Environmental Surveillance,
Education, and Research Program
January 2018
WAI-ESER-213

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

2017 Full Report

THIS PAGE INTENTIONALLY LEFT BLANK

WAI-ESER-213

Implementation of the Candidate Conservation Agreement for Greater Sage-Grouse on the Idaho National Laboratory Site: 2017 Full Report

February 2018

Quinn R. Shurtliff, Amy D. Forman, Jackie R. Hafla, Kristin N. Kaser, Jeremy P. Shive, Kurt T. Edwards, Bryan F. Bybee

Environmental Surveillance, Education, and Research Program
Wastren Advantage, Inc., 120 Technology Drive, Idaho Falls, ID 83401

Prepared for:

U.S. Department of Energy, Idaho Operations Office
Environmental Surveillance, Education, and Research Program
Contract No. DE-NE-0008477

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

RECOMMENDED CITATION

Shurtliff, Q.R., A.D. Forman, J.R. Hafla, K.N. Kaser, J.P. Shive, K.T. Edwards, and B.F. Bybee. 2018. Implementing the Candidate Conservation Agreement for Greater Sage-Grouse on the Idaho National Laboratory Site: 2017 Full Report. Environmental Surveillance, Education, and Research Program, Wastren Advantage, Inc., Idaho Falls, ID. WAI-ESER-213.

ACRONYMS

BEA	Battelle Energy Alliance, LLC
BLM	Bureau of Land Management
BMP	Best Management Practice
CCA	Candidate Conservation Agreement
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
LTV	Long-Term Vegetation
MPLS	Males Per Lek Surveyed
NAIP	National Agricultural Imaging Program
NOAA	National Oceanic and Atmospheric Association
RWMC	Radioactive Waste Management Complex
SGCA	Sage-grouse Conservation Area
USFWS	U.S. Fish and Wildlife Service
USDA	U.S. Department of Agriculture

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 2017 inventory and monitoring activities and results in support of the CCA, (2) address greater sage-grouse (hereafter 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 sage-grouse population trigger baseline for the INL Site equals the number of males counted in 2011 during peak male attendance on 27 active leks within the Sage-grouse Conservation Area (SGCA) (i.e. 316 males). The population trigger will trip if the three-year running average of males on those 27 leks decreases ≥20% (i.e. ≤253 males). In 2017, we surveyed the 27 baseline leks (19 of which were classified as active), six lek routes (three of which were newly created in 2017), all other active leks on the INL Site, and a few inactive leks that had not been surveyed for several years. Key results from population monitoring are as follows:

- Peak male attendance on the 27 baseline leks was 13% lower than 2016, but the three-year average (2015–2017) increased 5% and is now 160% of the trigger threshold. The three-year average attendance has increased 24% since 2013.
- The number of leks classified as active on and near the INL Site decreased from 49 in 2016 to 45 in 2017.
- Male counts on three lek routes that have been surveyed since 1999 were 1–27% lower in 2017 compared to 2016.

Monitoring Tasks 2 (historical lek surveys) and 3 (Discovery Surveys) were completed in 2017 and will no longer be implemented.

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 15,712 ha (38,824 ac) of sagebrush habitat within the SGCA are converted to a non-sagebrush-dominated vegetation class. Total sagebrush habitat area and distribution are monitored using aerial imagery and a Geographic Information System. To monitor the condition of sagebrush-dominated lands and areas recovering from wildland fire, we surveyed 75 vegetation plots distributed across both habitat types. The following is a summary of results from habitat distribution and condition monitoring tasks:

- Compared to the baseline, the total sagebrush habitat value remained unchanged in 2017 with no losses occurring within the SGCA. Only one small roadside fire (<0.25 acre) was documented on the INL Site in 2017, and it did not occur within sagebrush habitat.
- During the past four years, only an estimated 11 acres have burned on the INL Site. That is a lower amount than in any other five-year period since at least the early 1990s (the current annual INL

wildfire report contains data dating back to 1994). No losses in sagebrush habitat have been mapped within the SGCA 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 perennial herbaceous cover were also within guideline recommendations, but were likely at the upper end on their normal range of variability due to recent precipitation patterns.
- In areas recovering from wildland fire, cheatgrass has been increasing over the past three years, but it is unclear whether that pattern will continue or it is just a fluctuation resulting from anomalous precipitation events.

Threats and Threat Monitoring

Three monitoring tasks described in the CCA were designed to generate baseline data and track indicators of three threats—raven predation, annual grasslands, and infrastructure development. Key results and conclusions from threat monitoring tasks are listed below:

Raven Predation—We observed 41 raven nests on INL Site infrastructure and in ornamental trees, a decrease of 7% from 2016. The decrease was primarily driven by a reduction in nests on powerlines, which counterbalanced an increase in the number of nests associated with facilities. In 2014, we recorded five nests at facilities; in 2017, we observed 11 nests. Despite the slight decrease in total raven nests, the number of active nests in 2017 was 41% higher than in 2014 when surveys commenced.

Annual Grasslands—We surveyed a subset of wildfire containment lines in search of potential treatment plots where cheatgrass control measures can be applied and native plant communities rehabilitated. We identified two sites on the southern portion of the INL Site that had abundant cheatgrass and were associated with native plant communities. These sites were prioritized based on ease of access. We will now begin to explore treatment options for DOE to consider that would successfully reduce cheatgrass abundance and improve native perennial cover.

Infrastructure Development—We performed no work in 2017 associated with monitoring the infrastructure footprint within the SGCA and other areas dominated by big sagebrush. No high resolution imagery has become available for the INL Site since we completed this task in 2016, but we anticipate that new imagery will be available in 2018.

Implementation of Conservation Measures

No sagebrush habitat burned on the INL Site in 2017, marking five years since any sagebrush in the SGCA has been lost to wildfire. Although there was no need once again for DOE to prepare a burned area assessment (Conservation Measure 1), DOE and an INL contractor funded the planting of ~6,000 sagebrush seedlings in priority restoration areas. We revisited a subset of sagebrush seedlings planted in 2016 and estimate that 62% of seedlings survived their first year.

DOE has processes in place (e.g. Environmental Checklist) to ensure that many of the Conservation Measures outlined in the CCA routinely or automatically occur. A highlight this year is that a new process was developed to allow contractors to voluntarily pay a per-acre mitigation fee when sagebrush lands are disturbed. The fees will be used to plant sagebrush seedlings in priority restoration areas.

Synthesis and Conclusions

Population and habitat data from the INL Site suggest that sage-grouse abundance has increased in recent years and that sagebrush habitats are in relatively good condition. These results are probably due to favorable amounts and timing of precipitation. It is unlikely that any threats to sage-grouse and its habitats on the INL Site will push population or total habitat area below their pre-defined trigger thresholds in the near future. However, a large wildfire could change this outlook rapidly.

Adaptive Management

In 2017, we include a new section in this report where any changes to the CCA that are approved by DOE and the USFWS can be documented annually. The only changes made to the CCA during 2017 were the completion of Monitoring Tasks 2 and 3 (see above). We also documented a change made to the CCA in 2016 (the first substantial change to the CCA) by which the objective of Monitoring Task 7 was redefined.

1.0 INTRODUCTION, 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 2017 inventory and monitoring tasks managed 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 summarize inventory and monitoring results and conclusions so DOE and USFWS can track population and habitat trends and make informed decisions relative to adaptive regulatory triggers outlined in the CCA. On the INL Site, the two triggers and criteria that define them, which would initiate responsive action by both agencies, are:

- Population Trigger: The three-year running average of peak male attendance, summed across 27 leks within the Sage-grouse Conservation Area (SGCA), falls below 253 males—a 20% decrease from the 2011 baseline of 316 males;
- Habitat Trigger: Total area designated as sagebrush habitat within the SGCA falls below 62,846 ha (155,296 ac)—a 20% drop from the 2013 baseline of 78,558 ha (194,120 ac).

This report informs a continuing 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 ensures 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 report 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 of these chapters 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 the past year. Chapter 6 brings together the main results and conclusions from the eight monitoring tasks and addresses them in light of the ultimate goal of the CCA, which is to conserve sage-grouse. Finally, Chapter 7 outlines the ESER Program's work plan for the upcoming year and highlights changes that will be made to the past year's activities.

2.0 POPULATION TRIGGER MONITORING

The following three monitoring tasks enable ESER to estimate sage-grouse trends and to document the locations of active leks on the INL Site:

1) Lek Counts and Lek Route Surveys—Surveys of all active leks on the INL Site and some inactive leks. Leks may be individually counted or may be part of a lek route survey;
2) Historical Lek Surveys—Surveys of historical leks on the INL Site to determine if sage-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 Idaho Department of Fish and Game (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. This information was used in 2017 to establish three new lek routes prior to the start of the field season.

2.1 Task 1—Lek Counts and Lek Route Surveys

2.1.1 Introduction

The primary purpose of CCA Monitoring Task 1 (hereafter Task 1) is to survey all known active leks on the INL Site and the 27 baseline leks located in the SGCA (19 of which were classified active at the end of 2016). These surveys enable ESER to track peak male attendance trends on the 27 baseline leks within the SGCA, which is necessary to evaluate current trends relative to the population trigger threshold. The baseline value for the population trigger is 316 males—the summation of peak male attendance in 2011 when all 27 SGCA leks were active (Fig. 2-1; DOE and USFWS 2014). The population trigger will be tripped if the three-year running average of peak male attendance at these 27 leks falls below 253 (a 20% decrease from the 2011 value) (DOE and USFWS 2014).

In addition to the baseline lek surveys, Task 1 includes surveys of three lek routes (Tractor Flats, Radioactive Waste Management Complex [RWMC], and Lower Birch Creek) that were established by the IDFG in the 1990s and have been conducted annually since 1999 (Fig. 2-1). Many leks assigned to these routes are part of the group of 27 baseline leks, but lek route data are more useful than single-lek counts for trend monitoring because they address some of the confounding issues regarding sage-grouse movement among leks (Connelly et al. 2003). On the INL Site, lek routes have been surveyed long enough to provide a historical perspective to current trends of sage-grouse abundance (Garton et al. 2011, DOE and USFWS 2014). To strengthen our ability to track sage-grouse trends in the future, we assigned 11 leks (10 were active) to three new lek routes. Results from all six lek routes are reported below.

Each year, ESER surveys all active leks on the INL Site at least three times, even if they are not one of the 27 baseline leks or assigned to a lek route (Fig. 2-1). As part of this continuing effort to monitor all known active leks on the INL Site, we commenced in 2017 what will become an annual practice of surveying a subset of inactive lek sites that have not been visited for five years. Inactive lek surveys will aid ESER in maintaining an accurate map of active leks so contractors do not inadvertently disturb breeding birds.

2.1.2 Methods

We conducted surveys of individual leks and lek routes from March 22 to May 9 following standard ESER protocols (Shurtliff et al. 2015). For trend analysis (based on IDFG lek routes), we generated a value for each route representing the number of males per lek surveyed (MPLS) on the day that the route count was highest (Shurtliff et al. 2017).

2.1.3 Results and Discussion

SGCA Baseline Leks

We surveyed each of the 27 SGCA baseline leks 3–7 times ($\bar{x}$=5.5 surveys, SD=1.8; Fig. 2-1) in 2017. The sum of peak male attendance counts across the 27 leks was 412, a 13% decrease from 2016. However, the three-year average (2015–2017) increased to 406 males. This is 5% higher than last year's 2014–2016 average (Fig. 2-2), and 160% of the threshold (253 males) that would trigger predetermined action by DOE and the USFWS (DOE and USFWS 2014). The three-year average has been stable or has increased in each of the past four years.

Following the 2017 field season, we reclassified two baseline leks as inactive, reducing the number of active baseline leks to 17. Both reclassified leks were satellites to larger leks nearby. We expect that satellite leks will not be active each year because sage-grouse tend to use these areas more as local sage-grouse abundance increases and less as it decreases (Dalke et al. 1963). In each of the past five years, at least one baseline lek per year has been reclassified as inactive. However, across all baseline leks, the three-year average of peak male attendance continues to increase and was higher in 2017 than it has been since the baseline was established.

Other Non-Route Leks

We surveyed 27 additional (i.e. non-baseline) active leks 4–7 times ($\bar{x}$=4.8 surveys, SD=1.3), not including a new lek identified during discovery surveys (Fig. 2-1). Average peak male attendance was 12.1 males per lek (range: 0–36 males, SD=10.7), up from 10.1 and 10.6 males per lek in 2016 and 2015, respectively.

We surveyed 19 inactive leks that had not been visited since 2012 and one inactive lek that had not been visited since 2013. The 20 leks were visited twice and one was visited three times between March 27 and May 1, 2017. We did not record observations of male sage-grouse at any of the leks.

Lek Routes

Leks assigned to IDFG routes include baseline leks, "other active leks" (previous subsection), and two leks that are outside the INL Site boundaries. We surveyed each of the IDFG lek routes (Fig. 2-1) seven times during the official survey period (Table 2-1) and found that, compared to 2016, the Tractor Flats route was 27% lower (2016=14.4 males per lek surveyed [MPLS]), the RWMC route was 16% lower (2016=14.8 MPLS), and the Lower Birch Creek route was <1% lower (2016=13.2 MPLS) than 2017 MPLS counts (Table 2-1). The number of leks occupied by two or more displaying males in 2017 (not to be confused with an active lek designation, which describes lek activity over five years [Whiting et al. 2014]) was lower by one on both the Tractor Flats and the RWMC routes relative to 2016 (Table 2-1). However, one inactive lek on the RWMC route (INL 11—Fig. 2-1) was upgraded to active status in 2017 following two years of recorded sage-grouse occupation.

High counts on the Tractor Flats route in both 2016 and 2017 remained greater than any year since 2010 (i.e. prior to the Jefferson Fire; Fig. 2-3). Likewise, the nearly identical MPLS values in the past two years on the Lower Birch Creek route represent the highest number of sage-grouse per lek observed on that route since 2007.

We surveyed three additional lek routes for the first time in 2017 (Fig. 2-1). Survey effort was not as great for these routes as for the IDFG routes (Table 2-1) due to logistical constraints, but in future years we will survey all lek routes at least seven times. We observed sage-grouse on nine of the 11 leks assigned to these routes. The T-9 route had the lowest MPLS, but the MPLS was comparable on West T-3 and Frenchman's Cabin routes to the IDFG routes (12.3 and 15.3 MPLS, respectively). Several more years of data collection are required before we can begin to evaluate trends using data from the new lek routes.

Taken together, lek and route counts in 2017 indicated that fewer sage-grouse were on the INL Site during the breeding season than in 2016, but the decrease was not substantial nor is it unexpected, because sage-grouse abundance tends to fluctuate annually and may exhibit natural long-term periodicity (Fedy and Aldridge 2011). The MPLS on the Tractor Flats and Lower Birch Creek routes remains within the highest third of counts during the past seven years. The RWMC count for 2017, however, was among the lowest third of counts during the same time period. Despite the increase of sage-grouse counts on the Tractor Flats route since the Jefferson Fire, we observed that sage-grouse only occupied two of seven route leks surveyed in 2017. In 2010, prior to the Jefferson Fire, sage-grouse used all six leks that comprised the route at that time. It is unclear whether sage-grouse will recover to the levels they were prior to the fire in the eastern portion of the INL Site.

Table 2-1. 2017 data from INL Site lek routes.

Lek Route	Highest Single-Day Count	Total Leks Surveyed	Males / Lek Surveyed (MPLS)	Occupied Leks*	Males / Occupied Lek*	Surveys Conducted
Tractor Flats	84	8	10.5	2	42.0	7
RWMC	112	9	12.4	7	16.0	7
Lower Birch Creek	132	10	13.2	6	22.0	7
West T-3	49	4	12.3	4	12.3	4
T-9	34	4	8.5	3	11.3	4
Frenchman's Cabin	46	3	15.3	2	23.0	5

*For the purpose of analysis, leks on routes are considered occupied if two or more males were observed displaying during the current-year survey. This is different from an active lek designation that ESER uses to characterize leks on the INL Site, which is based on five years of data.

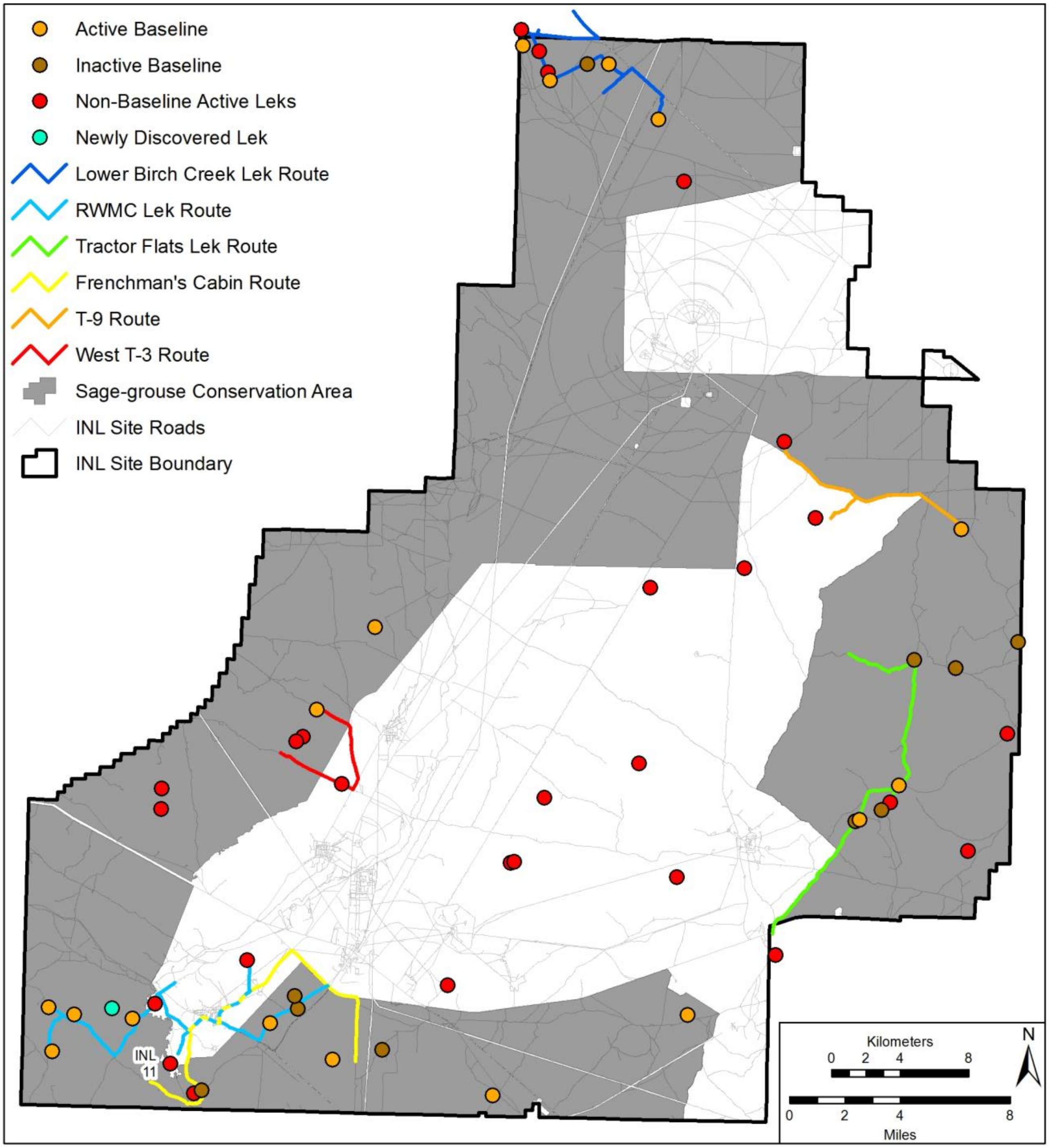

Figure 2-1. An overview of 2017 lek surveys and lek route efforts in support of Task 1. All leks surveyed by ESER are displayed, and lek activity designations are based on results from the 2016 season. Following the 2017 survey, two baseline leks were reclassified as inactive. Lek INL 11, surveyed as part of the RWMC route, was elevated to active status at the end of the field season.

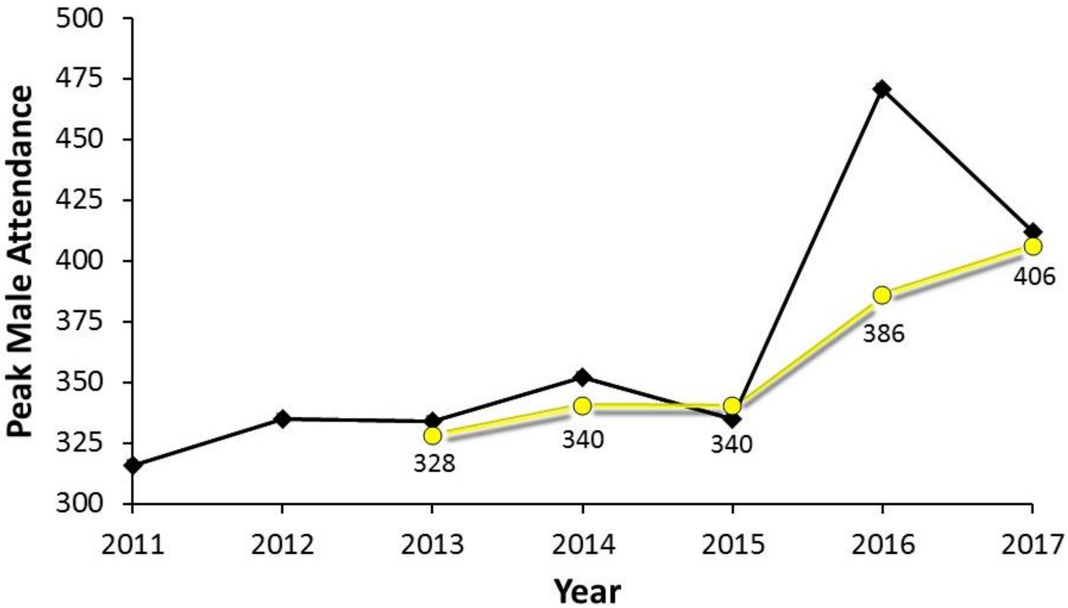

Figure 2-2. Peak male attendance on the 27 leks in the SGCA associated with the population trigger. Black diamonds are annual counts, and yellow dots represent the three-year running average.

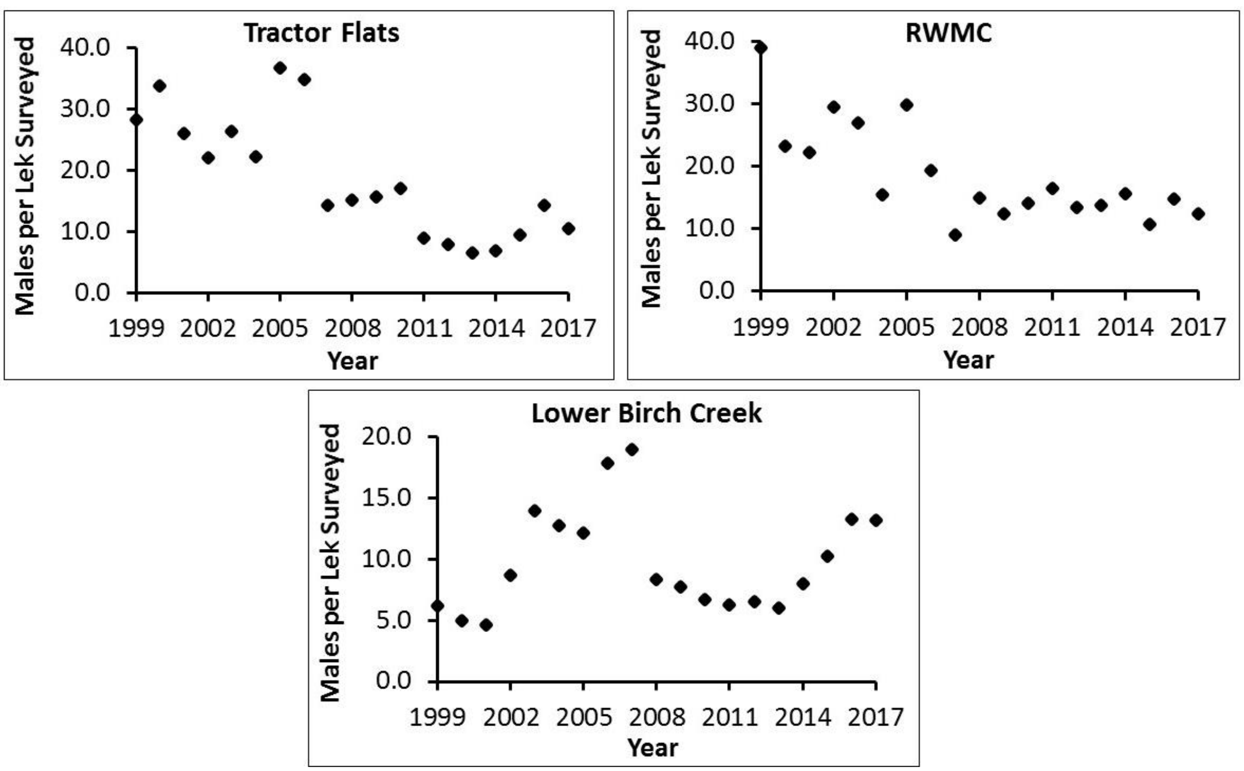

Figure 2-3. Mean number of males per lek surveyed during peak male attendance on three IDFG lek routes from 1999-2017 on the INL Site. The number of leks surveyed each year increased over the displayed time period as follows: Tractor Flats (4-8 leks), RWMC (2-9 leks), and Lower Birch Creek (6-10 leks). Note that the Y-axis is at a different scale in the Lower Birch Creek panel.

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 revisited a subset of historical leks each spring to determine if they remain active (DOE and USFWS 2014; Whiting et al. 2014). If no birds were seen on a lek, ESER continued to monitor the lek for up to five years or until we had sufficient information to reclassify the historical lek as either active or inactive. The objective of Task 2 was to determine which historical leks were active before establishing new lek routes (DOE and USFWS 2014). Although ESER established new lek routes at the beginning of 2017, we surveyed remaining historical leks one last year before reclassifying them.

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 2017, we surveyed historical lek sites from March 27 to April 19 (Fig. 2-4).

2.2.3 Results and Discussion

We surveyed five historical leks (Fig. 2-4) two times each, but observed no sage-grouse on any of these potential lek sites. Following the 2017 surveys, we reclassified all five historical leks as inactive because they had been surveyed at least four years and there was no longer a chance of breeding activity being recorded in at least two out of five years (Whiting et al. 2014).

The end of the 2017 field season marks the completion of Task 2. No more leks on the INL Site remain classified as historical. Since ESER began to survey historical leks in 2009, 26 have been reclassified as active (Shurtliff et al. 2016, 2014; Whiting et al. 2014).

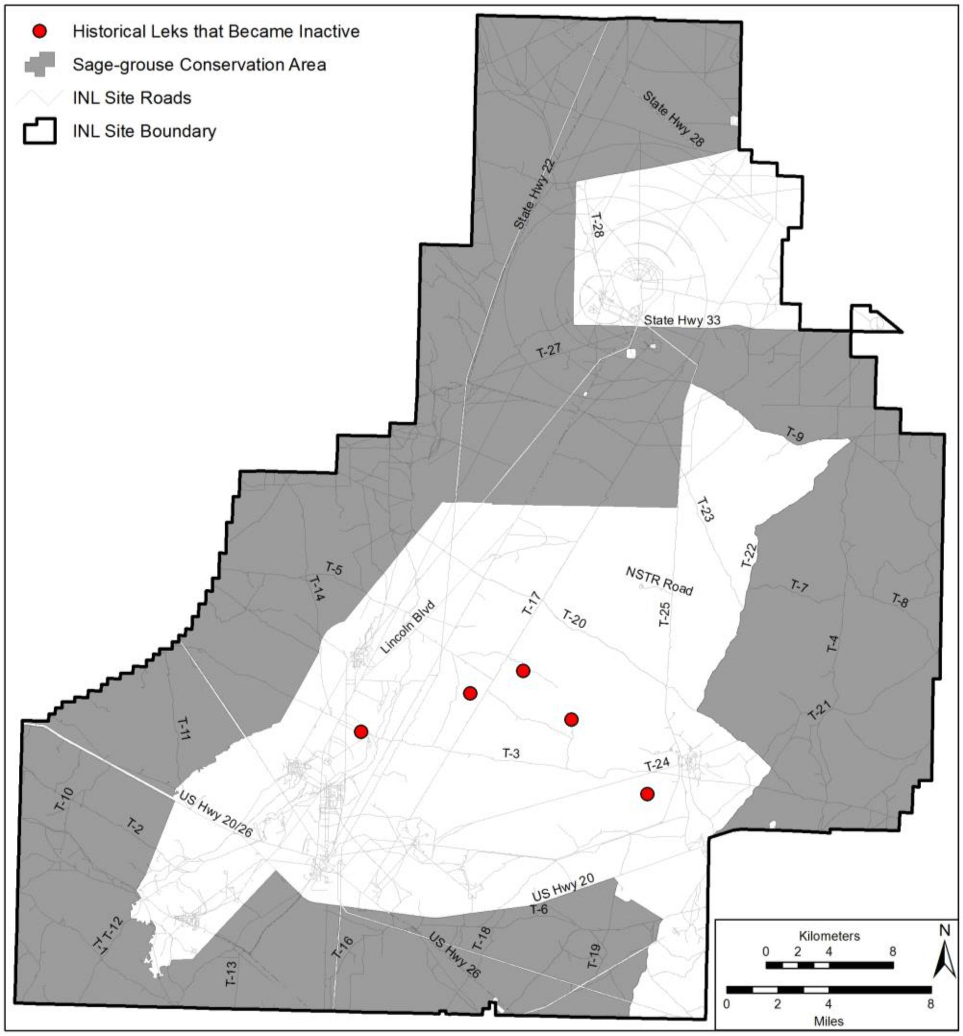

Figure 2-4. Historical leks surveyed in 2017. All were reclassified as inactive following the field season.

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 (Fig. 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). The objective of Task 3 is to survey suitable sage-grouse habitat within and near the SGCA where no leks are known to exist. Since 2013, ESER has systematically searched for unknown leks each spring. If a lek was discovered, it was included thereafter in ESER's annual monitoring program.

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). All locations were within the SGCA and included sagebrush-dominated areas between roads T-4 and T-21, near Middle Butte, and in other areas south of State Highway 20/26 where few leks have been identified (Fig. 2-5). Road locations were separated by 1 km (0.62 mi) and remote locations were at least 1.5 km from the nearest road location or known lek site At each survey 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 March 27 and May 8, 2017, we completed 68 surveys (52 road, 16 remote) within the SGCA in the southern portion of the INL Site. We discovered one sage-grouse lek (INL164, Fig. 2-5) where three males were observed strutting on one of two visits to the site.

Since Task 3 began in 2013, ESER has discovered seven previously-unknown leks. All are currently classified as active, and sage-grouse have been seen every year on all leks except one (INL159). In 2017, males were seen at each lek, and the mean peak male attendance was 10.9 males per lek (Range 3–19). Thus, most leks discovered under this task added to our understanding of sage-grouse breeding habitat on the INL Site and were not simply observations of males that had been flushed from larger leks (i.e. incidental observations).

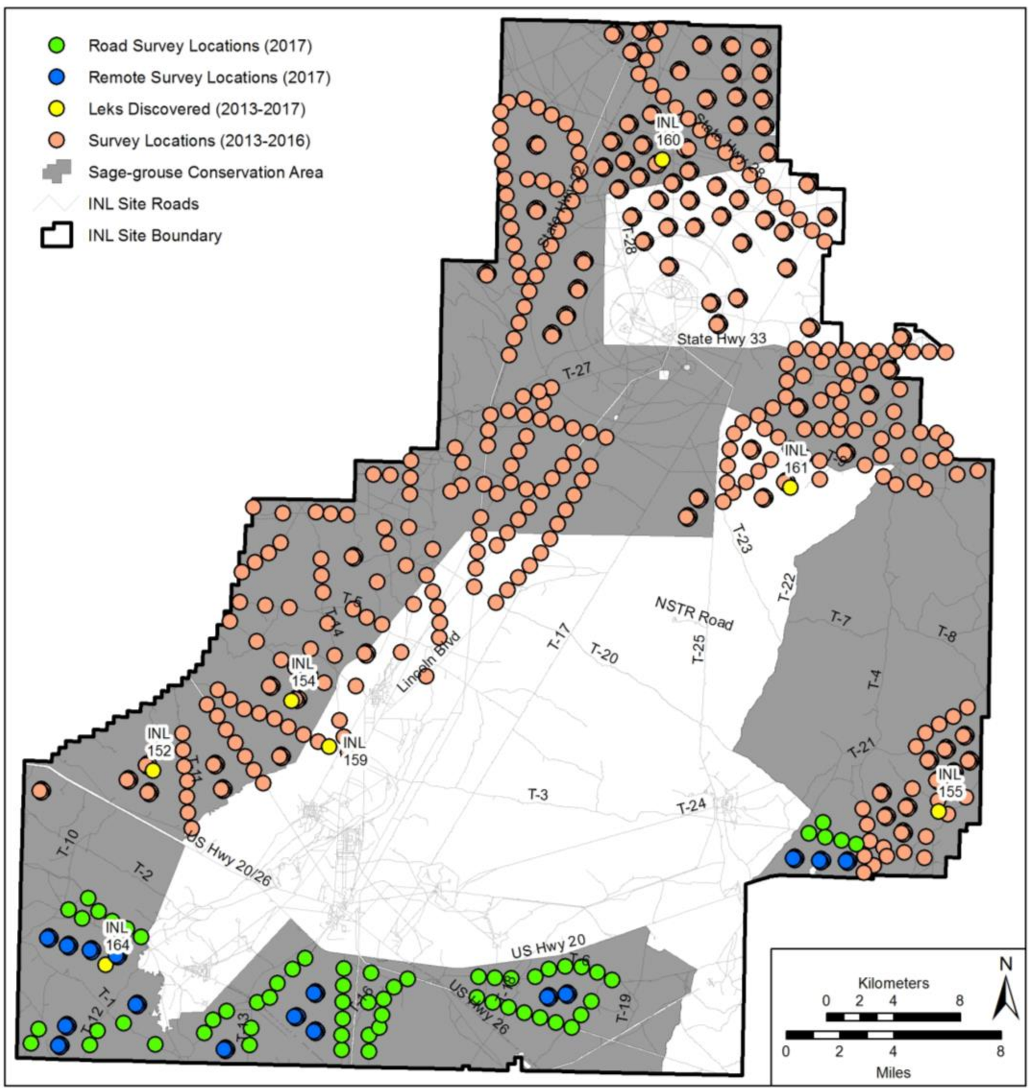

Figure 2-5. Locations of Task 3 surveys conducted since 2013. All active leks discovered as a result of these surveys are indicated by yellow dots.

2.4 Summary of Known Active Leks and of Changes in Lek Classification

Before the 2017 field season, 49 leks were designated active on or near the INL Site, including two just outside the Site boundaries that are part of the IDFG survey routes. After the field season, six leks (Fig. 2-6) were downgraded from an active to inactive status. With the discovery of one lek and the upgrade of an inactive lek to active status, the total number of known active leks on or near the INL Site is currently 45 (Fig. 2-7).

We did not empirically evaluate factors that may have influenced abandonment of these six lek over the past few years. However, a cursory examination of lek count records in light of the spatial distribution of leks suggests that the decline in use of these six lek sites may have been at least partly because some were satellite leks and others were impacted by wildfire. During years of high sage-grouse abundance, small satellite leks (usually <15 males) commonly form near large leks (Connelly et al. 2003), but these sites are typically unoccupied in years of lower abundance (Dalke 1963). Male attendance patterns for at least two of the six leks reclassified in 2017 as inactive fit the definition of a satellite lek (INL 35 and 117, Fig. 2-6). The other four inactive leks may have been abandoned as a result of sagebrush habitat loss from the large fires that burned in 2010 and 2011. Prior to the fires, male sage-grouse were observed at the four leks every year they were surveyed (some were surveyed annually, others were surveyed sporadically). Shortly after the fires, all four leks were abandoned. Our hypothesis about the influence of wildfire on the persistence of these four leks is supported by a modeling study of lek attendance in Wyoming ranging from 1980–2009. Researchers found that the probability of lek abandonment was a function of the percent area burned within a 1.0-km radius of leks (Hess and Beck 2012). The authors of this study also found evidence that other factors contributed to lek abandonment, and concluded that additive effects from multiple factors likely influenced lek abandonment more than impacts from single factors. On the INL Site, other factors could have contributed to lek abandonment, but we are unaware of any potential threat (e.g. infrastructure development, livestock grazing, human disturbance) that could have been a primary contributor at more than a single lek (for example, only one of the four leks occur within livestock grazing allotments). Regardless of why leks were abandoned, it is important to remember that the CCA population trigger is based on sage-grouse abundance in the SGCA, not the number of active leks on the INL Site. As reported above, the three-year running average of sage-grouse abundance on baseline leks has increased each year since the CCA was signed.

2.5 Adaptive Management

Prior to the start of the 2017 field season, we had created five new lek routes (Shurtliff et al. 2017); however, as the field season commenced we eliminated two of them (routes B and C) because they were not ideal routes (i.e. they were too close to other lek routes, the driving path passed leks on other routes, and the proposed route had long stretches along a paved highway). Notwithstanding this reduction, the number of lek routes that will be surveyed annually is double what it was in recent years.

The end of the 2017 field season marked the completion of CCA Tasks 2 and 3. No leks remain classified as historical (Task 2) and the purpose of discovery surveys (Task 3), which was to search poorly-sampled regions within the SGCA for unknown leks before establishing new lek routes, has been achieved. Going forward, ESER will continue to implement Task 1. That is, we will survey all known leks on the INL Site multiple times each year, with extra effort directed at surveying lek routes and the 27 baseline leks. In addition, ESER proposes, as part of Task 1, to annually revisit a subset of inactive lek sites each year, especially those within or near good nesting habitat. By regularly surveying a few different leks each year,

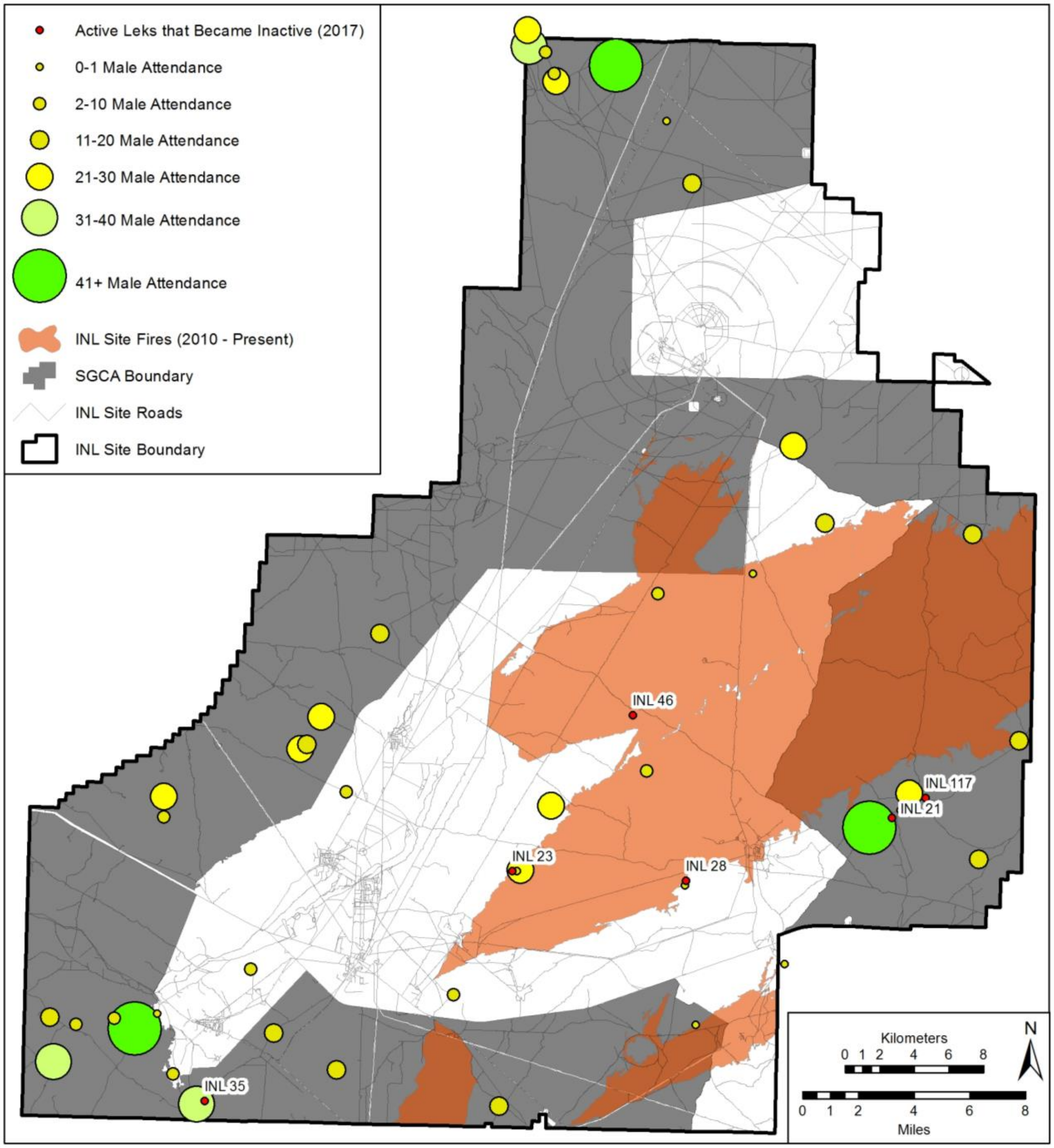

Figure 2-6. Locations and relative size of active leks (i.e. 2017 peak male attendance) on or near the INL Site. Symbol size reflects attendance only and does not represent the spatial extent of the lek site nor the 1 km lek buffers. Also depicted are the six leks downgraded to inactive status following the 2017 field season.

we could revisit all inactive lek sites approximately every five years to determine if sage-grouse use of those sites has changed.

The CCA states that following the establishment of new lek routes and the first year of data collection, DOE and the USFWS will meet to discuss whether summing maximum male counts across all lek routes "represents a reasonable new baseline for the population trigger" (DOE and USFWS 2014, pg. 36). In other words, the agencies agreed to consider whether the interim baseline for the population trigger, comprised of data from 2011 for 27 designated leks in the SGCA, should be replaced with a more commonly accepted form of tracking sage-grouse abundance (i.e. lek route counts). ESER recommends postponing consideration of changing the baseline, because we did not survey new lek routes seven times in 2017 and a new baseline would more accurately reflect current abundance patterns if a three-year running average was used rather than a single year of data.

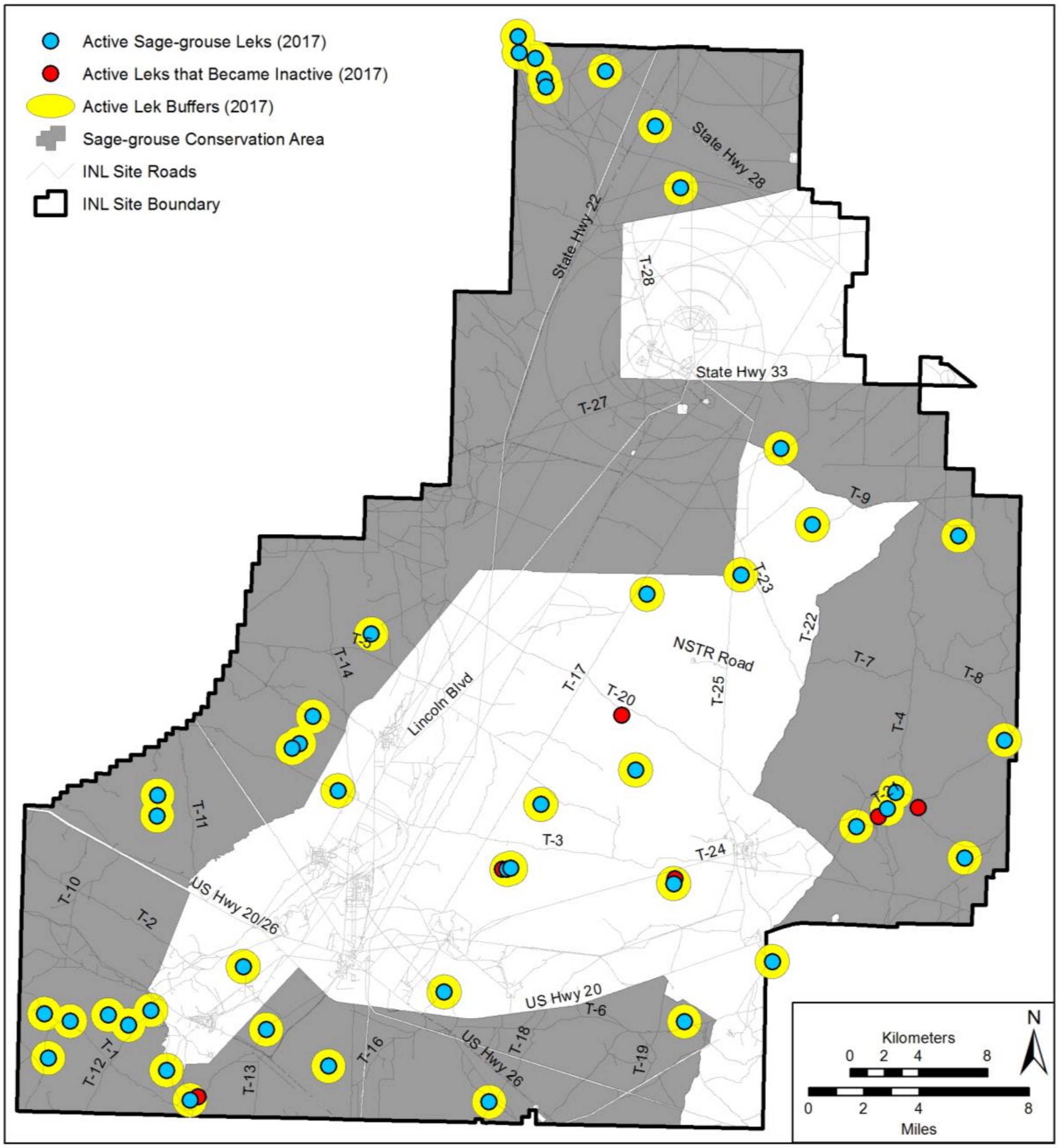

Figure 2-7. Locations of 45 active leks and six that were reclassified as inactive on or near the INL Site.

3.0 HABITAT TRIGGER MONITORING

All vegetation-based estimates of sagebrush habitat distribution 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 was either a big sagebrush or low sagebrush class. 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 baseline value of the habitat trigger is defined as the total area designated as sagebrush habitat within the SGCA at the beginning of 2013 (DOE and USFWS 2014). Currently, this baseline value is estimated at 78,558 ha (194,120 ac). Although no real changes in the amount of sagebrush habitat within the SGCA have been recorded since the CCA was signed, the habitat trigger baseline value was increased twice following improved fine-scale mapping of recent fires (Shurtliff et al. 2016, 2017). Based on updated habitat estimates, the trigger will trip if there is a 20% reduction in sagebrush habitat (i.e. a loss of >15,712 ha [38,824 ac]) within the SGCA. If the trigger is tripped, the USFWS will ask DOE to take action to compensate for the loss of habitat.

Two monitoring tasks are designed to identify vegetation changes across the landscape and assist in maintaining an accurate record of the condition and distribution of sagebrush habitat within the SGCA to facilitate annual evaluation of the habitat trigger:

Task 5: Sagebrush Habitat Condition Trends— This task provides information to support ongoing assessment of habitat condition within polygons mapped as sagebrush habitat and facilitates comparison of sagebrush habitat on the INL Site with sage-grouse habitat guidelines (e.g. Connelly et al. 2000). Data collected to support this task may also be used to document gains in habitat as non-sagebrush map polygons transition back into sagebrush classes, or to document losses when compositional changes occur within sagebrush polygons that may require a change in the assigned map class.

Task 6: Monitoring to Determine Changes in Sagebrush Habitat Amount and Distribution— This task is intended to provide an update to the current sagebrush habitat distribution map, and primarily deals with losses to sagebrush habitat following events that alter vegetation communities. As updates are made to map classes (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 provide the basis for maintaining an accurate map and estimate of condition 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, field-based sampling will be conducted within affected polygons to determine whether it has enough big sagebrush cover over a substantial 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 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-level threats in the CCA. The potential negative effects from annual grasses and other weeds, livestock, and seeded perennial grasses are also important, with each being ranked as a mid-level threat. These five threats are thought to affect sage-grouse populations directly and indirectly through their effects on habitat. The habitat condition monitoring task allows biologists to characterize broad-scale trends in habitat condition over time and to identify changes in condition associated with post-fire recovery, surface disturbance, livestock operations, and spread of introduced herbaceous species.

The habitat condition monitoring task was specifically designed to allow biologists to:

- characterize the vegetative component of 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 or recovery,
- interpret changes to habitat condition within the context of regional vegetation and weather patterns,
- continue to assess progress toward recovery where sagebrush was lost 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.

3.1.2 Methods

Sampling

We established a total of 225 plots for the purpose of monitoring sage-grouse habitat condition. All plot locations were selected using a stratified random sampling design (Shurtliff et al. 2016, Appendix B). Forty-eight annual plots 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 known or 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 23 years, and many of them have likely not burned for at least a few centuries (Forman et al. 2013). 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 location of rotational plots increases sample sizes in burned areas, 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 a 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, with respect to potential threats. The habitat data collected 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, presence of active ant mounds, 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 (Shurtliff et al. 2016, Appendix B).

Data Analyses

Data from plots that are sampled annually are used to evaluate general habitat condition across the INL Site, while rotational plots are used to address specific threats or concerns related to more localized areas (burned areas, grazing allotments, etc.). Annual plot data are used to summarize current habitat condition and to track trends in plant species or functional groups that have the potential to affect overall habitat condition. Analysis of rotational plots are completed once every five years, after data has been collected on all three plot subsets (150 total plots). The most recent analysis of rotational plots was completed in 2016 (see Shurtliff et al. 2017 for details).

Data collected in 2017 from annual plots were used to update habitat summary statistics from 2016, facilitating current comparisons between vegetative characteristics of polygons designated as sage-grouse habitat on the INL Site and those recommended for optimal sage-grouse habitat in guidance documents. Initial trend analysis on data collected from the annual plots began this year on data collected from 2013 through 2017, though results should be interpreted cautiously because enough temporal variability has probably not been captured to consider the resulting trends representative of the potential range of variation. Analysis of the 2017 data includes an overview of precipitation and the potential effects of precipitation patterns on the 2017 habitat condition monitoring data. In addition, vegetation trends over the past five years were interpreted with respect to associated precipitation patterns and within the context of longer-term vegetation trends on the INL Site.

3.1.3 Results and Discussion

Current Habitat Condition

We sampled 75 annual plots for the fifth time between June and August of 2017 (Fig. 3-1). In 2017, 44 of the 48 annual sagebrush habitat plots were assigned (using a dichotomous key to INL Site plant communities; Shive et al. 2011) to communities characterized by sagebrush dominance (Table 3-1a.). Two plots keyed to communities characterized by the codominance of green rabbitbrush (*Chrysothamnus viscidiflorus*) and winterfat (*Krascheninnikovia lanata*), and two keyed to communities characterized by crested wheatgrass (*Agropyron cristatum*) dominance. Results from 2017 were comparable to 2016 results, with the majority of plots assigned to one of the three big sagebrush communities described on the INL Site. Notable differences between 2016 and 2017 include a shift to keying more plots as being dominated specifically by Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) rather than being dominated by mixed and/or hybridized big sagebrush subspecies.

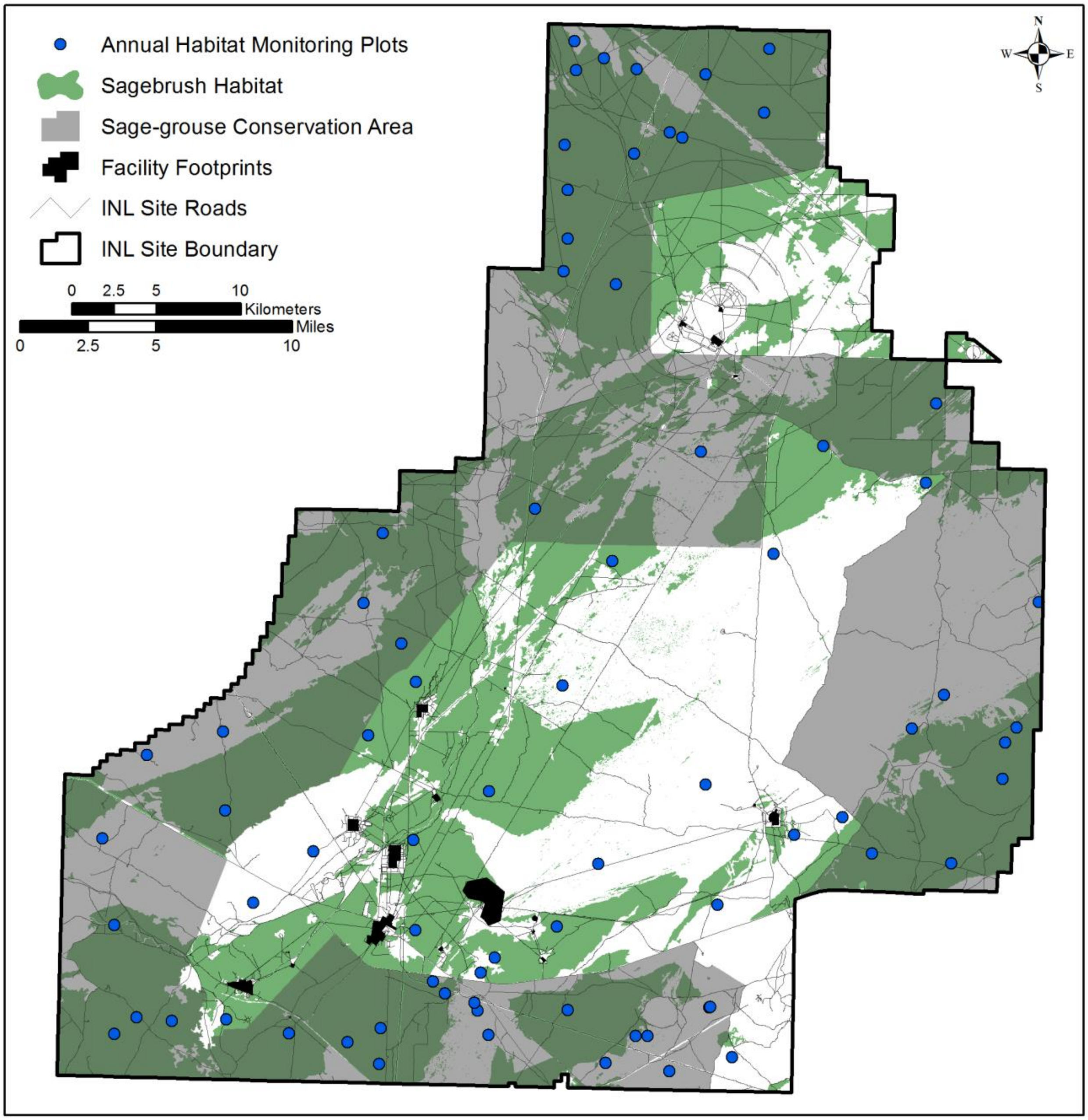

Figure 3-1. CCA sage-grouse habitat condition monitoring plots sampled in 2017 on the INL Site.

Table 3-1a. Plant community types for 48 sagebrush habitat plots in 2017 and 2016 on the INL Site. Plant communities were assigned using a dichotomous plant community key (Shive et al. 2011).

	Number of Plots 2017	Number of Plots 2016
Wyoming Big Sagebrush Shrubland	22	11
Big Sagebrush Shrubland (mixed subspecies)	11	25
Low Sagebrush Dwarf Shrubland	4	2
Three-tip Sagebrush Shrubland	3	3
Basin Big Sagebrush Shrubland	2	2
Black Sagebrush/Sandberg Bluegrass Dwarf-shrub Herbaceous Vegetation	2	2
Green Rabbitbrush – Winterfat Shrubland	2	2
Crested Wheatgrass Semi-natural Herbaceous Vegetation	2	0
Shadscale Dwarf Shrubland	0	1

Of the 27 annual non-sagebrush plots, 15 were assigned to shrublands or shrub herbaceous communities in 2017, and the remaining 12 were assigned to communities which are dominated entirely by herbaceous vegetation (Table 3-1b). With the exception of one plot, green rabbitbrush dominance characterized the plant communities on 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 12 plots assigned to herbaceous vegetation communities, three were dominated by native, perennial grasses, and the other nine were dominated or co-dominated by introduced grasses. In general, more non-sagebrush plots keyed to communities with an herbaceous layer dominated or co-dominated by introduced species than in previous years.

Through the first five 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 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 greater confidence in selecting a dominant subspecies than others. The phenology of big sagebrush may have also been quite different from one year to the next, making the positive identification of a subspecies easier in some years than in others. Given the probability of morphological hybrids across the INL Site (Shive et al. 2011), this result is not unreasonable. Overall, there was greater variability among sample years for communities assigned to 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. Plant community types for 27 non-sagebrush plots in 2017 and 2016 on the INL Site. Plant communities were assigned using a dichotomous plant community key (Shive et al. 2011).

Plant Community	Number of Plots 2017	Number of Plots 2016
Cheatgrass Semi-natural Herbaceous Vegetation	8	7
Green Rabbitbrush Shrubland	5	7
Green Rabbitbrush/Desert Alyssum Shrub Herbaceous Vegetation	4	1
Green Rabbitbrush/Bluebunch Wheatgrass Shrub Herbaceous Vegetation	3	1
Green Rabbitbrush/Streambank Wheatgrass (Western Wheatgrass) Shrub Herbaceous Vegetation	2	2
Bluebunch Wheatgrass – Sandberg Bluegrass Herbaceous Vegetation	2	3
Needle and Thread Herbaceous Vegetation	1	2
Shadscale Dwarf Shrubland	1	1
Tall Tumblemustard – Cheatgrass Semi-natural Herbaceous Vegetation	1	0
Indian Ricegrass Herbaceous Vegetation	0	3

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 2017 sage-grouse sign (scat) was present on 20 of the 48 (42%) annual sagebrush habitat plots and at least some of the scat appeared to be from the current year on three of those plots. Sage-grouse scat wasn't noted on any of the 27 non-sagebrush plots. Plots in sagebrush habitat have generally experienced more use over the past five years than plots in non-habitat.

Active ant mound counts were added to the sample protocol in 2014. In 2017, 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 four. Of the 34 plots with active ant mounds, 23 were sagebrush habitat plots (48% of the plots sampled) and 11 were non-sagebrush plots (41% of the plots sampled). Between 2014 and 2017 the number of plots with active ant mounds has ranged from 21 to 34. There were only two thatch mounds documented in 2017, one on a sagebrush habitat plot and one on a non-sagebrush plot. The abundance of crater mounds was slightly higher ($\bar{x}$=0.70) on non-sagebrush plots than ion sagebrush plots ($\bar{x}$=0.60). 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 9 (12%) of the annual habitat condition monitoring plots in 2017. Livestock manure was present in all nine plots, and trails were identified in two of the plots. All of the plots with documented anthropogenic influence are located within allotment boundaries. Six of the nine plots were located in areas currently designated as sagebrush habitat.

In 2017, absolute cover from sagebrush species averaged about 22% across the annual sagebrush habitat monitoring plots (Table 3-2a). On non-sagebrush monitoring plots, absolute sagebrush cover averaged approximately 0.3% during 2017 (Table 3-2b). Although this represents an increase over the past four years, sagebrush still contributes very little to total vegetative cover in previously burned, non-sagebrush polygons. The few sagebrush individuals that were present on those plots during the 2017 sample season were shorter, on average, than sagebrush individuals on sagebrush habitat plots (Tables 3-2a). Conversely, average cover and height of perennial grasses and forbs was greater on non-sagebrush plots than on sagebrush habitat plots in 2017. Perennial grass/forb height in 2017 was nearly 10 cm greater on sagebrush habitat plots than in 2016, but still not as high as on non-sagebrush plots in 2017. On non-sagebrush plots, perennial grass/forb height was comparable between the two years (Table 3-2b). Sagebrush density estimated across the annual sagebrush habitat plots was lower in 2017 than in 2016 (Tables 3-2a and 3-2b), but recruitment events on a handful of plots likely skewed the data in both years. When plots with seedling counts outside the historical range of variability are removed for both years, sagebrush density in 2017 was about 1 individual/m^2 greater than in 2016. It was also 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). The LTV Transects include vegetation monitoring data for the INL from 1950 through 2016; see Forman et al. 2013 for a description of the LTV project.

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 2017. The number marked by an asterisk (*) includes five plots with notable sagebrush seedling germination events. Most seedlings in these plots will fail due to self-thinning; the adjusted mean sagebrush density (without the five high-germination plots) is 4.21 individuals/m^2.

	Mean Cover (%)	Mean Height (cm)	Mean Density (individuals/m^2)
Sagebrush Habitat Plots (n = 48)			
Sagebrush	22.14	50.38	7.02*
Perennial Grass/Forbs	18.29	32.55	
Non-sagebrush Plots (n = 27)			
Sagebrush	0.32	35.43	0.12
Perennial Grass/Forbs	23.88	38.57	

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 2016. The number marked by an asterisk (*) includes seven plots with notable seedling germination events. Most seedlings in these plots will fail due to self-thinning; the adjusted mean sagebrush density (without the seven high-germination plots) is 3.09 individuals/m^2.

	Mean Cover (%)	Mean Height (cm)	Mean Density (individuals/m^2)
Sagebrush Habitat Plots (n = 48)			
Sagebrush	21.89	49.44	11.41*
Perennial Grass/Forbs	12.64	24.49	
Non-sagebrush Plots (n = 27)			
Sagebrush	0.25	39.72	0.08
Perennial Grass/Forbs	23.05	33.65	

Absolute total vegetation cover averaged across sagebrush habitat plots was about 15% higher in 2017 than in 2016 (Table 3-3a). About half of the total vegetation cover was from shrubs in 2017, and nearly 70%

of the shrub cover was from *Artemisia* species. Overall, sagebrush contributed 34% of the total vegetation cover on sagebrush habitat plots. Big sagebrush (*Artemisia tridentata)* was the most abundant and widespread sagebrush species; however, threetip (*Artemisia tripartita*), black sagebrush (*Artemisia nova*), and low sagebrush (*Artemisia arbuscula*) were locally abundant on the limited number of plots where they each occurred. Perennial grass cover increased from about 11% to 16% between 2016 and 2017. Overall, shrub cover remained relatively stable from 2013 to 2017, but perennial grass cover fluctuated from less than 3% in 2014 to more than 16% in 2017. Bottlebrush squirreltail (*Elymus elymoides*) was the most abundant perennial grass across the sagebrush habitat plots in 2017 while Indian ricegrass (*Achnatherum hymenoides*) was the most abundant perennial grass in 2016. Total cover from introduced species on sagebrush habitat plots was less than 4% in 2016 and was just over 11% in 2017. Cheatgrass cover has averaged <1% absolute cover on the sagebrush habitat plots between 2013 and 2016, but increased to 4% in 2017.

Table 3-3a. Mean absolute cover by species for 48 sagebrush habitat monitoring plots on the INL Site in 2017 and 2016. An asterisk (*) Indicates that this species was undetectable using the current sampling methodology in a given sample year. See Appendix A for a list of common names.

Plant Species	Absolute Cover (%) 2017	Absolute Cover (%) 2016
Native		
Shrubs		
Artemisia tridentata	18.13	17.82
Chrysothamnus viscidiflorus	6.38	5.53
Artemisia tripartita	1.61	1.63
Artemisia arbuscula	1.47	1.58
Atriplex confertifolia	1.15	1.16
Artemisia nova	0.93	0.86
Krascheninnikovia lanata	0.85	0.86
Linanthus pungens	0.21	0.13
Eriogonum microthecum	0.11	0.08
Tetradymia canescens	0.07	0.06
Others (n = 2, 2)	0.05	0.05
Total Native Shrub Cover	**30.97**	**29.76**
Succulents		
Opuntia polyacantha	**0.09**	**0.11**
Perennial Graminoids		
Elymus elymoides	5.51	2.65
Poa secunda	4.25	2.09
Achnatherum hymenoides	2.42	2.92
Pseudoroegneria spicata	1.43	1.55
Elymus lanceolatus	1.32	0.96

Plant Species	Absolute Cover (%) 2017	Absolute Cover (%) 2016
Hesperostipa comata	0.68	0.77
Pascopyrum smithii	0.51	0.36
Carex douglasii	0.31	0.23
Total Native Perennial Graminoid Cover	**16.43**	**11.54**
Perennial Forbs		
Schoenocrambe linifolia	0.74	0.33
Phlox hoodii	0.44	0.25
Sphaeralcea munroana	0.21	0.24
Phlox aculeata	0.11	0.05
Astragalus filipes	0.08	0.01
Erigeron pumilus	0.05	0.03
Arabis cobrensis	0.01	0.07
Penstemon pumilus	0.00	0.07
Others (n = 16, 8)	0.23	0.06
Total Native Perennial Forb Cover	**1.86**	**1.10**
Annuals and Biennials		
Descurainia pinnata	1.04	0.18
Lappula occidentalis	1.28	0.28
Cordylanthus ramosus	0.69	0.08
Gayophytum diffusum	0.18	0.03
Cryptantha scoparia	0.16	0.00
Mentzelia albicaulis	0.08	0.01
Eriastrum wilcoxii	0.07	0.03
Chenopodium leptophyllum	0.06	0.21
Gilia sinuata	0.03	0.08
Others (n = 7, 2)	0.04	0.01
Total Annual and Biennial Forb Cover	**3.63**	**0.90**
Total Native Cover	**52.97**	**43.41**
Introduced		
Perennial Grasses		
Agropyron cristatum	**2.06**	**1.38**
Annuals and Biennials		
Alyssum desertorum	4.08	0.69
Bromus tectorum	4.00	0.51
Halogeton glomeratus	0.83	1.25

Plant Species	Absolute Cover (%) 2017	Absolute Cover (%) 2016
Descurainia sophia	0.08	0.00
Others (n = 4,3)	0.02	0.01
Total Introduced Annual and Biennial Cover	**9.01**	**2.47**
Total Introduced Cover	**11.06**	**3.85**
Total Vascular Plant Cover	**64.04**	**47.26**

On the non-sagebrush plots, only about 17% of total vascular plant cover was from shrubs in 2017 and green rabbitbrush provided more than 90% of the cover from shrubs. Perennial grasses and forbs were responsible for about 57% of the cover from native species on non-sagebrush plots in 2017. Non-native herbaceous species were more abundant than native herbaceous species when averaged across non-sagebrush plots. Sandberg bluegrass (*Poa secunda*) was the most abundant native herbaceous species in 2017 with about 5% absolute cover. Average absolute cover from native, perennial grasses on non-habitat plots remained greater than on sagebrush habitat plots, and cover from introduced herbaceous species was about three times greater on non-habitat plots (Table 3-3b). Cheatgrass has been much more abundant on non-habitat plots than on sagebrush habitat plots in all five sample years. In 2017, cheatgrass cover was particularly high on non-sagebrush plots when compared to the same subset of plots from previous years.

Table 3-3b. Mean absolute cover by species for 27 non-sagebrush monitoring plots on the INL Site in 2017 and 2016. An asterisk (*) indicates that this species was undetectable using the current sampling methodology in a given sample year. See Appendix A for a list of and common names.

Plant Species	Absolute Cover (%) 2017	Absolute Cover (%) 2016
Native		
Shrubs		
Chrysothamnus viscidiflorus	11.82	11.28
Atriplex confertifolia	0.34	0.37
Artemisia tridentata	0.32	0.24
Tetradymia canescens	0.11	0.14
Eriogonum microthecum	0.09	0.05
Gutierrezia sarothrae	*	0.07
Krascheninnikovia lanata	0.06	0.03
Others (n = 4, 1)	0.12	0.02
Total Native Shrub Cover	**12.86**	**12.19**
Succulents		
Opuntia polyacantha	**0.13**	**0.11**
Perennial Graminoids		
Poa secunda	4.97	1.94
Pseudoroegneria spicata	4.22	5.12
Hesperostipa comata	3.00	3.84
Achnatherum hymenoides	2.86	4.01
Elymus elymoides	2.36	1.59
Elymus lanceolatus	1.94	3.04
Pascopyrum smithii	1.51	0.69
Leymus flavescens	0.98	0.81
Carex douglasii	0.13	0.19
Others (n = 2, 1)	0.04	0.01
Total Native Perennial Graminoid Cover	**22.00**	**21.23**
Perennial Forbs		
Sphaeralcea munroana	0.50	0.49
Phlox hoodii	0.35	0.36
Phlox aculeata	0.29	0.27
Erigeron pumilus	0.16	0.24
Crepis acuminata	0.15	0.17
Astragalus filipes	0.12	*

Plant Species	Absolute Cover (%) 2017	Absolute Cover (%) 2016
Schoenocrambe linifolia	0.10	0.07
Machaeranthera canescens	0.03	0.06
Lomatium triternatum	*	0.05
Others (n = 11, 8)	0.17	0.12
Total Native Perennial Forb Cover	**1.88**	**1.82**
Annuals and Biennials		
Lappula occidentalis	0.56	0.44
Descurainia pinnata	0.33	0.17
Mentzelia albicaulis	0.22	0.15
Eriastrum wilcoxii	0.08	0.26
Gayophytum diffusum	0.02	0.14
Gilia sinuata	*	0.12
Chenopodium leptophyllum	0.00	0.07
Others (n = 7, 6)	0.10	0.04
Total Native Annual and Biennial Cover	**1.31**	**1.39**
Total Native Cover	**38.19**	**36.74**
Introduced		
Perennial Grasses		
Agropyron cristatum	**0.81**	**0.71**
Perennial Forbs		
Carduus nutans	*	**0.04**
Annuals and Biennials		
Bromus tectorum	28.57	16.98
Alyssum desertorum	4.67	1.95
Sisymbrium altissimum	0.54	0.12
Halogeton glomeratus	0.49	2.38
Salsola kali	0.41	1.93
Descurainia sophia	0.17	*
Others (n = 2, 1)	0.02	0.00
Total Introduced Annual and Biennial Cover	**34.88**	**23.36**
Total Introduced Cover	**35.69**	**24.11**
Total Vascular Plant Cover	**73.87**	**60.85**

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). On 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, about 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. About half of the herbaceous height on sagebrush plots was from perennial grasses, and slightly less than half the herbaceous height on non-sagebrush plots was from perennial grasses. For both sagebrush habitat plots and non-sagebrush plots, height estimates from annuals were primarily from introduced species in 2017. Overall, mean height for shrubs on both sagebrush habitat and non-sagebrush plots remained about the same between 2016 and 2017, and mean height of herbaceous species was higher in each functional group 2017. However, a greater proportion of the herbaceous height estimate on both sagebrush habitat and non-sagebrush plots in 2017 was from functional groups of shorter-statured annual species.

Table 3-4a. Vegetation height by functional group for 48 sagebrush habitat monitoring plots on the INL Site in 2017 and 2016.

	2017		2016	
	Mean Height (cm)	Proportion of Sample	Mean Height (cm)	Proportion of Sample
Shrubs				
Sagebrush Species	50.38	0.70	49.44	0.69
Other Species	27.30	0.30	25.33	0.31
Herbaceous Species				
Perennial Grasses	35.11	0.50	26.04	0.64
Perennial Forbs	16.53	0.08	12.07	0.08
Annual Grasses	27.73	0.09	18.58	0.04
Annual Forbs	15.85	0.33	10.38	0.24

Table 3-4b. Vegetation height by functional group for 27 non-sagebrush monitoring plots on the INL Site in 2017 and 2016.

	2017		2016	
	Mean Height (cm)	Proportion of Sample	Mean Height (cm)	Proportion of Sample
Shrubs				
Sagebrush Species	35.43	0.10	39.72	0.07
Other Species	29.73	0.90	28.71	0.93
Herbaceous Species				
Perennial Grasses	39.62	0.42	36.40	0.47
Perennial Forbs	16.56	0.02	12.09	0.06
Annual Grasses	22.71	0.44	18.11	0.28
Annual Forbs	15.82	0.12	10.55	0.20

In 2017, sagebrush density ranged from less than one to approximately 77 individuals/m^2 on the sagebrush habitat plots (Table 3-5a). In 2016, seven plots appear to have experienced episodic recruitment events resulting in 20 or more individuals per square meter (the maximum in previous sample years has never been more than 16 individuals/m^2). Because most individuals counted in those plots were recently germinated juveniles, they will likely be lost to self-thinning over the next year. Therefore, we adjusted the mean density to remove short-term outliers. We observed a similar phenomenon on five plots located in a different region of the INL Site in 2017 and made similar outlier adjustments. Adjusted mean density (without the high-germination plots) was more than one individual/m^2 greater in 2017 than in 2016 (Table 3-5a and Table 3-5b). On the non-sagebrush plots, sagebrush density ranged from zero to a maximum of about one individual/m^2. Juvenile sagebrush frequency is a proportion of the eight density transects on each plot that contain juvenile shrubs. Averaged across all sagebrush habitat plots, juvenile shrubs were present on almost one out of every two sample transects. On non-habitat plots, juveniles were recorded on five transect across four plots in 2017 (Table 3-5a).

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 2017. The number indicated by an asterisk (*) includes five plots with notable seedling germination events and most seedlings in these plots will fail due to self-thinning; the adjusted mean sagebrush density (without the seven high-germination plots) is 4.21 individuals/m2.

	Sagebrush	Non-sagebrush
Mean Density (individuals/m^2)	7.02*	0.12
Minimum Density (individuals/m^2)	0.65	0.00
Maximum Density (individuals/m^2)	76.55	1.53
Mean Juvenile Frequency	0.43	0.02

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 2016. The number marked by an asterisk (*) includes seven plots with notable seedling germination events and most seedlings in these plots will fail due to self-thinning; the adjusted mean sagebrush density (without the seven high-germination plots) is 3.09 individuals/m2.

	Sagebrush	Non-sagebrush
Mean Density (individuals/m^2)	11.41*	0.08
Minimum Density (individuals/m^2)	0.43	0.00
Maximum Density (individuals/m^2)	130.13	1.20
Mean Juvenile Frequency	0.27	0.00

Precipitation

Both long-term climatic averages and short-term weather patterns influence the structure and species composition of plant communities, which locally determines the amount and condition of sagebrush habitat available at any given time. Over ecologically-meaningful periods of time (e.g. decades to centuries in arid systems), short-term shifts in precipitation may just contribute “noise” to overall trends in the trajectory of a plant community. However, patterns of seasonality and recent extreme events can be useful for understanding habitat condition at a given point in time. In the absence of an acute disturbance like wildland fire, precipitation is the single most important factor determining changes in plant communities from one year to the next (Forman et al. 2013).

Precipitation records indicate that the INL Site has been drier since 2000 than it was in the 50 years prior, with dry years now occurring more frequently and to greater extremes (Fig. 3-2). Mean annual precipitation from 1950-2000 was about 218 mm, while mean annual precipitation from 2001-2017 was only about 178 mm. The two driest years on record have also occurred since 2000, once in 2003 and again in 2013. The seasonality of precipitation over the past five years has shifted noticeably when compared to the previous five years as well. From 2007 through 2010, the wettest season generally occurred during April, May and June, which have historically been the wettest months on the INL Site (Fig. 3-3). From 2014 through 2017, however, some of the wettest months of the year have occurred in late summer and fall, a shift which deviates from long-term averages.

Total annual precipitation for 2017 was above average (Fig. 3-2). As with several recent years, the timing of precipitation in 2017 deviated markedly from historical patterns (Fig. 3-3). The first year of data collection for this monitoring task, 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. Almost half of the total precipitation from 2014 fell in August. Mean August precipitation, is about 13 mm (0.5 in.); total August precipitation from 2014 was 102 mm (4.0 in.). In 2015, May was abnormally wet, with a total of nearly 60 mm (2.4 in.), which is twice the historical monthly average. September and October of 2016 had more than three times average historical precipitation for the same time period and more than half of the annual precipitation fell after the summer growing season. Snowpack through the winter of 2016/2017 was much higher than average and is reflected in the December 2016 through February 2017 precipitation data. These short-term patterns, would certainly favor some plant species and functional groups over others.

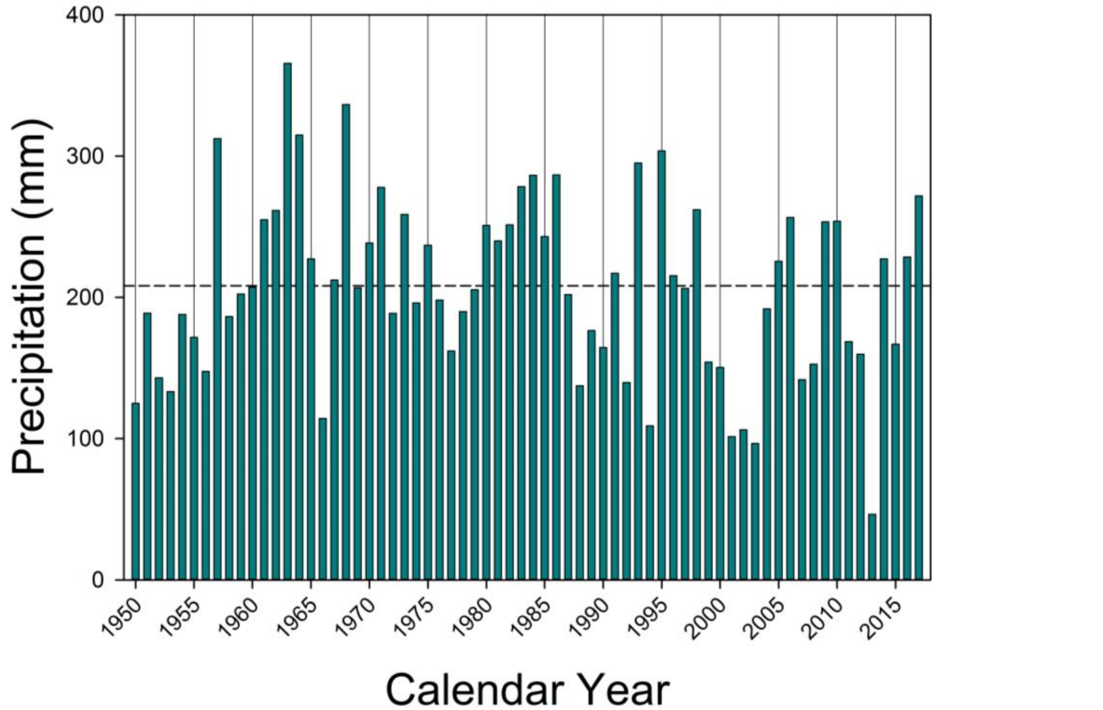

Figure 3-2. Total annual precipitation from 1950 through 2017 at the Central Facilities Area, INL Site. The dashed line represents mean annual precipitation.

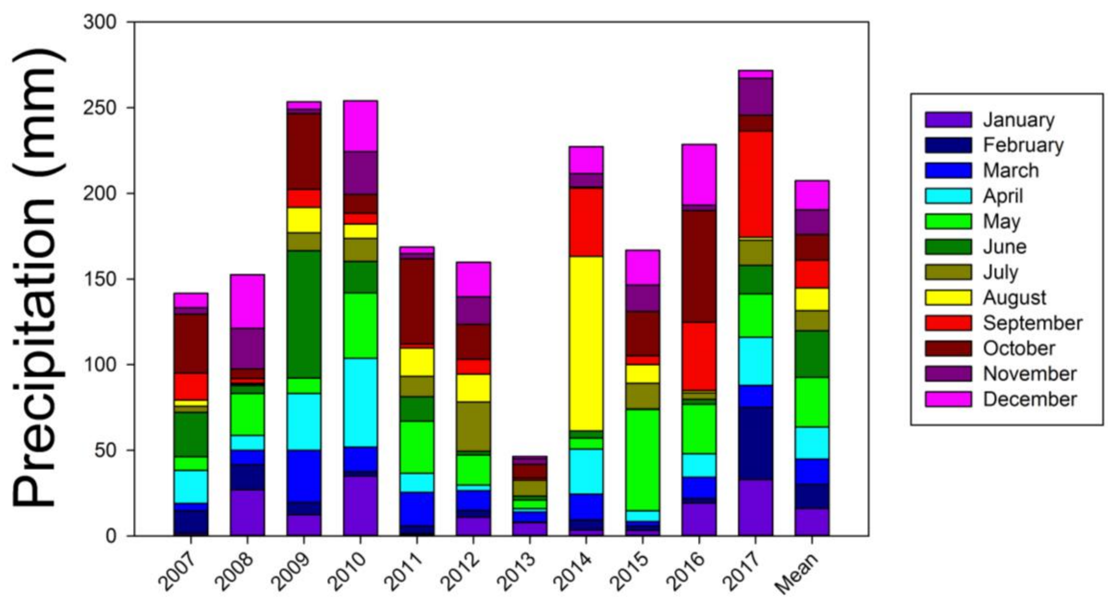

Figure 3-3. Annual precipitation by month from the Central Facilities Area, INL Site. Mean monthly precipitation includes data from 1950 through 2017.

Habitat Condition Trends

From 2013 through 2017 sagebrush cover and cover from all other shrub species has remained quite stable (Fig. 3-4a) on sagebrush habitat plots. Native perennial grass cover, however, has increased markedly over the past five years, and native annual and biennial forbs increased slightly between 2016 and 2017. Cover from introduced species (Fig. 3-4b) on sagebrush habitat plots has been low relative to native species, but introduced species do trend upward over the sample period (Fig. 3-4b).

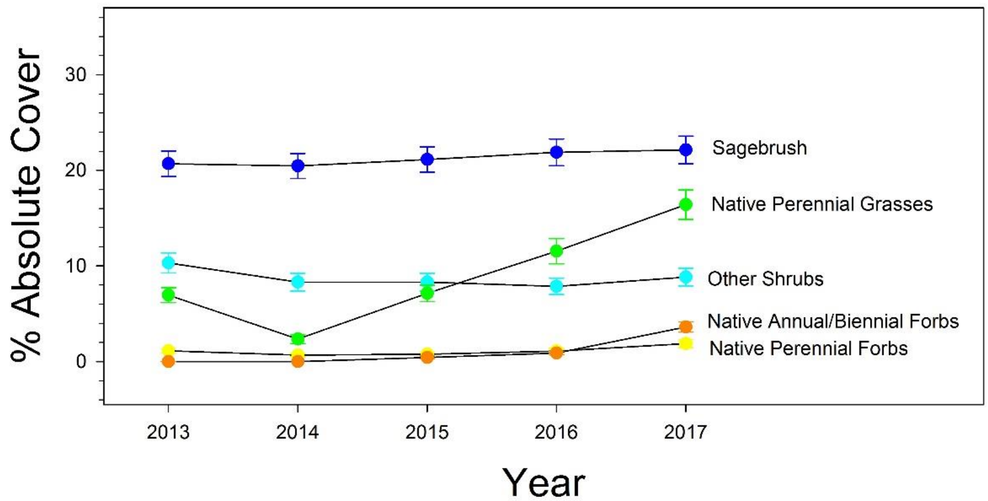

Figure 3-4a. Mean cover from functional groups of native species in sagebrush habitat plots (*n*=48) on the INL Site from 2013 through 2017. Error bars represent ± 1 SE.

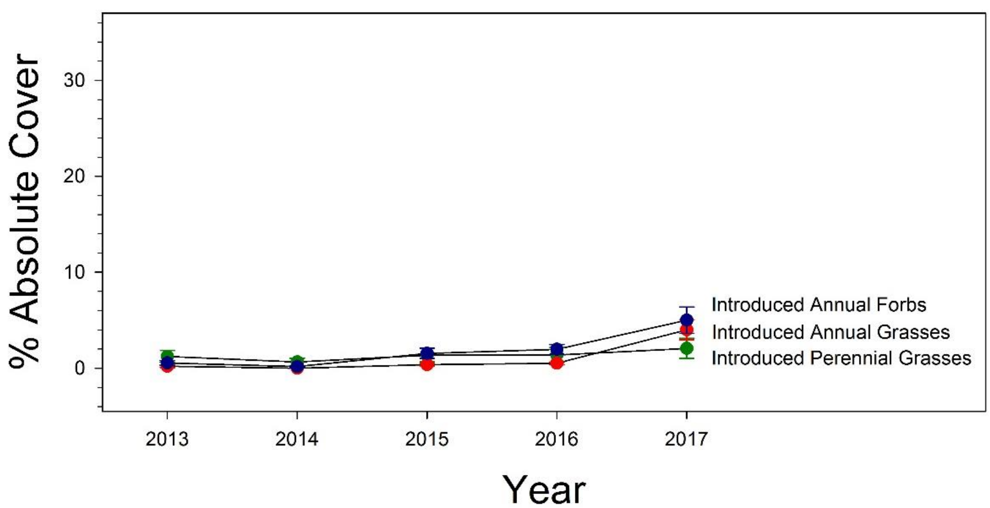

Figure 3-4b. Mean cover from functional groups of introduced species in sagebrush habitat plots (*n*=48) on the INL Site from 2013 through 2017. Error bars represent ± 1 SE.

On non-sagebrush monitoring plots, cover from shrubs, primarily green rabbitbrush, has been stable from 2013 to 2017 (Fig. 3-5a) and has been comparable to cover from the same functional group on sagebrush habitat monitoring plots (Fig. 3-4a). Native perennial grass cover increased notably from 2014 to 2015 and has remained at about 20% since 2015. Cover from introduced annual forbs also increased from 2014 to 2015 and has remained at about the same cover level since 2015. The most substantial change in cover on the non-sagebrush plots through the sample period is from cheatgrass (Fig. 3-5b). Cheatgrass cover increased from about 3% absolute cover in 2014 to nearly 30% absolute cover in 2017. The recent increase in cheatgrass cover does not appear to be at the expense of species in other functional groups.

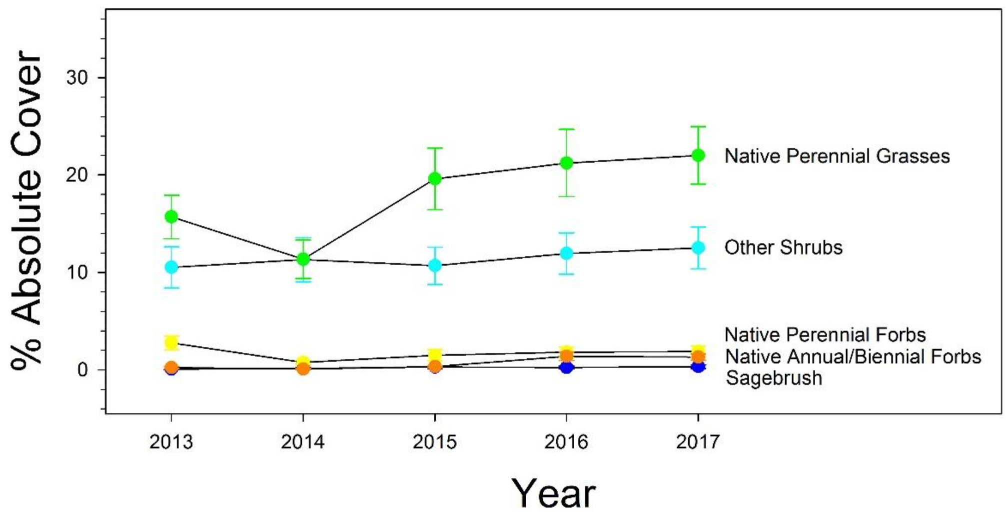

Figure 3-5a. Mean cover from functional groups of native species in non-sagebrush habitat plots (*n*=27) on the INL Site from 2013 through 2017. Error bars represent ± 1 SE.

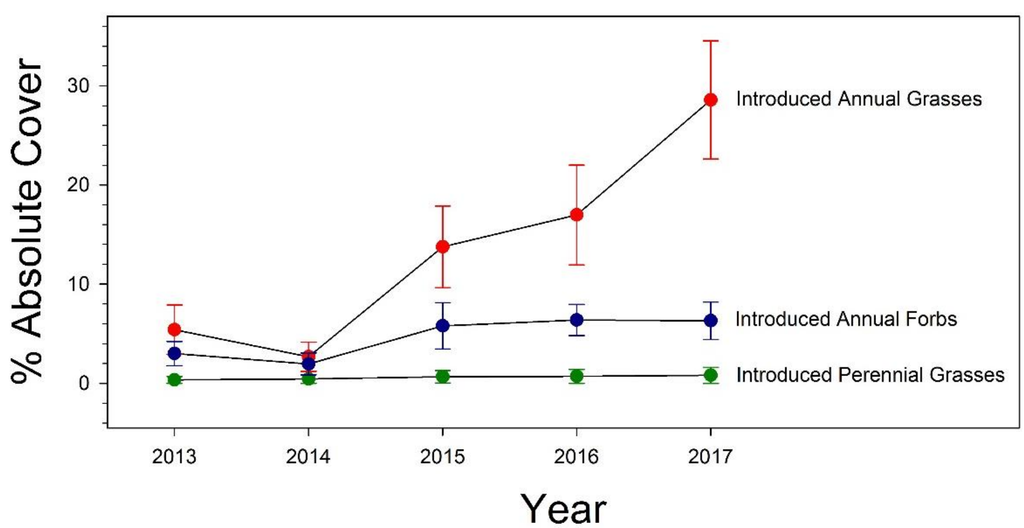

Figure 3-5b. Mean cover from functional groups of introduced species in non-sagebrush habitat plots (*n*=27) on the INL Site from 2013 through 2017. Error bars represent ± 1 SE.

3.1.4 Summary of Habitat Condition

Mean sagebrush cover from annual sagebrush habitat plots, and the sagebrush habitat polygons they represent, is near the upper end of the range suggested for optimal sage-grouse breeding (15-25%) and brood-rearing (10-25%) habitat in arid sites (Connelly et al. 2000). Mean sagebrush height is also within the suggested optimal range (40-80 cm [16-32 in.]). Perennial grass/forb mean height values were above the minimum value recommended (18 cm [7 in.]) in current sage-grouse habitat guidelines (Connelly et al. 2000). Average perennial grass/forb cover on sagebrush habitat plots was about 18% in 2017, which is above the minimum specified for breeding and brood-rearing habitat (15%), but it was higher in 2017 (18%) than in any of the four previous years and was likely at the upper end of the range of variability for this functional group on the INL Site.

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, but we can reasonably extrapolate trends for general functional groups. Overall trends in herbaceous cover on the LTV plots indicate that perennial grass and forb cover in good-condition sagebrush steppe on the INL Site are probably 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). High herbaceous cover values, like those from 2017, are not typical and likely result from unusual precipitation patterns.

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 through 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. The effects of these precipitation events on herbaceous vegetation may have carried over into 2016 as well. The above average snowpack of the winter of 2016/2017 provided ample spring moisture, which would also benefited herbaceous species. As with perennial herbaceous species, mean cheatgrass cover as well as cover from all annual species was probably uncharacteristically low in 2014 and was probably higher than normal in 2016 and 2017. Because more of the vegetation cover on non-sagebrush (burned) plots is from herbaceous species, they appear to be more responsive to precipitation and less stable in terms of total cover and species composition from one year to another.

Similar fluctuations in the abundance of herbaceous functional groups have been noted in the LTV dataset (Forman et al. 2013). Although the recent increase in cheatgrass on monitoring plots for this task is concerning, especially in the burned non-sagebrush habitat plots, longer-term data from the LTV show both upward and downward trends in cheatgrass abundance from one time period to another. The LTV data also indicate that cheatgrass occurrence is just as spatially variable as it is temporally variable. Cheatgrass cover actually decreased from about 5% average cover to about 1.5% average cover between the 2011 and 2016 LTV sample periods (unpublished data). The threat of cheatgrass to sagebrush habitat should not be underestimated, but five years of trend data are likely not enough to fully understand the nuances of invasion dynamics.

Continued monitoring is necessary to improve our understanding of how natural variation of herbaceous plant cover and height within sagebrush habitat that is used by sage-grouse at the INL Site relates to standard guidelines (Connelly et al. 2003). As we improve our understanding of the natural variation of each functional plant group, especially those which appear to be particularly sensitive to weather, like herbaceous perennials and introduced annuals, we will be better positioned to recognize degraded conditions and take action to ameliorate the problem. Over time, biologists will be able to establish a reasonable "baseline" for herbaceous species across sage-grouse habitat and non-habitat plots rather than rely upon general guidelines summarized from studies that occurred across the sage-grouse range (Connelly et al. 2003). 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.

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 identified as one of the primary causes of decline in sage-grouse populations (Idaho Sage-grouse Advisory Committee 2006, USFWS 2013). Direct loss of sagebrush habitat on the INL Site has occurred through several mechanisms including wildland fire and infrastructure development. 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 recover naturally or are restored 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 can routinely compare new imagery as it becomes available with existing land cover data from the most recently completed vegetation classification and mapping project. Ground-based point surveys and changes in plant species cover and composition documented through Task 5 (Section 3.1) 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 2012 baseline has been identified as a conservation trigger in the CCA (DOE-ID and USFWS 2014). The goal of Task 6 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 add 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 Task 5. 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.

3.2.2 Methods

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 global positioning system (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), actual fire edges were digitized from high resolution imagery to maintain spatial consistency across the map. Before new vegetation class delineations are produced inside fire boundaries, 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.

3.2.3 Results and Discussion

The distribution and area of sagebrush habitat remained unchanged in 2017 with no losses occurring within the SGCA or elsewhere on the INL Site. Only one small roadside fire (<0.1 ha [0.25 ac]) was documented on the INL Site in 2017, and it did not occur within sagebrush habitat. No additional field sampling was conducted within recently burned areas because a new vegetation community classification is currently pending, and all recently burned areas will be updated and published when the new vegetation map for the INL Site is completed in 2019.

4.0 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 (Chapter 5). Task 5, which was reported above (Section 3-1), provides information on the status of sagebrush habitat, and potential impacts to that habitat from wildland fire and livestock grazing. Some tasks, however, were designed specifically to gather baseline and continuing information about a threat because associated conservation measures could not be implemented without this *a priori* information. The following sections report on Tasks 4, 7, and 8, which were developed to address the threats of raven predation (Task 4), annual grasslands (Task 7), and infrastructure development (Task 8). Over time, these tasks will provide crucial 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 a native species in the Snake River Plain that historically constructed nests on elevated 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 such as power transmission lines, towers, and building platforms, with transmission line structures supporting the most nests (Howe et al. 2014; Shurtliff et al. 2017). These territory-holding nest 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 to deter raven nesting on utility structures (*Conservation Measure 10*; DOE and USFWS 2014). Before doing so, we must establish where ravens nest in highest density so that actions to deter nesting can be most effective. The timeframe for initiating this research (i.e. Conservation Measure 10) will be influenced by results from inter-annual trend analysis. If the number of raven nests on infrastructure is shown to be stable or decreasing, there would be less impetus for DOE to expend resources to deter nesting. Conversely, if raven use of infrastructure for nesting is shown to be increasing, DOE may prioritize funding to investigate how to successfully deter raven nesting. One benefit of Task 4 is that annual surveys will establish a baseline so that continued monitoring following deterrent installation can address whether actions had an impact on the number of raven nests on transmission structures.

The primary objective of Task 4 is to determine how many active raven nests are supported by anthropogenic structures on the INL Site each year and to evaluate the inter-annual trend. We also quantify distances between nearest nests of both ravens and raptors because this information provides insight into the home-range size of ravens and, consequently, the capacity of the landscape on the INL Site to support an increasing number or nesting ravens.

4.1.2 Methods

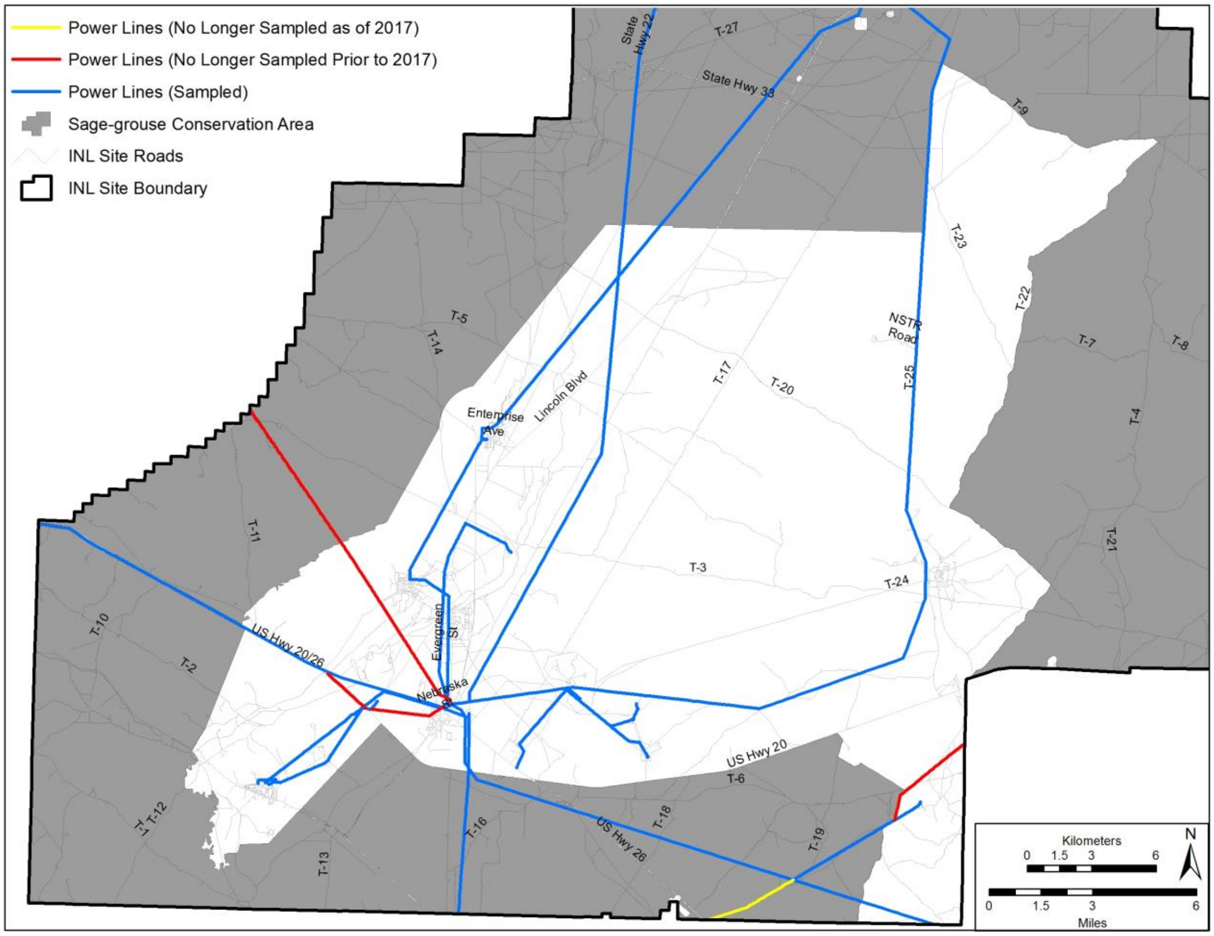

Figure 4-1. The southern portion of the INL Site, highlighted electrical power distribution line sections that were excluded in 2016 and 2017 from raven nest surveys.

Between April 3 and May 31, 2017, we systematically surveyed nearly all power lines (transmission lines=231 km, distribution lines=37 km), towers, raptor nesting platforms and facilities on the INL Site that had been surveyed the previous year (Shurtliff et al. 2017). The only exception was that we excluded a 4.3-km segment along a power distribution line comprised of a series of T-pole structures with single cross arms (Fig. 4–1). No ravens were observed nesting on this segment during the past four years and we concluded that the structures cannot support a raven nest throughout the breeding season. Therefore, this segment will not be surveyed in the future. We conducted all surveys following methods described elsewhere (Shurtliff et al. 2015).

All power line segments included in this study were surveyed four times during April and May, with each survey being separated by at least 14 days. Facilities, towers, and other infrastructure were surveyed at least twice, primarily in April (Shurtliff et al. 2015). If a nest was seen on a power line, but its activity level could not be confirmed, we revisited the nest again before the next formal survey of that power line section commenced. As a result, nests that remained unconfirmed throughout the nesting season were visited twice as often as nests with confirmed activity. This level of effort increased our confidence at the end of the season that remaining unconfirmed nests had not been occupied by ravens during the breeding season.

Trend Analysis

The number of raven nests classified as active each year is an index of the number of mated pairs on the INL Site that use infrastructure as a nesting substrate. Throughout the two-month survey period, nests occasionally blow down or are abandoned. If a mated pair loses a nest and rebuilds a second nest during the survey period, our sampling method records two active nests. This artifact of our sampling scheme produces an unknown level of variability that potentially affects the accuracy of raven nest trend data. To reduce this variability, we calculated an adjusted raven nest total as described elsewhere (Shurtliff et al. 2017).

Nearest-Nest Analysis

To indirectly examine how closely territory-holding raven pairs are willing to nest (and thus to project how many pairs potentially could be sustained on the INL Site), we started by identifying all raven nests that were within 2 km of each other. For each nest, we used a GIS measuring tool at a set scale (1:2,000) to manually calculate the distance to the nearest raven nest and, if a raptor nest was closer, to the nearest raptor nest. We did not count nests as "nearest" unless occupant activities from both nests overlapped temporally. When a single raven pair presumably established two or more nests, we excluded nearest-nest distances between nests from the same putative breeding pair. However, we calculated distances from each of the shared nests to nearby, non-related nests and included the distance that was the shortest. We did so because a primary objective of this analysis was to understand how close ravens are willing to nest to each other.

4.1.3 Results

We observed 43 active raven nests on man-made structures or in trees associated with facilities along survey routes (Tables 4-1, 4-2). Twenty-nine of the 43 nests were on power line structures. However, we merged two pairs of nests, N294/N247 and N227/N154, reducing the total number of active raven nests (i.e. adjusted total) to 41, with 27 (66%) of those on power lines. The two nests in each merged set were likely tended by the same raven pairs (Shurtliff et al. 2017). We observed that N294 was partially built in mid–April during one survey, but later that nest fell to the ground. After the last observation of activity on N294, a new nest (N247) appeared 1,900 m away and was attended by ravens. In the second case, a raven was initially seen on N227, but during the following survey, observers recorded a red-tailed hawk (*Buteo jamaicensis*) tending the nest and a new, active raven nest had appeared 440 m away.

We were unable to confirm nesting activity of 12 nests, half of which were located on transmission structures and the other half were in ornamental trees and on building structures associated with facilities. Nests in trees and on building platforms persist for many years because they are protected from strong winds, and it is unlikely that any of these nests were active in 2017. At four of the transmission structure sites, unoccupied nests were observed during the first survey, but those nests were on the ground during all subsequent surveys. Only two nests on power transmission structures that remained unconfirmed through the end of the surveys remained in place on the transmission structure. It is unlikely that nests with unconfirmed activity were occupied this year, especially those associated with facilities. However, it is possible that we failed to detect nest activity at some power line nests, especially if birds attended and then abandoned nests early in the season.

Power Lines

We completed four surveys of all transmission and distribution lines on the INL Site that could potentially support a raven nest. The first two surveys occurred from April 3–May 3, and the second two occurred from 2 May–31 May, 2017. All 27 raven nests associated with power lines were on transmission rather than distribution structures. This includes one nest that was on a large lattice structure used for power grid tests next to a transmission line. Twelve (43%) of the power line nests were within the SGCA (i.e. the SGCA bordered at least one side of the nest). Fourteen nests were on “Closed H Cable” structures, 11 were on “Sloped H”, one was on an “Open H” structure, two were on “Hybrid” structures, and one was on the lattice structure mentioned above (see Shurtliff et al. 2017 for pictures of structures).

Facilities

We surveyed the same 13 facilities in 2017 that were surveyed in 2016, between April 4 and May 3, 2017 (Table 4-1). We observed 11 active raven nests at nine facilities, including three nests at the U.S. Sheep Experiment Station. Except for the U.S. Sheep Experiment Station, no facility supported more than a single active raven nest.

Table 4-1. Facilities surveyed for raven nests in 2017. 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	2	22	Yes	Building Platform
Central Facilities Area Main Gate	2	15	Yes	Building Platform
Critical Infrastructure Test Range Complex (CITRC)	2	16**	Yes	Light Fixture
Experimental Breeder Reactor I	2	15	Yes	Building Platform
U.S. Sheep Experiment Station	2	16	Yes (3 nests)	Ornamental Trees
Idaho Nuclear Technology and Engineering Center	2	16	Yes	Effluent Stack
Materials & Fuel Complex /Transient Reactor Test Facility	2	21	Yes	Building Platform
Naval Reactors Facility (NRF)	2*	18	Yes	Building Platform
Specific Manufacturing Capability/Test Area North	2	20	Yes	Ornamental Tree
Advanced Test Reactor Complex	2	14	No	N/A
Central Facilities Area	2	13	No	N/A
Highway Department	2	23	No	N/A
RWMC	2	23	No	N/A

* ESER personnel are restricted from entering the NRF. Therefore, we initially trained, and then interviewed an NRF representative in the parking lot of the facility and he pointed out where he has seen active raven or owl nests.

**During the second survey, one part of CITRC was unavailable, so we returned to survey that section four days later.

Table 4-2. Summary of active raven nests (adjusted) observed during surveys of anthropogenic features on the INL Site during 2017.

# Active Nests	Substrate	Within SGCA	Outside SGCA
27	Power Line	12	15
5	Building Platform	0	5
1	Effluent Stack	0	1
3	Tower	2	1
4	Ornamental Tree	0	4
1	Other	0	1
Totals 41		**14**	**27**

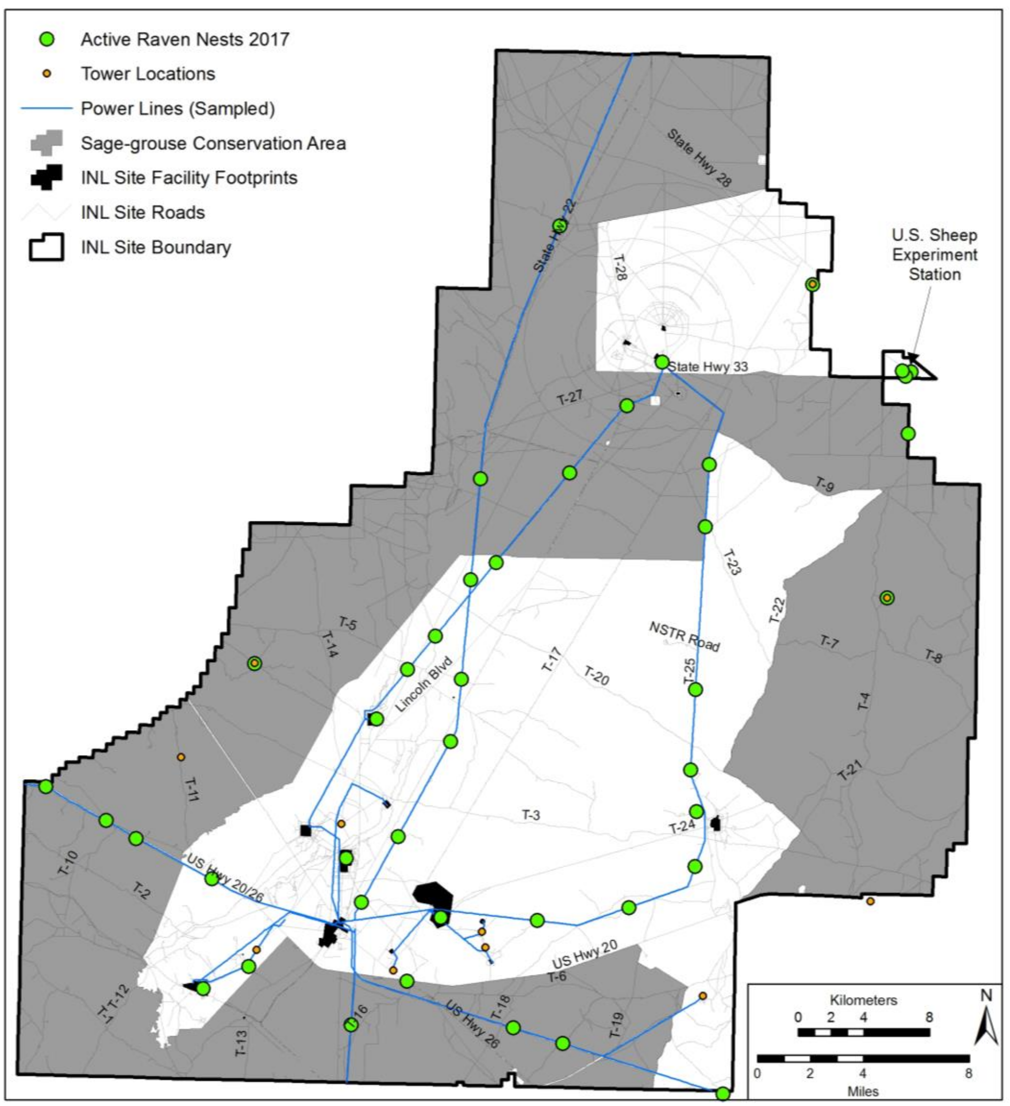

Figure 4-2. Results of 2017 raven nest survey. Raven nests displayed represent adjusted nest locations (*n*=41).

Towers

We surveyed 9 towers twice and one tower three times between April 3 and May 5, 2017. We formally surveyed two fewer towers than in 2016 because these two towers are thoroughly searched during facility surveys, so it is unnecessary to report them separately.

Ravens maintained nests on the same three towers they occupied last year (Shurtliff et al. 2017). Two of these are in the SGCA and one is 50 m off the INL Site near the northeastern boundary. Two of these towers are operated by the National Oceanic and Atmospheric Association (NOAA; Fig. 4-2).

Nesting Trends

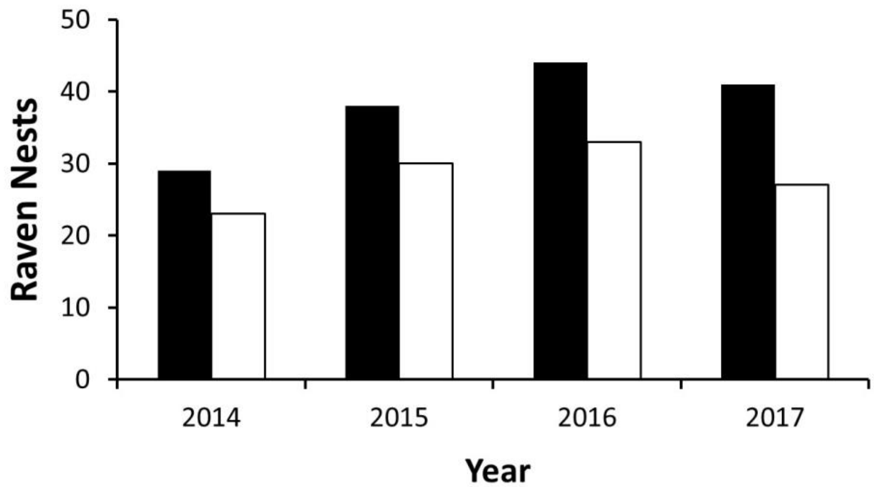

Figure 4-3. Adjusted number of raven nests observed on INL Site infrastructure. Black bars represent total nest counts and white bars represent nests on power lines.

The number of active raven nests (adjusted) on the INL Site was 7% lower in 2017 than in 2016, the first time since surveys began that fewer raven nests were recorded than the previous year (Fig. 4-3). The greatest decreases were on power lines (-18% from 2016, -9% from 2015). Although slightly lower than in 2016, the adjusted raven nest count in 2017 is 41% higher than in 2014, and nests on power lines are 30% higher than 2014 (Table 4-3).

Nest Distances

Raven–Raven

A cluster of three active raven nests were recorded within the U.S. Experiment Sheep Station on the northeast portion of the INL Site near Mud Lake (Fig. 4-2). The nearest pair were 377 m apart and the other pair were 421 m apart. Elsewhere on the INL Site, the closest two raven nests with evidence of simultaneous activity, were on transmission structures and were separated by 1,841m. No other raven nests in the final dataset were within 2 km of each other.

Raven–Raptor

We recorded 11 instances where raven and raptor nests that were concurrently active were within two kilometers of each other. The closest raven/raptor nests were 197 m apart, and the raptor nest was occupied by a red-tailed hawk. Three other red-tailed hawks nested within 1 km of active raven nests, and one nested ~1.9 km from a raven nest. Four great-horned owl (*Bubo virginianus*) nests were 208–1,124 m from raven nests. No ferruginous (*Buteo regalis*) or Swainson's hawk (*Buteo swainsoni*) nested closer than 1,385 m from a raven nest.

Table 4-3. Summary of raven infrastructure nest survey data since full surveys began on the INL Site. "Adjusted" data (columns 3–4, 6–7) are indexes of breeding pairs of ravens after accounting for nests that blew down and were likely rebuilt by the same nesting pair. The distance between the two closest active raven nests is listed in the penultimate column.

Year	Total Active Nests Observed	Adjusted Active Nests	Change from past year (Adjusted)	Total Power Line Nests Observed	Adjusted Power Line Nests	Change from past year (Power lines)	Nearest Nests (m)	Mean (SD) nest distance (m)
2014	35	29	N/A	29	23	N/A	1,525	3,366 (1,440)
2015	39	38	31%	31	30	23%	1,525	2,803 (1,282)
2016	46	44	16%	35	33	10%	1,216	3,220 (2,200)
2017	43	41	–7%	28	26	–21%	378	not calculated
Mean / Increase	**41**	**38**	***41%**	**31**	**28**	***13%**	****1,161**	

*Percent increase from 2014 to 2017.
**Mean from 2014 to 2017.

4.1.4 Discussion

The number of active raven nests recorded on INL Site infrastructure was lower in 2017 than in 2016, but the current-year levels are still substantially higher than when surveys began in 2014. Results may in fact reflect a slight decline in raven nesting on INL Site infrastructure in 2017, but this decline does not necessarily signal a reversal of the upward trend that has been observed during the previous three years. Observations of ravens during annual Breeding Bird Surveys on the INL Site often fluctuate greatly between years, but looking back across over 30 years of data, there is apparently a positive trend (Bybee and Shurtliff 2017).

An alternate explanation is that we failed to record some nests (i.e. more than usual) because of a delayed start to the breeding season. The winter of 2016–2017 was unusually harsh and snow lingered well into March. Because we record all observations of egg incubation, we have a good metric for comparing inter-annual variation in a core nesting activity, which can serve as an indicator of the timing of breeding. The median date that the first observation of incubation was recorded per nest in 2014, 2015, and 2016 was April 28 (n=29), April 17 (n=33), and April 20 (n=42), respectively. In 2017, the median date that the first observation of incubation was recorded per nest was May 2 (n=39). Thus, it appears that the breeding season was delayed in 2017. The number of first-time observations of incubation at a nest between May 15 and 31 from 2014–2016 was 1–5 (3–17% of total incubation observations). In 2017, seven observations occurred (18% of total). Thus, the number of observations of first-time incubations was only marginally higher during the last quarter of the survey period. Furthermore, no more than two first-time incubations (Range 0-2) have ever been observed between May 20 and May 30. Thus, we think it is unlikely, even with a delayed breeding season, that many first-observations of incubation would have occurred outside our sampling period.

Nesting at Facilities and on Towers

Although the number of raven nests on power lines was lower in 2017 than in 2016, the number of nests on structures and trees at facilities has increased each year of the surveys. In 2014, five raven nests were recorded at facilities. This number increased to six in 2015, eight in 2016, and 11 in 2017. Part of the increase since 2014 may be attributable to slightly better search effort (e.g. we did not survey AMWTP nor the main guard shack in 2014), new infrastructure (a large road-material covering near the main gate was not constructed, yet it supported a raven nest in 2017), and increased raven nesting density (three ravens at the U.S. Sheep Experiment Station in 2017). However, some facilities that have been well-surveyed each year had raven nests in 2017 but not in some of the past years (e.g. Experimental Breeder Reactor I, Specific Manufacturing Capability/Test Area North).

Nearly every facility on the INL Site supported a breeding pair of ravens in 2017. Although we did not record raven nests at four facilities (Table 4-1), two of these (Highway Department and RWMC) are within 1,500 m of other facilities that supported raven nests. Thus, it would have been unlikely for additional raven nests to be established at these two locations.

Ravens nested in one of the NOAA towers for the past three years and in the other for the past four years (Fig. 4-2). Although NOAA has unsuccessfully attempted to deter ravens from nesting on these structures in the past (Shurtliff et al. 2016), ESER discussed new ideas with NOAA for responding to the way ravens have adapted to previous deterrent designs. The NOAA director committed to try again to deter nesting by installing new deterrent material during fall 2017 (Pers. Comm., Rick Eckman, interim director of NOAA, Idaho Falls office; 08-17-2017).

Nearest-Nest Distances

Previously, we concluded that raven nesting pairs may not tolerate another raven nest within 1,200 m of their own nest on the INL Site (Shurtliff et al. 2017). Our conclusion was based on data from the first three years of raven nest surveys, during which time we had not observed any two raven nests closer than 1,216 m (Table 4-3). We were surprised, therefore, to observe three, simultaneously-active raven nests separated by only 377 and 421 m at the U.S. Sheep Experiment Station in 2017. The U.S. Sheep Experiment Station is located near the interface between sagebrush steppe and agricultural lands, and it is near two main highways and the town of Mud Lake. We surmise that resources were abundant near the U.S. Sheep Experiment Station in 2017. Elsewhere on the INL Site, the closest distance between two raven nests (adjusted) was 1,841 m, the greatest minimum distance recorded in the past four years (Table 4-3).

The data cited above supports a hypothesis that intraspecific competition for resources among ravens is a driver of the spatial distribution of nests on the INL Site. Interspecific competition between ravens and raptors apparently does not create the same need for spatial separation among nests. In 2017, four red-tailed hawk nests were within 900 m of raven nests. In each year of past surveys, we have documented one or two hawks (red-tailed or ferruginous) per year within 800 m of raven nests. At facilities, it is not uncommon for great-horned owl nests to be within 300 m of a raven nest. Thus, we hypothesize that competition among conspecifics for limited resources, but not heterospecifics, plays an important role in raven nest spacing on the INL Site.

Management Implications

Conservation Measure 10 in the CCA specifically identifies utility structures as the target for nest deterrent experiments because most raven nests on anthropogenic structures are on power transmission structures.

Since the CCA was signed however, a number of factors have reduced the priority of this conservation measure relative to other ongoing or potential actions that can or could be taken to address threats to sage-grouse. For example, during the January 2017 meeting between the USFWS and DOE, the USFWS emphasized that addressing wildland fire and invasive weeds is the highest priority for the USFWS region-wide.

Another contributing factor is that it is now clear that most power line sections that support raven nests are outside the SGCA. We know of no studies in similar sagebrush steppe habitat that have determined the territory size of breeding ravens, neither are we aware of any study in similar habitat that documents how far nesting ravens will travel to forage. Thus, we do not know if ravens that nest on power line structures up to several kilometers away from the SGCA will travel to the SGCA to forage. Understanding raven foraging behavior may be a more important priority than installing nest deterrents because the latter would be a much greater cost and could potentially be unnecessary (to avoid tripping the sage-grouse population trigger), if most nest-tending ravens don't forage in the SGCA.

4.2 Task 7—Identifying Non-Native Annual Grass Priority Restoration Areas

4.2.1 Introduction

Habitat loss due to dominance by non-native grasses, primarily cheatgrass (*Bromus tectorum*), is a threat to sage-grouse across its range and on the INL Site (DOE and USFWS 2014). Cheatgrass domination generally follows the loss of native herbaceous species, often due to soil disturbance associated with land use activities. In high densities, 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, resulting in an altered landscape in poor ecological condition and function for indefinite periods of time.

Task 7 task was developed to support and inform implementation of Conservation Measure 4, which has a goal to "maintain and restore healthy, native sagebrush plant communities" thereby reducing the threat of annual grasslands (DOE and USFWS 2014, pg. 57). The objective is different than what was originally developed for this task and is an updated version of last year's revised objective (Shurtliff et al. 2017), reflecting the adaptive management philosophy outlined in the CCA. The modified task is designed to be accomplished in three phases: 1) delineate the extent and distribution of containment lines on the INL Site; 2) determine the presence and relative abundance of non-native annual grasses on a subset of containment lines and develop a prioritized list of potential cheatgrass treatment areas; and 3) plan for the treatment and revegetation of prioritized areas. During phase 3, ESER will propose a treatment plan to DOE aimed at reducing the occurrence of cheatgrass at specified locations along containment lines.

Phase 1 of this task, to delineate the extent and distribution of containment lines, was completed in 2016 (Shurtliff et al. 2017). Utilizing the full time-series of U.S. Department of Agriculture (USDA) NAIP imagery (2004-2015), two GIS analysts independently marked all observed containment lines during an initial visual evaluation of the time-series imagery. Those locations were reconciled into a single list and each containment line was manually delineated as a vector line dataset using a GIS within the range of 1:1,000 to 1:2,000 mapping scale. The number of blade-widths were estimated along sections of each line and multiplied by the bulldozer blade widths of 3.7m – 4.6m (12ft – 15ft) to estimate the total area disturbed on the INL Site. The estimated area of vegetation removed from containment line construction was estimated to be 309.9 - 387.4 ha (765.9 - 957.4 acres). A total of 847.4 km (526.5 mi) of bladed containment lines were mapped on the INL Site. About 50% of those containment lines were one blade width and the rest ranged from two to six blade-widths.

The goal of Phase 2 was to identify non-native annual grasses, such as cheatgrass invaded areas on bladed containment lines which could reasonably be considered for cheatgrass treatments. Cheatgrass abundance, native species assemblage, and logistical requirements for treatment were the criteria considered for treatment feasibility. The ideal treatment plot would have an abundance of native species to utilize resources and fill niche-space once cheatgrass has been treated. Cheatgrass dominated landscapes contain only 0.05% of native seeds in the seed bank (Humphrey and Schupp 2001) making those poor candidates areas for seed bank restoration. A co-dominated cheatgrass invaded community would be the ideal target location as it would contain both the native and invasive seeds being treated in the seed bank. Wijayratine and Pyke (2012) demonstrated that sagebrush does have a short-term persistent seed bank which makes treatment areas that have both native shrubs and forbs desirable locations for cheatgrass treatment. Access to the areas must be reasonable to allow for efficient restoration ground based application treatments. Thus, a co-dominant cheatgrass area with a native assemblage that are easily accessible will be the ideal location to leverage existing native seed bank to improve sage-grouse habitat and reduce the threat from annual weeds (Still and Richardson 2015, Davies et al. 2011).

4.2.2 Phase II Methods

Site Selection

Field survey locations across the southern portion of the INL Site were selected from the containment lines delineated in 2016 (Fig. 4-4). We restricted our initial field survey to containment lines south of Highway 20/26 because there are numerous potential locations, which are easily accessible, and do not conflict with other monitoring and/or restoration projects. Potential future treatment areas were also considered for their logistical access by vehicles for the treatment phase of the task. Survey locations consisted of sites where two-track roads intersected mapped containment lines or where containment lines were bladed parallel to a two-track road. Field crews were given flexibility to survey multiple locations along containment lines that paralleled two track roads.

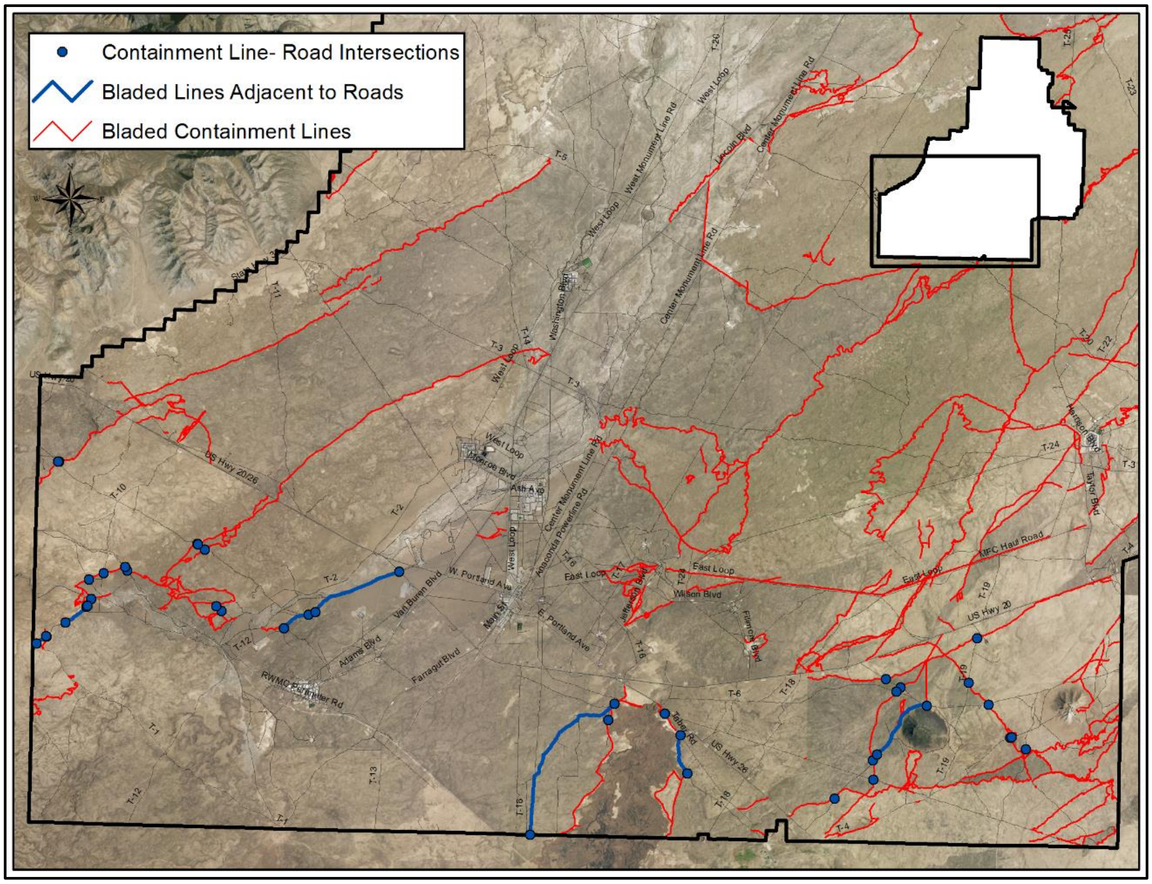

Figure 4-4. Distribution of bladed containment lines (plotted in red) mapped on the INL Site as of fall 2016. The blue dots represent survey locations at intersections and the blue lines represent transects driven along adjacent roads to contaiment lines.

Data Collection

The goal of the field data collection was to visually estimate the presence and relative abundance of cheatgrass and co-occurring native and introduced species on containment lines. At each survey location, two data points were surveyed approximately 50 m apart using GeoXH Trimble GPS unit. Location coordinates were collected in between the ricks of the bladed line at each data point and several categorical variables were recorded to describe the local plant community. Visual estimates of cheatgrass abundance were recorded using three categories: dominant, co-dominant, and sparse. If the cheatgrass was dominant (Fig. 4-5), the spatial extent of dominance in and around the containment line was noted. If cheatgrass was co-dominant (Fig. 4-6), then up to three other species that provide substantial cover in the plant community, along with their native status (Introduced or Native), were reported. If cheatgrass was sparse (Fig. 4-7), then up to three other species could be recorded as co-dominant. The sparse category ranged from an entirely native assemblage with no cheatgrass to cheatgrass occurring as a relatively minor component of the plant community. At each survey location, additional notes were recorded about accessibility, cheatgrass abundance and distribution, and other plants that occurred but were not dominant or co-dominant.

Figure 4-5. Dominant cheatgrass (*Bromus tectorum*) category in a containment line.

Figure 4-6. Co-dominant cheatgrass (Bromus tectorum) category with a native assemblage of sandberg bluegrass (Poa secunda), yellow rabbitbrush (Chrysothamnus viscidiflorus), and indian ricegrass (Achnatherum hymenoides).

Figure 4-7. Sparse cheatgrass (*Bromus tectorum*) category with a native assemblage of sandberg bluegrass (*Poa secunda*), yellow rabbitbrush (*Chrysothamnus viscidiflorus*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and other native species.

4.2.3 Results and Discussion

We collected 74 data points along transects and intersecting containment lines. The survey extended through multiple fire scars but most notably the Tin Cup fire (2000), Midway Fire (2012), Middle Butte Fire (2010), and the Twin Buttes Fire (2007) (Fig. 4-8). The most commonly occurring cheatgrass abundance category was co-dominant at 46% followed by sparse at 42%, and dominant at 12% (Table 4-4).

Within the co-dominant category, 68% of data points had a co-occurring native assemblage (Table 4-5). These areas are ideal for restoration because they have an existing native seed bank as well as mature individuals available to better compete for resources once cheatgrass has been treated (Humphrey and Schupp 2003). Within the sparse category, only 42% of data points had a native assemblage. Treatment in these areas would not be recommended because they are not at high risk of developing into a monoculture of cheatgrass and likely have other non-native species concerns.

Several potential cheatgrass treatment areas meet all criteria have been identified for restoration treatment(s). Two general locations are particularly favorable because they have co-dominant cheatgrass cover, reasonable abundance of native species, and are logistically accessible for treatment (Fig. 4-9). These locations includes a section of containment line was bladed during the Tin Cup Fire that parallels T-12 and several containment lines that were bladed during the Middle Butte Fire and intersect T-4, T-6, and T-19.

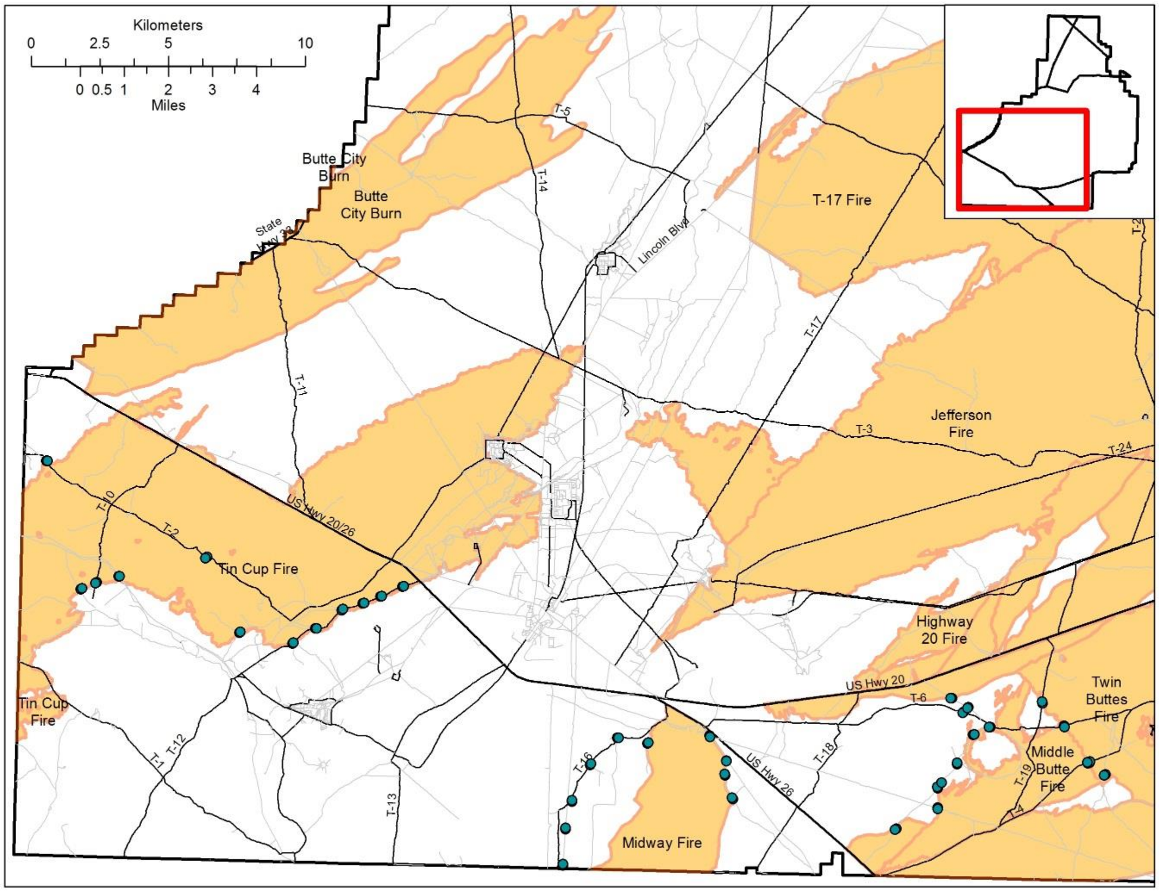

Figure 4-8. Survey locations (circles) where cheatgrass abundance data points were collected within bladed containment lines on the southern portion of the Idaho National Laboratory Site. Fire scars are shaded in light orange.

Table 4-4. Percent and number of cheatgrass data points by abundance category, which occurred along containment lines south of highway 20/26 on Idaho national laboratory Site.

Dominance Level	Recorded Number	Percent (%)
Dominant	9	12.0
Co-Dominant	34	46.0
Sparse	31	42.0

Table 4-5. Different abundance categories were compared by their percentage of native verses introduced plant assemblages from data collection locations which were either co-dominant or sparse with *cheatgrass*.

Co-Dominant Assemblage	Percent (%)	Sparse Assemblage	Percent (%)
Native	68	Native	42
Introduced	32	Introduced	55

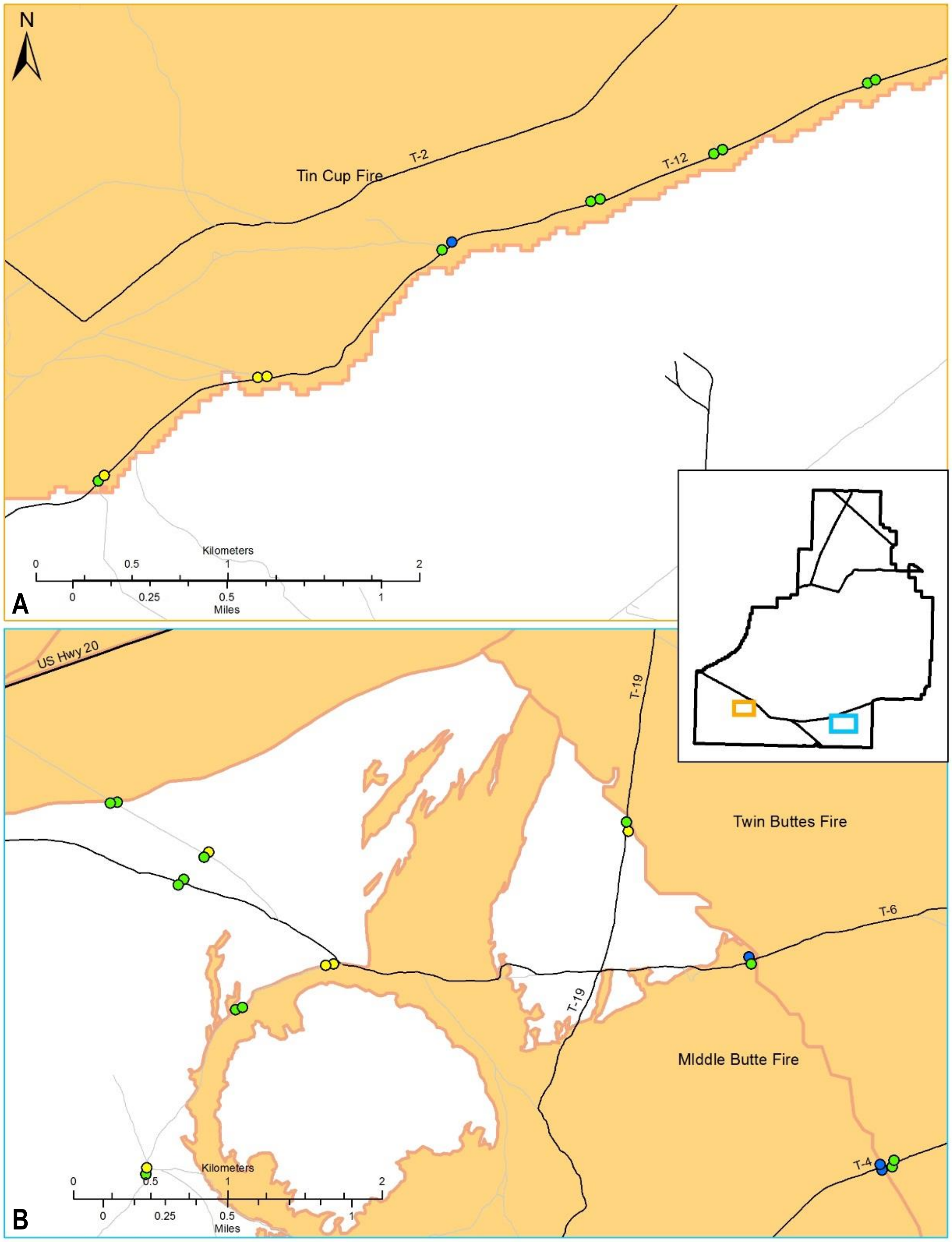

Figure 4-9. Two potential cheatgrass treatment areas are displayed south of Highway 20/26 on INL Site with fire scars shown in light orange. Box 'A' is the primary candidate restoration area and Box 'B' is the secondary restoration area. The green symbols reflect all three criteria, cheatgrass abundance, native species assemblage, and accessibility, have been met. The yellow symbols have two out of three criteria met and blue has one or none of the criteria met.

4.2.4 Conclusion

Field efforts from Phase 2 of this task have resulted in the identification of several proposed locations that are well-suited for potential cheatgrass treatments. The potential treatment areas share criteria that indicate they would benefit from cheatgrass treatment(s) because they are easily accessible, have good ecological native assemblage and existing seed bank.

Now that some potential cheatgrass treatment areas have been identified, ESER will begin exploring treatment options (Phase 3) that would reduce cheatgrass and improve native perennial cover. A proposed cheatgrass treatment(s) should be effective at decreasing cheatgrass cover, pose little risk to native plant communities, and be economical so that the project can be scaled to a meaningful level. No tools meeting all these criteria have yet been developed, and there is currently no accepted standard restoration approach. A recent review of several cheatgrass control methods concludes that meaningful long-term reductions in cheatgrass have only been achieved by a combination of applying chemical herbicides and planting desirable perennial species (Monaco et al. 2017). However, new, relatively untested tools are beginning to be applied regionally and across the West, and we are hopeful that viable options will emerge in the next few years.

Application of microbial herbicide is one tool that is gaining interest as a possible cheatgrass control mechanism. In particular, *Pseudomonas florenscens* (strains D7 and MB-906), which advantageously targets a select few non-native annual grasses, including cheatgrass, may provide a viable restoration approach in the future. Laboratory growth chamber tests confirmed that D7 significantly reduced root growth of cheatgrass (Kennedy et al. 2001). However, we are unaware of any literature that reports on the effectiveness of either D7 or MB-906 in long-term suppression of cheatgrass in sagebrush ecosystems.

The Bureau of Land Management (BLM) in Idaho and IDFG have recently and independently set up rangeland experimental plots in which *Pseudomonas florenscens* was applied to test its effectiveness at reducing cheatgrass. Results from these field tests will certainly inform any recommended approach to cheatgrass control on the INL Site in the future. Microbial herbicides are not currently a viable cheatgrass treatment option on the INL Site because the availability of D7 is limited and MB-906 in not currently a licensed herbicide.

4.3 Task 8—Monitor 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 [DOE and USFWS 2014]). Infrastructure can promote habitat fragmentation, and construction of new infrastructure nearly always disturbs soil, sometimes drastically. If proper controls are not in place, soil disturbance can facilitate the introduction and spread of invasive weeds, which may increase the risk of wildland fire. Weeds may also replace native plants and reduce plant diversity in localized areas and degrade sage-grouse habitat quality. Occasionally, mitigation following the completion of a construction project fails to meet its objectives, and infrastructure requirements may continue to expand as a project moves forward without new structures and disturbances being taken into account.

Inappropriate vehicle use, such as driving off of existing roads, may also cause habitat degradation in localized areas. Remote sensing imagery shows that the number of roads within grazing allotments on the INL Site has increased over time (unpublished data; Shurtliff et al. 2016). 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 new two-track appears, other drivers may follow it, further establishing the new road. 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 from unauthorized ones more recently created.

The goal of this monitoring task is to identify where expansion of infrastructure has occurred and document and map all road features within the SGCA and other areas dominated by big sagebrush. This task serves as the mechanism to identify and report on new infrastructure and two-track linear features being developed and to update the sagebrush habitat distribution data layer due to changes across the landscape not associated with wildland fires.

This monitoring task is conducted whenever new high resolution imagery that encompasses the entire INL Site becomes available. Currently, this task is reliant on the USDA NAIP, which typically collects aerial digital imagery in Idaho every two years and is made publically available for no cost. The frequency of high resolution NAIP imagery allows DOE to avoid the expensive cost of funding an image acquisition through a commercial vendor specifically to support this task. As high resolution imagery becomes available opportunistically (e.g. INL Site image acquisition following a large wildland fire), we will also incorporate those data to monitor infrastructure changes.

4.3.2 Results and Discussion

There was no work conducted on this task in 2017 because no new high resolution imagery was collected for the INL Site. The USDA NAIP collected high resolution imagery across the State of Idaho during the summer of 2017 and those data are typically made available the following spring. Once we download and process the new NAIP imagery, we will systematically review the INL Site for expansion of linear features and losses of sagebrush habitat due to facility or project footprint expansions, and those results will be presented in 2018.

5.0 IMPLEMENTATION OF CONSERVATION MEASURES

5.1 Summary of 2017 Implementation Progress

Section 10 of the CCA describes eight threats to sage-grouse and its habitats on the INL Site. DOE committed to implement 13 conservation measures to mitigate and reduce these threats. Table 5-1 summarizes DOE's actions during the past year to ameliorate threats to sage-grouse and its habitats.

Table 5-1. Accomplishments in 2017 for each CCA conservation measure (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 2017: BURN ASSESSMENT—A single human-caused wildfire burned <¼ acre next to a highway on the INL Site in 2017. (Unpublished wildland fire statistics summary for 2017; Eric Gosswiller, INL Fire Chief). Because the fire was small, no post-fire assessment or sagebrush reestablishment was required. An estimated 11 acres have burned on the INL Site during the past five years in eight separate incidents. Fewer acres have burned during the current five-year period than in any other five-year period since at least 1989 (the current annual INL wildfire report contains data dating back to 1994). **Associated Conservation Actions that Address the Wildland Fire Threat:** SAGEBRUSH PLANTINGS—ESER planted ~6,000 sagebrush seedlings in a priority restoration area (See Section 5.2). Approximately 3,800 of these seedlings were purchased by Battelle Energy Alliance to offset 3.74 acres of disturbance to sagebrush lands.	
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 Best Management Practices (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 2017: INL ADHEARANCE TO BMPs— In addition to listing BMPs, Conservation Measure 2 introduces DOE's goal of having no net loss of sagebrush anywhere on the INL Site. In 2017, contractors disturbed 4.5 acres (1.8 ha) of sagebrush-dominated land on the INL Site (Pers. Comm., Jenifer Nordstrom; September 26, 2017) and paid a per-acre mitigation fee for 3.74 (1.5 ha) of those acres. The fee allowed 3,800 sagebrush seedlings to be grown and planted in a priority restoration area in fall 2017 (Section 5-2). Where possible, contractors avoided disturbance, minimized habitat edge, and co-located new with existing infrastructure.	

Power Management installed nest deterrents (tent structures) on the lower cross arm of a double cross-arm distribution structure near the Critical Infrastructure Test Range Complex. This type of corner structure is one of the few places ravens or raptors could build a nest on a distribution line (Pers. Comm., Kenneth Barnes, Maintenance Manager, Power Management; September 25, 2017).

Conservation Measure 3—Accomplishments in 2017:

INSTALLATION OF MONITORING WELLS– The U.S. Geological Survey installed two new monitoring wells within the SGCA in 2017. Neither well site was within 1 km of a lek (Pers. Comm., Roy Bartholomay, U.S. Geological Survey INL Project Chief, Idaho Falls; November 22, 2017).

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 2017:

INVENTORY—See 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 the Bureau of Land Management (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 2017:

LIVESTOCK ON OR NEAR LEKS—As a technician approached an active lek (INL 161) on April 27, 2017, she saw a large water truck and a sheepherder's trailer stationed off road somewhat near the lek. No sage-grouse were present that day and we don't know if the sheepherder's outfit was the cause. For reference, no sage-grouse were seen at this lek three days earlier during a survey, but in mid-April, peak male attendance was 13 (the highest number recorded during the two years the survey was conducted).

UPDATED INFORMATION TO BLM—ESER provided updated lek maps to the DOE on January 26, 2017 so they could be forwarded to the BLM.

Conservation Measure 6—Accomplishments in 2017:

INVOLVEMENT DURING PERMIT RENEWAL PROCESS—The BLM did not assess any grazing allotments that overlap the INL Site during 2017, and they have no plans to do so in 2018 (Pers. Comm., Bret Herres, November 27, 2017).

Associated Conservation Actions that Address Livestock-related Issues:

<table>
<tr><td></td><td></td></tr>
<tr><td colspan="2">DOE and ESER staff met with BLM staff on April 3, 2017 in what we hope to be an annual meeting for the purpose of coordinating and communicating. Some of the issues we learned about and discussed were as follows:
• BLM has applied Psuedomonas florescens D7 to treat cheatgrass on its lands. ESER will be interested to keep updated on what is found.
• Spraying weeds on the INL Site is a low priority for the BLM, given the large area they are tasked to treat.
• BLM staff shared their experience planting sagebrush seedlings and seeding sagebrush. The information was useful as they have been involved in a great deal of sagebrush restoration.
• BLM updated ESER on its sage-grouse telemetry study and informed us that most of their marked birds moved to the southeastern portion of the INL Site to winter.</td></tr>
<tr><td>Threat:</td><td>Seeded Perennial Grasses</td></tr>
<tr><td>Objective:</td><td>Maintain the integrity of native plant communities by limiting the spread of crested wheatgrass.</td></tr>
<tr><td>Conservation Measures:</td><td>7) Cultivate partnerships with other agencies to investigate the mechanisms of crested wheatgrass invasion so that effective control strategies can be developed.</td></tr>
<tr><td colspan="2">Conservation Measure 7–Accomplishments in 2017:
<u>CULTIVATE PARTNERSHIPS</u>—No measurable progress has been made on this conservation measure.</td></tr>
<tr><td>Threat:</td><td>Landfills and Borrow Sources</td></tr>
<tr><td>Objective:</td><td>Minimize the impact of borrow source and landfill activities and development on sage-grouse and sagebrush habitat.</td></tr>
<tr><td>Conservation Measures:</td><td>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.</td></tr>
<tr><td colspan="2">Conservation Measure 8—Accomplishments in 2017:
<u>ELIMINATE HUMAN DISTURBANCE</u>— Fluor Idaho prepared an Environmental Checklist for the Borrow Source Study Field Sampling [EC No. ICP-16-002], which states,
“Project personnel will obtain an ecological resource survey and clearance granted prior to performing the proposed action. The clearance will include conservation measures and guidelines that must be followed from the CCA …. All known active sage-grouse leks on the INL Site have seasonal time-of-day restrictions on activities occurring within 1 km of a lek (Lek buffer) to minimize disturbance of sage-grouse courtship and breeding activities. Restrictions are in effect 6:00 pm to 9:00 am., March 15–May 15.”
Conservation Measure 9—Accomplishments in 2017:
<u>NO NET LOSS OF SAGEBRUSH AT BORROW PITS AND LANDFILLS</u>—No new borrow pits were developed or existing pits expanded at Fluor Idaho facilities in 2017 (Pers. Comm., Shawn Rosenberger, Environmental Engineer [Fluor Idaho], September 26, 2017).</td></tr>
<tr><td>Threat:</td><td>Raven Predation</td></tr>
</table>

Objective:	Reduce food and nesting subsidies for ravens on the INL Site.
Conservation Measures:	10) Support research 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 2017:

SUPPORTING RESEARCH—Nothing to report.

Associated Conservation Actions that Address Raven Predation Threat:

- Staff with the USDA were vigilant to keep ravens from building a nest on grain bins at the U.S. Sheep Experiment Station in the northeast portion of the INL Site near Mud Lake (Pers. Comm., Bret Taylor, Research Leader and Supervisory Scientist [U.S. Department of Agriculture], September 22, 2017). However, three raven pairs nested in ornamental trees at the station.
- INL Power Management installed three metal cross arms on power transmission structures west of the Materials & Fuels Complex. Unlike the wooden structures they replaced, it is unlikely ravens could build a nest on these metal cross arms (Pers. Comm., Kenneth Barnes, Maintenance Manager, Power Management; September 25, 2017).
- In October 2017, National Oceanic and Atmospheric Administration staff installed wire mesh on two of their towers in an effort to discourage raven nesting. These towers are in remote locations on the INL Site. Previous wire installation on these towers forced ravens to nest lower on the tower. The hope is that the latest improvements will force ravens to seek other places to nest.

Conservation Measure 11: Completed.

Threat:	Human Disturbance
Objective:	Minimize human disturbance of sage-grouse courtship behavior on leks and nesting females within the SGCA and 1 km (0.6 mi) Lek Buffers.
Conservation Measures:	12) Seasonal guidelines (March 15–May 15) for human-related activities within 1 km (0.6 mi) 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. • Unmanned aerial vehicle 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 (0.6 mi) of an active 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 2017:

TOWERS—The Environmental Checklist prohibits portable or permanent towers to be erected within the SGCA or within 1 km (0.6 mi) of active leks March 15–May 15, 2017 (Pers. Comm., Jenifer Nordstrom; September 26, 2017).

EXPLOSIVES—No explosives >1,225 kg (2,700 lbs) were detonated outside the seasonal guidelines in 2017 (Pers. Comm., Desiree Saupe, Materials and Physical Security Department Engineer, National and Homeland Security, September 25, 2017).

Conservation Measure 13—Accomplishments in 2017: TOWERS— The Environmental Checklist prohibits portable or permanent towers to be erected within the SGCA April 1–June 30 (Pers. Comm., Jenifer Nordstrom; September 26, 2017).	

5.2 Reports on Projects Associated with Conservation Measures

5.2.1 Conservation Measure #1—Sagebrush Seedling Planting for Habitat Restoration

Introduction

The objective of Conservation Measure 1 is to minimize the impact of habitat loss due to wildland fire and firefighting activities (Table 5-1). Although no wildfires >40 ha (99 acres) have burned on the INL Site since 2012, DOE began implementing an annually recurring task in 2015 that would facilitate planting at least 5,000 sagebrush seedlings each fall in priority restoration areas on the INL Site (DOE and USFWS 2014, Section 9.4.4). Planting sagebrush seedlings annually is a proactive measure that will hasten the reestablishment of sage-grouse habitat lost during past fires. In addition, Battelle Energy Alliance, LLC (BEA) has committed to mitigate the loss of sagebrush associated with project activities where sagebrush may be damaged. For every acre impacted, BEA will contribute funds to replant 946 seedlings and the seedlings will be grown and planted concurrently with DOE's seedlings in a priority restoration area.

The ESER program oversees the planting of sagebrush seedlings and monitors survivorship to evaluate the effectiveness of the task for DOE and BEA. Our aim is to plant at least 80 sagebrush seedlings per acre, resulting in a coverage of ≥25 ha (63 ac) per year (Shurtliff et al. 2016), although the acreage planted can be highly variable due to weather conditions, topography, planting conditions, travel, and planter abilities. The goal of planting at this stocking rate is to establish a seed source from which additional seedlings can establish to reduce the amount of time for sagebrush to become abundant enough to provide habitat.

Methods

Containerized sagebrush seedlings were grown from seed collected in 2014 on the INL Site. Information about the companies subcontracted to grow and plant seedlings, and details about procedures followed during the planting process, are described elsewhere (Shurtliff et al. 2016).

The area we chose for restoration in 2017 was on the southeastern edge of the Jefferson Fire, a central INL location, north of Highway 26 (Fig. 5-1). This area is within the SGCA as well as within the priority restoration area (Shurtliff et al. 2016). We also chose this site to diversify our planting areas across the INL, the proximity to sage grouse leks, and the desire from DOE and IDFG to begin rehabilitation on the Jefferson Fire.

Survivorship of seedlings planted in fall 2016 was monitored by revisiting and evaluating the condition of individual seedlings one year after planting. In fall 2016, we collected sub-meter GPS locations for >10% of seedlings planted. In September 2017, we revisited ≥10% of seedlings (randomly selected from marked individuals) and determined if each seedling was healthy, stressed, or dead, and provided a comments field (Fig. 5-2). After five years, seedlings will again be revisited and longer-term survivorship assessed.

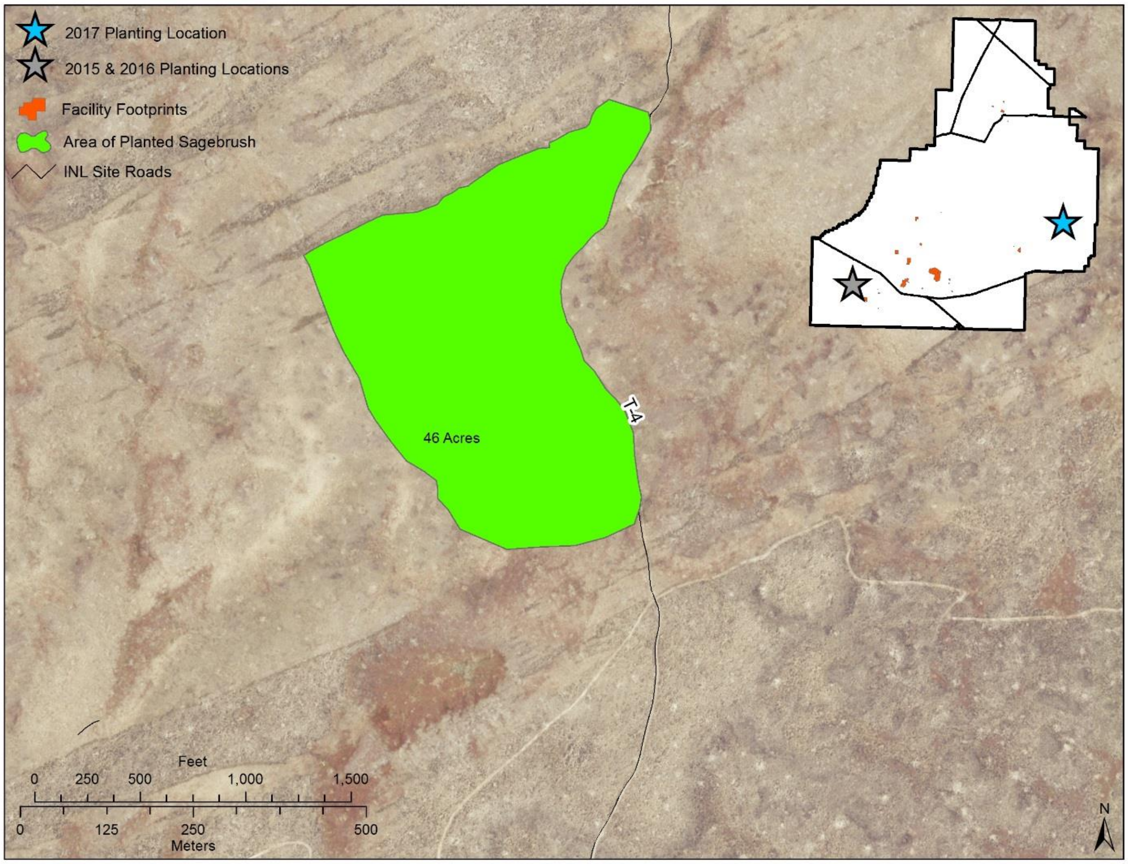

Figure 5-1. Area planted with big sagebrush seedlings in 2017.

Figure 5-2. Examples of sagebrush seedling conditions. From left to right: healthy, stressed, and dead.

Results and Discussion

We planted approximately 6,000 seedlings on 18.5 ha (46 ac)(~324 seedlings per ha [130 seedlings per ac]) from October 10 to October 14, 2017 in the east central part of the INL Site (Fig. 5-1) and marked the locations of 977 (~16%) seedlings for future monitoring. About 3,800 of those seedlings were purchased by

BEA to offset the disturbance of 1.5 ha (3.74 ac) across two project areas. The project areas included expansion at the Central Facilities Area Main Range and the Smartgrid project at the Critical Infrastructure Test Range Complex site.

A generous amount of rain fell the week before planting, creating favorable conditions for seedling growth and development. In addition, on the last day of planting, several inches of snow fell, which will help the seedlings establish. Typical sagebrush density planting rates in sage-grouse habitat is one to three plants per square meter, meaning that an acre normally contains 4,000–12,000 sagebrush plants. The intent of this sagebrush seedling task is not to plant sagebrush at densities that typify sage-grouse habitat, but rather to establish sagebrush seed sources in priority areas to shorten the time interval between a fire and the reestablishment of sage-grouse habitat.

To assess 2016 seedling survivorship and condition, we revisited 497 sagebrush seedlings in September 2017. We relocated 332 seedlings, of which 240 (48%) were healthy, 66 (13%) were stressed, and 26 (5%) were dead (Fig. 5-3). Assuming that the 165 (33%) plants that we were unable to locate did not survive, a total of 62% of the seedlings survived the first year. For comparison, in 2016 we revisited 501 seedlings that had been planted the previous year and recorded 129 (26%) healthy, 238 (48%) stressed, 61 (12%) dead, and 73 (15%) missing (Fig. 5-3). Assuming missing seedlings were dead, we concluded that one-year survivorship was 73% (Shurtliff et al. 2017).

The number of missing seedling increased dramatically from 2015 to 2016. Given the accuracy of our GPS units, it is likely that many of these missing seedlings did not survive, though we may have missed some live seedlings, especially if they were stressed and in areas with relatively high grass and forb cover. A conservative assessment would assume these 165 seedlings did not survive, increasing our estimate of seedling death from 5% to 38%. However, based on the fact that most of the relocated seedlings that were found were labeled healthy, it's possible that some were simply missed. ESER will revisit all locations again five years post-planting to refine estimates of survivorship and to evaluate the success of this project in hastening the return of sagebrush to the landscape.

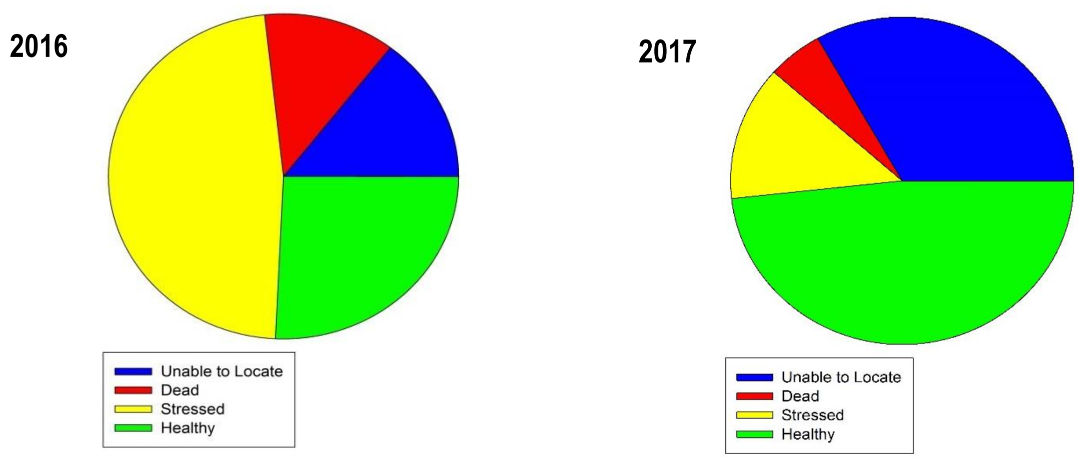

Figure 5-3. Results from two years of sagebrush seedling survivorship monitoring. Seedlings planted in 2015 were revisited in 2016 and seedlings planted in 2016 were revisited in 2017.

Precipitation patterns from fall 2016 to fall 2017 were characteristic of a good recruitment year. From the fall of 2016 through the spring of 2017, most months were above average precipitation. The summer growing season was above average (Fig. 3-3). Lack of moisture during summer can stress young plants, and is probably responsible for the high numbers of stressed plants we observed in 2015, while the abundant summer moisture of 2016 is responsible for a greater number of healthy individuals. Young sagebrush plants experience the highest mortality during the first year (Dettweiler-Robinson et al. 2013). In a review of 24 projects where containerized sagebrush seedlings were planted and survivorship was measured after one year, researchers reported first year survival of stock ranged from 14% to 94% (median = 59%, weighted average=57%). Thus, sagebrush establishment following the 2016 planting on the INL Site was higher than average even when the missing plants are calculated as part of the equation.

One of the reasons DOE chose to plant seedlings over a relatively small area each year rather than to drill or broadcast sagebrush seeds over a much larger area is because successful seed germination and establishment are affected by several climatic factors, including timing and amount of precipitation (Young et al. 1990, Boudell et al. 2002). The suite of factors that facilitate successful germination of seed and establishment of new plants fluctuates from year to year (Colket 2003; Forman et al. 2013), and in many years, few or no seeds may germinate and survive the summer (Brabec et al. 2015). DOE's decision to plant containerized seedlings instead of broadcasting or drill-planting seeds will continue to be justified as long as high survivorship of seedlings is consistently achieved, particularly during years in which establishment following seeding would be expectedly low (Fig. 5-4).

Figure 5-4. Seedlings in conetainers for the day's planting and seedling transferred to tree bag.

6.0 SYNTHESIS AND ADAPTIVE MANAGEMENT RECOMMENDATIONS

6.1 Sage-Grouse and Sagebrush Habitat Trends

Population and habitat data from the INL Site suggest that sage-grouse abundance has increased in recent years and that sagebrush habitats are in relatively good condition. These results are probably due to favorable amounts and timing of precipitation (Section 3.1.2). Three of the past four years produced above-average precipitation on the INL Site. Not only were the total amounts high, unusually high amounts of rain fell during spring and fall in 2014–2016, and snow levels were high during the winter of 2016–2017. High sage-grouse chick survival has been correlated with cool, wet springs (e.g. Blomberg et al. 2014), and recently a study in Wyoming showed a positive correlation between cool, wet springs and male attendance at leks the following spring (Peebles et al. 2017).

The information presented in this and previous reports suggest that it is unlikely that any threats to sage-grouse and its habitats on the INL Site will push population or total habitat area below their pre-defined trigger thresholds in the near future. However, we recognize that conditions can shift rapidly. Wildfire has burned almost no sagebrush habitat on the INL Site in over five years, but drier conditions could reverse this trend. Cheatgrass cover was relatively high during 2017, but we do not know if the increase represents a real shift in habitat conditions or if it simply reflects short-term precipitation patterns that are favorable. More than six decades of LTV transect data show that cheatgrass cover has fluctuated over time (Forman et al. 2013), so it may be that current conditions represent a high point in long-term oscillations. Regarding the livestock threat, last year (Shurtliff et al. 2017b) we found no evidence of a difference in habitat conditions between grazed and ungrazed sampling plots. Raven nesting on infrastructure has increased over 40% since 2014, but most nests are outside of the SGCA. Because we do not know how far ravens travel from their nests to forage, we do not know whether predation risk to sage-grouse in the SGCA is high. Regardless of the actual predation rate, sage-grouse abundance (based on a three-year running average) has continued to increase nearly every year since the CCA report was begun.

6.2 Changes made to the CCA

During the 2017 annual CCA meeting between the USFWS, DOE, and other stakeholders (held February 16), the USFWS suggested that the best way to acknowledge and track minor changes to the CCA would be to include them in a section of the annual CCA report. Hence, we have added this section (Section 6.2) to document all changes to the CCA approved by both DOE and the USFWS. Last year we reported the only change that has been made thus far to the CCA—a change to the objective of Monitoring Task 7 (hereafter Task 7)(Shurtliff et al. 2017b). To enable a future reader to easily find all changes made to the CCA, we include below a summary of the change made last year to Monitoring Task 7.

2016

Monitoring Task 7—When CCA Task 7 was developed, the primary goals were to (1) delineate areas both affected by anthropogenic disturbance and dominated by cheatgrass within the SGCA, and (2) identify the source of disturbance that made it possible for cheatgrass to dominate. The premise was that if DOE knew what caused the disturbance, it could reduce or eliminate the stressor, or work with partners to do so. In 2016, DOE recognized that Task 7 was not achieving its desired outcome, so DOE redefined the objective to read "inventory and delineate cheatgrass-dominated areas on wildfire containment lines on the INL Site" (Shurtliff et al. 2017b, pp. 20–21).

2017

Monitoring Task 2—Historical lek surveys will be discontinued in 2018 and this Task will no longer be implemented (Section 2.2.2).

Monitoring Task 3—Lek discovery surveys will be discontinued in 2018 and this Task will no longer be implemented (Section 2.3.2).

7.8 Spent Fuel Handling Project (SFHP) at the Naval Reactors Facility - The purpose of the SFHP is to provide the infrastructure necessary to support the naval nuclear reactor defueling and refueling schedules required to meet the operational needs of the U.S. Navy. Based on the life-cycle of current and new designs and planned construction of aircraft carriers and submarines, the ability to perform naval spent nuclear fuel handling will be required into the foreseeable future. Next-generation aircraft carriers have a ship life of approximately 50 years, while new nuclear submarines will have operational lives of approximately 30 years. The first next-generation nuclear-powered U.S. Navy aircraft carrier, GERALD R. FORD (CVN 78) was commissioned in 2017; new nuclear-powered submarines are also under construction. The Final Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the INL (DOE/EIS-0453-F) was issued on September 23, 2016 and the Record of Decision (ROD) was issued on November 15, 2016. The selected alternative, as outlined in the ROD, would acquire capital assets to recapitalize naval spent nuclear fuel handling capabilities. The Naval Nuclear Propulsion Program will recapitalize the infrastructure supporting naval spent nuclear fuel handling at the INL Site by constructing a new facility in the northeast section of the NRF site. This decision includes recapitalization of the naval spent nuclear fuel handling capabilities described in DOE/EIS-0453-F including: the capability to unload M-140 and M-290 shipping containers; temporary wet storage of naval spent nuclear fuel; initial examination of naval spent nuclear fuel; resizing and securing nuclear poison in naval spent nuclear fuel modules; capability to support transfer of naval spent nuclear fuel for more detailed examination at the examination location; loading naval spent nuclear fuel into naval spent nuclear fuel canisters; the capability to support transfer of naval spent nuclear fuel into or out of temporary dry storage; and capability to load waste shipping containers. Environmental impacts associated with the SFHP are negligible or small with the exception of the electrical energy consumption impacts which would be moderate. The project is bounded by the original analysis of large-scale infrastructure performed for the CCA. The location of the project is outside the SGCA and partially overlaps the existing facility footprint where there is no high-quality sagebrush habitat. However, there is potential to disturb several acres of sagebrush habitat during construction due to support areas that will be needed. These areas will be restored when no longer in use. The nearest lek is several miles from the location for the new infrastructure. When construction is complete, ongoing operations will not impact sage-grouse or sagebrush habitat.

6.3 Work Plan for Upcoming Year

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 for 2018
1. Lek Counts and Lek Route Surveys	In 2018, we will commence an annual effort to resurvey a subset of inactive leks, with the intent to resurvey all inactive leks within potential sage-grouse habitat approximately every five years.
2. Historical Lek Surveys	Completed.
3. Systematic Lek Discovery Surveys	Completed.
4. Raven Nest Surveys	• No changes to the surveys are anticipated, although we will evaluate whether efforts to deter ravens from nesting on NOAA towers was successful.
5. Sagebrush Habitat Condition Trends	• Sample all annual monitoring plots (n=75) and set 1 of the rotational plots (*n*=50). • Update annual habitat condition analyses and continue to explore trend analyses.
6. Monitoring to Determine Changes in Sagebrush Habitat Amount and Distribution	• No work to be conducted on this task inside recently burned areas until a new vegetation community classification and map is completed in 2019. New wildland fires will be mapped to document sagebrush habitat loss as needed.
7. Identifying Non-Native Annual Grass Priority Restoration Areas.	• ESER will begin to explore treatment options for reducing cheatgrass and improving native perennial cover.
8. Monitoring Expansion of the Infrastructure Footprint within the SGCA and Other Areas Dominated by Big Sagebrush	• Updated Idaho NAIP imagery will be available in 2018, and we will systematically review the INL Site to document evidence of expansion of linear features and losses of sagebrush habitat from project footprint expansions.

7.0 LITERATURE CITED

Bakker, J. P., P. Poschlod, R. J. Strykstra, R. M. Bekker, and K. Thompson. 1996. Seed banks and seed dispersal: important topics in restoration ecology. Acta botanica neerlandica 45:461-490.

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.

Boarman, W., III. 1993. When a native predator becomes a pest: a case study. Pages 186-201 in S. K. Majumdar, E. W. Miller, D. E. Miller, E. K. Brown, J. R. Pratt and R. F. Schmalz, editors. Conservation and resource management. Pennsylvania Academy of Science, Philadelphia, USA.

Boarman, W. I. and B. Heinrich. 1999. Common raven (Corvus corax). Pages 1-30 in A. Poole and F. Gill, editors. The birds of North America, No. 476. The Academy of Natural Sciences, Philadelphia, PA and The American Ornithologists' Union, Washington, DC, USA.

Bookhout, T. A., editor. 1996. Research and management techniques for wildlife and habitats. The Wildlife Society, Bethesda, Maryland.

Boudell, J. E., S. O. Link and J. R. Johansen. 2002. Effect of soil microtopography on seedbank distribution in the shrub-steppe. Western North American Naturalist 62:14-24.

Brabec, M. M., M. J. Germino, D. J. Shinneman, D. S. Pilliod, S. K. McIlroy and R. S. Arkle. 2015. Challenges of establishing big sagebrush (*Artemisia tridentata*) in rangeland restoration: effects of herbicide, mowing, whole-community seeding, and sagebrush seed sources. Rangeland Ecology & Management 68:432-435.

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.

Bybee, B. F., and Q. R. Shurtliff. 2017. 2016 breeding bird surveys on the Idaho National Laboratory Site. WAI-ESER-207, Idaho Falls, Idaho, http://idahoeser.com/BBS/2016BBSReport.pdf

Coates, P. S. and D. J. Delehanty. 2008. Effects of environmental factors on incubation patterns of Greater Sage-Grouse. The Condor 110:627-638.

Coates, P. S. and D. J. Delehanty. 2010. Nest predation of greater sage-grouse in relation to microhabitat factors and predators. Journal of Wildlife Management 74:240-248.

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

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., 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.

Conover, M. R., and A. J. Roberts. 2017. Predators, predator removal, and sage-grouse: a review. The Journal of Wildlife Management 81:7-15.

Dalke, P. D., D. B. Pyrah, D. C. Stanton, J. E. Crawford, and E. F. Schlatterer. 1963. Ecology, productivity, and management of sage grouse in Idaho. The Journal of Wildlife Management 27:811-841.

Davies, K. W., C. A. Boyd, J. L. Beck, J. D. Bates, T. J. Svejcar, and M. A. Gregg. 2011. Saving the sagebrush sea: an ecosystem conservation plan for big sagebrush plant communities. Biological Conservation 144:2573-2584.

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. www.id.energy.gov/eser/DOC/Candidate%20Conservation%20Agreement.pdf.

Dettweiler-Robinson, E., J. D. Bakker, J. R. Evans, H. Newsome, G. M. Davies, T. A. Wirth, D. A. Pyke, R. T. Easterly, D. Salstrom and P. W. Dunwiddie. 2013. Outplanting Wyoming big sagebrush following wildfire: stock performance and economics. Rangeland Ecology & Management 66:657-666.

Dinkins, J. B., M. R. Conover, C. P. Kirol and J. L. Beck. 2012. Greater Sage-Grouse (*Centrocercus urophasianus*) Select Nest Sites and Brood Sites Away from Avian Predators. The Auk 129:600-610.

Dunlap, T. R. 1986. American wildlife policy and environmental ideology: poisoning coyotes, 1939-1972. Pacific Historical Review 55:345-369.

Dunn, O. J. 1964. Multiple comparisons using rank sums. Technometrics, 6(3), pp.241-252.

Fedy, B. C., and C. L. Aldridge. 2011. The importance of within-year repeated counts and the influence of scale on long-term monitoring of sage-grouse. The Journal of Wildlife Management 75:1022-1033.

Fedy, B. C., and K. E. Doherty. 2011. Population cycles are highly correlated over long time series and large spatial scales in two unrelated species: greater sage-grouse and cottontail rabbits. Oecologia 165:915-924.

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. http://idahoeser.com/Publications_Ecology.htm#GIS.

Fremgen, A. L., C. P. Hansen, M. A. Rumble, R. S. Gamo, and J. J. Millspaugh. 2016. Male greater sage-grouse detectability on leks. The Journal of Wildlife Management 80:266-274.

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.

Hess, J. E., and J. L. Beck. 2012. Disturbance factors influencing greater sage-grouse lek abandonment in north-central Wyoming. The Journal of Wildlife Management 76:1625-1634.

Howe, K. B. 2012. Selection for anthropogenic structures and vegetation characteristics by common ravens (*Corvus corax*) within a sagebrush-steppe ecosystem. MS Thesis. Idaho State University, Pocatello.

Howe, K. B. and P. S. Coates. 2015. Observations of Territorial Breeding Common Ravens Caching Eggs of Greater Sage-Grouse. Journal of Fish and Wildlife Management 6:187-190.

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.

Humphrey, L. D. and E. W. Schupp. 2001. Seed banks of *Bromus tectorum*–dominated communities in the Great Basin. Western North American Naturalist 61:85-92.

Humphrey, L. D. and E. W. Schupp. 2004. Competition as a barrier to establishment of a native perennial grass (*Elymus elymoides*) in alien annual grass (*Bromus tectorum*) communities. Journal of Arid Environments 58:405-422.

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

Kristan, WB, III., W.I. Boarman, and J.J. Crayon. 2004. Diet composition of common ravens across the urban-wildland interface of the West Mojave Desert. Wildlife Society Bulletin 32:244-253.

Lockyer, Z. B., P. S. Coates, M. L. Casazza, S. Espinosa and D. J. Delehanty. 2013. Greater Sage-Grouse Nest Predators in the Virginia Mountains of Northwestern Nevada. Journal of Fish and Wildlife Management 4:242-255.

Marzluff, J. M. and B. Heinrich. 1991. Foraging by common ravens in the presence and absence of territory holders: an experimental analysis of social foraging. Animal Behaviour 42:755-770.

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.

Sauer, J. R., J. E. Hines and J. Fallon. 2008. North American breeding survey, results and analysis 1966-2007. Version 5.15.2008. U.S. Geological Survey Patuxent Wildlife Research Center, Laurel, Maryland, USA.

Scarpignato, A. L. 2011. Home range and habitat use of breeding common ravens in Redwood national and state parks. MS Thesis. Humboldt State University, Humboldt, CA.

Sergio, F. and I. Newton. 2003. Occupancy as a measure of territory quality. Journal of Animal Ecology 72:857-865.

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. http://idahoeser.com/Publications_Ecology.htm#GIS.

Shurtliff, Q. R., A. D. Forman, J. C. Whiting, J. P. Shive, R. D. Blew. 2014. 2013 Monitoring report in support of the Candidate Conservation Agreement for greater sage-grouse on the Idaho National Laboratory Site. Gonzales-Stoller Surveillance, LLC, Idaho Falls, ID. March 2014.

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. http://idahoeser.com/Publications_Wildlife.htm.

Shurtliff, Q. R., A. D. Forman, J. P. Shive, J. R. Hafla, K. T. Edwards, and R. D. Blew. 2016. Implementing the Candidate Conservation Agreement for Greater Sage-Grouse on the Idaho National Laboratory Site: 2015 Full Report. Environmental Surveillance, Education, and Research Program, Gonzales-Stoller Surveillance, LLC, Idaho Falls, ID. GSS-ESER-199. http://idahoeser.com/Publications_Wildlife.htm.

Shurtliff, Q.R., J.P. Shive, A.D. Forman, J.R. Hafla, K.T. Edwards, and B.F. Bybee. 2017. Implementing the Candidate Conservation Agreement for Greater Sage-Grouse on the Idaho National Laboratory Site:

2016 Full Report. Environmental Surveillance, Education, and Research Program, Wastren Advantage, Inc., Idaho Falls, ID. WAI-ESER-206.

Soulé, P. T. and P. A. Knapp. 1996. The influence of vegetation removal by western harvester ants (*Pogonomyrmex owyheei*) in a relict area of sagebrush-steppe in central Oregon. The American Midland Naturalist 136:336-345.

Still, S. M. and B. A. Richardson. 2015. Projections of contemporary and future climate niche for Wyoming big sagebrush (*Artemisia tridentata* subsp. *wyomingensis*): a guide for restoration. Natural Areas Journal 35:30-43.

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.

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://idahoeser.com/Publications_Wildlife.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.

Williams, C. K., A. R. Ives, R. D. Applegate and J. Ripa. 2004. The collapse of cycles in the dynamics of North American grouse populations. Ecology Letters 7:1135-1142.

Wijayratne, U. C. and D. A. Pyke. 2012. Burial increases seed longevity of two *Artemisia tridentata* (Asteraceae) subspecies. American Journal of Botany 99:438-447.

Young, J. A., R. A. Evans and D. Palmquist. 1990. Soil surface characteristics and emergence of big sagebrush seedlings. Journal of Range Management 43:358-367.

Zar, J. H. 1996. Biostatistical analysis, 3rd edition. Prentice Hall, Englewood Cliffs, New Jersey.

APPENDIX A.

A complete list of all species documented on the 75 annual habitat monitoring plots (48 sagebrush plots and 27 non-sagebrush plots) in 2017. Nomenclature follows the USDA PLANTS National Database (2017).

Scientific Name	Common Name
Achnatherum hymenoides	Indian ricegrass
Achnatherum thurberianum	Thurber's needlegrass
Agropyron cristatum	crested wheatgrass
Aliciella leptomeria	sand gilia
Allium textile	textile onion
Alyssum desertorum	desert alyssum/ desert madwort
Arabis cobrensis	sagebrush rockcress
Arabis holboellii	Holboell's rockcress
Arabis lignifera	desert rockcress
Arenaria franklinii	Franklin's sandwort
Artemisia arbuscula	low sagebrush/ little sagebrush
Artemisia nova	black sagebrush
Artemisia tridentata	big sagebrush
Artemisia tridentata Nutt. ssp. *tridentata*	basin big sagebrush
Artemisia tridentata Nutt. ssp. *wyomingensis*	Wyoming big sagebrush
Artemisia tripartita	threetip sagebrush
Astragalus calycosus	Torrey's milkvetch
Astragalus curvicarpus	curvepod milkvetch
Astragalus filipes	basalt milkvetch
Astragalus geyeri	Geyer's milkvetch
Astragalus lentiginosus	freckled milkvetch
Astragalus purshii	woollypod milkvetch
Atriplex confertifolia	shadscale saltbush
Atriplex falcata	sickle saltbush/ Nuttall saltbush
Balsamorhiza sagittata	arrowleaf balsamroot
Bromus arvensis	field brome
Bromus tectorum	cheatgrass
Calochortus bruneaunis	Bruneau mariposa lily
Camelina microcarpa	littlepod false flax
Camissonia andina	Blackfoot River evening primrose
Camissonia minor	small evening primrose
Carduus nutans	nodding plumeless thistle/ musk thistle
Carex douglasii	Douglas' sedge
Castilleja angustifolia	northwestern Indian paintbrush
Ceratocephala testiculata	bur buttercup/ curveseed butterwort
Chaenactis douglasii	Douglas' dustymaiden
Chenopodium leptophyllum	slimleaf goosefoot/ narrowleaf goosefoot
Chorispora tenella	purple mustard/ crossflower
Chrysothamnus viscidiflorus	yellow rabbitbrush/ green rabbitbrush

Scientific Name	Common Name
Cordylanthus ramosus	bushy bird's beak
Crepis acuminata	tapertip hawksbeard
Cryptantha circumscissa	cushion cryptantha
Cryptantha interrupta	Elko cryptantha
Cryptantha scoparia	Pinyon Desert cryptantha
Descurainia pinnata	western tansymustard
Descurainia sophia	herb sophia
Elymus elymoides	bottlebrush squirreltail
Elymus lanceolatus	thickspike wheatgrass
Eriastrum wilcoxii	Wilcox's woollystar
Ericameria nana	dwarf goldenbush
Ericameria nauseosa	rubber rabbitbrush/ gray rabbitbrush
Erigeron filifolius	threadleaf fleabane
Erigeron pumilus	shaggy fleabane
Eriogonum cernuum	nodding buckwheat
Eriogonum microthecum	shrubby buckwheat/ slender buckwheat
Eriogonum ovalifolium	cushion buckwheat
Erodium cicutarium	redstem stork's bill
Escobaria missouriensis	Missouri foxtail cactus
Gayophytum diffusum	spreading groundsmoke
Gayophytum racemosum	blackfoot groundsmoke/ racemed groundsmoke
Gilia sinuata	rosy gilia
Grayia spinosa	spiny hopsage
Gutierrezia sarothrae	broom snakeweed
Halogeton glomeratus	saltlover
Hesperostipa comata	needle and thread grass
Ionactis alpina	Lava aster
Ipomopsis congesta	ballhead gilia
Ipomopsis minutiflora	littleflower gilia/ littleflower ipomopsis
Iva axillaris	povertyweed
Krascheninnikovia lanata	winterfat
Lactuca serriola	prickly lettuce
Langloisia setosissima	spotted langloisia/ Great Basin langloisia
Lappula occidentalis	flatspine stickseed
Lepidium perfoliatum	clasping pepperweed
Leymus cinereus	basin wildrye
Leymus flavescens	yellow wildrye
Linanthus pungens	granite prickly phlox
Lomatium dissectum	fernleaf biscuitroot
Lomatium foeniculaceum	desert biscuitroot
Lupinus argenteus	silvery lupine
Lupinus pusillus	rusty lupine/ small lupine
Lygodesmia grandiflora	largeflower skeletonplant

Scientific Name	Common Name
Machaeranthera canescens	hoary tansyaster
Mentzelia albicaulis	whitestem blazingstar
Oenothera caespitosa	tufted evening primrose
Oenothera pallida	pale evening primrose
Opuntia polyacantha	plains pricklypear
Orobanche corymbosa	flat-top broomrape
Orobanche fasciculata	clustered broomrape
Packera cana	woolly groundsel
Pascopyrum smithii	western wheatgrass
Penstemon cyaneus	blue penstemon
Penstemon pumilus	Salmon River beardtongue
Penstemon radicosus	matroot penstemon
Phacelia glandulifera	sticky phacelia
Phacelia hastata	silverleaf phacelia
Phlox aculeata	sagebrush phlox/ pricklyleaf phlox
Phlox hoodii	Hood's phlox/ spiny phlox
Phlox longifolia	longleaf phlox
Pleiacanthus spinosus	thorn skeletonweed
Poa secunda	Sandberg bluegrass
Pseudoroegneria spicata	bluebunch wheatgrass
Psoralidium lanceolatum	lemon scurfpea
Pteryxia terebinthina	turpentine wavewing
Purshia tridentata	antelope bitterbrush
Salsola kali	Russian thistle
Schoenocrambe linifolia	flaxleaf plainsmustard
Sisymbrium altissimum	Jim Hill mustard/ tall tumblemustard
Sphaeralcea munroana	Munro's globemallow/ whitestem globemallow
Stanleya viridiflora	green princesplume
Stenotus acaulis	stemless mock goldenweed
Symphyotrichum eatonii	Eaton's aster
Tetradymia canescens	spineless horsebrush
Tetradymia spinosa	shortspine horsebrush
Townsendia florifer	showy Townsend daisy
Zigadenus venenosus	meadow deathcamas

USDA, NRCS. 2017. The PLANTS Database (http://plants.usda.gov, December 6, 2017). National Plant Data Team, Greensboro, NC 27401-4901 USA.