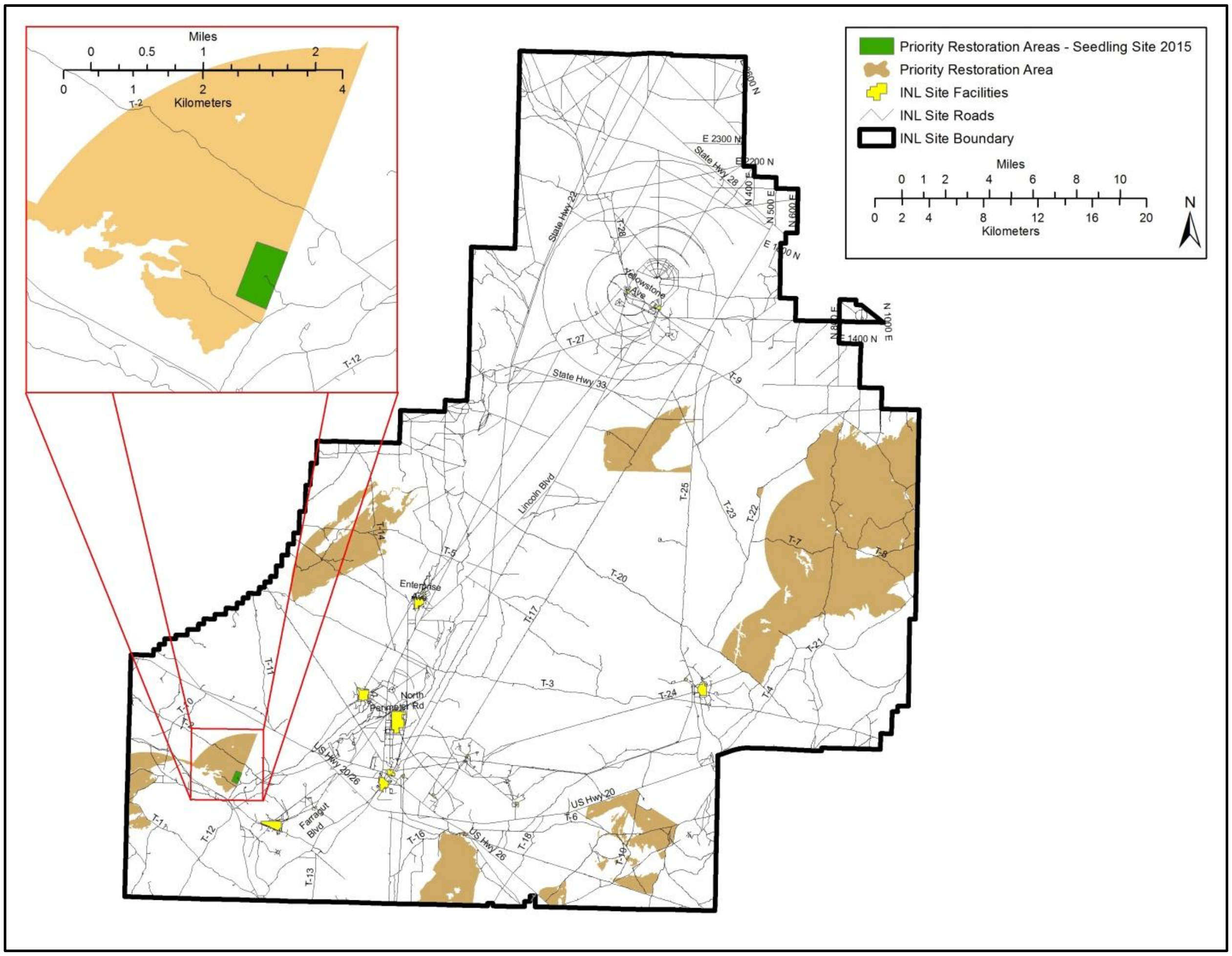


Figure 5-1. CCA Priority Restoration Area and the site that best met criteria for initial successful habitat restoration.

Of the three possible sites (Figure 5-2) identified in 2014 (Shurtliff et al. 2015), one near Tractor Flats and two in the Butte City Burn on the west side, Tractor Flats was selected as the best option. However, upon further investigation during the 2015 summer, the Tractor Flats location was found to be very weedy and not dominated by the desirable native grass species that would ultimately result in good sage-grouse habitat.

We began to ground truth all the areas selected as possible seedling planting locations as the original selection of Tractor Flats was not in the condition expected. Although we did locate other areas, many of them required over an hour on T- roads to access (i.e. Butte City Burn). We narrowed the options down and ultimately selected an area south of the rest stop on Hwy 26 (Figure 5-1). On the ground this area was one of the better places and boasted a range of native species, almost no invasive species, good soil, and ease of access. We had the area inspected by cultural resources and there would be no conflicts with cultural resources, which would make planting even easier.

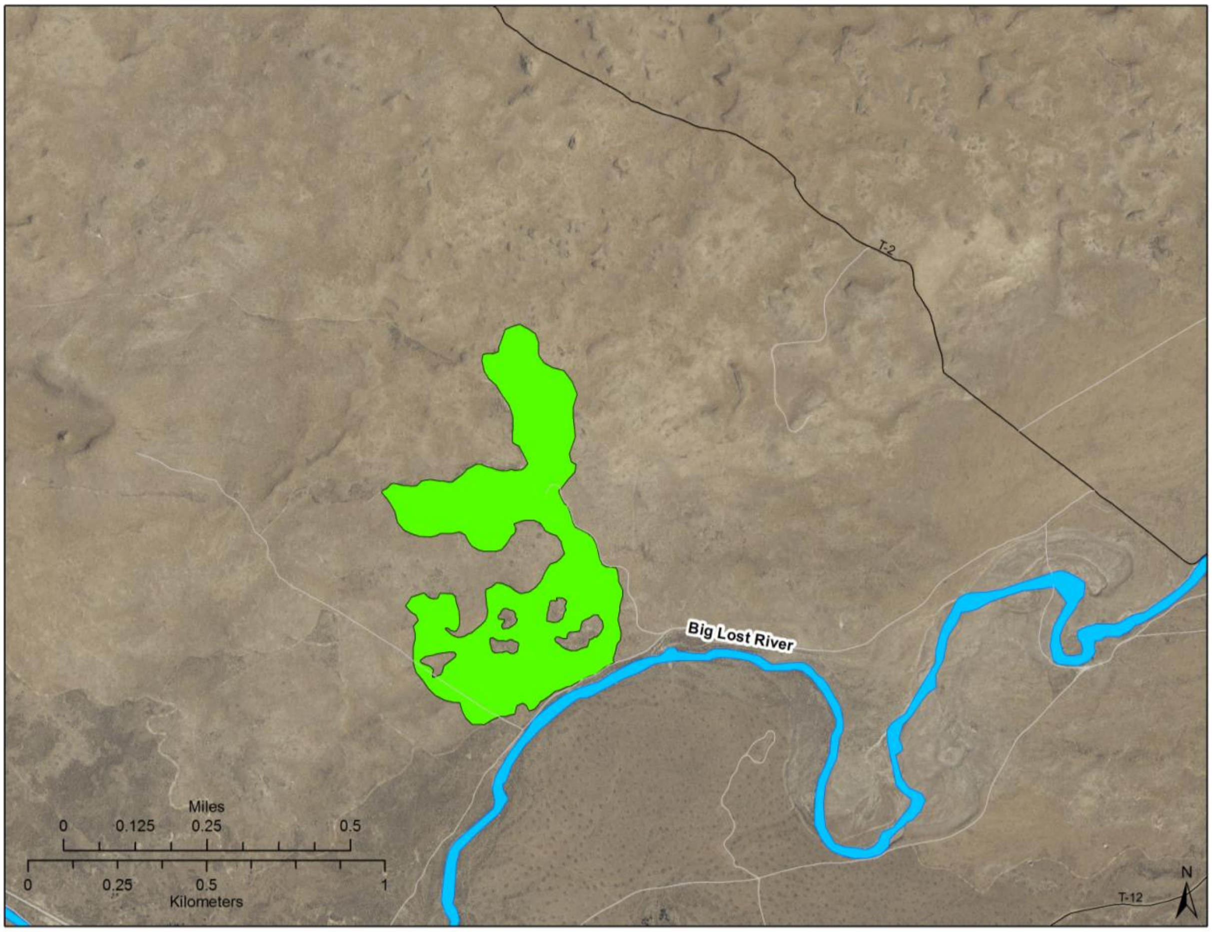


Figure 5-2. Actual area planted with big sagebrush seedlings in 2015.

Growing Containerized Stock –Foothills Botanical provided coordination for procurement of the plant materials and planting services. They also provided coordination between seed collector, seed cleaner, seedling grower, and planting crew. The plants were inspected for acceptance prior to shipping.

In January 2015, we formalized our Purchase Order with Tribal Forestry Department of the Confederated Salish and Kootenai Tribes in Ronan, Montana to produce containerized seedlings. We chose Ray Leach 10 cubic inch containers to improve the potential for successful establishment and purchased a total of 5,000 seedlings. The seedlings were delivered by Tribal Forestry on 21 October 21 and CFA maintenance provided a location for storage that was accessible to the planters throughout the weekend and had water available as needed for the seedlings.

Planting and Mapping

Planting began on 22 October and was completed on 26 October. FGR, Inc. of Plains, Montana was subcontracted to plant the seedlings on the INL site. Foothills Botanical, Inc. and a two man crew from FGR arrived the morning after the seedlings were delivered. Seedlings were loaded, 100 at a time, into saddlebags, and planting occurred with a hoedad, at random, about every 20 feet. The planters carried SPOT GPS trackers which allowed us to map their walking track to avoid overlapping planting from one day to the next and to make sure there were minimal gaps.

Five thousand seedlings were successfully planted over the course of four and one half days. Figure 5-2 shows the area actually planted. The weather was ideal for planting with rain previous to the planting and again during the week afterward. This should provide good conditions for seedling success.

Monitoring

Monitoring will be initiated by determining condition of individual seedlings at specific time intervals. At the time of planting, we collected sub-meter GPS locations on 767 seedlings. We will return to these seedlings in August of the following year and again at five years. We will record the condition of each seedling using the ranking system in Table 5-2. We will also record the height and whether or not the individual is producing seed.

Table 5-2. Condition rating for determining success of sagebrush seedling planting.

Rating	Condition Description
1	Shrub is completely dead or is absent
2	Approximately ¼ of the shrub's biomass is alive
3	Approximately ½ of the shrub's biomass is alive
4	Approximately ¾ of the shrub's biomass is alive
5	Shrub is completely alive

5.3 Literature Cited

Shurtliff, Q.R., A.D. Forman, J.C. Whiting, J.P. Shive, J.R. Hafla, K.T. Edwards, R.D. Blew. 2015. 2014 monitoring report in support of the candidate conservation agreement for greater sage-grouse on the Idaho National Laboratory Site. DOE/ID-11527. Gonzales-Stoller Surveillance, LLC, Idaho Falls, ID. January 2015.

6. CONCLUSIONS AND ADAPTIVE MANAGEMENT RECOMMENDATIONS

6.1 Status of Population and Habitat Triggers

The population trigger for sage-grouse would trip if the three-year average of peak male attendance falls below 253 males across the 27 baseline leks within the SGCA. This would represent a decrease of over 20% of the 316 males counted in 2011. The 3-year average peak male attendance (2013-2015) on the 27 baseline leks remains at 340 individuals, the same as last year's 3-year average. Thus, this index shows no evidence that sage-grouse abundance is declining on the INL Site.

Following the 2016 lek season, we should have sufficient lek data to create new, permanent lek routes that will be monitored annually in addition to the three existing IDFG routes. The routes will be surveyed in 2017, after which DOE and USFWS will meet and discuss whether the peak male attendance values represent a reasonable new baseline for the population trigger. Ultimately, the new routes will replace the interim population trigger that is based on 27 leks in the SGCA (Section 9.4.1, Shurtliff et al. 2015).

In 2015, we refined the Jefferson fire boundary and updated the INL Site infrastructure footprint to more precisely estimate the 2013 SGCA sagebrush habitat baseline value. The current estimate of sagebrush habitat in the SGCA is 78,504 ha (193,988 acres). Therefore, the habitat trigger would trip if a net of 15,701 ha (38,798 acres), representing 20% of the sagebrush habitat baseline within the SGCA, is lost or converted to a non-sagebrush-dominated vegetation class. In 2015, no wildland fires or other activities reduced the area of sagebrush habitat within the SGCA. If fact, less than two hectares (five acres) have burned on the INL Site in the past three years, so there is no need for DOE to compensate for habitat loss as outlined in section 9.4.3 of the CCA.

6.2 Threats Assessment

Monitoring and inventory tasks supporting threat assessment and reduction (i.e., Task 4: raven nest surveys; Task 7: non-native annual grass inventories; Task 8: delineation of infrastructure footprint) successfully established baseline values to which future results may be compared. The only management recommendation ESER proposes for 2016 is that DOE encourage responsible parties to take advantage of low-cost opportunities to deter raven nesting at perennial nest sites on towers and within facilities that are in or near the SGCA. Highest priority are two NOAA towers and specific structures within AMWTP, Test Area North, Advanced Test Reactor Complex, and NRF. In fall, 2015, ESER initiated a conversation with local NOAA staff and presented a plan for installing devises that would discourage raven nesting on NOAA towers. Staff from NOAA agreed to install these devises prior to the nesting season. Task 4 will verify if those devises are effective.

6.3 Conservation Measures

DOE and INL Site contractors began to implement all 13 conservation measures in 2015. They fully completed conservation measure 11, which included aims to produce training modules and teach employees to eliminate food subsidies for ravens and other wildlife. In support of conservation measure 1, employees with the ESER program coordinated the planting of 5,000 sagebrush seedlings during fall 2015 and mapped the locations of about 15% of them to facilitate survivorship monitoring in the future.

6.4 Literature Cited

Shurtliff, Q.R., A.D. Forman, J.C. Whiting, J.P. Shive, J.R. Hafla, K.T. Edwards, R.D. Blew. 2015. 2014 monitoring report in support of the candidate conservation agreement for greater sage-grouse on the Idaho National Laboratory Site. DOE/ID-11527. Gonzales-Stoller Surveillance, LLC, Idaho Falls, ID. January 2015.

7. WORK PLAN FOR 2015

The following table describes activities or changes that are planned for the upcoming year. The purpose of this table is to highlight upcoming activities and analyses that will be different than the regular annual activities associated with each task.

Task	Schedule and Changes in 2016
1. Lek Surveys	• All active leks on the INL Site and inactive leks that are part of the baseline suite will be monitored as in the past. • Following the 2016 field season, DOE will establish (in consultation with the Idaho Department of Fish and Game) two or more additional lek routes in the SGCA (see section 9.4.1 of the CCA).
2. Historical Lek Surveys	• 14 historical leks remain unclassified as active or inactive. These will be monitored again in 2016.
3. Systematic Lek Discovery Surveys	• Surveys will be performed on the north-east portion of the INL Site, south of Highway 33.
4. Raven Nest Surveys	• Identify high-use raven nesting areas on power lines to better understand the effort required to deter nesting along a stretch of power lines. • Determine whether efforts to deter raven nesting on two NOAA towers occupied in 2015 were successful. If not, adjust methods. • Explore the feasibility of deterring raven nesting at priority locations identified in Section 4.1.4.
5. Sagebrush Habitat Condition Trends	• Sample all annual monitoring plots (n=75). • Conduct preliminary analyses for rotational plots focusing on potential impacts on allotments and in burn scars.
6. Monitoring to Determine Changes in Sagebrush Habitat Amount and Distribution	• Begin mapping and updating the vegetation class boundary delineations within the entire Jefferson Fire. • Collect field data within the 2010 Midway Fire boundary, and begin mapping and updating the vegetation class boundary delineations.
7. Inventory and Monitoring of Sage-grouse Habitat for Areas Dominated by Non-native Annual Grasses.	• Continue surveys.
8. Monitoring Unauthorized Expansion of the Infrastructure Footprint within the SGCA and Other Areas Dominated by Big Sagebrush	• Update after imagery becomes available.

Appendix A - INL Site Vegetation Class Dichotomous Key

This key was designed for use in collecting accuracy assessment data to support the final vegetation map. Because specific ranges of cover values are difficult to estimate rapidly in the field, dichotomies in the key are driven by relative abundance concepts like; “dominant,” “co-dominant,” “abundant,” “common,” and “rare.” Whereas these concepts facilitate efficient data collection, they necessarily oversimplify the range of variability present in most plant communities. In some cases, neither choice in a dichotomy describes a specific assemblage encountered in the field very well. Under those circumstances, the user was encouraged to choose the better of the two options. On rare occasions, plant communities were dominated by species not represented in the key. This occurred most often in assemblages dominated by non-native species which are not characteristic of a semi-natural vegetation class. When this situation occurred, the user was directed to make choices based on the most abundant species which are represented in the key. Classes 1 and 9 were combined subsequent to the development of the key, therefore any community that keys to either 1 or 9 may be considered as keying to 1/9.

INL Site Plant Community Key

1a Trees are common to abundant, providing at least 10% absolute canopy cover
Wooded or Woodland Vegetation Classes pg 1

1b Trees are absent to sparse; when present, individuals are scattered with less than 10% absolute canopy cover

- **2a** Shrubs clearly dominate the plant community; herbaceous species may be common, but don't contribute substantial relative vegetation cover
  - **3a** Dominant shrub species generally exceed 50 cm in height at maturity
    Shrubland Vegetation Classes pg 1
  - **3b** Dominant shrub species are generally less than 50 cm in height at maturity*
    Dwarf Shrubland Vegetation Classes pg 3
- **2b** Herbaceous species are abundant, providing substantial relative vegetative cover
  - **4a** Shrub species are abundant to co-dominant and contribute substantial cover
    - **5a** Dominant shrub species generally exceed 50 cm in height at maturity
      Shrub Herbaceous Vegetation Classes pg 4
    - **5b** Dominant shrub species are generally less than 50 cm in height at maturity*
      Dwarf Shrubland Vegetation Classes pg 3
  - **4b** Herbaceous species clearly dominate the plant community; shrubs may be common, but don't contribute substantial cover
    - **6a** Dominant herbaceous species are native
      Herbaceous Vegetation Classes pg 6
    - **6b** Dominant herbaceous species are introduced
      Semi-natural Vegetation Classes pg 7

Wooded or Woodland Vegetation Classes

1a *Juniperus osteosperma* clearly dominates the plant community; absolute canopy cover is greater than 25% with individual crowns closely spaced to nearly touching
Class 11d – Utah Juniper Woodland

1b *Juniperus osteosperma* forms an open canopy with crowns widely spaced and absolute canopy cover of less than 25%; shrubs and/or grasses generally co-dominate the plant community
Class 11c – Utah Juniper Wooded Shrub and Herbaceous Vegetation

Shrubland Vegetation Classes

1a The shrub stratum of the plant community is dominated or co-dominated by an *Artemisia species*

- **2a** *Artemisia tripartita* is the dominant sagebrush species, or *Artemisia tripartita* and *Artemisia tridentata* ssp. *wyomingensis* co-dominate the shrub stratum
  - **3a** *Chrysothamnus viscidiflorus* is absent to sparse; when present, individuals occur only sporadically and don't contribute significant cover
    Class 18 – Three-tip Sagebrush Shrubland
  - **3b** *Chrysothamnus viscidiflorus* is abundant
    - **4a** *Artemisia tridentata* ssp. *wyomingensis* is abundant to co-dominant
      Class 7 – Wyoming Big Sagebrush Shrubland
    - **4b** *Artemisia tridentata* ssp. *wyomingensis* is absent to sparse
      Class 4b – Green Rabbitbrush/Bluebunch Wheatgrass Shrub Herbaceous Vegetation

2b *Artemisia tridentata* is the dominant sagebrush species

5a *Artemisia tridentata* subspecies are mixed and/or hybridized

Class 2 – Big Sagebrush Shrubland

5b *Artemisia tridentata* subspecies are uniform and easily identified

6a *Artemisia tridentata* ssp. *tridentata* is the dominant big sagebrush subspecies

7a Shrub species associated with remnant riparian areas, including *Salix exigua*, *Populus angustifolia*, *Rosa woodsii*, *Ribes aureum*, etc. are also abundant in the plant community

Class 17b – Remnant Riparian Shrub Herbaceous Vegetation

7b Shrub species associated with remnant riparian areas are absent to sparse in the plant community

Class 6 – Basin Big Sagebrush Shrubland

6b *Artemisia tridentata* ssp. *wyomingensis* is the dominant big sagebrush species

Class 7 – Wyoming Big Sagebrush Shrubland

1b The shrub stratum of the plant community is dominated by non-*Artemisia* species

8a Shrub species associated with remnant riparian areas, including *Salix exigua*, *Populus angustifolia*, *Rosa woodsii*, *Ribes aureum*, etc. are the dominant shrubs in the plant community

Class 17b – Remnant Riparian Shrub Herbaceous Vegetation

8b Upland shrub species dominate the plant community

9a *Chrysothamnus viscidiflorus* is the dominant shrub species

10a *Chrysothamnus viscidiflorus* is clearly the dominant species in the shrub stratum, other shrub species are not abundant

Class 4a – Green Rabbitbrush Shrubland

10b *Chrysothamnus viscidiflorus* dominates or co-dominates the shrub stratum, but additional shrub species are also abundant and contribute significant cover

11a *Artemisia tridentata* subspecies are abundant in the shrub stratum

12a *Artemisia tridentata* subspecies are mixed and/or hybridized

Class 2 – Big Sagebrush Shrubland

12b *Artemisia tridentata* subspecies are uniform and easily identified

13a *Artemisia tridentata* ssp. *tridentata* is the most abundant big sagebrush species in the shrub stratum

Class 6 – Basin Big Sagebrush Shrubland

13b *Artemisia tridentata* ssp. *wyomingensis* is the most abundant big sagebrush species in the shrub stratum

Class 7 – Wyoming Big Sagebrush Shrubland

11b *Krascheninnikovia lanata* is abundant in the shrub stratum

Class 5 – Green Rabbitbrush – Winterfat Shrubland

9b Other shrub species dominate the community

14a *Grayia spinosa* is the dominant shrub species

Class 20 – Spiny Hopsage Shrubland

14b *Tetradymia canescens* is the dominant shrub species

15a Herbaceous species are predominantly introduced

Class 8 – Green Rabbitbrush/Desert Alyssum Shrub Herbaceous Vegetation

15b Herbaceous species are predominantly native

16a *Pseudoroegneria spicata* is common

Class 4b – Green Rabbitbrush/Bluebunch Wheatgrass Shrub Herbaceous Vegetation

16b *Pseudoroegneria spicata* is absent to sparse

Class 5 – Green Rabbitbrush – Winterfat Shrubland

Dwarf Shrubland Vegetation Classes

1a The shrub stratum of the plant community is dominated or co-dominated by an *Artemisia* species
  2a *Artemisia arbuscula* is the dominant shrub species
    3a *Artemisia arbuscula* is clearly the dominant species in the shrub stratum, other shrub species are not abundant
Class 19 – Low Sagebrush Dwarf Shrubland
    3b *Artemisia arbuscula* dominates the shrub stratum, but *Chrysothamnus viscidiflorus* and/or *Krascheninnikovia lanata* are also abundant and contribute significant cover
Class 5 – Green Rabbitbrush – Winterfat Shrubland
  2b *Artemisia nova* is the dominant shrub species
Class 16b – Black Sagebrush / Sandberg Bluegrass Dwarf-shrub Herbaceous Vegetation
1b The shrub stratum of the plant community is dominated by non-*Artemisia* species
  4a The shrub stratum of the plant community is dominated by an *Atriplex* species
    5a *Atriplex falcata* is the dominant shrub species
Class 15 – Sickle Saltbush Dwarf Shrubland
    5b *Atriplex confertifolia* is the dominant shrub species
      6a *Atriplex confertifolia* is clearly the dominant species in the shrub stratum, other shrub species are not abundant
Class 22 – Shadscale Dwarf Shrubland
      6b *Atriplex confertifolia* dominates the shrub stratum, but additional shrub species are also abundant to and contribute significant cover
        7a *Artemisia tridentata* ssp. *wyomingensis* is abundant
Class 7 – Wyoming Big Sagebrush Shrubland
        7b *Artemisia tridentata* ssp. *wyomingensis* is absent to sparse
          8a *Chrysothamnus viscidiflorus* is abundant
Class 5 – Green Rabbitbrush – Winterfat Shrubland
          8b *Chrysothamnus viscidiflorus* is absent to sparse
            9a *Artemisia arbuscula* is abundant in the shrub stratum
Class 19 – Low Sagebrush Dwarf Shrubland
            9b *Artemisia nova* is abundant in the shrub stratum
Class 16b – Black Sagebrush / Sandberg Bluegrass Dwarf-shrub Herbaceous Vegetation
  4b The shrub stratum of the plant community is dominated by other shrub species
    10a The shrub stratum is dominated by *Ericameria nana* and/or *Gutierrezia sarothrae*
Class 21 – Dwarf Goldenbush Dwarf Shrubland
    10b The shrub stratum is dominated by *Krascheninnikovia lanata*
Class 5 – Green Rabbitbrush – Winterfat Shrubland

Shrub Herbaceous Vegetation Classes

1a *Agropyron cristatum* or *Agropyron desertorum* clearly dominate the herbaceous stratum, other herbaceous species are not abundant
Class 10 – Crested Wheatgrass Semi-natural Herbaceous Vegetation
1b *Agropyron cristatum* or *Agropyron desertorum* ranges from absent to common and native herbaceous species provide significant cover in the herbaceous stratum

2a *Chrysothamnus viscidiflorus* is the most abundant shrub species in the plant community

3a Native perennial grasses are the most abundant herbaceous species in the plant community

4a Bunchgrasses are the most abundant grass species

5a *Pseudoroegneria spicata* dominates the herbaceous stratum

Class 4b – Green Rabbitbrush/ Bluebunch Wheatgrass Shrub Herbaceous Vegetation

5b Other species of native perennial bunchgrasses dominate the herbaceous stratum

6a *Elymus elymoides* and/or *Poa secunda* are the dominant species in the herbaceous stratum

Class 4a – Green Rabbitbrush Shrubland

6b *Achnatherum hymenoides* and/or *Hesperostipa comata* are the dominant species in the herbaceous stratum

7a Relative cover of *Achnatherum hymenoides* and *Hesperostipa comata* is roughly equal

Class 12 – Indian Ricegrass Herbaceous Vegetation

7b Either *Achnatherum hymenoides* or *Hesperostipa comata* clearly dominates the herbaceous layer, both species are not abundant

8a *Achnatherum hymenoides* is the most abundant species in the herbaceous stratum

Class 12 – Indian Ricegrass Herbaceous Vegetation

8b *Hesperostipa comata* is the most abundant species in the herbaceous stratum

Class 3 – Needle and Thread Herbaceous Vegetation

4b Rhizomatous grasses are the most abundant grass species

Class 1 – Streambank Wheatgrass Herbaceous Vegetation

3b Introduced annuals are the most abundant herbaceous species in the plant community

Class 8 – Green Rabbitbrush/Desert Alyssum Shrub Herbaceous Vegetation

2b Species other than *Chrysothamnus viscidiflorus* are the most abundant shrubs in the plant community

9a *Artemisia* species are the most abundant shrubs in the plant community

10a *Artemisia tridentata* is the most abundant sagebrush species in the plant community

11a *Artemisia tridentata* subspecies are mixed and/or hybridized

Class 2 – Big Sagebrush Shrubland

11b *Artemisia tridentata* subspecies are uniform and easily identified

12a *Artemisia tridentata* ssp*. tridentata* is the most abundant big sagebrush subspecies in the plant community

Class 6 – Basin Big Sagebrush Shrubland

12b *Artemisia tridentata* ssp. *wyomingensis* is the most abundant big sagebrush subspecies in the plant community

Class 7 – Wyoming Big Sagebrush Shrubland

10b Other *Artemisia* species are the most abundant shrubs in the plant community

13a *Artemisia tripartita* is the most abundant shrub in the plant community

Class 18 – Three-tip Sagebrush Shrubland

13b Dwarf sagebrush species are the most abundant shrubs in the plant community

14a *Artemisia arbuscula* is the most abundant shrub species in the plant community

Class 19 – Low Sagebrush Dwarf Shrubland

14b *Artemisia nova* is the most abundant shrub species in the plant community

Class 16b – Black Sagebrush/Sandberg Bluegrass Dwarf-shrub Herbaceous Vegetation

9b Non-*Artemisia* species are the most abundant shrubs in the plant community

15a Dwarf shrubs species are the most abundant shrubs in the plant community
16a The plant community occurs on a basalt outcropping
Class 21 – Dwarf Goldenbush Dwarf Shrubland
16b The plant community occurs on soil, generally fine in texture
17a *Atriplex falcata* is the most abundant shrub species in the plant community
18a *Poa secunda* is abundant to co-dominant, providing substantial cover
Class 16a – Sandberg Bluegrass Herbaceous Vegetation
18b *Poa secunda* is absent to sparse
Class 15 – Sickle Saltbush Dwarf Shrubland
17b *Krascheninnikovia lanata* is the most abundant shrub species in the plant community
19a *Artemisia tridentata* ssp. *wyomingensis* is also common in the plant community
Class 7 – Wyoming Big Sagebrush Shrubland
19b *Artemisia tridentata* ssp. *wyomingensis* is sparse to non-existent in the plant community
20a *Poa secunda* is abundant to co-dominant, providing substantial cover
Class 16a – Sandberg Bluegrass Herbaceous Vegetation
20b *Poa secunda* is absent to sparse
Class 5 – Green Rabbitbrush – Winterfat Shrubland
15b Taller stature shrub species are the most abundant shrubs in the plant community
21a Shrub species associated with remnant riparian areas, including *Salix exigua*, *Populus angustifolia*, *Rosa woodsii*, *Ribes aureum*, etc. are the most abundant shrubs in the plant community
Class 17b – Remnant Riparian Shrub Herbaceous Vegetation
21b Upland shrub species are the most abundant shrubs in the plant community
22a *Grayia spinosa* is the most abundant shrub species in the plant community
Class 20 – Spiny Hopsage Shrubland
22b *Tetradymia canescens* is the most abundant shrub species in the plant community
23a Herbaceous species are predominantly introduced
Class 8 – Green Rabbitbrush/Desert Alyssum Shrub Herbaceous Vegetation
23b Herbaceous species are predominantly native
24a *Pseudoroegneria spicata* is abundant
Class 4b – Green Rabbitbrush/Bluebunch Wheatgrass Shrub Herbaceous Vegetation
24b *Pseudoroegneria spicata* is absent to sparse
Class 5 – Green Rabbitbrush – Winterfat Shrubland

Herbaceous Vegetation Classes

1a The herbaceous stratum is dominated by native perennial bunchgrasses
2a *Poa secunda* is abundant to dominant in the herbaceous stratum
3a *Poa secunda* clearly dominates the plant community, other species are not abundant
Class 16a – Sandberg Bluegrass Herbaceous Vegetation
3b Other species are abundant to dominant in the plant community
4a *Pseudoroegneria spicata* is abundant to dominant in the plant community
Class 11ab – Bluebunch Wheatgrass – Sandberg Bluegrass Herbaceous Vegetation
4b *Artemisia nova* is abundant in the plant community
Class 16b – Black Sagebrush/Sandberg Bluegrass Dwarf-shrub Herbaceous Vegetation
2b *Poa secunda* is absent from the herbaceous stratum or occurs with low relative cover

5a *Achnatherum hymenoides* and/or *Hesperostipa comata* are the dominant species in the herbaceous stratum

6a Relative cover of *Achnatherum hymenoides* and *Hesperostipa comata* is roughly equal
Class 12 – Indian Ricegrass Herbaceous Vegetation

6b Either *Achnatherum hymenoides* or *Hesperostipa comata* clearly dominates the herbaceous layer, both species are not abundant

7a *Achnatherum hymenoides* is the most abundant species in the herbaceous stratum

8a Dwarf shrubs are abundant, contributing substantial cover

9a *Atriplex falcata* is the most abundant dwarf shrub species
Class 15 – Sickle Saltbush Dwarf Shrubland

9b *Krascheninnikovia lanata* is the most abundant dwarf shrub species
Class 5 – Green Rabbitbrush – Winterfat Shrubland

8b Dwarf shrubs are absent to sparse
Class 12 – Indian Ricegrass Herbaceous Vegetation

7b *Hesperostipa comata* is the most abundant species in the herbaceous stratum
Class 3 – Needle and Thread Herbaceous Vegetation

5b *Leymus cinereus* is the dominant species in the herbaceous stratum
Class 14 – Basin Wildrye Herbaceous Vegetation

1b The herbaceous stratum is dominated by native perennial rhizomatous grasses

10a Relative cover of *Elymus lanceolatus* and *Pascopyrum smithii* is roughly equal
Class 1 – Streambank Wheatgrass Herbaceous Vegetation

10b Either *Elymus lanceolatus* or *Pascopyrum smithii* clearly dominates the herbaceous layer, both species are not abundant

11a *Elymus lanceolatus* is the most abundant species in the herbaceous stratum
Class 1 – Streambank Wheatgrass Herbaceous Vegetation

11b *Pascopyrum smithii* is the most abundant species in the herbaceous stratum
Class 9 – Western Wheatgrass Herbaceous Vegetation

Semi-natural Vegetation Classes

1a Introduced perennial species dominate or co-dominate the plant community

2a *Agropyron cristatum* or *Agropyron desertorum* clearly dominate the plant community, other species are not abundant
Class 10 – Crested Wheatgrass Semi-natural Herbaceous Vegetation

2b *Agropyron cristatum* or *Agropyron desertorum* dominate or co-dominate the plant community, but *Alyssum desertorum* and/or *Chrysothamnus viscidiflorus* are abundant
Class 8 – Green Rabbitbrush/Desert Alyssum Shrub Herbaceous Vegetation

1b Introduced annual and/or biennial species dominate the plant community

2a *Bromus tectorum* clearly dominates the plant community, other species are not abundant
Class 13 – Cheatgrass Semi-natural Herbaceous Vegetation

2b Introduced annual forbs are abundant and *Bromus tectorum* ranges from sparse to co-dominant

3a *Ericameria nana* and/or *Gutierrezia sarothrae* are present
Class 21 – Dwarf Goldenbush Dwarf Shrubland

3b *Ericameria nana* and *Gutierrezia sarothrae* are absent

4a *Sisymbrium altissimum* is the most abundant introduced annual species or *Sisymbrium altissimum* and *Bromus tectorum* co-dominate the plant community

5a Riparian shrub species including *Salix exigua*, *Populus angustifolia*, *Rosa woodsii*, *Ribes aureum*, etc. are present
Class 17b – Remnant Riparian Shrub Herbaceous Vegetation

5b Riparian shrub species are absent
Class 17a – Tall Tumble Mustard – Cheatgrass Semi-natural Herbaceous Vegetation

4b *Sisymbrium altissimum* is absent or sparse

6a *Alyssum desertorum* is the most abundant introduced annual species

7a *Chrysothamnus viscidiflorus* is abundant in the plant community
Class 8 – Green Rabbitbrush/Desert Alyssum Shrub Herbaceous Vegetation

7b *Hesperostipa comata* is abundant in the plant community
Class 3 – Needle and Thread Herbaceous Vegetation

6b *Halogeton glomeratus* or *Salsola kali* is the most abundant introduced annual species

8a *Halogeton glomeratus* is the most abundant introduced annual species

9a Shrubs are abundant in the plant community

10a *Artemisia tridentata* ssp. *wyomingensis* is the most abundant shrub species
Class 7 – Wyoming Big Sagebrush Shrubland

10b *Artemisia tridentata* is sparse to absent

11a *Chrysothamnus viscidiflorus* and/or *Krascheninnikovia lanata* are the most abundant shrub species

12a *Krascheninnikovia lanata* is present
Class 5 – Green Rabbitbrush – Winterfat Shrubland

12b *Krascheninnikovia lanata* is absent
Class 4a – Green Rabbitbrush Shrubland

11b *Atriplex falcata* is the most abundant shrub species
Class 15 – Sickle Saltbush Dwarf Shrubland

9b Shrubs are sparse to absent in the plant community

13a *Agropyron cristatum* or *Agropyron desertorum* are abundant in the plant community
Class 10 – Crested Wheatgrass Semi-natural herbaceous Vegetation

13b *Elymus lanceolatus* is abundant in the plant community
Class 1 – Streambank Wheatgrass Herbaceous Vegetation

8b *Salsola kali* is the most abundant introduced annual species

14a *Bromus tectorum* is abundant to co-dominant

15a *Sisymbrium altissimum* is abundant
Class 17a – Tall Tumblemustard – Cheatgrass Semi-natural Herbaceous Vegetation

15b *Sisymbrium altissimum* is sparse to absent
Class 13 – Cheatgrass Semi-natural Herbaceous Vegetation

14b *Bromus tectorum* is sparse

16a *Pascopyrum smithii* is the most abundant native graminoid
Class 9 – Western Wheatgrass Herbaceous Vegetation

16b *Achnatherum hymenoides* is the most abundant native graminoid
Class 12 – Indian Ricegrass Herbaceous Vegetation

* Dwarf shrub species include; *Artemisia arbuscula*, *Artemisia nova*, *Krascheninnikovia lanata, Atriplex falcata*, *Atriplex confertifolia*, *Ericameria nana*, and *Gutierrezia sarothrae*.

Appendix B - Study Design, Sample Protocol, and Data Transfer Protocol for Task 5: Habitat Condition Monitoring

B-1. Study Plan for Task 5: Habitat Condition Monitoring

Background

Characterization and monitoring of sagebrush habitat quality, or condition, was identified as an integrated component of the CCA monitoring plan to address conservation efforts for sage-grouse on the INL Site. Annual monitoring of sagebrush habitat is necessary to track trends in the condition of habitat available for sage-grouse and to understand the potential for declines in habitat quality associated with threats. Two threats, wildland fire and infrastructure development, were ranked as “high “in the CCA threats assessment. The potential threat from annual grasses and other weeds, livestock, and seeded perennial grasses were also important, with each receiving a “medium” ranking. These five threats are thought to affect sage-grouse populations partially or wholly through their effects on habitat. Therefore, the habitat condition monitoring task was developed to allow biologists to characterize broad-scale trends in habitat condition over time as well as to identify annual changes in condition associated with post-fire recovery, surface disturbance, livestock operations, and spread of introduced herbaceous species.

Objectives

The overarching objective of this monitoring task is to characterize sage-grouse habitat quality and understand the effects of potential threats on habitat quality, or condition. This monitoring effort is intended to track general trends across the INL Site. It has been designed to allow biologists to characterize habitat quality in any given year, and allow them to track trends in habitat decline and/or recovery. If habitat condition becomes a concern at a specific location or in relation to a specific lek, additional sampling will be necessary. To characterize Site-wide condition and trend for sage-grouse habitat, sample locations are representative of current sagebrush habitat and of habitat which has been impacted by threats. Several aspects of plant community will be sampled at each location to adequately characterize habitat quality according to current guidelines (Connelly et al. 2000) and to understand trends in habitat condition which have the potential to affect sage-grouse populations.

Study Design

Plot Selection and Sample Frequency

To the extent possible, we plan to utilize plots established to support the plant community classification for the vegetation community map. Use of pre-existing plots for sage-grouse habitat monitoring will be important because we already have data spanning back five years and statistical classifications which characterize the plant communities at each plot. We will select a subset of the vegetation community plots to be surveyed annually, with an additional, larger subset surveyed on a rotating basis over a five-year period. We will visit 225 plots, most of which are associated with the vegetation community map over the next three years (2013 through 2015), followed by the LTV plots in 2016. The plots associated with the vegetation community map will be used to address specific issues associated with habitat quality and the effects of potential threats. The LTV data can be used to address several habitat quality issues as well; but more importantly, they will be used to provide a historical context within which to interpret the speed and magnitude of vegetation change.

Of the 225 plots which will be used for habitat monitoring, a total of 75 have been selected for annual sampling and the remaining 150 will be sampled on a rotational basis. The plots which will be sampled on an annual basis are divided into plots which represent current big sagebrush habitat and plots which are located in areas where sagebrush has been lost due to impacts from threats, primarily wildland fire. About 62% of the INL Site remained unburned through 2012. Accordingly, about 62%, or 48 annual habitat monitoring plots will be located in sagebrush habitat and the remaining 27 plots will be located in areas which were known or thought to have been dominated by sagebrush prior to burning. Because most of the sagebrush habitat on the INL Site is dominated by big sagebrush, all but 10 of the annual plots located in sagebrush habitats will be in big sagebrush vegetation types. The remaining 10 sagebrush plots to be sampled on an annual basis will be distributed among black sagebrush, little sagebrush, and three-tip sagebrush dominated vegetation types. The 27 plots located in burn scars will be distributed to best capture the range of fire scar ages and the most frequently occurring vegetation types within each fire scar.

The 150 plots which will be sampled on a rotational basis are also divided into those which represent current sagebrush habitat and those which have the potential to have been impacted by threats. However, the rotational plots will be located with an emphasis on better characterizing the potential effects of threats such as wildland fire, livestock grazing, and invasive species. Among the 150 rotational plots, 103 will be selected in areas which have burned and the remaining 47 will be selected in sagebrush habitat. As with the annual plots, we will select plots in burn scars to reflect the range of scar ages and the plant communities currently occurring within those scars. Rotational plots within sagebrush habitat are representative of the spatial abundance of sagebrush vegetation types as they occur across the INL Site. Several burned and non-burned plots are located within grazing allotments and in areas with substantial cover from weedy species.

We will be able to utilize plots sampled in 2008 to support the vegetation community map for 162 of the 225 habitat monitoring plots. See Shive et al. (2011) for a thorough description of the initial plot selection process for these plots. For the 75 annual monitoring plots, we will be able to utilize 68 vegetation community map plots, and the remaining 7 plots will be selected to fill in large spatial gaps in sagebrush habitat where no vegetation map plots occurred. Most of the new plots will be established as rotational plots to characterize current sagebrush habitat. Because the objectives of the plant community classification effort differed from the objectives of this monitoring project, we did not sample enough sagebrush communities in 2008 to support accurate habitat assessment. Furthermore, several of the sagebrush-dominated plots sampled in 2008 have since burned. All of the new plots will be selected according to the constrained random process described for plant community classification in Shive et al. (2011).

The 150 plots which will be sampled on a rotational basis will be divided into three groups of 50 and will be sampled over three consecutive years. The three consecutive sample years for rotational plots will occur once every five years. Over a period of five years habitat quality plot sampling will occur as follows:

- Year 1: 75 annual plots, 50 rotational plots (set 1)
- Year 2: 75 annual plots, 50 rotational plots (set 2)
- Year 3: 75 annual plots, 50 rotational plots (set 3)
- Year 4: 75 annual plots, LTV plots
- Year 5: 75 annual plots

Data Metrics

The data metrics collected at each of the 225 habitat monitoring plots were selected for two purposes. The first is to support basic description and assessment of sage-grouse habitat quality (e.g. Connelly 2000, Table 3). The second is to track trends which allow biologists to characterize compositional change in vegetation through time and with respect to potential threats. The original sample design of the plant community classification will be revised and augmented to ensure all important data metrics are addressed. The habitat data which will be sampled at each plot include:

- Plot Photos – Photo Frames and landscape photos will provide a visual summary of general plot condition.
- Cover by Species – Will be used to estimate relative species composition of important habitat types and to track trends for pertinent plant species and functional groups. For example, increases or decreases in sagebrush cover and shifts from perennial herbaceous species to annual herbaceous species can be detected in cover data. Point interception techniques are described by Floyd and Anderson (1982).
- Vegetation Height – This metric is commonly used to infer the amount of vertical structure and visual cover available for sage-grouse.
- Sagebrush Density/Juvenile Frequency – These metrics will be used to assess the condition and probability of change in condition of sagebrush populations across the INL Site.
- Species List – Will be used to document species that are typically underrepresented by traditional quantitative sampling techniques, but which may have disproportionally greater importance on habitat quality than is suggested by their proportional abundance in the plant community. For example species list can be used to detect important forage forbs or for early detection of noxious weeds or other non-native species which could impact habitat quality.
- Qualitative Plot Context, Use, and Condition Metrics – These categorical data types will be collected to help characterize the biological context and potential sage-grouse use of each plot. They will include notes about disturbance, sage-grouse sign, and which plant community currently occupies the plot, as identified by a plant community key.

Details about the about the quantitative and categorical data fields are included in the study protocol. These include a plot sampling schematic, descriptions and references for methodologies used for quantitative metrics, and potential values for each qualitative data field.

Data Management and QA/QC Procedures

Data will be collected using electronic spreadsheets for quantitative data metrics and a GPS data dictionary for qualitative data metrics. A digital camera will be used for plot photographs. Field data will generally be downloaded on a daily basis, but if logistics prevent daily downloads, data must be downloaded no more than two working days after they were collected. A hardcopy plot checklist (Figure B-2) will be completed as each plot is sampled and the initial data download is completed. This checklist is used to ensure that all data types are collected at every plot and that all raw data files are downloaded from each plot. The checklist can be found attached to the study protocol. A template of the electronic datasheets used for collecting quantitative data can be found in the ESER directory for this project.

A data transfer protocol has been developed to guide the download of all electronic data associated with each plot. As electronic data are downloaded, raw data files and photographs will be archived in a directory specific to this project. Raw quantitative data files and photographs will be archived in plot-specific folders on the ESER server and GPS and qualitative data metrics will be archived in a project-specific directory of the GIS partition of the ESER server. The data transfer protocol provides instruction for renaming photographs so that they can be easily identified within context of the data archive, for combining and naming electronic datasheets on plots where more than one device was used, and for ensuring the GPS and associated data dictionaries are downloaded. The data transfer protocol is maintained in the ESER directory for this project.

As plots are sampled and data are downloaded throughout the sample season, quantitative data from each plot will be processed in a QA/QC database specific to this project. A spreadsheet documenting the import and initial QA/QC process for raw quantitative data was developed for use by the data manager and can be found in the ESER directory for this project. The intent of the initial validation and QA/QC process is to ensure that all data fields were completed for each plot, that all data values are recognized by the project database, and that metadata values are populated for data fields which are not recorded while plot sampling occurs. The QA/QC database is also used to summarize raw data into a format more amenable to future data analysis. Once data for each plot has been processed in the QA/QC database, plot data are imported and accumulated into an annual project database which will contain all data from all plots sampled in a given year. The annual project database is a “working copy” of the primary project database, which contains all sample data from all sample years. The format of the annual project database mirrors that of the primary project database, but allows more flexibility in user access. Within one week of being downloaded, the QA/QC process must be completed for all raw data collected for a given plot and the processed data must be imported into the annual project database. This timeline will allow a plot to be revisited in a timely manner if any data are missing or are obviously incorrect.

Spatial (GPS) data and associated qualitative data dictionaries will also be processed and an initial QA/QC effort completed for each plot within one week of data collection. The QA/QC process for GPS coordinates entails differentially correcting point locations and plotting them in a GIS to ensure that each plot is established within a reasonable distance of the site selected for that plot and that the estimated accuracy of the location is adequate. Data dictionaries will be reviewed to ensure that all fields have been populated and that categorical values are reasonable for each plot given its location and positional context. At the end of the sample season, the GPS locations from all plots will be combined into one GIS project file and managed as such, and qualitative data from the data dictionaries collected for each plot will be combined into one database table for import into the primary project database.

Both quantitative data from electronic spreadsheets and qualitative data from data dictionaries will ultimately be managed and analyzed from a project-specific Access database. A primary project database will house all monitoring data for all sample years. Data will be uploaded to the primary project database at the end of each sample year upon completion of data validation and all QA/QC processes. In addition to the initial QA/QC process used while summarizing raw data from each plot and incorporating it into the annual project database, a final QA/QC process will be used when transferring data from an annual project database into the primary project database. The final QA/QC process will ensure that all data fields for both quantitative and qualitative data are 1) present, 2) complete, and 3) reasonable. First, the annual database will be queried to confirm that data are present for all metrics on all plots sampled during the sample period. Next, a series of queries will be used to ensure that the data are complete. For example, queries which verify that the correct numbers of fields are present for each metric for each plot may be used. Finally, the summarized values of data in the annual database will be checked for reasonableness in terms of the potential range of data values, the likelihood of species occurrences at specific plot locations, continuity with data values and species identities previously reported for plots which have been sampled prior to the current sample season, estimated species abundance when compared to plot location and context, etc. If data from any metric on any plot is flagged during the final QA/QC process, it will be compared to the raw data file and initial QA/QC results to identify the source of the error. Once all errors have been corrected, data from the annual project database are imported into the primary project database. All data analysis for this project will use data from the primary project database.

B-2. Sample Protocol for Task 5: Habitat Condition Monitoring

Establish Plots

1. Navigate to the SW corner of the selected plot.
    a. If the plot was previously sampled (plot # is < 400), locate the SW corner as accurately as possible.
    b. If the plot is new (plot # is >999), locate the SW corner such that the plot is relatively homogenous and is as representative of the surrounding vegetation as possible.
2. Establish the plot corners and boundaries.
    a. Minimize plot trampling while completing setup.
    b. Place a rebar stake marking the SW corner.
    c. Establish a 20m-long baseline transect, from west to east, using a compass bearing of 110º magnetic, and place a rebar stake in the SE plot corner.
    d. Establish a perpendicular 20m-long plot boundary from south to north using the 3, 4, 5 triangulation method and place rebar stakes marking the NW and NE plot corners.

Photographs - Using Nikon Coolpix L1

1. The camera will be setup according to the following guidelines:
    a. Download SD Card.
    b. Install SD Card.
    c. Spare batteries in the camera case.
    d. Mode Selector is set to Auto.
    e. Flash is turned Off.
    f. Lens in zoomed out such that the maximum area possible is visible in the frame.
2. Two photos will be taken at each plot, a photo-plot photo and a landscape photo
    a. The photo-plot photo will be taken by placing the 1m x 1m photo frame at the appropriate location within the plot.
        i. The photographer should stand 12-18” behind the SW corner of the photo frame.
        ii. The height of the camera will be determined using a meter stick.
        iii. Hold the camera at the top of the meter stick and rotate the lens downward so that the entire photo frame is within the camera’s viewing frame.
        iv. Depress the shutter-release button about half way to auto focus. The letters AF and a green circle will appear on the screen when the lens is focused.

v. Depress the shutter-release button the rest of the way to release the shutter and take the photo.

vi. Review the photo and retake if necessary.

b. The landscape photo will be taken with the photographer standing in the same location as was used for the photo frame.

i. The camera should be held at the top of the meter stick.

ii. Rotate the camera lens upward and compose the photo such that as much of the plot as possible and at least some of the sky is visible in the frame.

1. The NE corner of the plot should be centered in the frame.

iii. Depress the shutter-release button about half way to auto focus. The letters AF and a green circle will appear on the screen when the lens is focused.

iv. Depress the shutter-release button the rest of the way to release the shutter and take the photo.

v. Review the photo and retake if necessary.

3. Record the photo file names on the plot checklist (Figure B-2).

Electronic Data File Setup

1. Open the electronic data sheet template and enter the date and plot ID in the appropriate cells of the first worksheet.
2. Select “save as” from the file menu and rename the template according to the following convention:
   a. Acronym of project
      i. “sghm” for this project
   b. Date with 6 numbers and no symbols
      i. mmddyy
   c. Plot number preceded by the letter “p”
   d. Initials of recorder
   e. Letter indicating which GPS unit is used.

For example:

sghm062812p1005afa

indicates that the data file is from the Sage-Grouse Habitat Monitoring Project on June 28, 2012. Plot 1005 was collected by Amy Forman using tablet/GPS unit a.

Plant Cover by Species – Point Frame

1. Position the point frame according to the plot diagram and such that the long axis is parallel to and centered along the tape marking the transect line.
2. Make sure that the point frame is level.
3. Read the point frame and record vegetation “hits” at the species level using foliar cover rules.
   a. All vegetative structures (non-reproductive) intercepted by shrubs, grasses, and forbs are considered “hits.” Record non-vegetation entities only if a vegetative layer is not present at a given point. Record more than one “hit” for a point if more than one species is present under a point (i.e. multiple vegetation layers).
4. Record data in the electronic data form using standardized INL species codes.
5. Repeat the procedure at all point frame sampling locations within the plot.

Vegetation Height

1. Locate individuals to be sampled according to the plot diagram (Figure B-1).
2. At each sample location, measure height of two individuals, one shrub, and one herbaceous grass or forb.
   a. For shrub:
      i. Find the individual which intercepts the transect line closest to and within 1m of the sample location.
      ii. Use a meter stick to measure the shrub's height at its tallest point above the soil surface in cm to the nearest ½ cm.
      iii. Record the species (and subspecies, if applicable) and its height in the electronic data form using standardized INL species codes.
      iv. If there are no shrubs intercepting the transect line within 1m of the sample location, record and "na" in the electronic data form.
      v. Do not sample the same shrub twice. If it is the closest individual to two sample locations, select the next closest shrub to the second sample location.
   b. For herbaceous individual:
      i. Find the individual of an herbaceous species which intercepts the transect line closest to and within 1m of the sample location. Use the location of the stem or tiller at the soil surface to determine which individual is closest.
      ii. Use a meter stick to measure the individual's height at its highest point above the soil surface (this may be droop height for species with growth habits which are not strictly erect) in cm to the nearest ½ cm.
      iii. Record the species of the individual and its height in the electronic data form using standardized INL species codes.
      iv. If there are no individuals of a perennial, herbaceous species within 1m of the sample location, record "na" in the electronic data form.
      v. Do not sample the same individual twice. If it is the closest individual to two sample locations, select the next closest individual to the second sample location.
3. Complete height measurements for both individuals at each of the 40 sampling locations.

Sagebrush Density/Juvenile Frequency

1. Locate the beginning of the first 5m x 1m belt transect according to the plot diagram (Figure B-1).
2. Use a meter stick, held perpendicular to and centered along the plot transect line, to visualize a belt transect 1m in width.
3. Move down the belt transect and count all of the sagebrush individuals under the meter stick.
   a. Count only individuals which are rooted within the visualized boundary of the belt transect.
   b. Shrubs with multiple stems at the soil surface should be counted as 1 individual.
   c. Count all sagebrush shrubs within the transect regardless of species; do not count non-shrubby Artemisia species.
4. Record the total number of individuals in the electronic data form.
5. Determine whether or not there are juvenile sagebrush in the belt transect.
   a. An individual can be considered a juvenile if:
      i. It is < 10cm in height,
      ii. It has 3 or fewer branches and they occur above the soil surface,

iii. It has no sign of reproductive structures from previous growing seasons, and/or
iv. Individuals of a similar size, but destructively sampled outside the plot boundary, have < 3 annual growth rings.

6. Record whether or not juveniles were present in the belt transect in the electronic data form.
7. Repeat the process described on the remaining 7 belt transects, for a total of 8.

Species List

Record a complete, but not necessarily exhaustive, list of species occurring within the plot boundaries in the electronic data form. A thorough sweep of the plot should be completed and an adequate sample effort made (at least 10 minutes) to capture all species which occur in the plot. Sample effort should be limited to no more than 30 minutes. It is understood that occasionally a small individual will be missed, especially in plant communities with complex physical structure.

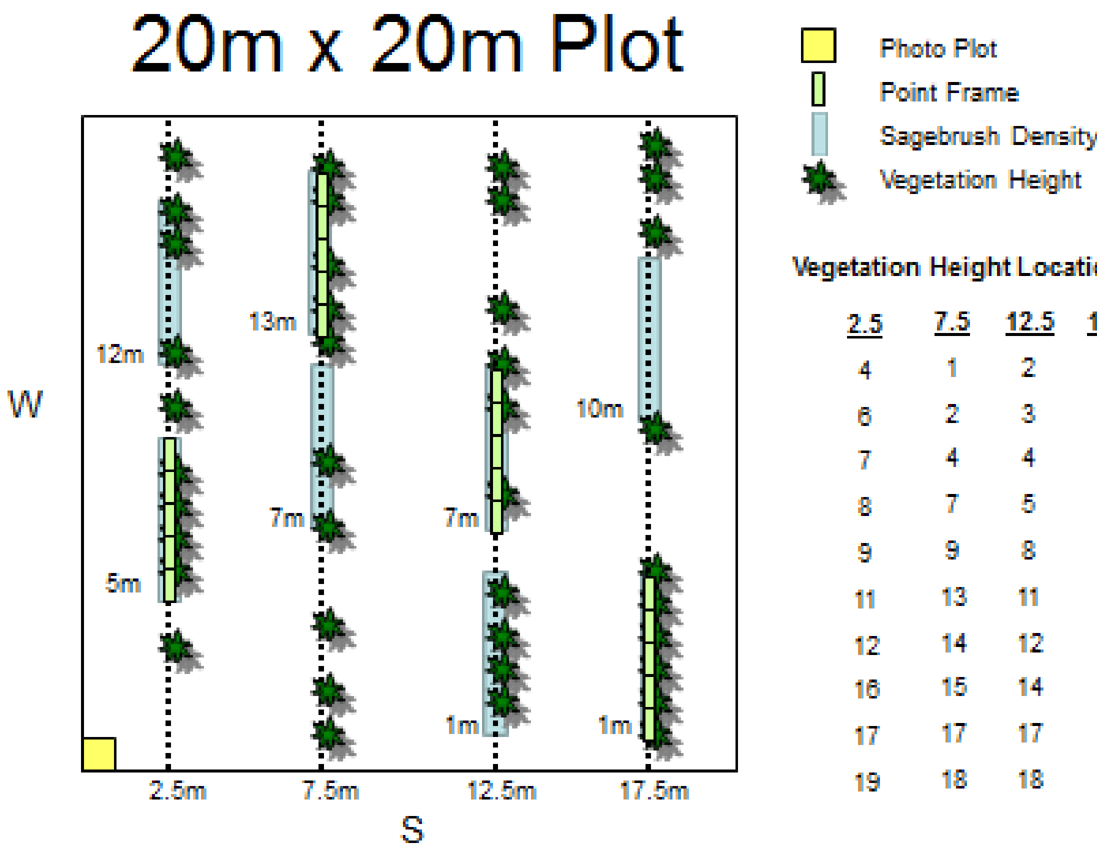
GPS Location, Key Plant Community, and Note Sage-grouse Sign

1. The GPS units will be set up using the following guidelines:
   a. Datum: NAD 83
   b. Projection: UTM Zone 12N
   c. Logging intervals: Every second with static collection for 2 minutes (total of 120 points).
   d. PDOP: as low as possible (4 to 6 range preferable).
   e. Elevation mask: 15º.
   f. SNR: around 40.
2. A GPS position will be collected at each plot.
   a. A point feature will be collected on the SW and SE corner of square plots.
   b. The data dictionary will be populated while collecting the point feature at the SW plot corner and will include:
      i. Use the plant community key to assign a vegetation class to the community represented within the plot boundary and record the appropriate vegetation class in the data dictionary.
      ii. In the data dictionary, indicate whether or not the community assigned by the key is representative of the community at the plot (i.e. did the key work well).
      iii. Make any additional comments about the plant community.
      iv. Use the data dictionary to indicate whether or not sage-grouse or sage-grouse sign were present on the plot.
      v. If sage-grouse were flushed from the plot, estimate how many.
      vi. Indicate whether there were any chicks among the birds flushed from the plot.
      vii. If there are sage-grouse sign on the plot, indicate what type of sign (e.g. eggs, feathers, and/or scat)
      viii. If scat is present, indicate whether there are just a few scattered pellets or more distinct piles.
      ix. If there are distinct piles, indicate how many.
      x. Indicate whether any scat appears to be from this season, or whether it is all older (Figs. B-3 & B-4).
      xi. Include any other pertinent notes about sage-grouse sign.
      xii. Indicate the whether there are any active ant mounds within the boundary of the plot.

xiii. Estimate the number of active thatch mounds.
xiv. Estimate the number of active crater mounds.
xv. Use the data dictionary to document any sign of disturbance to the plot.
xvi. If there are signs of disturbance, indicate which type (e.g tire tracks, wildland fire containment lines, livestock salt or water, sheep pellets or cow pies, livestock or game trails, etc.).
xvii. Indicate whether or not livestock were present at the time of sampling. Can you see livestock from the plot during the time you are there?
xviii. Make any additional comments about signs of disturbance.

Unknown Species Log

1. Any individual which cannot be readily identified to the species level during the plot sampling process should be collected for identification in the laboratory using the INL Site Reference Herbarium collection and/or appropriate flora keys.
2. Use a unique unknown code to identify the unknown individual in the electronic datasheet. Codes that make reference to identifying characteristics of an individual are particularly helpful. For example "UNKFYelFlow" could be used to denote an unknown forb with a yellow flower.
3. Every attempt should be made to collect a specimen outside the plot boundary. If an individual cannot be located adjacent to the plot, then photos should be taken of the unknown individual. Photos should capture as many details of leaf shape, flower anatomy, etc. as possible to facilitate the identification process.
4. Once a specimen has been located outside the plot boundary, as much of the individual as possible should be collected, including; roots, stems, leaves, flowers, and/or fruit. The specimen should be placed in either a plastic bag or plant press. A plastic bag may be used if the specimen will be identified within a day or two of collection. A plant press should be used if more than a few days will pass between collection and identification.
5. Label the plastic bag or the corner of the blotter paper in the plant press with the plot number and the unknown code used in the electronic datasheet.
6. Complete the unknown species log on the plot checklist (Figure B-2) indicating where the individual was located within the plot, a brief description of the individual, and the unknown code used to designate the individual in the electronic data form. The "Final ID" section of log will be completed once a positive identification has been made in the laboratory.



Vegetation Height Locations

2.5	7.5	12.5	17.5
4	1	2	1
6	2	3	2
7	4	4	3
8	7	5	4
9	9	8	5
11	13	11	6
12	14	12	10
16	15	14	16
17	17	17	18
19	18	18	19

Figure B-1. Plot schematic for CCA Task 5: Sage-grouse habitat condition monitoring.

Figure B-2. Sage-Grouse Habitat Monitoring Plot Check List.

Plot Number _____________ Date __________________ Observers ____________________

Data Collection (Initial as Completed)

____ Photos Taken:

Photo-Plot File Name ___________ Landscape Photo File Name ___________

____ Cover Data - Point Frames

____ Vegetation Height

____ Sagebrush Density/Juvenile Frequency

____ Species List

____ GPS Location/Data Dictionary

Data Transfer (Check off as Completed)

____ Photos

____ Electronic Data File(s)

____ GPS Positions/Data Dictionary

Unknown Species Log

Location in Plot____
Description____
Code in Electronic Data Sheet____
Final ID ____

Location in Plot____
Description____
Code in Electronic Data Sheet____
Final ID ____

Location in Plot____
Description____
Code in Electronic Data Sheet____
Final ID ____

Figure B-3. Recent sage-grouse feces (right) are light to dark brown with small areas of white near the end. Fresh cecal casts of sage-grouse (left) are a semi-liquid material that is black.

Figure B-4. Old, weathered sage-grouse scat appears mostly white.

B-3. Data Transfer Protocol for Task 5: Habitat Condition Monitoring

Sage-Grouse Habitat Monitoring Data Transfer

A. Electronic and hardcopy data will be transferred on a daily basis.
B. Appropriate file and folder structures will be maintained on the server such that one folder will be available for all electronic data associated with each plot.
C. Copy the pair of photographs taken at each plot from the camera to the appropriate folder on the server.
D. Open and review each of the photos to ensure that both a photoplot and landscape image are present for each plot.
E. After the photos have been copied to the server, rename each photo on the server according to the following convention:
   i. Acronym of the project (in this case "sghm").
   ii. Date in mmddyy (6 numbers and no symbols).
   iii. Plot number preceded by the letter "p."
   iv. The letter "p" again, to denote that it is a photo file, followed by a "1" or "2." The number "1" indicates that the photo is of the photoplot, and the number "2" indicates that the photo is of the landscape.
   iv. Example:

sghm060628p1p2

indicates that the photo is from the Sage-Grouse Habitat Monitoring project on June 28, 2006. Plot 1 was photographed from the landscape perspective.

F. Copy the electronic data files from the hand held unit to the appropriate folders on the server.
G. Open and review each file to ensure that the datasheets are complete. If more that one hand held unit was used at each plot, resulting in multiple data files, combine the data files so that one complete data file is available for each plot. Maintain the original data files as they were upon completion of data collection in the field and name the new, complete data file according to the file naming convention described above. Omit the letter indicating the observer and which handheld unit was used and add "combined" to the end of the file name for all files generated during the download process.
H. Download GPS position and data dictionary information.
I. Mark the plot checklist to indicate that data transfer has been completed for the plots photos, electronic data files, and photo identification label.
J. Deliver completed plot checklists to the project manager.

Literature Cited

Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28:967-985.

Floyd, D. A. and J. E. Anderson. 1982. A new point interception frame for estimating cover of vegetation. Vegetatio 50:185-186.

Shive, J. P., A. D. Forman, K. Aho, J. R. Hafla, R. D. Blew, and K. T. Edwards. 2011. Vegetation community classification and mapping of the Idaho National Laboratory Site. Environmental Surveillance, Education, and Research Program Report, Gonzales-Stoller Surveillance LLC., Idaho Falls, ID. Report GSS-ESER-144.