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Implementing the Candidate Conservation Agreement for Greater Sage-Grouse on the Idaho National Laboratory Site: 2020 Full Report

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EXECUTIVE SUMMARY

In 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 the benefit of greater sage-grouse (*Centrocercus urophasianus*) on the Idaho National Laboratory (INL) Site. The primary purposes of the current report are to (1) document 2020 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.

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 be tripped if the three-year running average of males on those 27 leks (hereafter, baseline leks) decreases ≥20% (i.e., ≤253 males). In 2020, we surveyed baseline leks, six lek routes, 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 summed across baseline leks was 227 males—a 25% decrease from 2019 and the lowest value recorded on these leks since we began analyzing them as a unit in 2011. The three-year average (2018–2020) was 299 males (SD = 69), a 17% decrease from 2019. This value is 18% above the trigger threshold. Next year, if the summed annual count of males is lower than the 2020 count by only a single male, the 3-year running average will drop below 253, and the population trigger will be tripped.
- Male attendance on six lek routes was on average 17% lower than in 2019 (range 20% to −54%).
- The number of leks classified as active on and near the INL Site was unchanged at 40, and 19 of 27 baseline leks were active as in 2019.

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 there is a reduction of ≥20% (15,712 ha [38,824 ac]) of sagebrush habitat within the SGCA. 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 125 vegetation plots distributed across both habitat types. The following is a summary of results from habitat distribution and condition monitoring tasks:

- In polygons currently identified as sagebrush habitat, the mean cover for sagebrush and perennial herbaceous functional groups were near or above baseline and height estimates were within or near baseline. Trend analyses using functional group cover estimates indicated native perennial grasses likely reached the upper end of their normal range of variability in the previous few growing seasons and have begun to decline toward baseline values in 2020. Sagebrush cover slightly fluctuated, but it was unlikely ecologically meaningful. Introduced functional groups cover remained low and stable.

- In areas without sagebrush recovering from wildland fire, the annual mean for cover estimates of sagebrush and perennial herbaceous functional groups was greater than baseline. Heights for sagebrush were taller while perennial grasses and forbs were shorter in 2020 than baseline. Trend analyses for native species and the non-native crested wheatgrass remained stable, while cheatgrass cover fluctuated significantly over the past four years.
- Four wildland fires removed sagebrush habitat on the INL Site in 2020. A total of 1,067.4 ha (2,637.6 ac) of sagebrush habitat was removed from the SGCA. The current estimated acreage of sagebrush habitat in the SGCA is 77,486 ha (191,472.1 ac) representing a 1.4% decrease from the original baseline.
- In 2020, wildland fires also burned 21 ha (51.9 ac) of sagebrush habitat outside the SGCA and infrastructure expansion (see Section 4.2) removed an additional 35.7 ha (88.2 ac). The current estimated area of sagebrush habitat remaining outside the SGCA is 28,284.1 ha (69,891.5 ac).

Threat Monitoring

Raven Nest Surveys—Thirty-three active common raven nests were observed on the INL Site in 2020, a 17% increase from 2019. This value remains lower than most annual observations since surveys began in 2014, and no trend is evident, suggesting the raven breeding population on the INL Site is stable.

Infrastructure Expansion— There were nine locations mapped where infrastructure expansion removed sagebrush habitat resulting in a total loss of 35.7 ha (88.2 ac). However, all locations of sagebrush habitat loss from infrastructure occurred outside the SGCA.

Two-tracks were found to be prevalent across the INL Site with 238.3 km (148.1 mi) of new linear features detected and mapped within the SGCA or existing sagebrush habitat. In addition to the new two-track linear features, 30.4 km (18.9 mi) of two-tracks were mapped, but when cross-referenced to previously collected imagery from the National Agricultural Imagery Program, these features were found to be present but missed during the last review process.

Conservation Measures Associated with Habitat Restoration

The Environmental Surveillance, Education, and Research Program (ESER) managed the planting of 20,000 sagebrush seedlings in fall of 2020 in an area prioritized for restoration. Survivorship of seedlings planted in 2019 was 4.6%.

In response to the 2019 Sheep Fire, DOE, contractors and other stakeholders began implementing a post-fire recovery plan in 2020. The INL recontoured containment lines and began noxious weed control efforts along these lines. To control cheatgrass within the burn, ESER identified four areas with substantial cheatgrass that had enough remnant native perennials to facilitate good herbaceous recovery after herbicide application, which will begin in 2021. Stakeholders assisted in acquiring sagebrush seed and DOE aerially applied the seed to about 3,116 ha (7700 ac). Unfortunately, precipitation was low in 2020 and during extensive surveys in August, no seedlings were found that could be attributed to the aerial seeding.

Synthesis and Conclusions

Similar to trends observed on the INL Site, sage-grouse lek counts have declined substantially during the past five years across many parts of southeast Idaho. A recent analysis by an inter-agency Idaho Adaptive

Management Team concluded that repeated wildfires are the most significant issue facing sage-grouse in this region, including on the INL Site. Other concerns include the detrimental role of cheatgrass and a lack of a full complement of forb and grass species in sagebrush communities. On the INL Site, almost no sagebrush habitat was lost to wildfire between 2012 and 2019, but cumulative impacts of INL Site fires over the past 25 years have likely contributed to present declines. The ESER program has found that intact sagebrush habitat on the INL Site is apparently resistant to cheatgrass dominance and is generally in good condition. Annual monitoring has also revealed that the number of raven breeding pairs occupying INL Site infrastructure is roughly the same now as it was in 2014. Although sage-grouse numbers are relatively low now, it is possible that broad-scale climatic and environmental factors that have historically resulted in cyclic population trends in Idaho are contributing to the declines. If so, we would expect to see lek counts stabilize in the next three or four years.

Adaptive Management

No changes are proposed to the CCA.

Changes Made to the CCA in 2020

The USFWS and DOE made no changes to the CCA or associated monitoring tasks in 2020.

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The ESER Program recognizes and gives special thanks to Emma Casselman, Carson Kantack, Cory Braastad, Holly Forster, and Mauro Hernandez. These technicians completed one of the most challenging seasons the program has experienced. The team handled the challenges from the pandemic with grace and flexibility while taking on a workload that was substantially greater than previous efforts. We appreciate their refreshing enthusiasm and dedication to collect quality data over many dusty miles. We also thank Brande Hendricks for assistance with document formatting and Alana Jensen for cover design.

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ACRONYMS

ANOVA	analysis of variance
BEA	Battelle Energy Alliance, LLC
BLM	Bureau of Land Management
CA	conservation area (Idaho Department of Fish and Game)
CCA	Candidate Conservation Agreement
CFA	Central Facilities Area
DOE	U.S. Department of Energy, Idaho Operations Office
ESER	Environmental Surveillance, Education, and Research Program
FY	fiscal year
GIS	geographic information system
GPS	global positioning system
HMA	habitat management area
IDFG	Idaho Department of Fish and Game
INL	Idaho National Laboratory
MFC	Materials and Fuels Complex
MPLS	males per lek surveyed
NAIP	National Agricultural Imagery Program
NEPA	National Environmental Policy Act
SGCA	Sage-grouse Conservation Area
USFWS	U.S. Fish and Wildlife Service
WFMC	Wildland Fire Management Committee

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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 includes monitoring tasks designed to track sage-grouse abundance and habitat indicators, key threats, and conservation measures intended to reduce these threats. The current report, produced by DOE's Environmental Surveillance, Education, and Research Program (ESER), documents year-end results of CCA monitoring tasks and DOE and INL contractor activities associated with CCA conservation measures. A summary of monitoring results from this report is provided each January to the USFWS and can be found on the ESER website (http://www.idahoeser.com/).

A primary purpose of this report is to provide an update on sage-grouse population and habitat trends as they apply to adaptive regulatory triggers established in the CCA. If a regulatory trigger is tripped, a responsive action by DOE and USFWS will be initiated (DOE and USFWS 2014, Section 9.4.3). The two triggers and criteria that define them 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 acres)—a 20% drop from the 2013 baseline of 78,558 ha (194,120 acres).

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 grounded in the best available science, and retains its value to both signatories.

Related monitoring tasks are grouped into three sections: Population Trigger Monitoring (Section 2), Habitat Trigger Monitoring (Section 3), and Threat Monitoring (Section 4). Section 5 reports how DOE and contractors implemented conservation measures listed in the CCA during the past year. Section 6 synthesizes results from all monitoring tasks and discusses results and their implications in context of regional trends, and future management directions. This section also documents changes and updates to the CCA that have been approved by both signatories during the past year and outlines the upcoming CCA annual work plan.

2.0 POPULATION TRIGGER MONITORING

2.1 Task 1—Lek Counts and Lek Route Surveys

2.1.1 Introduction

In 2013, a sage-grouse population monitoring task (Task 1—CCA Section 11.1.1) was designed to track abundance trends on the INL Site and provide information to DOE and USFWS regarding the direction of trends relative to the population trigger threshold. Counts from 27 leks located in the SGCA (hereafter, baseline leks) are the basis of the population trigger (Figure 2-1; DOE and USFWS 2014). These leks are surveyed annually, either individually or as part of a lek route. The baseline value for the population trigger is 316 males—the sum of peak male attendance in 2011 when all baseline leks were classified active. The population trigger will be tripped if the three-year running average of peak male attendance at these baseline leks falls below 253, a 20% decrease from the 2011 value (DOE and USFWS 2014).

In addition to baseline lek counts, we survey six lek routes annually—three that have been surveyed since the late 1990s and three that were established in 2017—to evaluate long-term sage-grouse abundance trends. Surveying a cluster of leks in the same order and on the same day (i.e., lek routes) reduces some of the confounding issues inherent in surveys of individual leks; thus, lek route data are considered more suitable for tracking abundance trends across relatively small spatial extents than data from individual lek surveys (Connelly et al. 2003, DOE and USFWS 2014). Data from these routes continue to build on more than two decades of sage-grouse monitoring on the INL Site, providing context to interpret short-term results derived from baseline lek monitoring. The CCA stipulated that following completion of historical lek surveys and lek discovery surveys, additional lek routes would be established, and the basis for the population trigger would be converted from baseline leks to lek routes. Such a proposal is currently under consideration.

Finally, Task 1 includes rotational surveys of inactive leks that are not included in annual baseline lek and lek routes surveys. The goal is to revisit all leks classified as inactive at least once every five years to determine if sage-grouse have reoccupied the sites. This, and other monitoring activities described above, help maintain accurate records of the number and location of active leks on the INL Site.

2.1.2 Methods

Field Methods

Depending on road conditions, we begin lek counts on or soon after March 20 and end after the first week of May when male counts on all lek routes are less than the seasonal peak. Lek counts occur between 30 minutes before and 90 minutes after sunrise, and only during reasonably clear and calm weather (i.e., no precipitation and winds <12 miles per hour). If sage-grouse are present at a lek, an observer tallies the number of visible males three or four times over a five- to 10-minute period. The highest tally is recorded as the lek count for the day. Visits to single leks and lek routes are separated by at least seven days. The primary goal each year is to survey all known active leks on the INL Site and lek routes (including inactive leks on routes) ≥4 times, inactive baseline leks ≥3 times, and inactive leks not assigned to lek routes or designated as baseline leks (i.e., rotational surveys) ≥2 times.

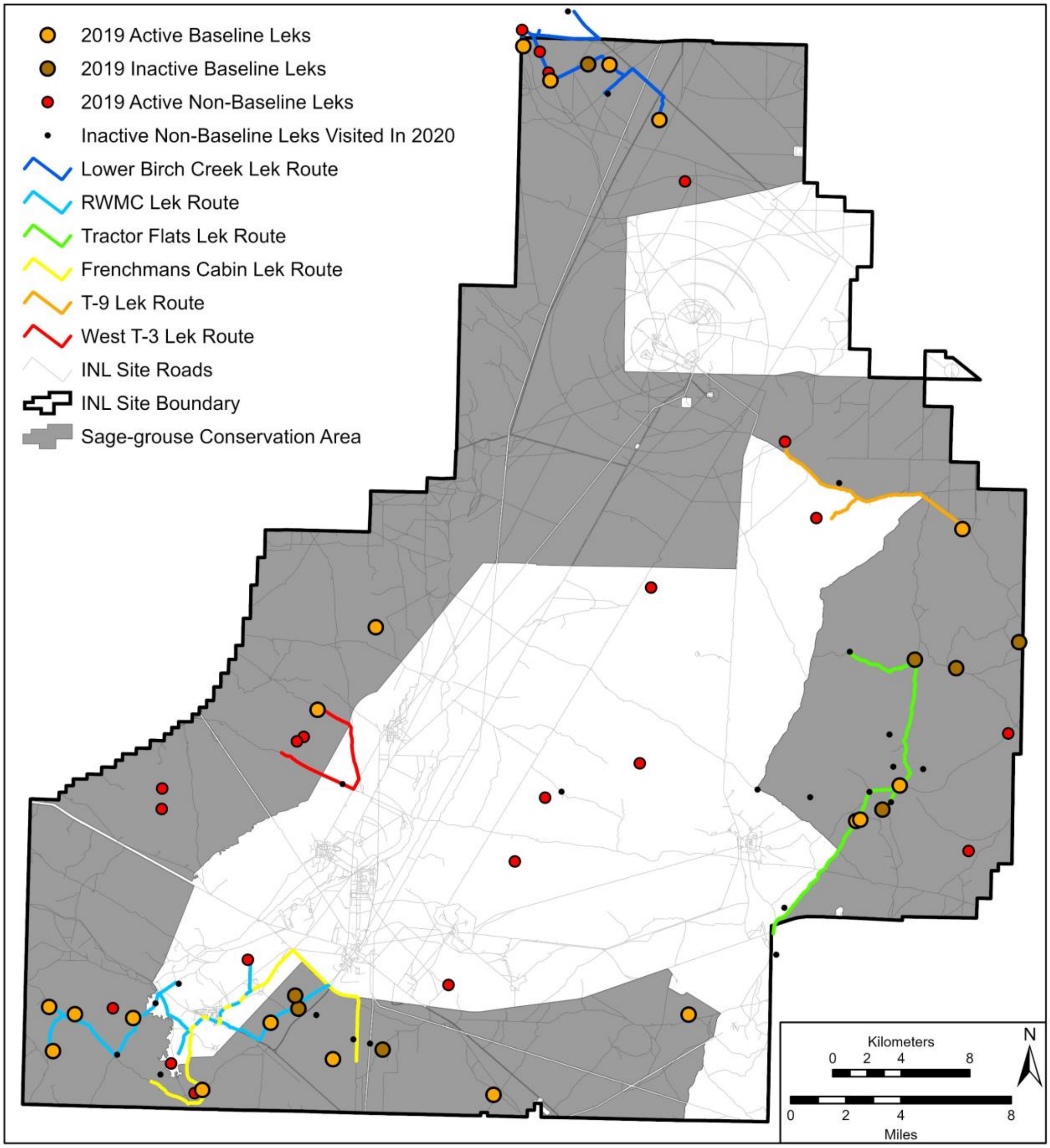

Figure 2-1. An overview of sage-grouse leks surveyed on the Idaho National Laboratory Site in 2020. Lek activity designations (active vs. inactive) refer to lek status at the end of 2019.

Six lek routes (Figure 2-1) were surveyed approximately once per week, with at least seven days separating each visit. Routes consisted of three to 10 active and inactive leks, and all leks on a route were visited on the same day and in the same order. Three routes have been surveyed annually since the mid-1990s (Lower Birch Creek, Tractor Flats, and Radioactive Waste Management Complex), and three have been surveyed since 2017 (West T-3, T9, and Frenchmans Cabin[1]). Tractor Flats and Lower Birch Creek routes each include a lek located off the INL Site within 0.5 km of the boundary.

Following a route survey, counts of males are summed across all leks to produce a single route value. Upon completion of the field season, we determined peak male attendance for each route based on the survey with the highest count.

Lek Status

We classify a lek active if it was attended by two or more male sage-grouse that were displaying in at least two of the previous five years of surveys (Connelly et al. 2000, Whiting et al. 2014). Leks that do not meet these criteria are classified inactive. Following each field season, we examine data from the past five years for each surveyed lek and adjust its activity status as necessary.

To ensure that our list of active leks is accurate, we visit inactive leks that are not one of the baseline or route leks on a rotational basis. Our goal is to visit each inactive, non-baseline lek at least once every five years to determine if its status has changed. Prior to the start of the field season, we search our database for all inactive leks and select a number that can be reasonably added to our upcoming workload. We also survey other inactive leks as requested by the Idaho Department of Fish and Game (IDFG).

Analysis

We calculated separate summary statistics for baseline leks and lek routes, although some baseline lek counts contribute to both summaries. Separating the two summaries was necessary because some baseline leks are isolated and therefore counted singly, whereas others are part of lek routes (Figure 2-1).

To determine the population trigger relative to the critical threshold of 253 males, we identified peak male attendance on each baseline lek (i.e., the highest male count recorded during any visit after March 20) and summed those counts across all 27 leks. This annual count was then averaged with the preceding two years to produce a three-year running average—the population trigger metric (DOE and USFWS 2014).

We assessed long-term abundance trends by examining the number of males per lek surveyed (MPLS) for each of the six lek routes. This was done by identifying annual peak male attendance for each route (i.e., the highest number of males observed on a route in a single morning) and dividing the total by the number of leks visited, including inactive leks.

2.1.3 Results and Discussion

SGCA Baseline Leks

Lek surveys occurred from March 24 through May 8, 2020 (hereafter, the field season), and we surveyed each baseline lek three to seven times ($\bar{x}$ = 4.7 surveys, SD = 1.1). Peak male attendance, summed across all baseline leks, was 227, a 25.3% decrease from 304 individuals recorded in 2019. This value is the lowest recorded on these leks since we began analyzing them as a unit in 2011 (Figure 2-2). The 2020 count represents the fourth consecutive year of double-digit percent declines on baseline leks. Male attendance has declined 52% since it peaked in 2016, and it is now 28% below the 2011 value. Upon completion of the field season, the number of active baseline leks remained unchanged at 19.

[1] "Frenchmans Cabin" is a recognized map feature by the U.S. Board on Geographic Names and is not misspelled.

The three-year (2018–2020) running average of peak male attendance on baseline leks was 299 males (SD = 69.2), a 16.9% decrease from 2019. This value is the lowest recorded since we began calculating the average in 2013 (Figure 2-2) and it is 18% above the threshold (253 males) that, if crossed, would trigger specified action by DOE and the USFWS (DOE and USFWS 2014). If the summed annual count of males in 2021 is lower than the count in 2020 by only a single male, the 3-year running average will drop below 253, and the population trigger will be tripped.

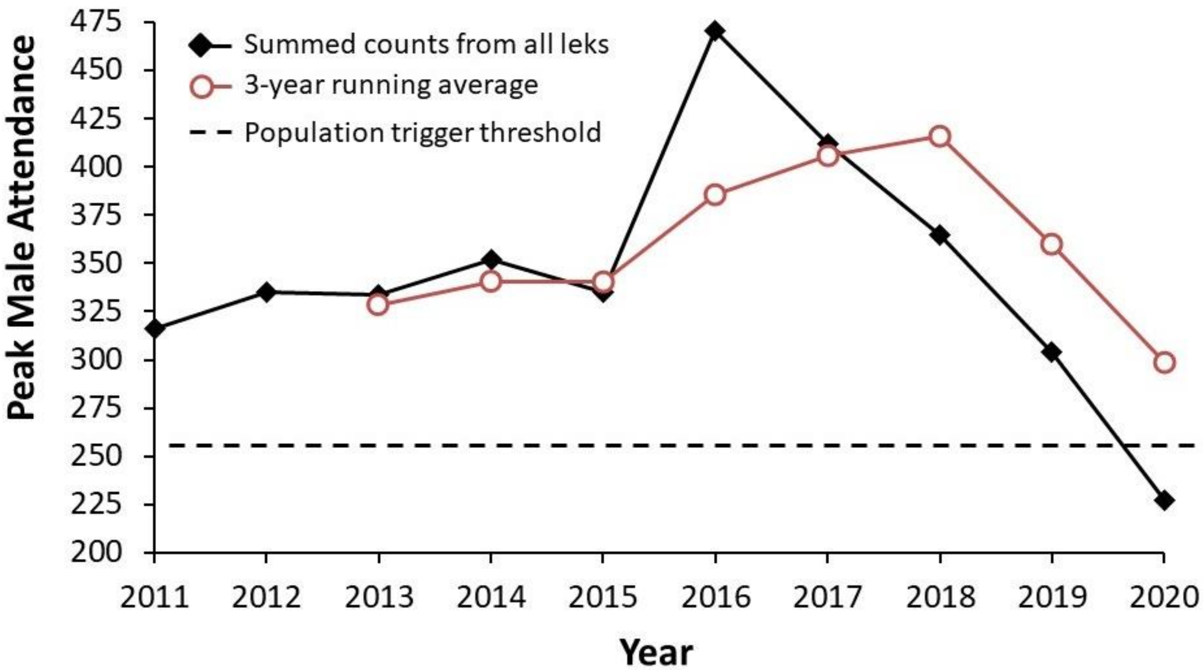

Figure 2-2. Peak male attendance of greater sage-grouse on the 27 leks in the Sage-grouse Conservation Area that are the basis for the population trigger. The population trigger will be tripped if the 3-year running average falls below the indicated threshold.

Lek Routes

We surveyed each lek route five or six times, and total leks surveyed per route was the same as last year, ranging from three to 10 (Table 2-1). During one survey of the three leks on Frenchmans Cabin route, data were recorded incorrectly, and we were forced to discard them for that day. The error was not discovered until after the field season was complete, so only two surveys were used on that route to calculate the MPLS value and peak count.

For all but one route (West T-3), MPLS values were lower in 2020 than in 2019, with reductions ranging from 11%–54%. On average, lek route counts declined 17.0% (SD = 23.5%).

Table 2-1. Lek Route data from 2020 surveys on the Idaho National Laboratory Site and multi-year means for each route.

Lek Route	Highest Single-Day Count	Multi-Year Mean*	Total Leks Surveyed	Males / Lek Surveyed (MPLS)	MPLS % change from 2019	Occupied Leks†	Surveys Conducted
Tractor Flats	56	77.1	8	7.0	−18.6	3	5
Radioactive Waste Management Complex	28	108.4	9	3.1	−53.7	3	5
Lower Birch Creek	76	80.9	10	7.6	−19.1	5	5
West T-3	19	37.3	4	4.8	20.0	2	6
T-9	31	36.0	4	7.8	−11.4	2	6
Frenchmans Cabin	15	36.7	2	7.5	−19.4	1	6

*For the first three routes, the 10-year mean (2010-2019) is displayed; for the last three, it is a 3-year mean (2017-2019), being the only data available.

† Leks on routes are considered occupied if two or more males were observed displaying during the current year's survey. This is different from an active lek designation that DOE's Environmental Surveillance, Education, and Research Program uses to characterize leks on the Idaho National Laboratory Site, which is based on five years of data. Here, we report the number of leks occupied on the day the route count peaked.

Rotational Surveys of Inactive Leks

We visited 13 inactive leks twice, 11 of which had not been visited since 2016. These leks are not included on survey routes, nor are they baseline leks. No sage-grouse were observed at any of these leks, so each will retain its inactive status and will be visited again in approximately five years.

Changes in Lek Classification

Following the 2020 field season, one baseline lek on the Tractor Flats route (INL 18) was upgraded to active status and another (INL 29) was downgraded to inactive status, leaving the count of known active leks on or near the INL Site at 40. The upgrading of INL 18 occurred following two consecutive years of male attendance (Figure 2-3) wherein a high of 33 males (2019) and 31 males (2020) were observed. Prior to 2019, no sage-grouse had been observed on INL 18 for five years. Lek INL 29 is in an area that burned in 2007 and nearly burned a second time in 2010 during a fire event. Male counts have generally declined at this lek since the first recorded observation in 2007, and no males have been observed at the site since 2016.

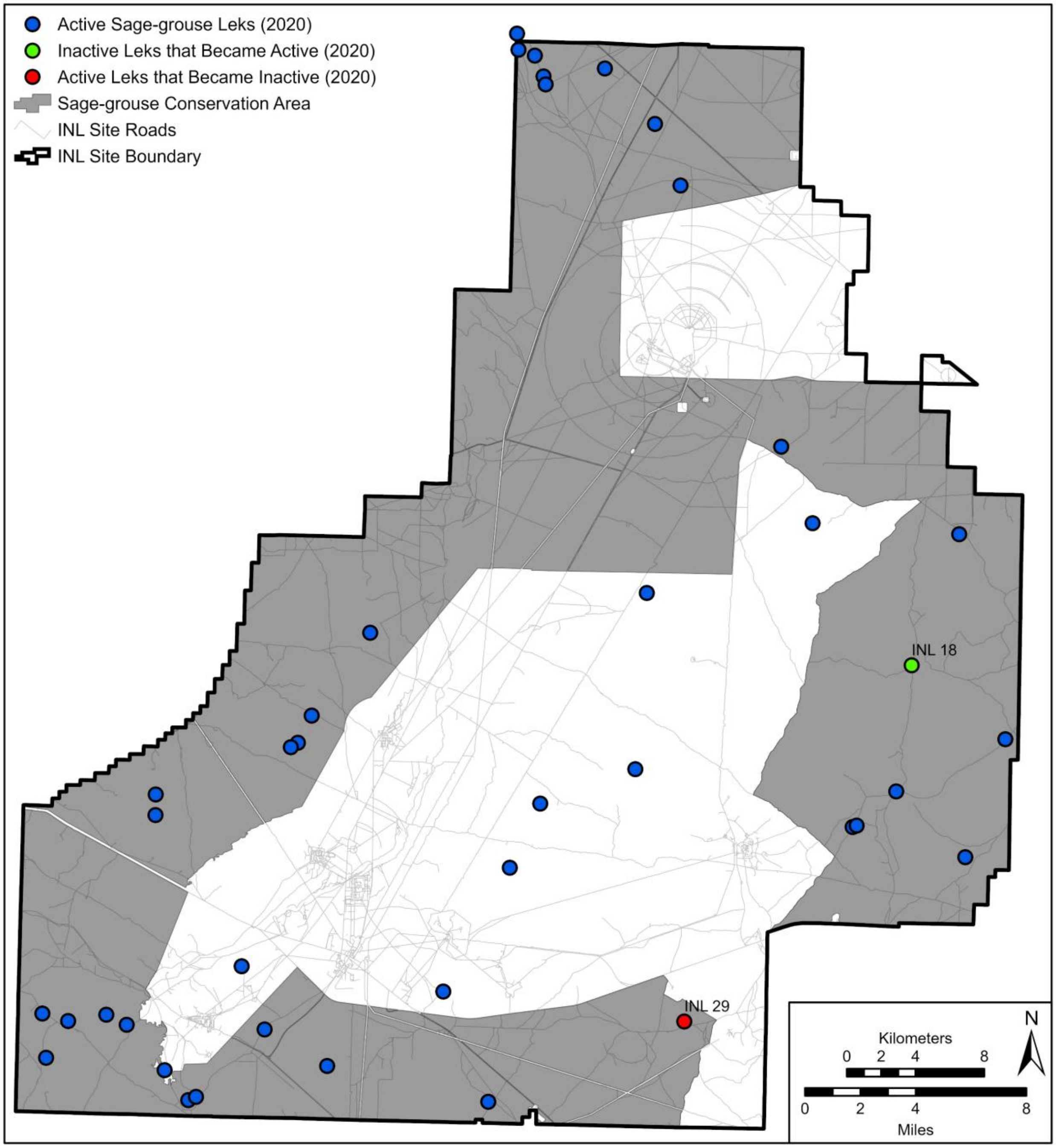

Figure 2-3. Map of all known active leks on or near the Idaho National Laboratory Site following the 2020 field season and lek status update. Both leks that had a status change are baseline leks.

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 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 acres). Until 2020, no real changes in the amount of sagebrush habitat within the SGCA have been recorded since the CCA was signed; however, 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 be tripped if there is a loss of >15,712 ha (38,824 acres) within the SGCA (i.e., a 20% reduction in sagebrush habitat). If the trigger is tripped, the USFWS will ask DOE 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 current-year sagebrush habitat on the INL Site with site-specific expected values. 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 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 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. Wildland fire was ranked as a high-level threat in the CCA. The potential negative effects from annual grasses and other weeds, infrastructure development, and seeded perennial grasses are also important, with each being ranked as a mid-level threat. Livestock operations is also recognized as a potential threat to sage-grouse on the INL Site and is ranked as a low-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 annual 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 and/or recovery,
- interpret changes to habitat condition within the context of regional vegetation and weather patterns,
- continue to assess progress toward recovery in areas that were lost from current habitat status due to wildland fire or other disturbances,
- understand the effects of various threats on habitat condition,
- provide a link between areas mapped as habitat and the vegetative characteristics of the plant communities in those polygons, and
- inform the process used to update the estimate of sagebrush habitat distribution.

3.1.2 Methods

Sampling

In 2013, we established 225 vegetation sampling plots for the purpose of monitoring sage-grouse habitat condition on the INL Site. All plot locations were selected using a stratified random sampling design (Shurtliff et al. 2016). A subset of 75 plots are surveyed annually (hereafter annual plots), about two-thirds of which are located in map polygons designated as current sagebrush habitat (hereafter sagebrush habitat plots). The remaining one-third of the annual plots are in burned areas, where the plant community prior to the wildland fire was thought to include sagebrush habitat (hereafter non-sagebrush plots). An additional 150 plots are surveyed on a rotational basis (hereafter rotational plots) with a subset of 50 plots sampled each of three years over the span of five years. The rotational plots are located in burned areas, grazing allotments, and areas likely to be impacted by non-native plants to increase sample sizes.

The data metrics collected at each of the habitat plots were selected to facilitate characterization of general habitat condition (Connelly et al. 2000). The main purpose of collecting and summarizing these metrics is to support basic description and assessment of sage-grouse habitat quality (Shurtliff et al. 2019). The data are also used to track trends, which allows for characterization of compositional change in vegetation through time, and aids in assessing the effects of potential threats on habitat quality. Data metrics sampled at each plot include: vegetation cover by species, vegetation height for shrubs and herbaceous species, sagebrush density, frequency of juvenile sagebrush occurrence, comprehensive species lists, photographic documentation, sign of use by sage-grouse, indicators of anthropogenic disturbance, and documentation of the current local plant community. A complete description of sample site selection and plot sampling methodology can be found in the study plan and sample protocol for this monitoring project (Shurtliff et al. 2016, Appendix B).

Data Analyses

Annual plots are used to assess and characterize habitat condition each year, while rotational plots are used to address specific threats or concerns related to localized areas (burned areas, grazing allotments, etc.). Analysis of rotational plots are completed once every five years, after data have been collected on all three plot subsets. The most recent analyses of rotational plots were completed in 2016 (Shurtliff et al. 2017). The results of rotational analyses will be presented in the monitoring report for the 2021 calendar year. Analyses included in this report only include data from annual plots, which are evaluated to characterize habitat condition.

Data analyses are two-fold; they include comparing annual habitat condition against baseline values and evaluating trends in habitat condition through time. Annual cover and height values of several vegetative functional groups (e.g. shrubs, grasses, forbs) and of sagebrush density and juvenile frequency are compared to baseline values. Trend analyses utilize cover data for plant functional groups from data collected over eight years (2013 – 2020) to assess changes in vegetative composition through time. In addition to vegetation-based analyses, a summary of precipitation and the potential effects of precipitation patterns on the habitat condition monitoring data are included.

From 2013 through 2017, annual plot summaries were used to compare habitat condition on the INL Site to general regional guidelines (Connelly et al. 2000). Beginning in 2018, we transitioned to using locally derived habitat condition baseline values to evaluate the current year's habitat condition data. These baseline values were collected over five years (2013-2017) from the 75 annual plots. The baseline values provide a more accurate estimation for evaluating annual habitat condition than generalized regional guidelines due to the large variation across the diverse sagebrush steppe ecosystem (Connelly et al. 2000).

To evaluate trends in vegetative functional groups over the past eight years, cover data were analyzed using one-way repeated measure of analysis of variance (ANOVA) (Zar 1999) to ascertain statistical significantly differences between years within each habitat type. This is the most appropriate test for the study design due to permanent, random plot design. Repeated measure tests assume that all samples within a sample group experienced the same treatment over time, resulting in a balanced statistical design (Aho 2013). Treatments were defined in this monitoring effort as either a sagebrush habitat plot or non-sagebrush plot. Three sagebrush plots burned during data collection efforts in 2019 and their habitat status was updated prior to 2020 to reflect a change to non-sagebrush habitat status. To maintain balance in the statistical design, data collected from those plots prior to burning were classified as sagebrush habitat plots whereas data collected after burning were then classified as non-sagebrush plots. Sample sizes were still more than adequate for meaningful interpretation of statistical results (Zar 1999). Significance was determined at the α = 0.05 level and multiple comparisons were evaluated using the pairwise multiple comparison Holm-Sidak method (Šidák 1967). Only cases in which ANOVA and the Holm-Sidak method identified significant difference were reported because while some cases had significant ANOVA results, there was no discernable significance between groups after the Holm-Sidak method was applied.

3.1.3 Results and Discussion

Current Habitat Condition

We collected data on 125 vegetation plots from June 1 through August 5, 2020. This report focuses on the 75 annual plots surveyed. The annual plots are divided into two subgroups. There are 45 sagebrush habitat plots located within current sagebrush habitat polygons and 30 non-sagebrush plots located within polygons where sagebrush has been lost to wildland fire (Figure 3-1). The sagebrush habitat plots are in polygons that have not burned in at least the last 20 years, and many of them have likely not burned for at least a few centuries (Forman et al. 2013). All the non-sagebrush plots have burned at least once since 1994 and have the potential to recover to sagebrush habitat. The 2019 Sheep Fire burned over several plots, both sagebrush and non-sagebrush. The habitat status of the three plots that were in sagebrush habitat prior to the fire was changed to non-sagebrush and the status of the plots that were in non-sagebrush polygons prior to the fire remained unchanged. There were multiple wildland fires on the INL Site in 2020. Two annual plots were burned; however, all plots were sampled prior to any wildland fires.

Annual Habitat Condition Summary

Annual values for absolute cover, height, and sagebrush density were compared to baseline values to evaluate the current status of potential sage-grouse habitat on the INL Site (Table 3-1a, Table 3-1b). Within sagebrush plots, absolute cover for sagebrush species was slightly higher than baseline values and perennial grass/forb cover was also greater than baseline in 2020. Sagebrush density was lower in 2020 when compared to baseline values. Within non-sagebrush plots, cover and density for sagebrush species and herbaceous functional groups 2020 values were within baseline ranges, but 2020 height values were higher for sagebrush and lower for perennial grasses and forbs when compared to baseline.

Cover: Sagebrush Habitat Plots

Absolute cover of species is organized by nativity and vegetative functional groups (Table 3-2a). In 2020, total absolute cover on sagebrush habitat plots was near the baseline value. Overall, native functional groups contributed substantially more cover than introduced functional groups and native shrubs were the most abundant functional group. Relative cover of shrubs was lower in 2020 because absolute cover of native grasses was higher than baseline. The native perennial graminoid functional group was the second most abundant functional group in 2020 and the remaining native functional classes were below baseline cover values contributing less relative cover. Introduced functional groups, including cheatgrass, provided little absolute cover on sagebrush habitat plots in 2020.

Within native shrubs, sagebrush species (*Artemisia* spp.) comprised more than three quarters of the functional group and absolute cover in 2020 was slightly greater than baseline values. Big sagebrush (*Artemisia tridentata*) remains the most abundant sagebrush species but threetip sagebrush (*A. tripartita*) and black sagebrush (*A. nova*) were locally abundant on the limited number of plots where each occurred. Low sagebrush (*A. arbuscula*) cover was lower than the baseline value and likely reflected differences in identification among similar species between 2020 and baseline data. The second most abundant shrub species was green rabbitbrush (*Chrysothamnus viscidiflorus*). Shadscale saltbush (*Atriplex confertifolia*) and winterfat (*Krascheninnikovia lanata*) contributed minor cover in 2020 as well.

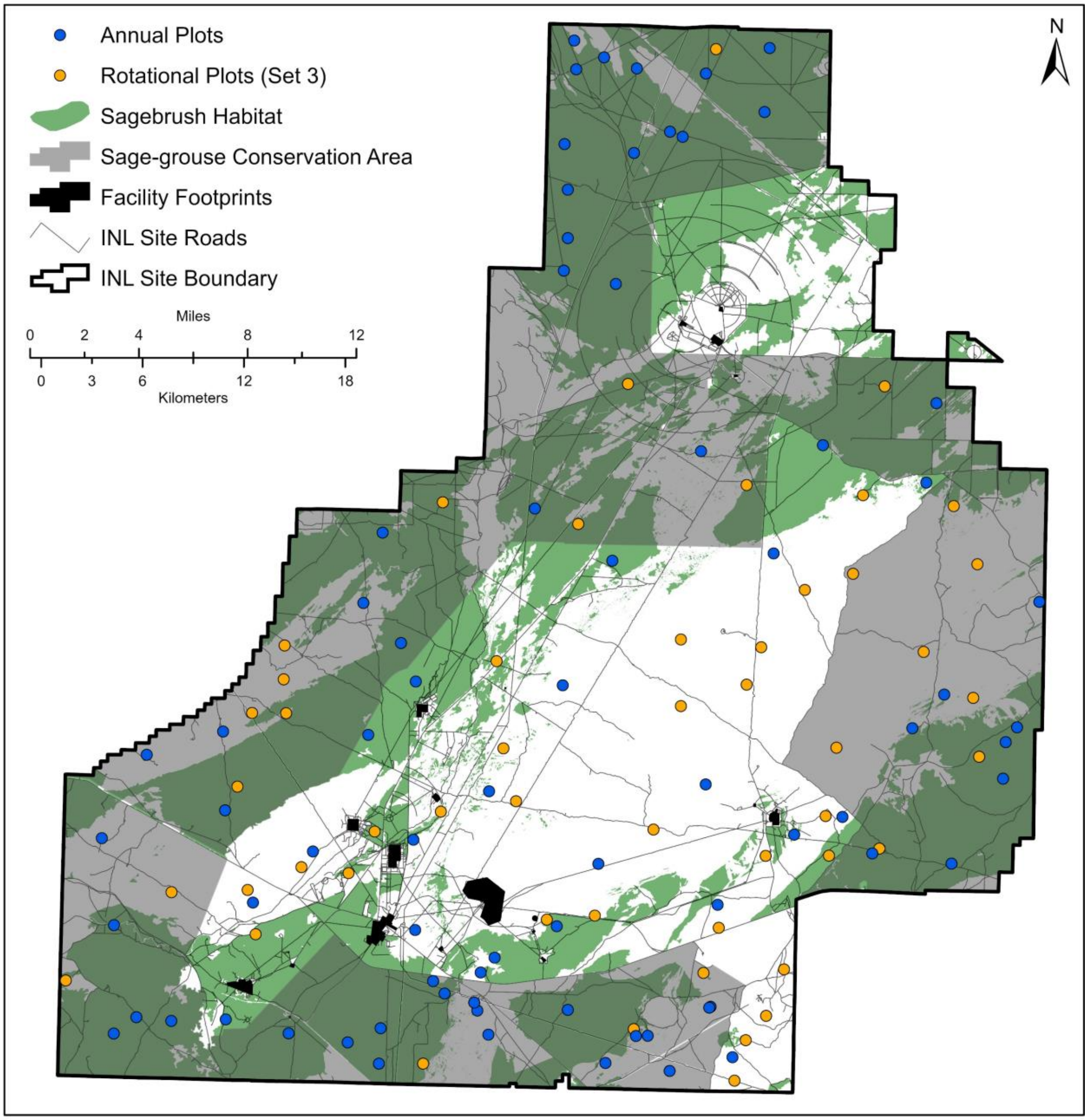

Figure 3-1. Sage-grouse habitat condition monitoring plots sampled on the Idaho National Laboratory Site in 2020 to support the Candidate Conservation Agreement. Annual and rotational plots are displayed over sagebrush habitat and Sage-grouse Conservation Area polygons.

Table 3-1a. Summary of vegetation measurements for characterization of condition of sagebrush habitat monitoring plots and non-sagebrush plots on the Idaho National Laboratory Site in 2020.

2020 Summary			
Sagebrush Habitat Plots (n = 45*)	Mean Cover (%)	Meant Height (cm)	Mean Density (individuals/m^2)
Sagebrush	23.05	46.24	3.45
Perennial Grass/Forb	16.17	19.93	
Non-sagebrush Plots (n = 30*)			
Sagebrush	0.40	39.38	0.12
Perennial Grass/Forb	20.93	22.61	

*indicates sample size difference from past sampling efforts.

Table 3-1b. Baseline values of selected vegetation measurements for characterization of condition of sagebrush habitat and non-sagebrush monitoring plots on the Idaho National Laboratory Site. Baseline values were generated from five years of data (2013-2017).

Baseline Summary						
Sagebrush Habitat Plots (n = 48)	Mean Cover (%)	SE	Mean Height (cm)	SE	Mean Density (individuals/m^2)	SE
Sagebrush	21.27	± 0.33	47.81	± 0.98	5.19	± 1.80
Perennial Grass/Forb	9.99	± 2.53	20.70	± 3.67		
Non-sagebrush Plots (n = 27)						
Sagebrush	0.22	± 0.22	33.54	± 1.94	0.07	± 0.01
Perennial Grass/Forb	19.73	± 2.17	29.58	± 3.81		

Sandberg bluegrass (*Poa secunda*) and bottlebrush squirreltail (*Elymus elymoides*) were the most abundant species within the native perennial graminoid functional group and made up two thirds of the group's vegetation composition in 2020. These two grasses are also the most abundant grasses contributing to the baseline cover values. Bluebunch wheatgrass (*Pseudoroegneria spicata*) and thickspike wheatgrass (*Elymus lanceolatus*) cover values were consistent with baseline absolute cover values and in cover relative to other perennial grasses.

The 2020 total absolute cover from introduced species remained lower than native species mirroring baseline cover values for introduced functional groups. The most abundant non-natives were crested wheatgrass (*Agropyron cristatum*) and cheatgrass (*Bromus tectorum*). Crested wheatgrass contributed to more than half of the vegetation composition for introduced species because nearly all other species fell well below their baseline cover values. Cheatgrass accounted for nearly all vegetation cover in the annuals and biennials functional group and there was a notable decrease from 9% in 2019 (Shurtliff et al. 2020) to 1% in absolute cover in 2020.

Table 3-2a. Absolute cover (%) for observed species within 45 annual sagebrush habitat plots. Baseline absolute cover values are compared to 2020 absolute cover values by species and functional groups. Baseline values were generated from five years of data (2013-2017).

Plant Species†	Baseline Absolute Cover (%)	2020 Absolute Cover (%)
Native		
Shrubs		
Artemisia tridentata	17.41	20.06
Chrysothamnus viscidiflorus	6.64	5.42
Artemisia tripartita	1.80	2.09
Artemisia arbuscula	1.16	0.00
Atriplex confertifolia	0.95	0.78
Artemisia nova	0.90	0.90
Krascheninnikovia lanata	0.72	0.44
Linanthus pungens	0.22	0.20
Eriogonum microthecum	0.10	0.05
Tetradymia canescens	0.04	0.04
Ericameria nauseosa	0.02	0.02
Others (n = 2, 1)	0.03	0.00
Total Native Shrub Cover	**29.99**	**30.01**
Succulents		
Opuntia polyacantha	**0.10**	**0.06**
Perennial Graminoids		
Elymus elymoides	2.15	4.81
Poa secunda	2.03	4.45
Achnatherum hymenoides	1.85	1.39
Pseudoroegneria spicata	1.21	1.28
Elymus lanceolatus	0.80	0.86
Hesperostipa comata	0.51	0.25
Pascopyrum smithii	0.21	*
Carex douglasii	0.11	0.17
Others (n=1,0)	0.02	*
Total Native Perennial Graminoid Cover	**8.88**	**13.21**
Perennial Forbs		
Phlox hoodii	0.47	0.40
Schoenocrambe linifolia	0.24	0.00
Sphaeralcea munroana	0.12	0.01
Erigeron pumilus	0.04	0.07
Astragalus filipes	0.03	0.21
Arabis cobrensis	0.02	0.01
Astragalus lentiginosus	0.01	0.08
Ipomopsis congesta	0.00	0.05
Others (n = 22, 11)	0.18	0.13

Plant Species†	Baseline Absolute Cover (%)	2020 Absolute Cover (%)
Total Native Perennial Forb Cover	**1.11**	**0.96**
Annuals and Biennials		
Lappula occidentalis	0.34	*
Descurainia pinnata	0.27	*
Cordylanthus ramosus	0.15	0.03
Chenopodium leptophyllum	0.08	*
Others (n = 13, 4)	0.14	0.01
Total Annual and Biennial Forb Cover	**0.99**	**0.04**
Total Native Cover	**41.07**	**44.28**
Introduced		
Perennial Grasses		
Agropyron cristatum	**1.34**	**2.01**
Annuals and Biennials		
Alyssum desertorum	1.08	0.01
Bromus tectorum	1.02	1.02
Halogeton glomeratus	0.74	0.03
Others (n = 7, 1)	0.03	0.02
Total Introduced Annuals and Biennials Cover	**2.87**	**1.08**
Total Introduced Cover	**4.21**	**3.09**
Total Vascular Plant Cover	**45.28**	**47.37**

* Species that were undetectable using the current sampling methodology.
† Appendix A provides a complete species list with scientific and common names.

Cover: Non-sagebrush Plots

Total absolute cover was lower in 2020 than the baseline value on the non-sagebrush plots (Table 3-2b). Native species provided greater cover than introduced species, which is consistent with baseline functional group composition. The native perennial graminoid functional group had slightly greater absolute cover when compared to baseline values. The native shrub functional group was the second most abundant, closely followed by introduced annuals and biennials. Total absolute cover values reflected less cover from introduced species when compared to baseline and they contributed to a smaller portion of vegetation cover.

Within the native perennial graminoid functional group, Sandberg's bluegrass was the most abundant species with greater absolute cover in 2020 than baseline, followed by bottlebrush squirreltail and western wheatgrass. Some species also had lower cover in 2020 than their baseline cover values like Indian ricegrass and needle-and-thread grass (*Hesperostipa* comata). Within the shrub functional group, green rabbitbrush was the most abundant species contributing 90% of the relative cover of that group. Although there were small contributions from other shrub species, these recovering habitats are defined by the presence of this shrub because it can resprout easily after wildland fire.

Total cover from the introduced annuals and biennials functional group in 2020 was half that of their baseline cover values. In both the baseline and 2020 values, cheatgrass is by far the most abundant species in this functional group. Cheatgrass cover was below the baseline value in 2020 and has decreased substantially over the last two seasons, from 36% absolute cover in 2018 to 28% absolute cover in 2019 (Shurtliff et al. 2020) and now to 8% absolute cover in 2020. However, it continues to be the dominant species in the functional group. Cheatgrass is a self-pollinating winter annual. It grows during seasons that native plants are typically dormant providing it a head start but, it is still an annual species and likely dramatically fluctuates in abundance in response to variable annual environmental conditions.

Table 3-2b. Absolute cover (%) for observed species within 30 annual non-sagebrush plots. Baseline values are compared to 2020 absolute cover values by species and functional groups. Baseline values were generated from five years of data (2013-2017).

Plant Species†	Baseline Absolute Cover (%)	2020 Absolute Cover (%)
Native		
Shrubs		
Chrysothamnus viscidiflorus	10.72	9.80
Atriplex confertifolia	0.33	0.37
Artemisia tridentata	0.21	0.33
Tetradymia canescens	0.18	0.09
Eriogonum microthecum	0.07	0.01
Gutierrezia sarothrae	0.02	0.10
Artemisia tripartita	0.01	0.06
Others (n = 3, 2)	0.08	0.12
Total Native Shrub Cover	**11.62**	**10.88**
Succulents		
Opuntia polyacantha	**0.10**	**0.06**
Perennial Graminoids		
Pseudoroegneria spicata	4.82	4.08
Poa secunda	3.01	5.01
Hesperostipa comata	2.68	1.69
Achnatherum hymenoides	2.45	0.88
Elymus lanceolatus	2.08	1.96
Elymus elymoides	1.42	2.02
Pascopyrum smithii	0.84	2.51
Leymus flavescens	0.58	1.00
Carex douglasii	0.08	0.08
Others (n = 2, 1)	0.03	0.01
Total Native Perennial Graminoid Cover	**17.98**	**19.23**
Perennial Forbs		
Phlox hoodii	0.40	0.29
Sphaeralcea munroana	0.31	0.04
Crepis acuminata	0.29	0.07

Plant Species†	Baseline Absolute Cover (%)	2020 Absolute Cover (%)
Erigeron pumilus	0.15	0.06
Phlox aculeata	0.11	*
Phlox longifolia	0.10	0.04
Machaeranthera canescens	0.07	0.01
Schoenocrambe linifolia	0.07	*
Astragalus filipes	0.06	0.04
Pteryxia terebinthina	0.01	0.08
Astragalus lentiginosus	0.01	0.31
Others (n = 17, 9)	0.17	0.11
Total Native Perennial Forb Cover	**1.75**	**1.06**
Annuals and Biennials		
Lappula occidentalis	0.26	*
Descurainia pinnata	0.11	*
Mentzelia albicaulis	0.09	0.21
Eriastrum wilcoxii	0.09	0.01
Mentzelia albicaulis	0.09	0.21
Others (n = 12, 3)	0.14	0.04
Total Native Annual and Biennial Cover	**0.67**	**0.26**
Total Native Cover	**32.12**	**31.49**
Introduced		
Perennial Grasses		
Agropyron cristatum	**0.59**	**0.64**
Perennial Forbs		
Carduus nutans	**0.01**	*
Annuals and Biennials		
Bromus tectorum	13.48	7.94
Salsola kali	1.78	0.01
Alyssum desertorum	1.40	0.15
Halogeton glomeratus	1.22	0.04
Sisymbrium altissimum	0.21	0.10
Descurainia sophia	0.06	*
Tragopogon dubius	0.01	0.24
Lactuca serriola	*	0.14
Others (n = 1, 0)	0.01	*
Total Introduced Annual and Biennial Cover	**18.17**	**8.62**
Total Introduced Cover	**18.78**	**9.26**
Total Vascular Plant Cover	**50.90**	**40.75**

* Species that were undetectable using the current sampling methodology.
† Appendix A provides a complete species list with scientific and common names.

Vegetation Height: Sagebrush Habitat Plots

The vegetation height metric provides an assessment of vertical structure by functional group in sagebrush habitat and non-sagebrush plots (Tables 3-3a and 3-3b). Sagebrush species were the individuals measured most frequently within the shrub functional group in sagebrush habitat plots. On average, sagebrush species were nearly twice as tall as the other species of shrubs which were the second tallest functional group. Perennial grasses were the individuals encountered most frequently within the herbaceous functional group, as indicated by the proportion of the sample measured, than the baseline and the combined remaining functional groups were half as likely to be measured. Annual grasses were half their baseline height.

Table 3-3a. Vegetation height by functional group for 45 annual sagebrush habitat plots on the Idaho National Laboratory Site in 2020. Baseline values are compared to functional groups for height (cm) and were generated from five years of data (2013-2017).

Sagebrush Habitat Plots	Baseline		2020	
Functional Group	Mean Height (cm)	Proportion of Sample	Mean Height (cm)	Proportion of Sample
Shrubs				
Sagebrush	47.81	0.72	46.24	0.71
Other Species	25.57	0.28	24.15	0.29
Herbaceous				
Perennial Grasses	22.49	0.67	20.45	0.85
Perennial Forbs	9.98	0.12	11.86	0.06
Annual Grasses	18.95	0.04	9.77	0.08
Annual Forbs	9.09	0.17	9.17	0.01

Table 3-3b. Vegetation height by functional group for 30 annual non-sagebrush plots on the Idaho National Laboratory Site in 2020. Baseline values are compared to functional groups for height (cm) and were generated from five years of data (2013-2017).

Non-sagebrush Plots	Baseline		2020	
Functional Group	Mean Height (cm)	Proportion of Sample	Mean Height (cm)	Proportion of Sample
Shrubs				
Sagebrush	33.54	0.08	39.38	0.16
Other Species	26.82	0.92	26.74	0.84
Herbaceous				
Perennial Grasses	31.49	0.55	23.78	0.63
Perennial Forbs	11.64	0.06	9.04	0.05
Annual Grasses	16.96	0.25	12.43	0.29
Annual Forbs	10.94	0.15	7.76	0.03

Vegetation Height: Non-sagebrush Plots

Shrub height measurements were mainly collected from non-sagebrush shrub species, primarily green rabbitbrush, within the shrub functional group. Perennial grasses, which are the defining characteristic for available vertical structure on non-sagebrush plots, were the individuals sampled most frequently within the herbaceous functional group (Table 3-3b). The average height for non-sagebrush shrubs was similar to baseline height values, while the few sagebrush species recorded were taller than baseline values. Average height values for all herbaceous functional groups were shorter in 2020 than the baseline and grasses were a larger proportion of the herbaceous functional group than forbs. Finally, sagebrush was uncommon in these plots, but it was encountered twice as often and was taller than average.

Sagebrush Density

Of the sagebrush habitat plots, sagebrush density was lower in 2020 than baseline. In non-sagebrush plots, sagebrush density was slightly higher in 2020 when compared to baseline (Table 3-4). On the sagebrush habitat plots, sagebrush density ranged from less than one individual per square meter to approximately eight individuals per square meter. On the non-sagebrush plots, sagebrush density ranged from zero to a maximum of one individual per square meter. Averaged across all sagebrush habitat plots, juvenile shrubs were present on a third of all transects sampled in 2020, which is slightly below the baseline. Juvenile frequency on non-sagebrush plots was lower by half in 2020 compared to baseline juvenile frequency values; about one out of every 100 transects contained juveniles. Although sagebrush density in non-sagebrush plots was slightly above baseline, it still represents a low density of sagebrush. Overall, the densities and frequencies of sagebrush were low.

Table 3-4. Sagebrush density (individual/m^2) and juvenile frequency from sagebrush habitat monitoring plots (n=45) and non-sagebrush monitoring plots (n=30) on the Idaho National Laboratory Site in 2020 compared to baseline values. Baseline values were generated from five years of monitoring data (2013-2017).

Sagebrush Density	Sagebrush Habitat Plots		Non-sagebrush Plots	
	Baseline	2020	Baseline	2020
Mean Density (individuals/m^2)	5.19	3.45	0.07	0.12
Minimum Density (individuals/m^2)	0.43	0.55	0.00	0.00
Maximum Density (individuals/m^2)	47.60	7.58	0.74	1.20
Mean Juvenile Frequency	0.38	0.33	0.02	0.01

Precipitation

Precipitation data for this report are summarized from the 70-year Central Facilities Area (CFA) records (National Oceanic and Atmospheric Administration 2020, unpublished data). Over the last two decades, there have been several years with precipitation well below average and those dry years have departed farther from the mean than wet years (Figure 3-2, Forman and Hafla 2018). Seasonality of precipitation has also departed from long term-averages since habitat condition monitoring to support the CCA began. Historically, the wettest months generally occurred during April, May, and June on the INL Site (Figure 3-3). However, from 2013 through 2019 some of the wettest months of the year occurred in August, September, and October. The change of distribution of precipitation throughout the year has departed from the means for the last several years and this difference from the long-term precipitation patterns would certainly favor some plant species and functional groups over others.

In 2020, total annual precipitation was about half the yearly average (Figure 3-3). Most spring months were below average, and the lack of precipitation extended into the summer months through the peak growing season. Semi-arid plant species are adapted to surviving with limited resources. Species within different plant functional groups rely on different life history strategies to compete for water and nutrients in extreme conditions. Less precipitation early in the year likely affected early spring biennials and annuals more than perennials because they require spring moisture to complete their life cycles. Although native perennial plants are well adapted to short periods of harsh conditions and cover did not appear to substantially affect by one year of below average precipitation, prolonged drought conditions can weaken native perennials. Invasive annual species, like cheatgrass, are often able to thrive in conditions that are less ideal for natives and could eventually outcompete native species if dry conditions continue to stress native species.

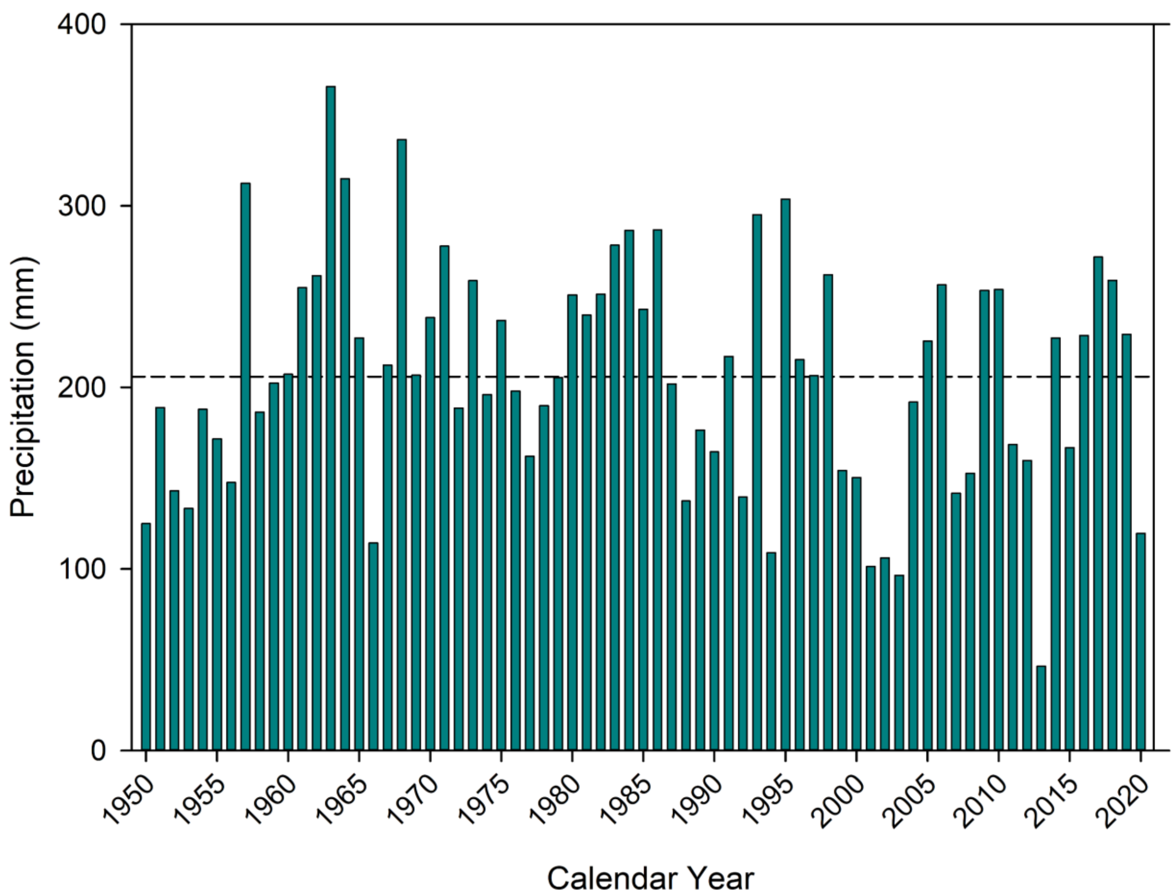

Figure 3-2. Annual precipitation from 1950 through 2020 at the Central Facilities Area, Idaho National Laboratory Site. The dashed line represents mean annual precipitation (206 mm).

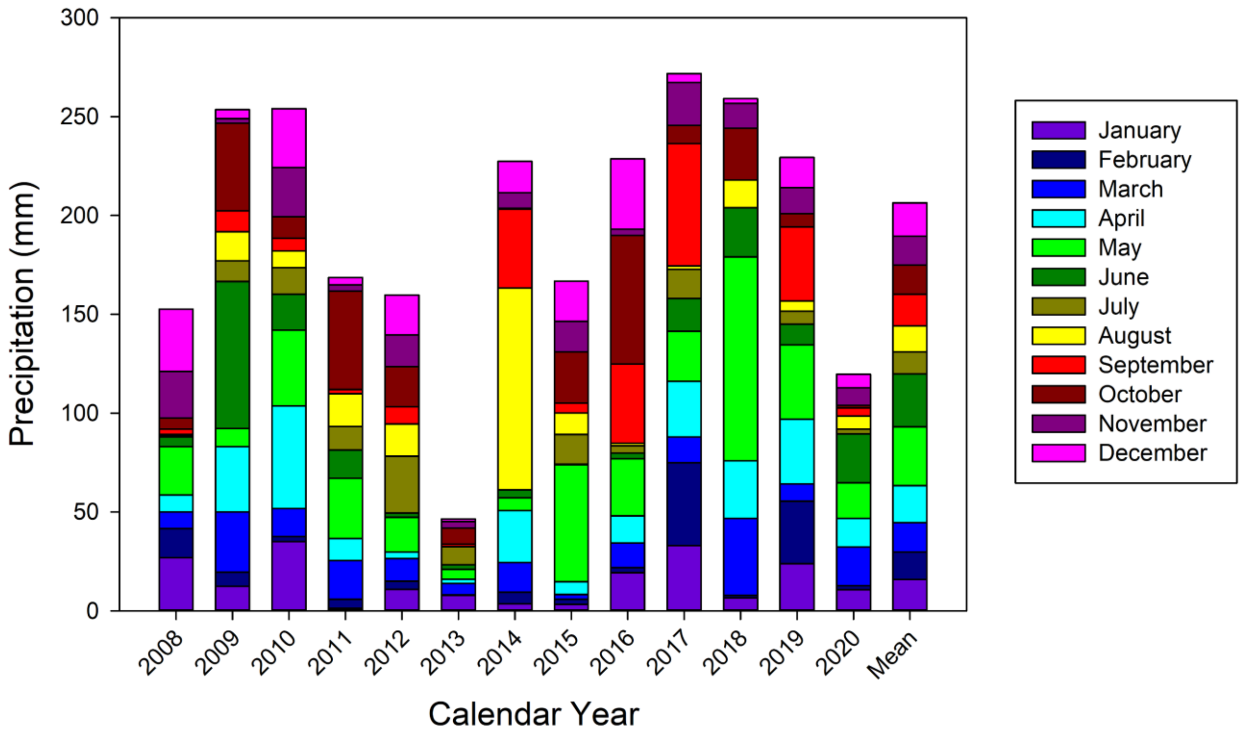

Figure 3-3. Annual precipitation by month from the Central Facilities Area, Idaho National Laboratory Site. Mean monthly precipitation includes data from 1950 through 2020 (206 mm).

Habitat Condition Trend Analyses

Sagebrush Habitat Plots

From 2013-2020, absolute cover within sagebrush habitat plots remained stable for native perennial forbs and non-sagebrush shrubs (Figure 3-4a). Sagebrush cover continues to have minor fluctuations, but these variations from the mean are unlikely ecologically meaningful. Native perennial grasses trended upward from 2014 to 2018, likely reaching their upper range of variability in response to favorable weather events, but are now decreasing toward a value near their baseline average of about 10% absolute cover. Native perennial grasses had significantly greater cover in 2020 than in 2013, 2014, and 2015 ($p<0.01$) but significantly less than 2018 ($p<0.01$) and 2019 ($p<0.02$) (Table 3-5a). Native annual and biennial forbs have decreased since 2017, likely in response to lower total precipitation over the past three years (Figure 3-3). Native annual and biennial forbs had significantly less cover in 2020 than 2018 and 2019 ($p<0.01$) (Table 3-5a).

Total cover from introduced species on sagebrush habitat plots has been much lower than total cover for native species throughout the monitoring period (Figure 3-4b). Introduced perennial grass cover has remained low and stable since monitoring efforts began in 2013. Although, cover from introduced annual forbs and grasses has fluctuated more from one year to another, likely in response to weather events and available soil water. Introduced annual forbs had significantly less cover in 2020 than in 2017, 2018, and 2019 ($p<0.01$). Additionally, introduced annual grasses had significantly less cover in 2020 than in 2018 ($p<0.01$) and 2019 ($p<0.04$) (Table 3-5b).

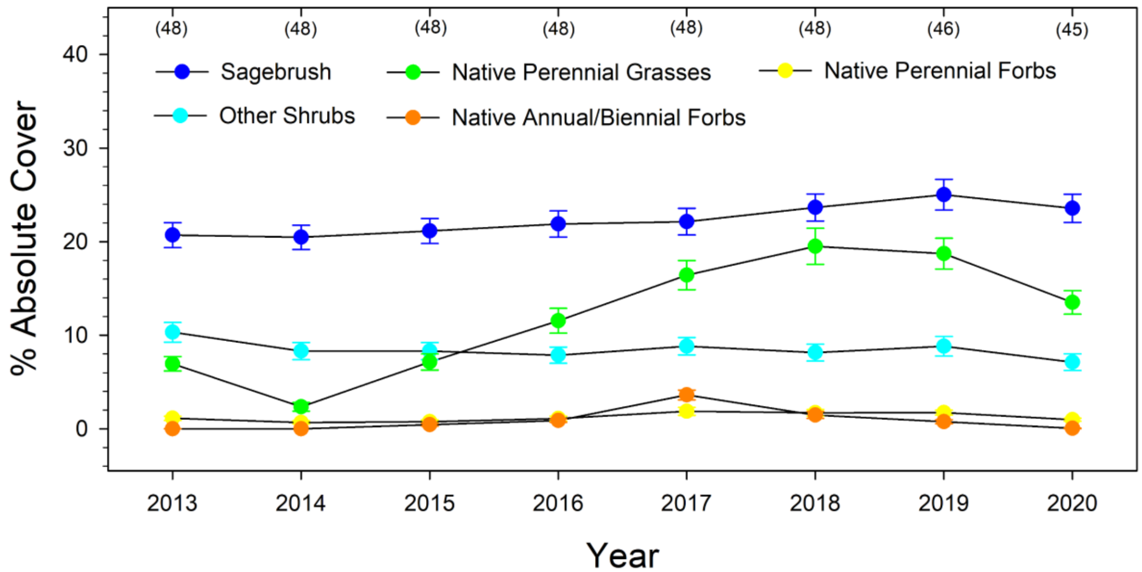

Figure 3-4a. Mean absolute cover (%) from functional groups of native species in sagebrush habitat plots on the Idaho National Laboratory Site from 2013 through 2020. Error bars represent ± 1 SE. Tick marks along the top denote sample size.

Table 3-5a. Mean cover (%) from functional groups of native species in sagebrush habitat plots on the Idaho National Laboratory Site from 2013 through 2020. Minimum Significant Difference is reported for each functional group using Holm-Sidak method for pairwise comparisions.

Sagebrush Habitat Plots: *Native Species*					
		Mean Cover (%)			
Year	Sagebrush	Other Shrubs	Native Perennial Grasses	Native Perennial Forbs	Native Annual/Biennial Forbs
2013	20.692	10.316	6.951	1.130	0.00563
2014	20.463	8.311	2.351	0.673	0.000
2015	21.134	8.310	7.144	0.768	0.434
2016	21.887	7.871	11.541	1.100	0.891
2017	22.140	8.826	16.426	1.875	3.619
2018	23.655	8.154	19.496	1.713	1.469
2019	25.019	8.827	18.725	1.734	0.758
2020	23.564	7.118	13.502	0.972	0.0451
Minimum Significant Difference	4.315	N/A	4.397	1.201	1.409

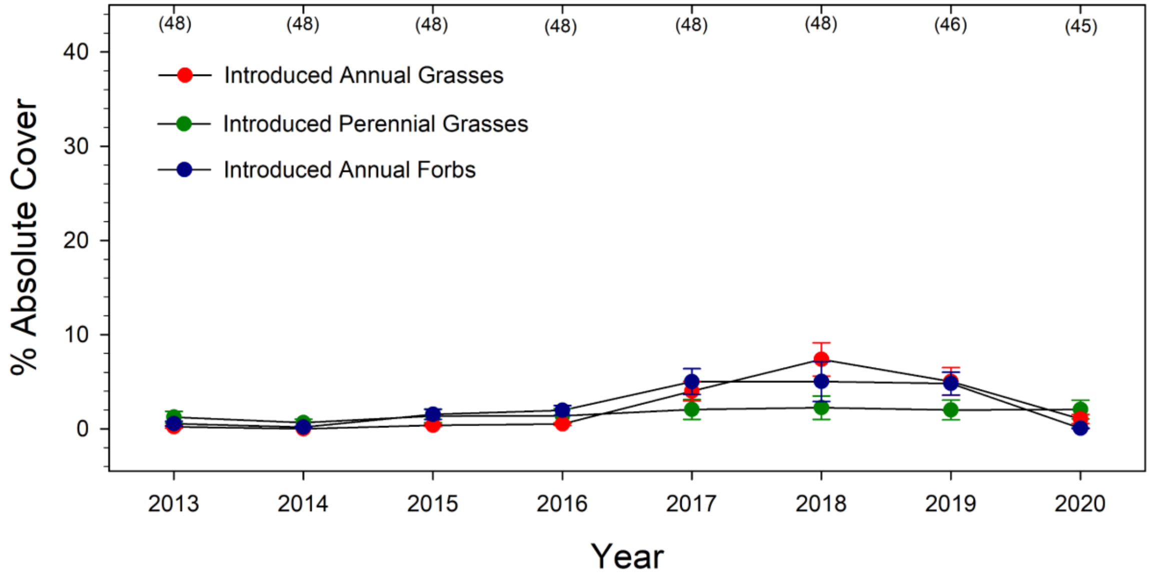

Figure 3-4b. Mean cover from functional groups of introduced species in sagebrush habitat plots on the Idaho National Laboratory Site from 2013 through 2020. Error bars represent ± 1 SE. Tick marks along the top denote sample size.

Table 3-5b. Mean cover (%) from functional groups of introduced species in sagebrush habitat plots on the Idaho National Laboratory Site from 2013 through 2020. Minimum Significant Difference is reported for each functional group using Holm-Sidak method for pairwise comparisions.

Sagebrush Habitat Plots: *Introduced Species*			
		Mean Cover (%)	
Year	Introduced Perennial Grasses	Introduced Annual Grasses	Introduced Annual Forbs
2013	1.235	0.211	0.543
2014	0.656	0.000	0.179
2015	1.368	0.372	1.542
2016	1.383	0.510	1.964
2017	2.057	3.998	5.010
2018	2.242	7.369	5.022
2019	2.004	5.024	4.800
2020	2.052	1.044	0.0602
Minimum Significant Difference	N/A	3.626	3.336

Non-sagebrush Plots

Within the native functional groups, perennial grasses and non-sagebrush shrub species, predominantly green rabbitbrush, remain the most abundant functional groups on non-sagebrush plots (Figure 3-5a). Native perennial, biennial, and annual forbs along with sagebrush species are the least abundant functional groups. All native functional groups have remained relatively stable since 2013, except native perennial grasses. Though the cover of native perennial grasses has changed since we began monitoring in 2013, there are no sample years for which cover values are significantly different from one another (Table 3-6a).

Cover of introduced perennial grasses remained stable through this year's dry conditions (Figure 3-5b). Introduced annual forbs decreased from last season but no sample years could be isolated for which significant differences occurred (Table 3-6b). Cheatgrass is the only introduced annual grass species found on the INL Site. It was near 5% absolute cover in 2013, reached a high of 36% in 2018, but has since decreased to 8% in 2020 (Figure 3-5b). Cheatgrass cover was significantly lower in 2020 than in 2017, 2018 ($p<0.01$) and 2019 ($p<0.02$) (Table 3-6b). These results support annual species are sensitive to seasonal distribution of precipitation because cover from annuals fluctuated dramatically from one year to the next.

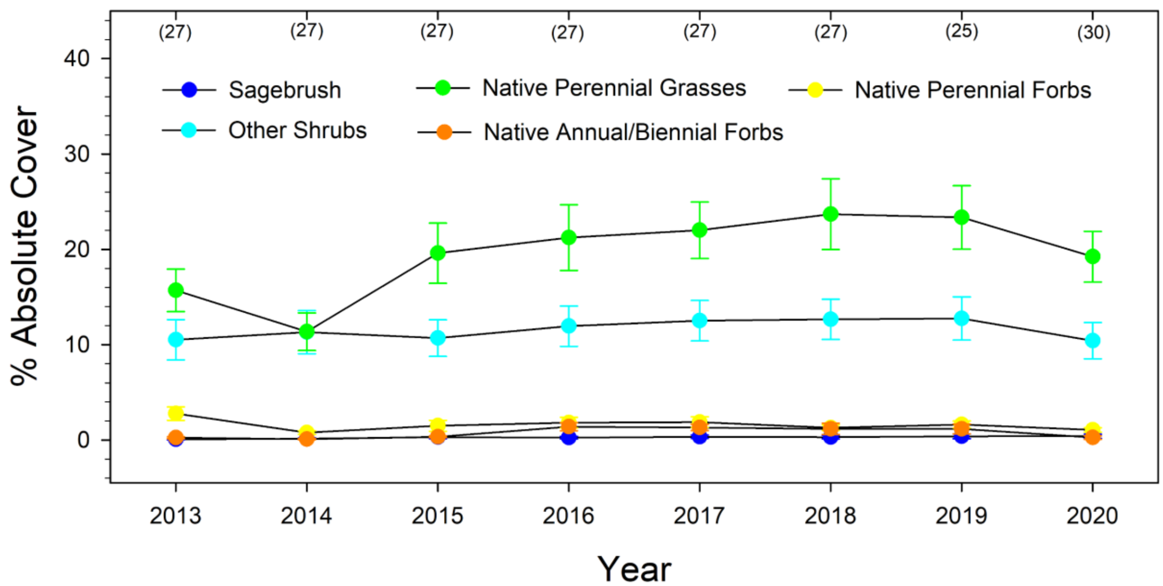

Figure 3-5a. Mean cover from functional groups of native species in non-sagebrush habitat plots on the Idaho National Laboratory Site from 2013 through 2020. Error bars represent ± 1 SE. Tick marks along the top denote sample size.

Table 3-6a. Mean cover (%) from functional groups of native species in non-sagebrush plots on the Idaho National Laboratory Site from 2013 through 2020. Minimum Significant Difference is reported for each functional group using Holm-Sidak method for pairwise multiple comparisions.

Non-sagebrush Plots: *Native Species*		Mean Cover (%)			
Year	Sagebrush	Other Shrubs	Native Perennial Grasses	Native Perennial Forbs	Native Annual/Biennial Forbs
2013	0.0763	10.515	15.704	2.766	0.239
2014	0.149	11.319	11.364	0.771	0.0915
2015	0.297	10.692	19.600	1.495	0.335
2016	0.251	11.934	21.228	1.824	1.390
2017	0.343	12.515	22.004	1.878	1.312
2018	0.308	12.654	23.688	1.284	1.161
2019	0.394	12.738	23.347	1.634	1.170
2020	0.397	10.420	19.229	1.061	0.257
Minimum Significant Difference	N/A	N/A	N/A	N/A	N/A

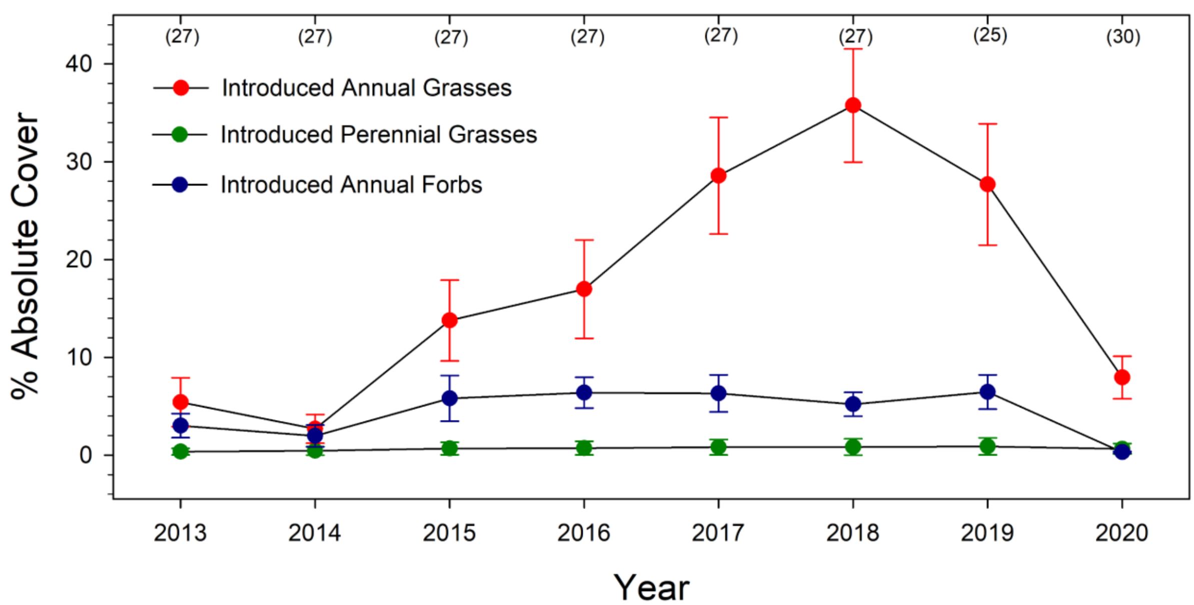

Figure 3-5b. Mean cover from functional groups of introduced species in non-sagebrush habitat plots on the Idaho National Laboratory Site from 2013 through 2020. Error bars represent ± 1 SE. Tick marks along the top denote sample size.

Table 3-6b. Mean cover (%) from functional groups of introduced species in non-sagebrush plots on the Idaho National Laboratory Site from 2013 through 2020. Minimum Significant Difference is reported for each functional group using Holm-Sidak method for pairwise multiple comparisions.

Non-sagebrush Plots: *Introduced Species* Mean Cover (%)			
Year	Introduced Perennial Grasses	Introduced Annual Grasses	Introduced Annual Forbs
2013	0.354	5.409	3.010
2014	0.437	2.684	1.961
2015	0.663	13.766	5.792
2016	0.709	16.977	6.386
2017	0.807	28.575	6.305
2018	0.833	35.757	5.193
2019	0.888	27.678	6.454
2020	0.643	7.935	0.296
Minimum Significant Difference	N/A	18.779	N/A

3.1.1 Summary of Habitat Condition

Within sagebrush habitat plots, 2020 vegetation cover and height values were within or near baseline ranges for most native functional groups. Mean sagebrush density in 2020 was slightly below the baseline range, likely due to low juvenile recruitment rates, as seen in lower-than-average juvenile frequency. Non-native abundance remained low and stable in 2020. In non-sagebrush plots, cover of native functional groups was within baseline ranges for 2020, while sagebrush height was higher than baseline and perennial herbaceous species were lower than baseline in 2020. Non-native cover, particularly from cheatgrass, has dramatically fluctuated over the past four years while crested wheatgrass remains stable.

Vegetation metrics from sagebrush habitat and non-sagebrush plots reflected a decrease in precipitation in 2020 when compared to previous years. Total precipitation was about half of the 70-year average and decreases in vegetation cover were recorded for multiple plant functional groups in 2020. Perennials have adaptations to withstand stressful semi-arid deserts and are less likely to respond to short-term weather conditions. Conversely, annuals wait for favorable conditions to complete their life cycle rather than adapting to the harsh environmental conditions, so their abundance often changes in response to short-term weather events. The decrease in cover from all annual functional groups, most notably introduced annual grasses like cheatgrass, is not surprising as low precipitation likely disproportionately affected annuals over other functional groups. The Long-Term Vegetation study last updated by Forman and Hafla (2018), suggests cheatgrass is capable of large upward and downward fluctuations in abundance in response to weather patterns.

Intact sagebrush shrubland vegetation continues to be stable for most native and introduced functional groups. However, non-sagebrush plant communities had dramatic fluctuations of cheatgrass cover while native functional groups remained relatively stable. Cheatgrass has been a minor component for several decades; however, cheatgrass appears to become much more abundant and more likely to dominate herbaceous plant communities post-fire (Forman and Hafla 2018). Patterns from this dataset are consistent with other local studies conducted on the INL Site. This indicates non-sagebrush areas are likely more susceptible to dominance from cheatgrass as it is widely distributed across the INL Site, occurring in all plant communities, but rarely dominating within intact sagebrush habitat. Sagebrush plant communities are likely more resistant to cheatgrass dominance than recovering habitats, a pattern that is particularly evident in years with weather patterns that favor the invasive non-native annual grass.

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 after fire or are restored following decommissioning of existing facilities. Changes in land cover can be determined using airborne or satellite imagery that is readily available at little or no cost. ESER geographic information system (GIS) analysts routinely compare new imagery as it becomes available with results from the most current vegetation classification and mapping project. Ground-based point surveys and changes in plant species cover and composition documented through Task 5 (Section 3.1) are also used to provide spatial information to assist with periodic map updates needed to monitor the habitat trigger in the CCA.

A 20% loss of sagebrush habitat from the 2013 baseline has been identified as a conservation trigger in the CCA (DOE and USFWS 2014). The purpose of Task 6 is to maintain and update regions of the INL Site vegetation map to accurately document changes in sagebrush habitat area and distribution. This task documents changes in sagebrush habitat following losses due to wildland fire or other disturbances that remove or significantly alter vegetation across the landscape. In addition to documenting losses of sagebrush habitat, this monitoring task also maps the addition of sagebrush habitat when sagebrush cover increases within a mapped polygon and warrants a new vegetation map class designation, or to refine existing vegetation map class boundaries when changes in species cover and composition are documented through Task 5. Lastly, this task supports post-fire mapping when the fire extent is unknown, and also allows for modifying existing wildland fire boundaries and unburned patches of vegetation when mapping errors are observed on the ground.

There were five wildland fires over one hectare in size that burned on the INL Site in 2020, altering existing vegetation map class distribution, including sagebrush habitat[2]. The Howe Peak Fire was human-caused and started off-Site on July 2, 2020. As a consequence of wind-driven growth, the fire crossed Highway 33 and spread onto the INL Site. Retardant application and developed agricultural lands limited fire spread to the north and bulldozer containment lines stopped the fires from spreading further east until INL suppression operations ceased on July 3 and the fire was deemed controlled on July 9. The Telegraph

[2] Unpublished wildland fire statistics summary for 2020; Eric Gosswiller, INL Fire Chief.

Fire ignited near the eastern border of the INL Site on July 8, 2020 along with a second separate fire about one mile to the east off-Site. The fire was declared human-caused and began north of the roadside where it spread to the north, fueled by high winds. The Telegraph Fire was considered controlled on July 11. The Lost River Fire began on August 6, 2020, south of Highway 20/26 and west of the public rest area. The Lost River fire was started from a lightning strike and due to shifting winds, the fire burned in a patchy manner until it was controlled the following day on August 7. The CFA Fire Complex started on August 15, 2020 as a series of three small fires on the north side of Highway 20/26 east of Gate 3. These fires were deemed human-caused and direct suppression efforts contained the fire the same day without the need for containment lines, and it was considered controlled on August 16. The Cinder Butte Fire started on August 18, 2020 southeast of Gate 4 and less than a mile from the 2011 T-17 Fire boundary. The fire ignited under a Red Flag warning and lightning was observed in the area. Fortunately, a rainstorm helped limit initial growth and the fire was declared contained later that same day and controlled on August 19.

There were two additional fires that burned on the INL Site; however, due to the small footprint these fires were not mapped[2]. On June 20, 2020, the Rye Grass Flats Fire started on the roadside of Highway 26 and burned approximately less than ¼ ac. On August 16, 2020, an unnamed fire started near Highway 20/26 and also burned less than ¼ ac. Both fires were declared to be of human-origin and were controlled with direct suppression efforts not requiring the construction of containment lines.

3.2.2 Methods

The process of maintaining the INL Site vegetation map following wildland fire involves two-steps. 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 burned area extent. Prior to initiating the second step of delineating new vegetation class boundaries within the burned area, the mapped fire boundaries need to be generated at similar mapping scales as the original vegetation map to maintain consistency in the dataset.

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 classes present. New wildland fires are sampled to identify the vegetation classes present across the burned area to assist with the mapping update. It can be difficult to assess the vegetation classes that establish immediately after a fire, especially during drought years. We allow for a few growing seasons, and possibly longer if the years following fire were excessively dry and hinder normal reestablishment of vegetation communities. Field surveys also commence when a map polygon or burned area begins to show sign (i.e., via habitat condition monitoring data) that the current vegetation class has changed to another class and warrants reassignment. High resolution imagery is used as the source data layer to delineate new vegetation class boundaries within recent wildland fire boundaries when it becomes available, either through the National Agricultural Imagery Program (NAIP) or from INL Site-specific acquisitions.

The initial fire boundaries for the 2020 fires were produced from GPS field data to delineate containment lines collected by BEA Cultural Resources Management Office. However, experience with other recent large fires suggests the actual burned area boundary typically differs from the containment line boundary created immediately post-fire. In response to the fires that burned in 2020, and to support post-fire ecological evaluation and recommendations, the INL Wildland Fire Committee funded the acquisition of high resolution satellite imagery across the entire Site. On October 4, 2020, Digital Globe's Worldview-2 and Worldview-3 satellite sensors collected 8-band multispectral imagery across the extent of the INL Site. The Worldview imagery was delivered georeferenced, orthorectified, and pan-sharpened to a spatial resolution of 31 cm (1ft).

The Worldview imagery was mosaicked into a seamless basemap image dataset that was used to delineate the burned area extent in each fire. Wildland fire boundaries were manually digitized at a 1:2,000 mapping scale to ensure smaller, unburned patches of sagebrush could be accurately delineated. Once each fire boundary was mapped and updated, the burned area footprint was intersected with the existing sagebrush habitat layer to calculate the area of sagebrush removed from each fire.

3.2.3 Results and Discussion

The Howe Peak Fire burned an area of 664 ha (1,640.8 ac; Figure 3-6). There was 382 ha (944 ac) of sagebrush habitat within the SGCA removed in the Howe Peak Fire (Figure 3-6). The most recent vegetation map showed Crested Wheatgrass Ruderal Grassland as the most common non-sagebrush map class within the fire boundary with a small patch of Green Rabbitbrush / Thickspike Wheatgrass Shrub Grassland and Needle and Thread Grassland class also present prior to the fire.

The mapping results for the Telegraph Fire showed a burned area of 677.9 ha (1,675.1 ac) which is a reduction from the original burned area estimate from the outer containment line (Figure 3-7). The Telegraph Fire burned area was located entirely within sagebrush habitat inside the SGCA, so the burned area and sagebrush habitat loss were spatially coincident. There were numerous patches of unburned sagebrush habitat mapped inside the fire boundary and in regions where the fire was extinguished prior to reaching the containment line (Figure 3-7).

The Lost River Fire burned an area of 208.4 ha (5,151.1 ac). The Lost River Fire is located within the SGCA in a region that was previously burned in the 2000 Tin Cup Fire. The most recent vegetation map shows the Green Rabbitbrush / Desert Alyssum (Cheatgrass) Ruderal Shrubland vegetation most common within the burned area. This task is primarily concerned with sagebrush habitat loss; therefore, a more detailed map of the fire is not presented because there was no sagebrush habitat impacted from the fire.

The CFA Fire Complex burned across three separate areas totaling 17.5 ha (43.2 ac; Figure 3-8). Nearly the entire area that burned, except for very thin roadside strips, was entirely within sagebrush habitat located outside of the SGCA (Figure 3-8).

The Cinder Butte Fire burned an area of 11 ha (27.1 ac) which was composed entirely of sagebrush habitat and the fire boundary partially overlapped the SGCA boundary (Figure 3-9). There was 7.5 ha (18.4 ac) of sagebrush habitat that was lost in the fire that was also located inside the SGCA (Figure 3-9).

As of 2019, the sagebrush habitat area in the SGCA on the INL Site was 78,553.4 ha (194,109.7 ac). Following the fires in 2020, a total of 1,067.4 ha (2,637.6 ac) of sagebrush habitat was removed from the SGCA. The current estimated acreage of sagebrush habitat in the SGCA is 77,486 ha (191,472.1 ac) representing a 1.4% decrease from original baseline established in the CCA (DOE and USFWS 2014). This is the first year since the signing of the CCA that there has been any appreciable loss in sagebrush habitat inside the SGCA, although the loss is minimal and we do not anticipate tripping the habitat trigger in the near future.

The sagebrush habitat outside of the SGCA is considered a “conservation bank” that could be incorporated into the SGCA to replace lost sagebrush habitat resulting from wildland fire or new infrastructure development (DOE and USFWS 2014). The wildland fires in 2020 burned 21 ha (51.9 ac) of sagebrush habitat outside the SGCA and infrastructure expansion (see Section 4.2) removed an additional 35.7 ha (88.2 ac). The current estimated area of sagebrush habitat remaining outside the SGCA is 28,284.1 ha (69,891.5 ac).

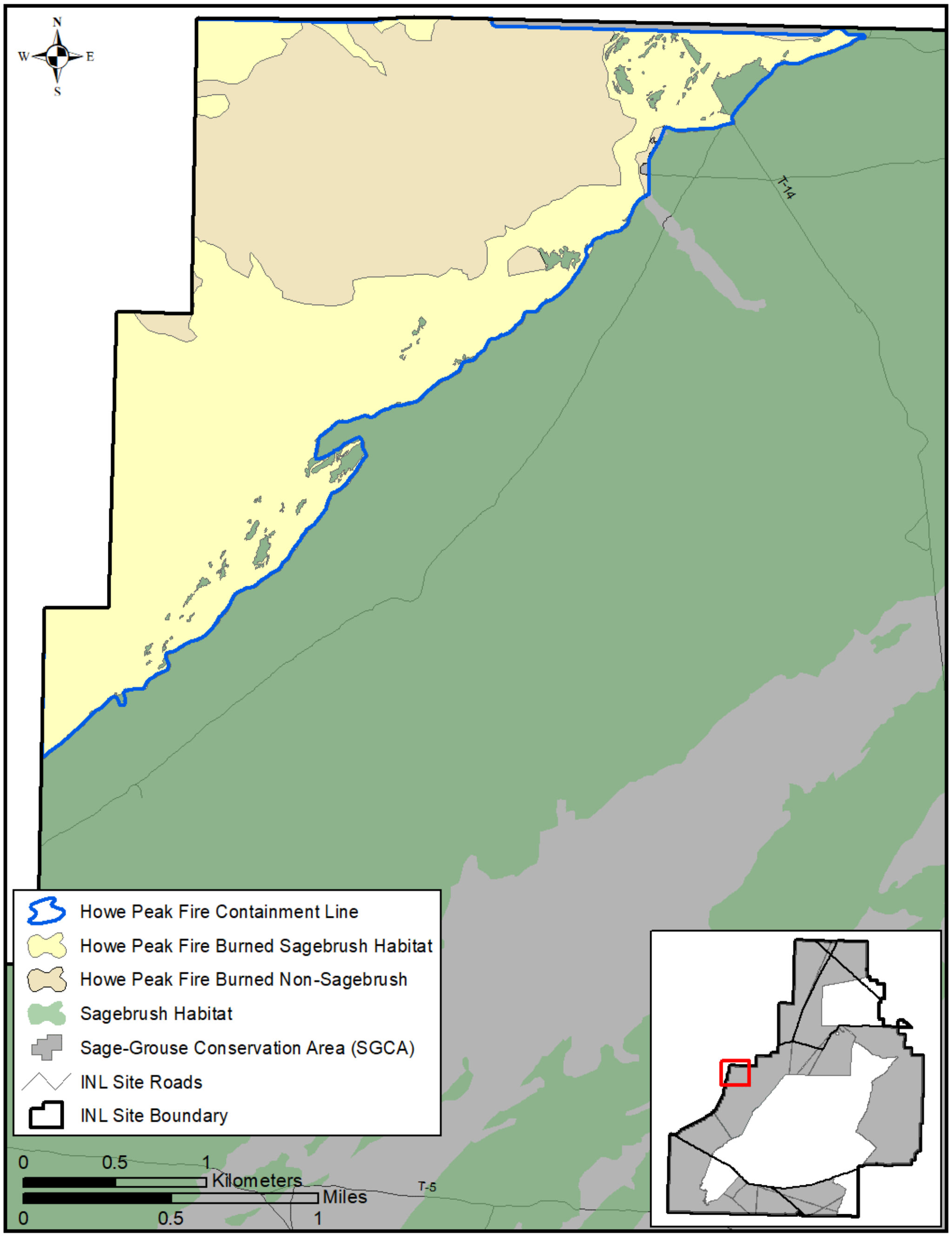

Figure 3-6. Howe Peak Fire boundary on the Idaho National Laboratory Site mapped using high resolution imagery. All the sagebrush habitat displayed in the figure is inside the Sage-grouse Conservation Area.

The mapping results this year emphasize the importance of continually acquiring high resolution imagery after a fire to more accurately map the fires and make ecological evaluations. The containment line boundary data collected on the ground overestimated the actual burned area in all the fires where containment lines were present. Understanding the presence and distribution of unburned patches of sagebrush habitat inside a fire can also assist with post-fire restoration where sagebrush seeding and planting can be strategically placed to connect unburned patches of habitat.

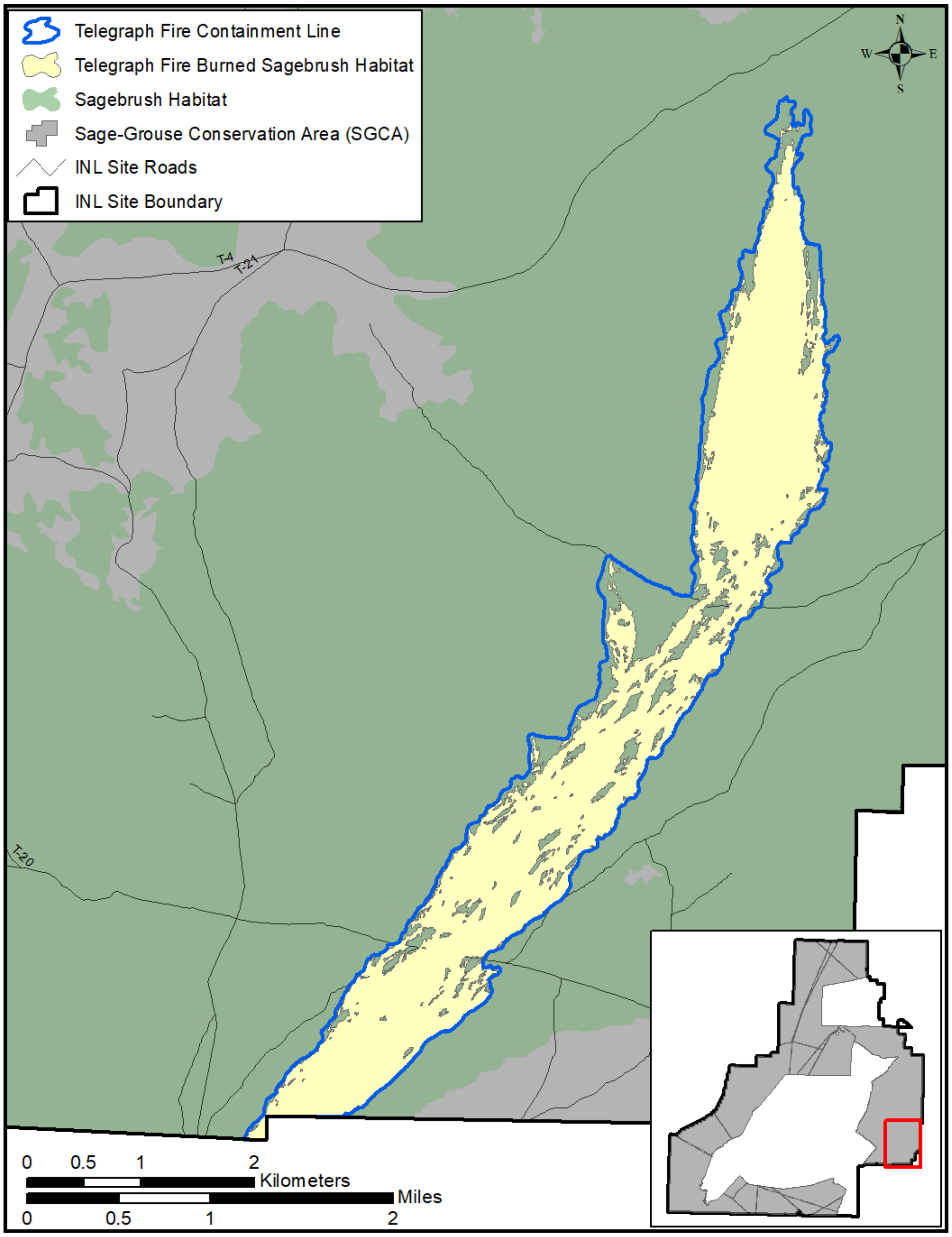

Figure 3-7. Telegraph Fire boundary on the Idaho National Laboratory Site mapped using high resolution imagery. The burned area extent was completely within sagebrush habitat in the Sage-grouse Conservation Area.

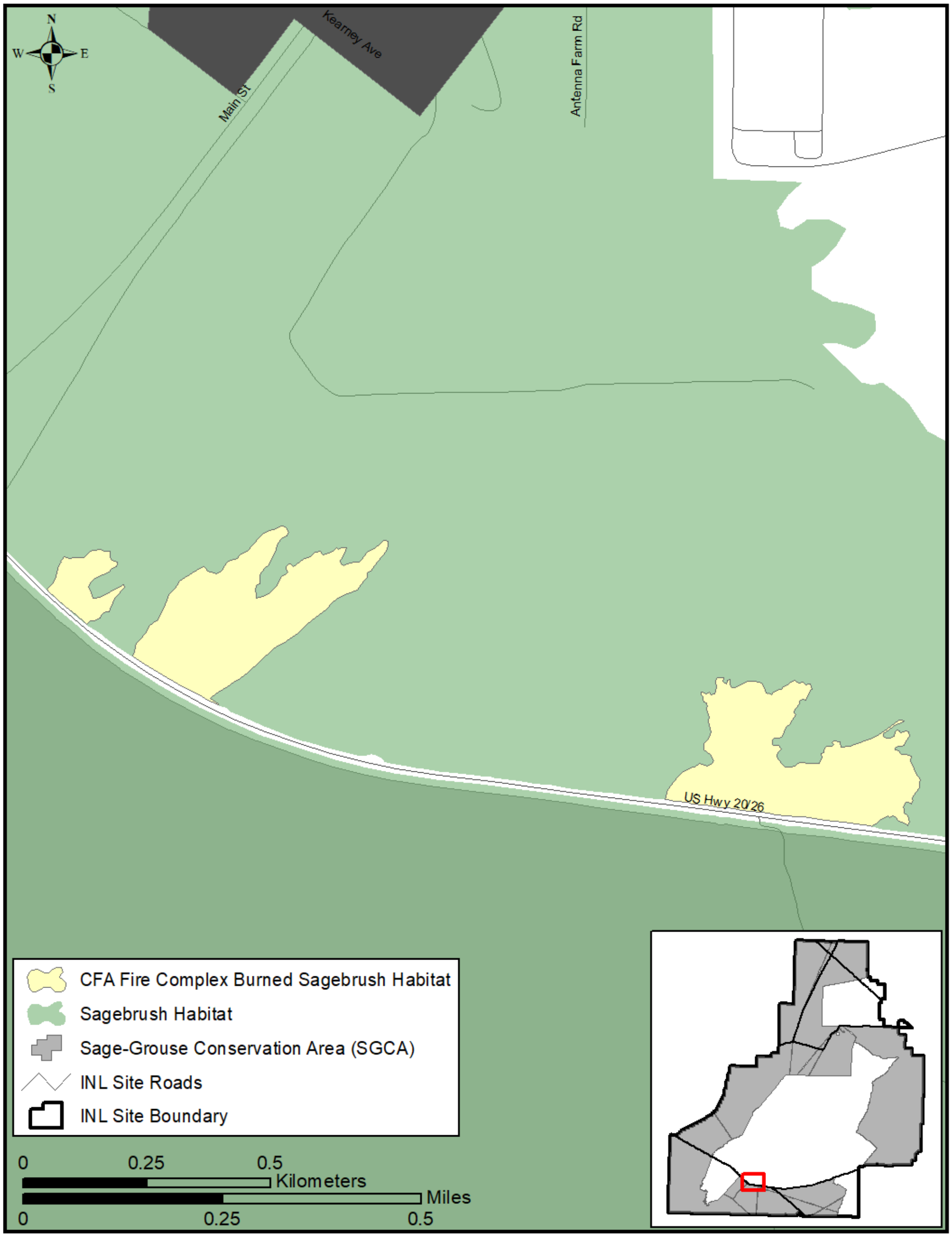

Figure 3-8. Central Facilities Area Fire Complex boundary on the Idaho National Laboratory Site mapped using high resolution imagery. The burned area was completely within sagebrush habitat but outside the Sage-grouse Conservation Area boundary identified as the darker green in the map.

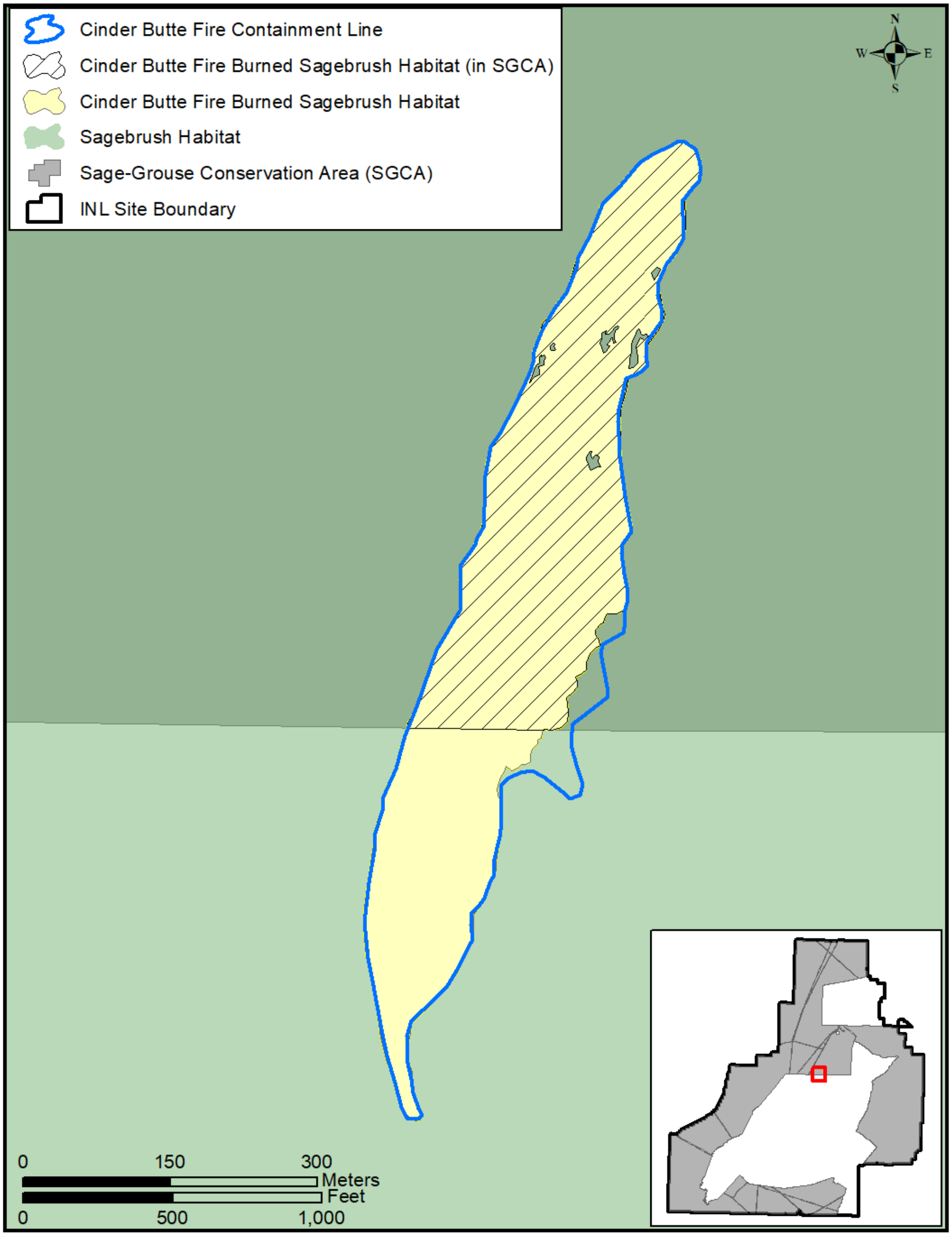

Figure 3-9. Cinder Butte Fire boundary on the Idaho National Laboratory Site mapped using high resolution imagery. The burned area was completely within sagebrush habitat and partially within the Sage-grouse Conservation Area boundary, and the darker green displays where the two data layers overlap.

4.0 THREAT MONITORING

The CCA identifies and rates eight threats that potentially impact sage-grouse and its habitats on the INL Site. Most threats are addressed by conservation measures DOE has implemented or continues to implement (see Section 5.0). Some threats require monitoring to understand the extent of the problem and to establish baseline evidence so the success of interventions, once implemented, can be evaluated. These include wildland fire, livestock, raven predation, annual grasslands, and infrastructure development. The potential impacts of wildland fire and livestock on sage-grouse habitat are assessed once every five years and were last reported in 2016 (Shurtliff et al. 2017). Raven predation and infrastructure development are addressed in Sections 4.1 and 4.2. Although annual grasslands are recognized as a medium-level threat to sage-grouse on the INL Site (DOE and USFWS 2014), cheatgrass control is currently being addressed as a component of post-fire restoration by the INL Wildland Fire Management Committee. Continued monitoring of the abundance and spatial distribution of cheatgrass (see Section 3.1) through CCA threat monitoring is necessary to continue to understand the distribution of cheatgrass in areas that have not recently burned.

4.1 Task 4—Raven Nest Surveys

4.1.1 Introduction

During the last century, common raven (*Corvus corax*, hereafter raven) abundance has greatly increased throughout the historic range of sage-grouse (Larsen and Dietrich 1970, Andrén 1992, Engel and Young 1992, Boarman et al. 1995, Sauer et al. 2011), and in recent years, increasing raven densities have been negatively associated with sage-grouse nest success and lek count trends (Bui et al. 2010, Coates and Delehanty 2010, Dinkins et al. 2016, Peebles et al. 2017, Coates et al. 2018). High raven densities likely increase predation on sage-grouse clutches where the two species co-occur, but it is probably the combination of raven predation and other factors, such as poor concealment cover or adverse weather during the brooding period, that contribute to negative reproductive results for sage-grouse in some areas (Coates 2007, Peebles et al. 2017). For this reason, raven predation alone is not considered a high-level threat to sage-grouse on the INL Site or across its range (Shurtliff et al. 2019, Federal Register 2010). Unlike the primary threats of wildland fire and conversion to exotic plant monocultures, which are unlikely to be abated with current technologies and climate patterns (Federal Register 2010), reducing nesting opportunities for ravens as a strategy for lowering pressure on sage-grouse reproductive success is a feasible strategy that could have localized positive effects.

Most raven breeding pairs on the INL Site nest on anthropogenic structures including towers, building platforms, and electric power transmission structures, with the latter supporting the most nests (Howe et al. 2014; Shurtliff et al. 2018). Originally, the CCA indicated that research aimed at developing methods to deter raven nesting on utility structures would be supported (*Conservation Measure 10*, DOE and USFWS 2014). In 2018, this scope was changed to a commitment by DOE to work with INL contractors and the National Oceanic and Atmospheric Administration to reduce raven nesting on power lines, towers and at facilities (Shurtliff et al. 2019).

To support the original design of Conservation Measure 10 and the new scope, nearly all infrastructure on the INL Site are monitored during the core raven nesting period under CCA Monitoring Task 4. The purpose of this task is three-fold: (1) to determine how many raven nests are supported each year by anthropogenic structures on the INL Site so DOE may be alerted to increasing trends; (2) to identify structures or stretches of power line favored by ravens for nesting year after year, which may be candidates for retrofitting; and (3) to allow us to evaluate the effectiveness of deterrents after they are installed.

4.1.2 Methods

We surveyed power lines, towers, and raptor nesting platforms, and systematically searched structures and ornamental trees at INL Site facilities that could potentially support a raven nest. Surveys were performed between April 1 and June 5, 2020, and we allowed at least 14 days between repeat surveys. During April and the first few days of May, surveys commenced approximately 1.5–2.0 hours after sunrise (following sage-grouse lek surveys) and typically concluded by early afternoon. After sage-grouse lek surveys were completed for the year on May 8 (see Section 2.1.2), raven nest surveys were performed between sunrise and late afternoon. Inclement weather did not restrict survey activity if roads were passable, as we assumed ravens would display nest-tending behaviors regardless of weather conditions.

When a stick nest was observed on a structure, we identified the associated corvid or raptor species, if present, and determined if the nest was active. Nests were classified active if one or more of a breeding pair were observed incubating (i.e., sitting in the nest bowl), perched on or near the nest, carrying nesting materials to the nest, or engaging in other behavior that suggested they were tending or defending the nest. Presence of eggs or chicks also confirmed the activity status of a nest, and adults were always observed in these cases to confirm the species identify. A single positive observation was sufficient for a nest to be classified active. One exception was when the only observation was of one or more birds perched nearby (i.e., on the same structure as the nest). We required two observations of this type on separate days to classify a nest active.

After each complete survey of INL Site infrastructure, we revisited most unconfirmed nests before the next survey commenced to verify the nest's status. Some unconfirmed nests at facilities were not revisited because it was logistically difficult to reschedule an escort (six fenced facilities require such) or because they were dilapidated and on structures that protected them from being blown off by strong winds. Thus, nests remaining unconfirmed at the end of the field season may have been visited up to twice as often as nests with confirmed activity, increasing our confidence that they were not occupied by ravens during the breeding season.

We surveyed power lines four times, twice in April and twice in May, whereas facilities and towers were surveyed only twice, primarily in April. The difference in survey effort is an historical artifact because the primary purpose of the monitoring task when it was initiated was to find and track nests on power lines as a precursor to testing the effectiveness of nest deterrents on those structures (DOE and USFWS 2014).

Power Lines

For logistical purposes, power lines were divided into survey sections where they intersected convenient access roads. We surveyed the same power lines (transmission = 231 km [144 mi], distribution = 37 km [23 mi]) on the INL Site that were surveyed 2017–2019 (e.g., Shurtliff et al. 2018). In 2014 and 2015, surveys occurred along an additional 49 km (30 mi) of distribution lines, but these sections were removed from survey routes in 2016 when it became clear that ravens would be unable to maintain a nest on the structures because they were primarily comprised of single cross arms (Shurtliff et al. 2017). In 2017, an additional 4.3 km (2.7 mi) of distribution line was removed from survey routes for the same reason (Shurtliff et al. 2018).

We surveyed all power-line segments four times by driving along utility access or other nearby roads and scanning frequently for nests through binoculars. When a nest was observed, the location was recorded and an activity status was assigned as described above.

Facilities

We surveyed 13 facilities, defined as any non-linear feature that includes at least one building. Since surveys began in 2014, the list of facilities surveyed has been augmented to include the CFA main gate area (Shurtliff et al. 2017) and a parcel of INL Site land occupied by the Idaho Transportation Department (Shurtliff et al. 2018). Facilities were surveyed at least twice, primarily in April.

Towers

Many towers that could support a raven nest are within facility footprints and are examined during facility surveys. If a nest is observed on a tower at a facility, it is reported as a facility-based nest. Conversely, towers outside facilities are surveyed as discreet structures and we report nest observations on these structures separately. Towers outside facilities are usually lattice structures conducive for supporting nests, and most are equipped with cellular network or meteorological equipment. We surveyed eleven towers outside of facilities twice during April, not including revisits to confirm nest activity.

Three towers are outside but near INL Site boundaries. One, northwest of the U.S. Sheep Experiment Station (Figure 4-1), is approximately 40 m (44 yd) outside the boundary. Two others are near the southeastern border immediately north of U.S. Highway 20, the farthest of which is approximately 400 m (440 yd) outside the boundary. Because ravens that occupy these towers likely forage on the INL Site, we include them in the surveys.

Renest Attempts

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 on power-line structures occasionally blow down. If a mated pair loses one or more nests and rebuilds during the survey period, our sampling method records at least two active nests, even though only one could possibly fledge young. 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 adjusted the number of raven nests considered active as in past years (e.g., Shurtliff et al. 2017) by examining each nest on a power-line structure that was initially characterized as active, but later in the nesting season had fallen to the ground. For each of these failed nests, we noted the period during which we collected evidence that the nest was active. We assumed that the nest may have fallen at any time following the last recorded active observation. We then examined dates during which activity was recorded at all other active nests within a 6-km (3.7 mi) radius. If a nest within this radius was recorded as active for the first time after the last activity was recorded of the failed nest, we assumed that the occupants of the failed nest renested at that location.

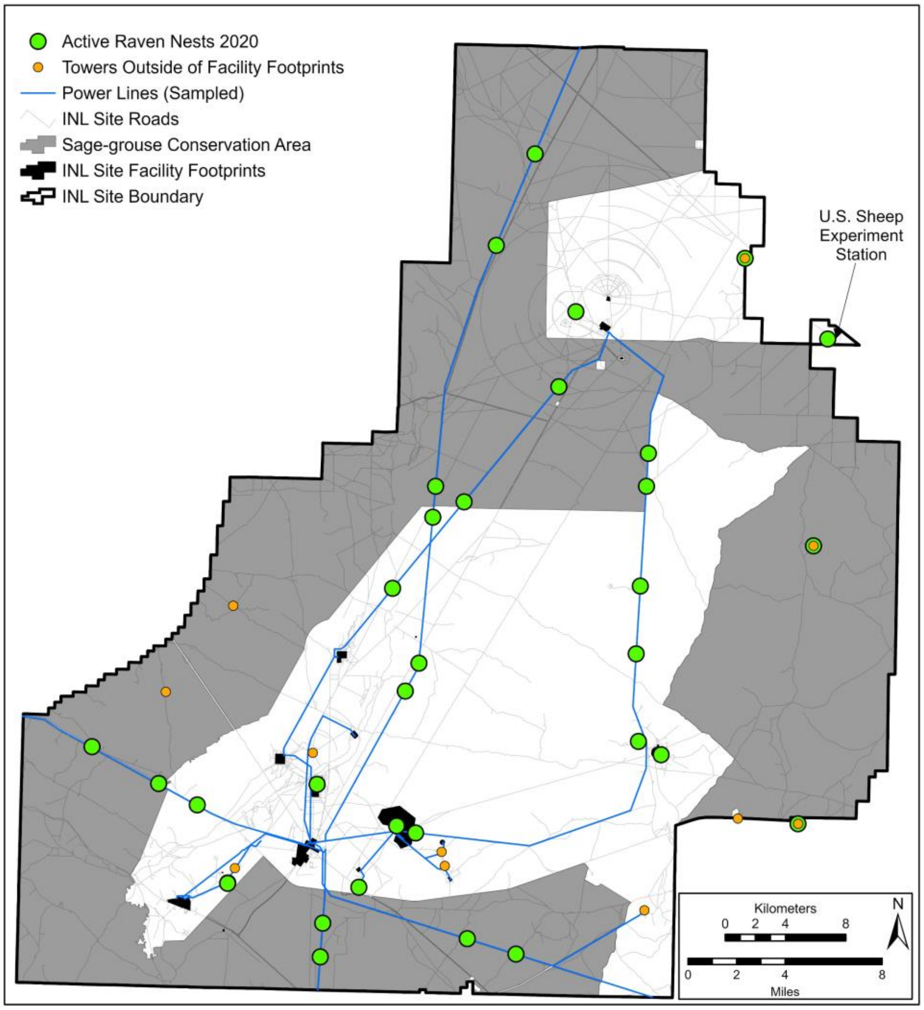

Figure 4-1. Results of the 2020 raven nest survey depicting all documented active raven nests on infrastructure, after accounting for nests that were potentially occupied by the same breeding pair.

The 6-km threshold was chosen somewhat arbitrarily, but our intent was to have the threshold large enough to encompass the entire breeding territory of nest occupants, as we assumed breeding pairs are likely to renest within their territory (Skarphédinsson et al. 1990). We also wanted to be conservative in our estimate of the number of breeding pairs (i.e., a higher number of second nests identified results in a lower estimate of breeding pairs). When we first developed this method (Shurtliff et al. 2017), we chose 6 km as the threshold after considering that the median distance from an active raven nest to the nearest active conspecific nest over the previous three years had been 2.7–3.1 km (1.7–1.9 mi). Although it is unknown how large raven breeding territories are in sagebrush steppe or how far they move to renest after losing a nest, a 6-km radius typically overlaps several raven nests on the INL Site, and therefore we felt the distance is reasonable given our assumptions and objectives.

4.1.3 Results and Discussion

All surveys were completed from April 1–June 5, 2020. We observed 37 active raven nests on anthropogenic structures or in trees associated with facilities, including 25 on power-line structures. We merged four pairs of power-line nests that met the criteria of having been likely occupied by the same mated pair. For merged nest pairs, only the location of the first nest is reported. After accounting for merged nests, the total active raven nests (i.e., adjusted total) was 33, with 21 (64%) on power-line structures (Table 4-1; Figure 4-2). All references hereafter to nest results refer to adjusted totals. Thirteen (62%) of the 21 power-line nests were in the SGCA or at its boundary (i.e., within 75 m), and all were on transmission structures, including 11 on “Closed H Cable” structures, nine on “Sloped H” structures, and one on a “Hybrid” structure (see Shurtliff et al. 2017 for pictures).

Table 4-1. Summary of active raven nests (adjusted) on the Idaho National Laboratory Site, observed on anthropogenic structures during 2020 surveys. Nests within 75 m of the Sage-Grouse Conservation Area (SGCA) boundary were counted as being inside the SGCA.

# Active Nests	Structure	Inside SGCA	Outside SGCA
21	Power Line	13	8
5	Building Platform	0	5
1	Effluent Stack	0	1
4*	Tower	1	3
2	Ornamental Tree	0	2
Totals 33		**14**	**19**

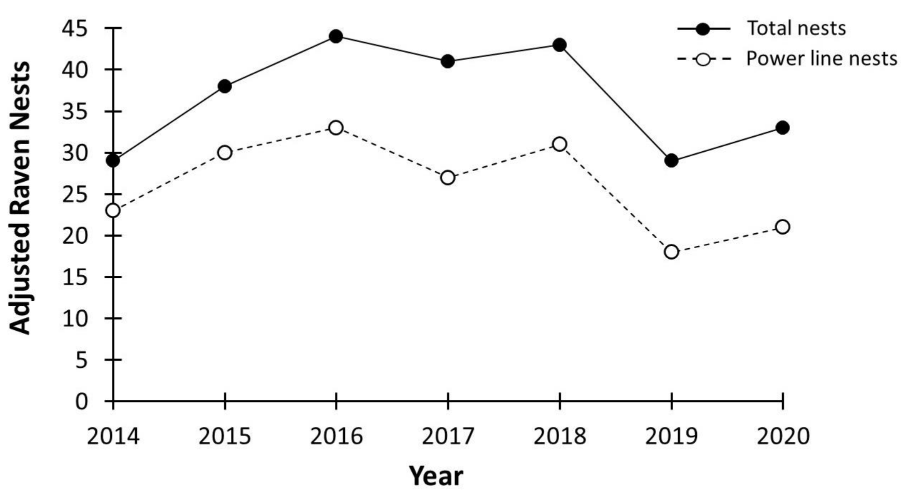

Figure 4-2. Raven nests observed on Idaho National Laboratory Site infrastructure (adjusted values).

Surveys of facilities occurred April 6–May 4, 2020. Due to restrictions associated with the Covid-19 pandemic, only one complete survey was conducted within two of the 13 facilities (Table 4-2); however, known nest sites visible from outside the fence were checked one or more additional times. In total, we documented nine active raven nests at eight facilities (Table 4-2). Active raven nests were observed on building platforms (*n* = 5), effluent stacks (*n* = 1), in ornamental trees (*n* = 2) and on a meteorological tower (*n* = 1).

We surveyed 11 towers outside facility footprints 2–5 times each. Seventy-four percent of visits were in April, but occasional revisits to nests with unconfirmed status occurred through June 5. In total, we observed three active raven nests on towers (Table 4-1), all of which were on the east side of the INL Site. One of the three nests was inside the SGCA (Figure 4-1).

The status of 27 nests remained unconfirmed at the close of the survey period. Fifteen of the nests were on structures such as building platforms and ornamental trees where they are not easily dislodged by wind and can therefore remain unmaintained for many years. The other 12 were on power lines and had been newly built in 2020. Seven of these 12 were present during only one survey, and only three were still in place the last time the structure was visited. Thus, most if not all unconfirmed power-line nests represent failed or abandoned nests by an unknown species.

Overall, active raven nests recorded on all infrastructure associated with the INL Site was 14% higher in 2020 than 2019, and active nests on power lines was 17% higher. Raven nests on all infrastructure was less than other years except 2014 and 2019, whereas raven nests on power lines remains lower than all other years except 2019 (Figure 4-2).

Table 4-2. Summary of raven nest survey effort and results at Idaho National Laboratory Site facilities in 2020.

Facility	# Times Surveyed	Days Between Surveys	Active Raven Nest Confirmed	Substrate Supporting Active Nest
Advanced Mixed Waste Treatment Project	2	14	No	N/A
Advanced Test Reactor Complex	1	N/A	No	N/A
Central Facilities Area	2	14	No	N/A
Central Facilities Area Main Gate	2	14	Yes	Building Platform
Critical Infrastructure Test Range Complex	2	16	Yes	Ornamental Tree
Experimental Breeder Reactor I	2	14	Yes	Building Platform
Highway Department	2	14	No	N/A
Idaho Nuclear Technology and Engineering Center	2	21	Yes	Effluent Stack
Materials and Fuel Complex /Transient Reactor Test Facility	1	N/A	Yes (2 nests)	Building Platform, Tower
Naval Reactors Facility	2[a]	N/A	Yes	Building Platform
Radioactive Waste Management Complex	2	14	No	N/A
Specific Manufacturing Capability/Test Area North	2	15	Yes	Building Platform
U.S. Sheep Experiment Station	2	14	Yes	Ornamental Tree

[a] Environmental Surveillance, Education, and Research personnel are restricted from entering the NRF. A Naval Reactors Facility representative reports to ESER two times each season on raven nest observations.

4.2 Task 8—Monitor Expansion of the Infrastructure Footprint within the SGCA and Other Areas Dominated by Big Sagebrush

4.2.1 Introduction

Infrastructure development is considered a medium-ranked threat to sage-grouse on the INL Site (see Section 6.2.1). Infrastructure promotes habitat fragmentation, and construction of new infrastructure nearly always disturbs soil. If proper controls are not in place, soil disturbance can facilitate the introduction and spread of invasive weeds, which in turn can increase the risk of wildland fire. Weeds may also replace native plants and reduce plant diversity in localized areas, which impacts habitat condition.

Prior to the start of an INL Site construction project that may affect undeveloped land, a National Environmental Policy Act (NEPA) analysis is conducted on the portion of land slated for the project and the estimated area of habitat lost is captured as part of the NEPA process. Evidence from remotely sensed images of the INL Site spanning over a decade suggests that sometimes infrastructure footprints expand beyond what was originally authorized during the NEPA review. Thus, there is a possibility that an unplanned impact to sagebrush habitat and other native plant communities could occur following infrastructure development. Occasionally, mitigation following the completion of a construction project fails to meet its objectives. If no overarching plan for mitigation is developed, infrastructure requirements may continue to slowly expand as a project moves forward, without new structures and disturbances being considered.

Inappropriate vehicle use associated with trespass and livestock grazing management can also cause habitat degradation in localized areas. Remote sensing imagery shows that the number of linear features (e.g., two-track roads) on the INL Site, especially within grazing allotments, continues to increase since the establishment of baseline condition for this monitoring task (unpublished data; Shurtliff et al. 2017). It is likely that most of these two-tracks 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 a new unauthorized 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 and prevent this type of infrastructure expansion.

The U.S. Department of Agriculture NAIP collects digital imagery across the State of Idaho every two years. The publicly available image dataset product consists of four spectral bands (blue, green, red, and near-infrared), usually collected at 1 m spatial resolution. Occasionally, a State will contribute additional funds to have higher resolution imagery collected across the entire State. The 2013 Idaho NAIP imagery was acquired at 0.5 m spatial resolution and that dataset was used to establish the baseline for this monitoring task (Shurtliff et al. 2016). The availability of high resolution imagery collected across Idaho every two years, at no cost to the user, provides an invaluable tool to monitor the INL Site landscape and identify changes over time using a GIS.

The primary goal of this task is to update sagebrush habitat distribution by identifying where expansion of infrastructure has removed sagebrush habitat within the SGCA and other areas of existing sagebrush habitat. In some cases, there has been approved expansion at facilities (e.g., Materials and Fuels Complex ponds) that was not present when the INL Site vegetation map was originally being completed (Shive et al. 2011). Because the estimated amount of sagebrush habitat is generated from the vegetation map by cross-walking all classes dominated by sagebrush, there are regions currently mapped as sagebrush habitat that are not reflective of recent ground conditions and need to be updated periodically.

An important secondary goal of Task 8 is to continually monitor the increase in linear features (e.g. two-track roads) across the INL Site landscape, specifically within sagebrush habitat and the SGCA. Newly created linear features can provide vehicle access to formerly undisturbed areas. This can serve as a vector for non-native species and can also result in direct disturbance to sagebrush habitat by damaging or removing sagebrush. When numerous two-tracks begin to appear in areas previously void of road access, it can serve as an early indication that further habitat degradation is possible.

4.2.2 Methods

The GIS analysis workflow for this task includes three steps: (1) download new aerial imagery when available and mosaic a new basemap dataset, (2) review the entire INL Site and mark potential infrastructure expansions and new linear features, and (3) delineate all new infrastructure footprints and digitize linear features, and then modify sagebrush habitat polygons where expansion has removed sagebrush.

Throughout the late summer and early fall of 2019, high resolution multispectral digital imagery was collected across the State of Idaho through the NAIP. The 2019 Idaho NAIP imagery was collected with the standard four spectral bands, but spatial resolution was increased to 0.6 m (2 ft) compared to most years where 1 m (3.3 ft) resolution imagery is collected. The 2019 spatial resolution provides a nearly four-fold increase from 2017 which greatly improves the ability to detect subtle two-track linear features.

Two GIS analysts systematically zoomed into regions of the INL Site and looked for evidence of surface disturbance throughout the SGCA and within sagebrush habitat outside of the SGCA. Occasionally, image properties were adjusted to accentuate pixel values in an area of interest or add more contrast to help with feature identification. The image review process occurred at fine map scales so minor changes on the landscape (e.g., a new set of vehicle two-tracks) were more easily detected. We visually scanned around facilities, borrow sources and new project areas to investigate whether the infrastructure footprint has expanded and now overlaps regions previously mapped as sagebrush habitat. Areas where surface disturbance was most commonly observed consisted of linear features created by the presence of new two-track roads. Anytime a potential location was identified by an analyst, it was marked for a secondary review.

Once each GIS analyst had thoroughly reviewed the entire INL Site, all potential infrastructure expansion locations were reconciled into a single list for final review. The monitoring task lead investigated each marked location and determined if the feature warranted delineation. Whenever infrastructure expansion removed sagebrush habitat, or linear features were observed, the area of disturbance and total linear distance was manually delineated using editing tools within a GIS. The new polygon and line features were managed within an ESRI File Geodatabase to maintain accurate area and length statistics. Lastly, all sagebrush habitat polygons were manually updated using GIS polygon editing tools to create the most current sagebrush distribution on the INL Site.

The INL Site had five large wildland fires over one hectare that burned during summer of 2020. In response to the fires and to support post-fire ecological evaluation and recommendations, the INL Wildland Fire Committee funded the acquisition of high resolution imagery across the entire Site. On October 4, 2020 Digital Globe's Worldview-2 and Worldview-3 satellite sensors collected 8-band multispectral imagery.

The Worldview imagery was delivered orthorectified and pan-sharpened to a spatial resolution of 31 cm (1 ft).

Due to the limited amount of time between the 2020 imagery acquisition and the reporting deadline for this task, infrastructure expansion was only evaluated within the vicinity of new wildland fires and around existing expansions already documented this year. Further comprehensive review of the 2020 imagery will be completed and presented in the next iteration of this monitoring task.

4.2.3 Results

There were nine locations mapped where infrastructure expansion removed sagebrush habitat resulting in a total loss of 35.7 ha (88.2 ac). All locations of sagebrush habitat loss from infrastructure occurred outside the SGCA, and the sagebrush was removed from what is considered a "conservation bank" that could be incorporated into the SGCA to replace lost sagebrush habitat resulting from wildland fire or new infrastructure development (DOE and USFWS 2014).

The largest infrastructure expansion that removed sagebrush habitat was at the NRF facility where a new parking lot and additional construction footprints were cleared for a total loss of 21 ha (51.9 ac; Figure 4-3). The three next largest infrastructure expansion locations were all at gravel pits where the excavated boundaries expanded into adjacent sagebrush habitat (Figure 4-4). The mapped losses due to borrow source expansion are primarily because when the sagebrush habitat layer was originally developed, the extent of the existing sagebrush at the time was used rather than the administrative boundary of the gravel pit already approved for future expansion. The remaining locations of sagebrush loss were associated with minor expansions near facilities (e.g., guard gates and new concrete pads).

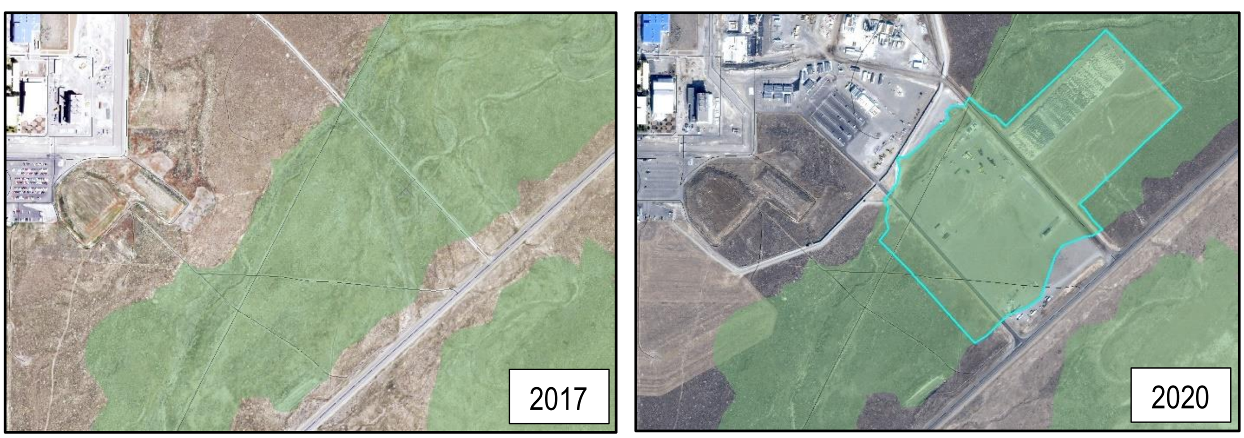

Figure 4-3. Comparison of an area at the Naval Reactor Facility on the Idaho National Laboratory Site imaged in 2017 and 2019. The transparent green overlay represents existing sagebrush habitat. The highlighted polygon in the 2019 image delineates the area of sagebrush habitat lost due to facility expansion.

Two-tracks were found to be prevalent across the INL Site with 238.3 km (148.1 mi) of new linear features detected and mapped within the SGCA or existing sagebrush habitat (Figure 4-5). Any linear feature that overlapped existing sagebrush habitat or the SGCA boundary was included in the mapping results even if a portion of the feature extended outside sagebrush habitat or the SGCA. The vast majority of new two-track features mapped were in proximity to recent wildland fires. In previous years, most new two-tracks consisted of side-loops from existing roads and shortcuts between roads that were generally short distances. However, the most recent analysis shows that two-track linear features have substantially increased in distance and density near containment lines, inside the burned area and also in unburned regions that provide access to the fire (Figure 4-6). The previous two times this task has been reported, the longest new two-track mapped was 1.6 km (1 mi) in length with only a few mapped lines exceeding 1 km (0.6 mi) in length. This year there were 54 two-track linear features mapped that were at least 1 km (0.6 mi) in length with the longest feature reaching 5.7 km (3.5 mi).

In addition to the new two-track linear features, 30.4 km (18.9 mi) of two-tracks were mapped, but when cross-referenced to previously collected NAIP imagery, these features were found to be present but missed during the last review process (Figure 4-5). The NAIP imagery is collected across numerous days throughout the summer with the goal of producing cloud free images. Subsequently, the sun elevation angle will sometimes differ between image tiles and the shadows cast by lower sun angles sometimes help illuminate linear features, improving our ability to detect them. Increased spatial resolution also contributes significantly to confidently identifying two distinct tracks whereas coarser resolution imagery can be more difficult to interpret whether the feature is from vehicular travel. Figure 4-7 provides an example where new imagery distinctly showed the presence of two-tracks where it was more difficult to confirm them in the previous NAIP image dataset. Additional linear features were identified on the INL Site in 2020; however, only features that are within or partially within either the SGCA or sagebrush habitat were included in this report.

Figure 4-4. Example gravel pit borrow source expansion that removed sagebrush habitat on the Idaho National Laboratory Site. The image on the left shows the T-12 gravel pit with mapped sagebrush habitat displayed with a transparent green overlay. The image on the right is the same location imaged in 2019 showing highlighted expansion to the southeast into adjacent sagebrush habitat.

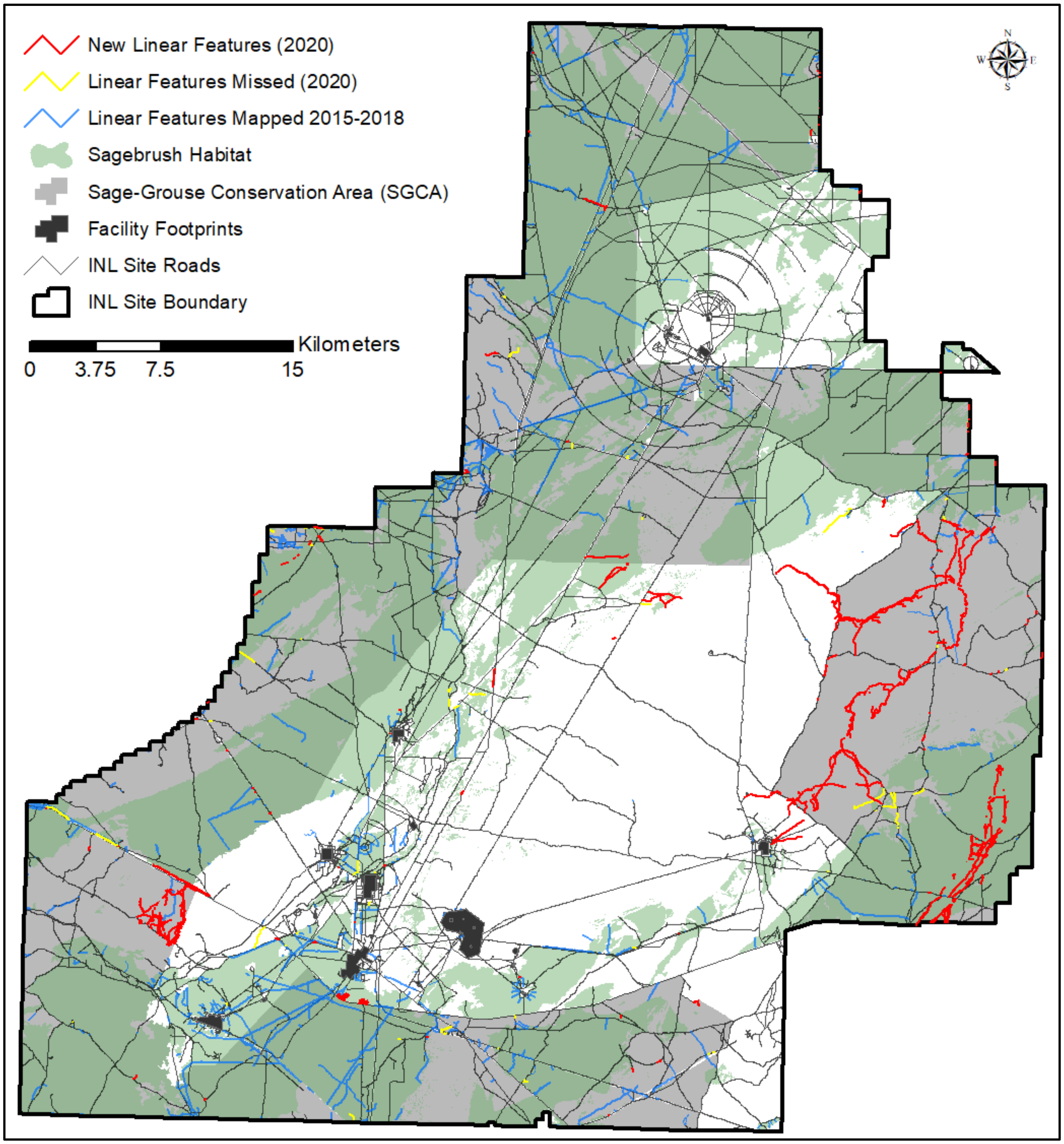

Figure 4-5. Two-track linear feature expansion mapped in 2020 within the Sage-Grouse Conservation Area or existing sagebrush habitat on the Idaho National Laboratory Site.

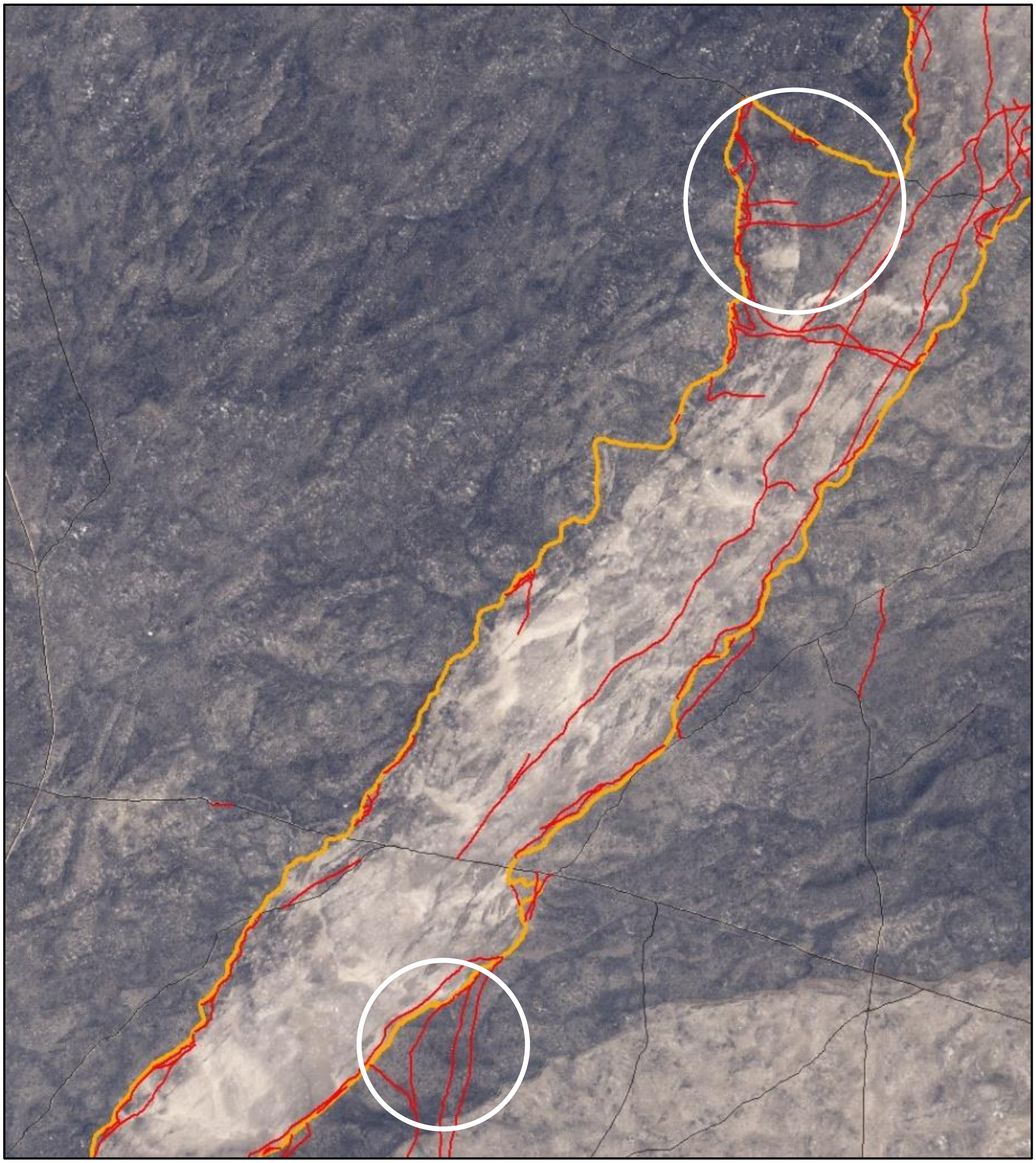

Figure 4-6. A portion of the Telegraph Fire that burned on the Idaho National Laboratory Site in 2020. The bladed containment line boundary is displayed in orange and the red lines represent new two-track linear features mapped using high resolution imagery collected after the fire. The white circles highlight regions where new two-tracks were mapped within unburned sagebrush habitat.

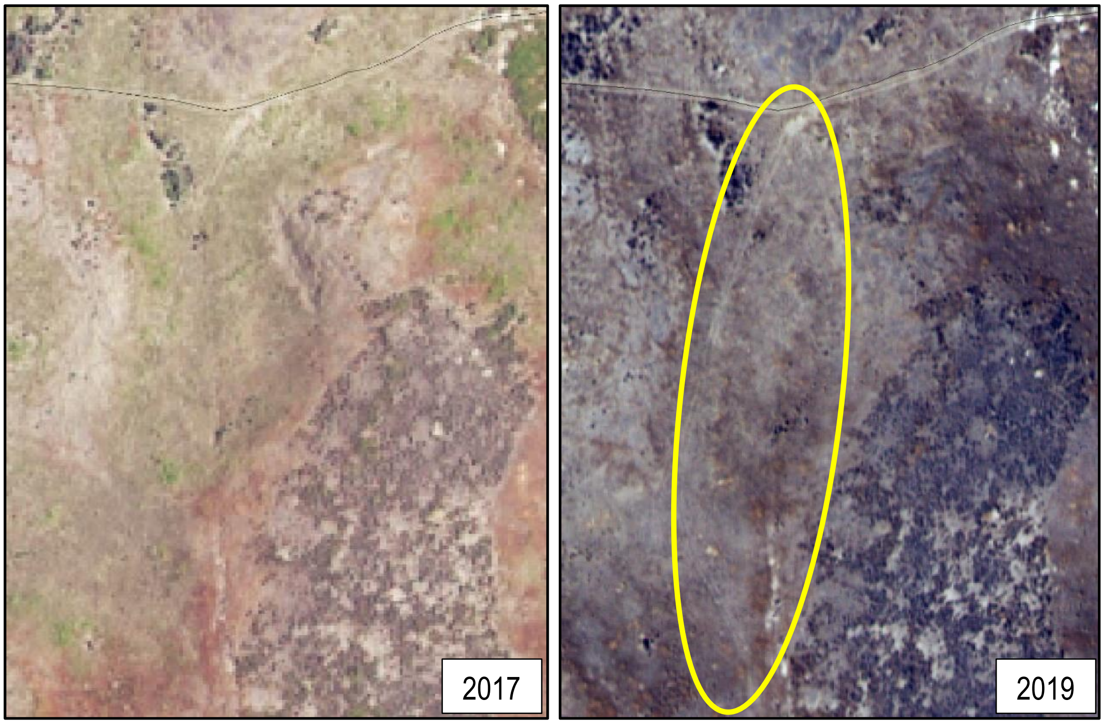

Figure 4-7. Example of a new two-track linear feature imaged in 2017 and 2019 at the Idaho National Laboratory Site. The 1 m (3.3 ft) resolution imagery from 2017 shows a potential new spur road, but two distinct tracks could not be verified so this feature was not mapped. The 2019 image shows the same location and with an increased spatial resolution of 0.6 m (2 ft), the two individual tracks are now more visible.

4.2.4 Discussion

The large number of two-track linear features mapped as the initial baseline in 2015 (Shurtliff et al. 2016) likely represents many years of accumulated unauthorized expansion rather than activities that have occurred in the years between signing of the CCA and the initial infrastructure expansion review. Although the amount of new two-track linear features was drastically lower in years since the baseline was established, this year's analysis showed a substantially greater amount of new features. There were only 7.4 km (4.6 mi) mapped in 2016, and 9.6 km (6 mi) mapped in 2018, compared to 226.6 km (192.6 mi) mapped in 2020. It had been seven years since the INL Site had experienced a large wildland fire, then the Sheep Fire occurred in 2019 followed by five more fires in 2020. Many of the newly mapped two-tracks were in close proximity to the fires, and while the exact cause of the increase is unknown, the extensive amount of area burned in 2019 and 2020 was likely a factor.

The spatial location of some two-tracks are a greater concern than the total distance of new two-tracks mapped in 2020. We documented sets of two-tracks adjacent to one another going through unburned sagebrush habitat both inside and outside of fire boundaries (Figure 4-6). Even when access roads were available nearby, new two-tracks were created. This growing network of linear features may pose a threat to long-term sagebrush habitat condition as the likelihood of non-native species introduction into more pristine habitat becomes an increasing concern. While these linear expansions may seem insignificant compared to the total area of the INL Site, continuous cumulative impacts over time should be monitored closely.

Despite the large increase in mapped two-tracks in 2020, the total linear distance is still likely an underestimate of the actual amount of new two-tracks. We observed examples of two-tracks departing from a containment line headed toward the interior of a fire when the tracks seemingly disappeared. This is likely due to sand and soil movement from wind that effectively filled in and covered some two-tracks. High resolution imagery showed peculiar streaking and soil deposition patterns within the 2019 Sheep Fire suggesting there were high wind events after the fire, which could explain why some two-tracks disappeared in areas within the burned area that were devoid of vegetation.

An encouraging observation made while reviewing the 2019 NAIP imagery, was that some previously mapped two-tracks were becoming difficult to detect and appear to be blending into the background landscape. It is unknown how long some of the mapped two-tracks persist, and we have refrained from calling them roads because we suspect that some of the mapped features may represent one or maybe a few passes from vehicles rather than continued use common on an established road. Continued monitoring with high resolution imagery will help us better understand the longevity of mapped two-track features and what the implications may be to existing sagebrush habitat and recovering post-fire vegetation communities.

5.0 IMPLEMENTATION OF CONSERVATION MEASURES

5.1 Summary of 2020 Implementation Progress

The CCA identifies eight threats to sage-grouse and its habitats on the INL Site, and it outlines 13 conservation measures designed to mitigate and reduce these threats. The agreement also articulates DOE's desire to achieve no net loss of sagebrush due to infrastructure development. The following table (Table 5-1) summarizes actions and accomplishments associated with each conservation measure that DOE, contractors, and stakeholders achieved in the past year to ameliorate threats to sage-grouse and its habitats on the INL Site. Sagebrush losses, if any, are documented under Conservation Measure 2 with a description of contractor plans and current activities to mitigate those losses.

Table 5-1. Accomplishments in 2020 for each CCA conservation measure.

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 2020: BURN ASSESSMENT—Five wildfires over one hectare in size occurred on the INL Site in 2020, burning an estimated 1,934 ha (4,779 ac)[3]. The INL Wildland Fire Committee recommended that a post-fire assessment and recovery plan be developed for the three fires that were greater than 40 ha and an 11-ha (28-acre) fire that burned in the SGCA and required containment lines. The plan, which will be completed by spring 2021, will include an assessment of the natural resources impacted by the fire and provide numerous restoration options for improving habitat recovery. **Associated Conservation Actions that Addressed the Wildland Fire Threat:** FIREFIGHTING ACTIVITIES—The INL fire department applied many lessons learned from the 2019 Sheep Fire to aggressively attack the 2020 wildfires and minimize fire size. Most of this effort was directed toward improving coordination and deployment of bulldozer and support resources and creating a new bulldozer boss function to improve their performance. The fire department also invested in a tactical tender that allowed crews to engage initial attack more aggressively and safely (i.e., all firefighters in the cab of the vehicle could attack the blaze with triple the onboard water supply). The fire department gratefully acknowledges the support from the Bureau of Land Management (BLM) and other support agencies, which made it possible to aggressively combat the fires (Personal Communication with Eric Gosswiller, INL Fire Chief, 11/19/2020). POST FIRE ADAPTIVE MANAGEMENT—In early 2021, BLM will close areas to livestock grazing that were impacted by two wildfires on the INL Site in 2020, the Telegraph Fire and the Lost River Fire (Personal Communication with Jordan Hennefer, Rangeland Management Specialist, BLM, 11/13/2020). With the help of agency partners, DOE strip seeded approximately 10,117 ha (25,000 ac) of the Sheep Fire with big sagebrush in February 2020.	

[3] Unpublished wildland fire statistics summary for 2020; Eric Gosswiller, INL Fire Chief.

The INL dedicated funding to experiment with control measures in select areas of the Sheep Fire footprint that are at high risk of cheatgrass dominance. The first control measure to be used is aerial spraying of a pre-emergent, which will be applied in the early fall of 2021. The sample area is approximately 809 ha (2,000 ac). These actions are intended to improve understory conditions and increase the likelihood that high-quality sagebrush habitat will return.

Threat:	Infrastructure Development
Objective:	Avoid new infrastructure development within the SGCA and 1 km (0.6 mi) 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 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—Implementation of Best Management Practices in 2020:

Multiple projects in fiscal year (FY) 2020 co-located new infrastructure with existing infrastructure to avoid damage to sagebrush. Test Area North (TAN)-691, maintenance and vehicle-storage building (EC INL-20-035) was sited immediately adjacent to the Specific Manufacturing Capability fence. Two storage pads at Advanced Test Reactor (ATR) Complex (EC INL-20-103) are under construction inside the fence where old underground storage tanks once sat. A snowplow turnaround on U.S. Highway 20 (EC INL-20-148) was placed in a previously disturbed gravel lot. The U.S. Environmental Protection Agency is conducting cybersecurity and infrastructure tests within the existing Critical Infrastructure Test Range Complex (CITRC) footprint (EC INL-20-126). Security equipment for TAN-676 is being installed in coordination with the Nile Ave project (EC INL-19-143 R1) to avoid disturbing additional ground (EC INL-20-110).

Conservation Measure 3—Accomplishments in 2020:

INL Environmental Support and Services staff are unaware of any infrastructure built outside exempted corridors in FY 2020.

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.~~ DISCONTINUED (See Section 6.2.4, Shurtliff et al. [2019]).

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 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 that rangeland improvements follow guidelines in the BLM Land Use Plan and the CCA.

Conservation Measure 5—Accomplishments and Disturbances in 2020:

PERMIT RENEWAL—The Twin Buttes Allotment permit renewal is currently in a Protest and Appeal period, and when a Final Decision is published, Terms and Conditions on the permits will be amended (Personal Communication with Jordan Hennefer, Rangeland Management Specialist, BLM, 11/13/2020).

UPDATED INFORMATION TO BLM—DOE provided updated GIS shapefiles of active lek locations to BLM early in 2020. ESER staff also participated in a BLM and IDFG fact-finding meeting that was part of a formal causal factor analysis aimed at trying to understand why lek counts in the region have fallen steeply in recent years.

Conservation Measure 6—Accomplishments in 2020:

COMMUNICATION & COLLABORATION—Due to the Covid-19 pandemic, the annual meeting among BLM, DOE, and ESER staff did not occur in 2020 as it has in the past. However, ESER provided data from the CCA Habitat Condition monitoring task to the BLM district office to support allotment assessments of the Quaking Aspen Allotment. DOE and ESER also engaged BLM in post-fire activities related to the Sheep Fire. Specifically:

- the BLM Boise Seed Warehouse sourced about 8,000 lbs. of seed for an aerial seeding effort;
- the local BLM district office contributed 1,600 lbs. of sagebrush seed through excess property transfer for aerial seeding;
- a BLM fire ecologist continued participating in INL's Wildland Fire Management Committee;
- BLM offered ESER and DOE advice about aerially spraying cheatgrass post-fire;
- BLM discussed challenges and options for controlling rush skeletonweed with ESER personnel;
- BLM provided recommendations to consider for potential vendors for spaying cheatgrass and growing sagebrush seedlings.

RANGELAND IMPROVEMENTS—DOE supported a 2019 decision by BLM to permit installation of an underground pipe to maintain water troughs in the Deadman and Quaking Aspen allotments. An Environmental Assessment for the project is nearly complete, and when it is mailed out, the Protest and Appeal period will open. The project, if authorized, will allow for a more reliable water source, resulting in better livestock distribution and less road traffic (Personal Communication with Jordan Hennefer, Rangeland Management Specialist, BLM, 11/13/2020).

Threat:	Seeded Perennial Grasses
Objective:	Maintain the integrity of native plant communities by limiting the spread of crested wheatgrass.
Conservation Measure:	7) Inform INL contractors about negative ecological consequences resulting from crested wheatgrass and persuade them to rehabilitate disturbed land using only native seed mixes that are verified to be free of crested wheatgrass contamination.

Conservation Measure 7—Accomplishments in 2020:

ESER has a native perennial seed mix list that is recommended whenever contractors request information prior to revegetation work. In 2020, all revegetation work on the INL Site was performed using certified native seed as recommended by ESER.

Threat:	Landfills and Borrow Sources
Objective:	Minimize the impact of borrow source and landfill activities and development on sage-grouse and sagebrush habitat.
Conservation Measures:	8) Eliminate human disturbance of sage-grouse that use borrow sources as leks (measure applies only to activities from 6 p.m. to 9 a.m., March 15–May 15, within 1 km [0.6 mi] of active leks). 9) Ensure that no net loss of sagebrush habitat occurs due to new borrow pit or landfill development. DOE accomplishes this measure by: • avoiding new borrow pit and landfill development in undisturbed sagebrush habitat, especially within the SGCA; • ensuring reclamation plans incorporate appropriate seed mix and seeding technology; • implementing adequate weed control measures throughout the life of an active borrow source or landfill.

Conservation Measure 8—Accomplishments in 2020:

INL complied with seasonal and time-of-day restrictions associated with sage grouse. Per "Idaho National Laboratory Gravel/Borrow Pits (Overarching) Environmental Checklist" (EC INL-14-045), projects must complete Form 450.AP01, "Gravel/Borrow Source Request Form," before removing gravel. This form reminds gravel-pit users of restrictions in place to protect sage grouse. Projects must also submit, in writing to Environmental Support and Services personnel, that they complied with the directives in this EC. Adams Boulevard, Lincoln Boulevard, Monroe Boulevard, Ryegrass Flats, T-12, and T-28 South are covered by this EC.

Conservation Measure 9—Accomplishments in 2020:

No new borrow pits or landfills were opened in 2020. According to INL Facilities and Site Services, T-12 was closed for all use in the spring of 2020, and there are no plans to reopen it anytime soon. Expansion of existing borrow sources and landfills is limited to footprints approved in Appendix C of the Spent Nuclear Fuel Environmental Impact Statement (EIS) (DOE/EIS-0203) or the Environmental Assessment (EA) for Silt/Clay Development and Use (DOE-EA-1083). Any expansion of gravel or borrow pits that would disturb surface soil or vegetation also requires a survey of cultural and biological resources by ESER. INL Facilities and Site Services personnel assist in the identification of approved footprints.

Threat:	Raven Predation
Objective:	Reduce food and nesting subsidies for ravens on the INL Site.
Conservation Measures:	10) DOE will work with INL contractors and the National Oceanic and Atmospheric Administration to opportunistically reduce raven nesting on power lines and towers and at facilities. 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 2020:

INL Power Management operates and maintains 130 miles of overhead power lines. New power lines go through the NEPA process to determine whether nesting deterrents are required. When Power Management performs maintenance on distribution overhead lines, they install avian protection on each structure as the engineer and linemen see fit. There are approximately five different types of avian protection devices available for install. Per the Facilities and Site Services Program Environmental Lead, Power Management installed avian protection on 83 structures in FY 2020. Power Management replaces transmission structures based on age and deterioration by installing prefabricated metal crossarms in place of the existing wooden crossarms. The new crossarms are inherently nesting deterrents because only one beam is available for birds to build on (instead of two). In FY 2020, Power Management installed 16 new transmission-line cross arms.

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 Measures 12 and 13—Accomplishments in 2020: Due to COVID-19 there were few detonations at the National Security Test Range (NSTR) this spring. All CCA requirements were met, and restrictions followed. No meteorological, sound detection and ranging, or other cell towers were erected within 0.6 miles of a sage-grouse lek or within the SGCA during FY 2020. INL Environmental Support and Services staff are not aware of any other Site activities that could disrupt nesting sage-grouse within the SGCA.	

5.2 Reports on Projects Associated with Conservation Measures

Since the CCA was signed, DOE, INL, and ESER have implemented activities on an as-needed and recurring basis to reduce the impact of wildland fire to sage-grouse habitats and to support the objective of Conservation Measure 1 (Table 5-1). These activities were not specifically identified in the CCA, but year-end results and updates are provided here because of their relevance to the mitigation of impacts from wildland fires.

5.2.1 Conservation Measure 1—Post-fire Recovery Planning, Implementation, and Monitoring

Background

The threat level of wildland fire was ranked as high in the CCA (DOE and USFWS 2014) and wildland fire is one of the top threats to sage-grouse across their range (Federal Register 2010). Wildland fire impacts sage-grouse habitat by removing sagebrush and by making the recovering plant community less resistant to invasion and dominance by non-native weeds like cheatgrass (Connelly et al. 2011, Bradley 2010). Annual grasslands were independently ranked as medium-level threat to sage-grouse in the CCA. Cheatgrass is currently the primary introduced annual grass of concern on the INL Site. Although it can become dominant under a variety of conditions, post-fire plant communities are particularly susceptible (see Section 3.1), making the threats of wildland fire and cheatgrass interrelated. Firefighting activities, although necessary to minimize sagebrush loss, can compound the threat of cheatgrass dominance after wildland fire by disturbing soil and creating vectors for the spread of cheatgrass and other weeds that have the potential to reduce habitat value.

Wildland fire on the INL Site was relatively infrequent prior to 1994; only a few large fires were known to have occurred or could be seen in imagery prior to that time (Shive et al. 2011). Over the past 25 years, several large fires (>40 ha [>99 ac]) have burned across the INL Site. Potential effects of wildland fire on natural resources were initially addressed in the Wildland Fire Management Plan and Environmental Assessment (DOE 2003), which was drafted after four notable fires. At that time, native sagebrush habitat was still dominant across the INL Site, and fire recovery efforts were focused on areas directly impacted by fire suppression efforts.

The CCA represented the next major effort to address the effects of wildland fire on some aspects of natural resources. It was signed in 2014 and three sizeable wildland fires occurred between 2010 and 2014, while it was being developed, including the Jefferson Fire, which burned over 35,000 ha (86,487 ac) on the INL Site and was the largest fire to date. Based on the analysis of the threat of wildland fire to sage-grouse and on wildland fire activity at the time, a conservation measure was developed for inclusion in the CCA that stated an assessment evaluating the need for post-fire restoration would be prepared and DOE would guide an approach for hastening sagebrush reestablishment on fires larger than 40 ha (99 ac). The objective for this conservation measure was to minimize the impact of habitat loss due to wildland fire, as well as habitat impacted by soil disturbance from firefighting activities. After the CCA was signed, the INL Site did not experience any wildland fires meeting the conservation measure criteria for nearly five years.

In 2019, the Sheep Fire burned more than 40,000 ha (98,842 ac) on the INL Site. To address the CCA wildland fire conservation measure and to comply with the INL Wildland Fire Environmental Assessment (DOE 2003), INL's Wildland Fire Management Committee (WFMC) directed the ESER Program to prepare an assessment of ecological impacts and a fire recovery plan for the area impacted by the Sheep Fire. In 2020, there were two very small wildland fires (<1000 m^2 or ¼ ac) and five wildland fires ranging in size from 11.0 ha (27.1 ac) to 677.9 ha (1,675.1 ac) on the INL Site (Figure 5-1). Only three of the five fires were large enough to meet the wildland fire conservation measure criteria; however, the WFMC requested an ecological assessment and fire recovery plan for four of the fires. The 11.0 ha (27.1 ac) fire was included because it was partially in the SGCA, it was designated as sagebrush habitat prior to the fire, and containment lines (i.e., soil disturbance) were used to control it. This section of the report contains a summary of the fire recovery plans, restoration actions, and initial monitoring results from the Sheep Fire and the 2020 wildland fires.

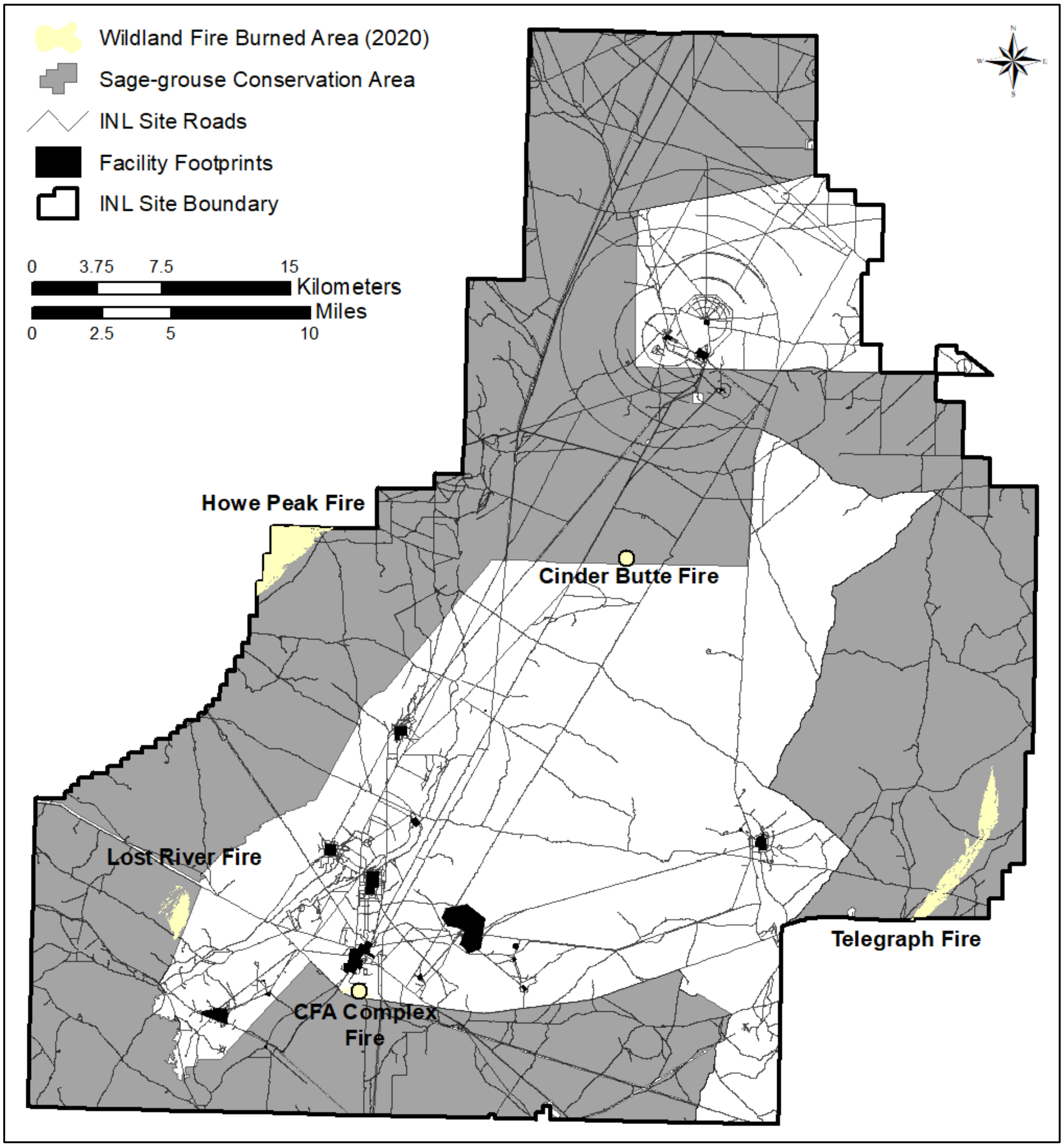

Figure 5-1. Five wildland fires >1000 m² (¼ ac) on the Idaho National Laboratory Site that burned during the summer of 2020.

2019 - Sheep Fire

Fire Summary and Post-fire Restoration Planning

The lightning-caused Sheep Fire started on July 22, 2019 in a remote region of the INL Site east of T-4 and south of T-9. The INL Site Fire Department and BLM responded under a unified command employing multiple fire suppression strategies. Red flag and thunderstorm warnings were posted on July 23 and 24 as winds increased and relative humidity remained low, and the fire expanded to over 32,375 ha (80,000 ac). Minimal fire activity was reported on July 25, and the Sheep Fire was 100% contained by the afternoon of July 26. The Sheep Fire boundary was created by the BLM and the burned area was initially estimated to be approximately 45,368 ha (112,107 ac). The estimated footprint of the actual area burned in the Sheep Fire was later reduced to 40,403 ha (99,839 ac) based on aerial imagery collected the following September.

Under the direction of the WFMC, the ESER Program completed the Sheep Fire Ecological Resources Post-Fire Recovery Plan in January 2020 (Forman et al. 2020). Several natural resource recovery goals were identified within the plan and they were organized into four primary recovery objectives: 1) Soil stabilization for erosion and weed control immediately post-fire, 2) Cheatgrass and noxious weed control within the larger burned area, 3) Native herbaceous recovery, and 4) Sagebrush habitat restoration. Several restoration and/or treatment options were provided within each recovery objective to achieve natural resource recovery goals. Upon finalization of the recovery plan, the WFMC met and prioritized restoration/treatment actions within two post-fire recovery objectives: cheatgrass control and big sagebrush habitat restoration.

Emergency wildland fire response actions and soil stabilization actions are addressed in the INL Wildland Fire Environmental Assessment (DOE 2003); however, many of the post-fire recovery options presented in the Sheep Fire Ecological Resources Post-Fire Recovery Plan are not. Prior to the Sheep Fire, each non-emergency post-fire recovery action was subject to NEPA review. Given the number of post-fire recovery actions that were recommended by the WFMC after the Sheep Fire, the INL has begun work on an Environmental Compliance Permit to address all potential restoration activities that could take place after the Sheep Fire or any other wildland fire. This Environmental Compliance Permit will facilitate a more comprehensive and efficient response, with respect to post-fire restoration in the future.

Emergency Soil Stabilization and Noxious Weed Control

The INL began addressing soil stabilization and noxious weed control on the Sheep Fire containment lines during the fall of 2019. These actions are prescribed by the INL's Wildland Fire Environmental Assessment (DOE 2003), so they were initiated prior to completion of the Sheep Fire Ecological Resources Post-Fire Recovery Plan. Recontouring efforts were completed on the Sheep Fire containment lines in 2020. Noxious weed control efforts on the containment lines began as part of emergency stabilization efforts and will continue as part of an ongoing noxious weed control program across the INL Site.

Noxious weed control is an annual land management task across the INL Site; however, the Sheep Fire burned area was one primary focus area in 2020. Ongoing noxious weed control will be implemented through the Sheep Fire Ecological Resources Post-Fire Recovery Plan and other INL Site weed control programs. During a post-Sheep Fire scoping meeting in 2019, local stakeholders raised a concern about rush skeletonweed (*Chondrilla juncea*) invading recently burned areas on the INL Site as this noxious weed is becoming increasingly problematic in adjacent rangelands. The ESER Program collected incidental data on noxious weed locations throughout the Sheep Fire in 2020. These data were transmitted to INL for inclusion in their noxious weed treatment plan.

Cheatgrass Control

The ESER Program was funded by the WFMC to monitor areas at high risk of cheatgrass invasion during the summer of 2020 using a rapid assessment sampling approach to prioritize areas that would benefit from pre-emergent herbicide application. The Sheep Fire Ecological Resources Post-Fire Recovery Plan identified approximately 4,347 ha (10,741 ac) that had a substantial cheatgrass component prior to the Sheep Fire. Optimal application areas would have enough cheatgrass to warrant control measures and enough remnant native perennials to facilitate desirable herbaceous recovery after herbicide application. Much of the area identified in the recovery plan was sampled during August 2020 to verify suitability of conditions for treatment.

Results from ground-based monitoring were used to identify four approximately 809 ha (2,000 ac) polygons meeting the criteria for herbicide application (Figure 5-2). The polygons were prioritized so that the area most likely to respond well to treatment will be sprayed first and additional areas can be added as funding allows. Details regarding sampling, criteria for prioritization, and treatment recommendations can be found in the Sheep Fire Ecological Resources Post-Fire Monitoring Report (Forman et al. 2020). Using the recommendations made in the monitoring report, the INL has begun addressing processes and work controls necessary to perform this type of work, contracted an aerial vendor, and will spray cheatgrass beginning in 2021.

Sagebrush Habitat Restoration

Based on stakeholder input and involvement, DOE agreed to collaboratively pursue aerial sagebrush seeding on portions on the Sheep Fire during the winter of 2019/2020. The ESER Program provided logistical support for this effort and the USFWS, the BLM, and the Idaho Office of Species Conservation helped with seed acquisition. The seeding was completed across a target area of approximately 10,100 ha (25,000 ac) in and adjacent to the SGCA. Monitoring germination and establishment of sagebrush in the seeded areas using rapid assessment techniques was also included in the 2020 monitoring plan and monitoring results were used to determine if there were areas of poor establishment where additional planting with sagebrush seedlings should be considered.

Approximately 3,629 kg (8,000 lbs.) of bulk sagebrush seed was purchased from the BLM seed warehouse. In addition to coordinating the seed purchase, BLM provided an additional 726 kg (1,600 lbs.) of local seed at no cost to DOE through an excess property transfer. All seed was applied aerially with a helicopter over two days in February 2020. Sagebrush seed was applied on snow, and the target planting area was seeded in strips so that about 1/3 of the total acreage, or about 3,116 ha (7,700 ac) were seeded (Figure 5-3). A total of 58.7 km (36.5 mi) of 20 m (66 ft)-wide belt transects, or an area of 1,174 ha (2,901 ac) were surveyed for sagebrush seedling establishment in late August (Figure 5-3). There were no sagebrush seedlings observed that could be attributed to the aerial seeding. A few sagebrush individuals were encountered during the survey effort, but they were too large and mature to have established this spring. The seedlings were likely located in patches of vegetation that did not burn in 2019. Additional detail about the aerial seeding and subsequent monitoring can be found in the Sheep Fire Ecological Resources Post-Fire Monitoring Report (Forman et al. 2020).

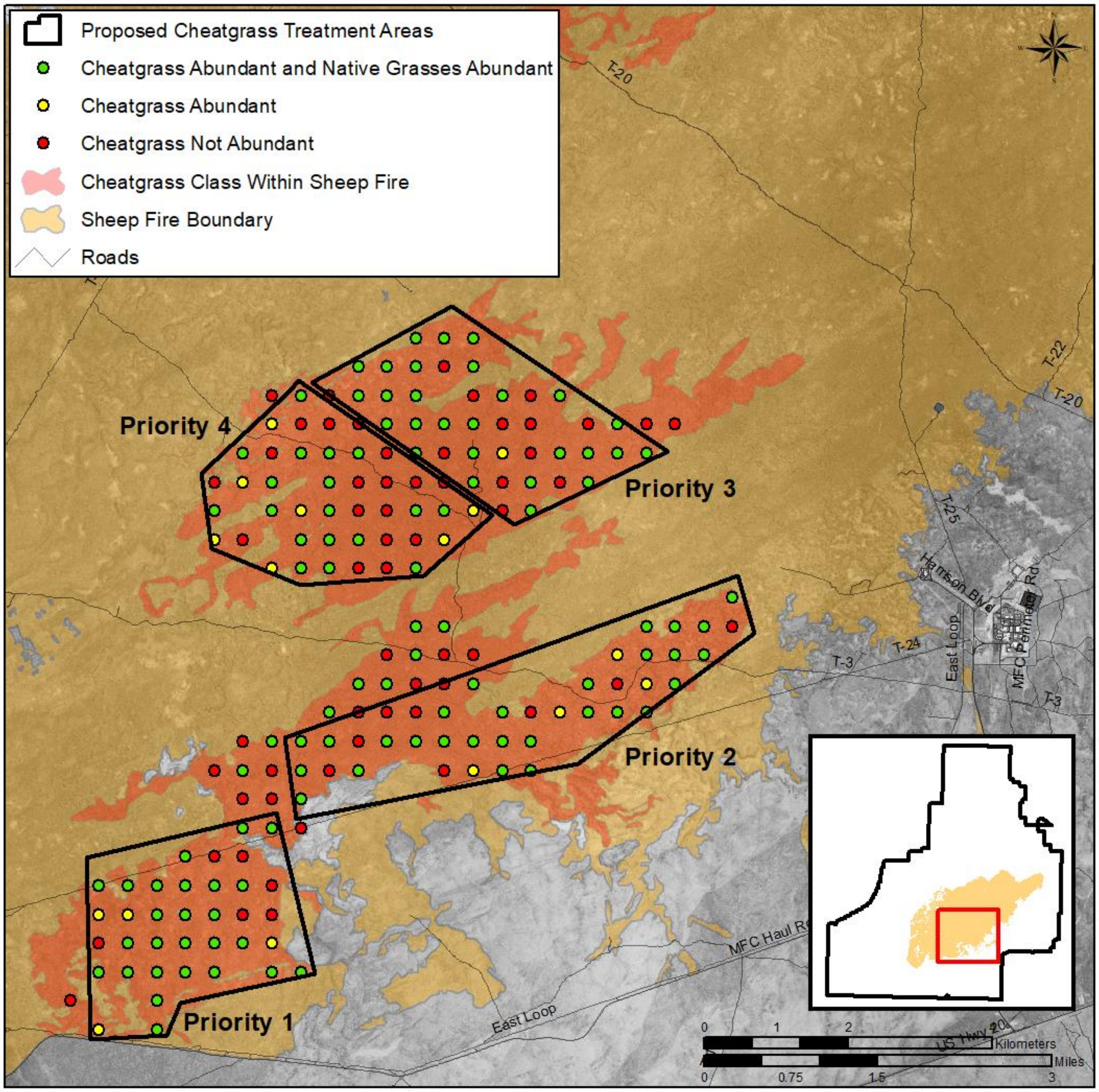

Figure 5-2. Results of cheatgrass monitoring to identify high priority treatment areas for pre-emergent herbicide application within the Sheep Fire footprint on the Idaho National Laboratory Site.

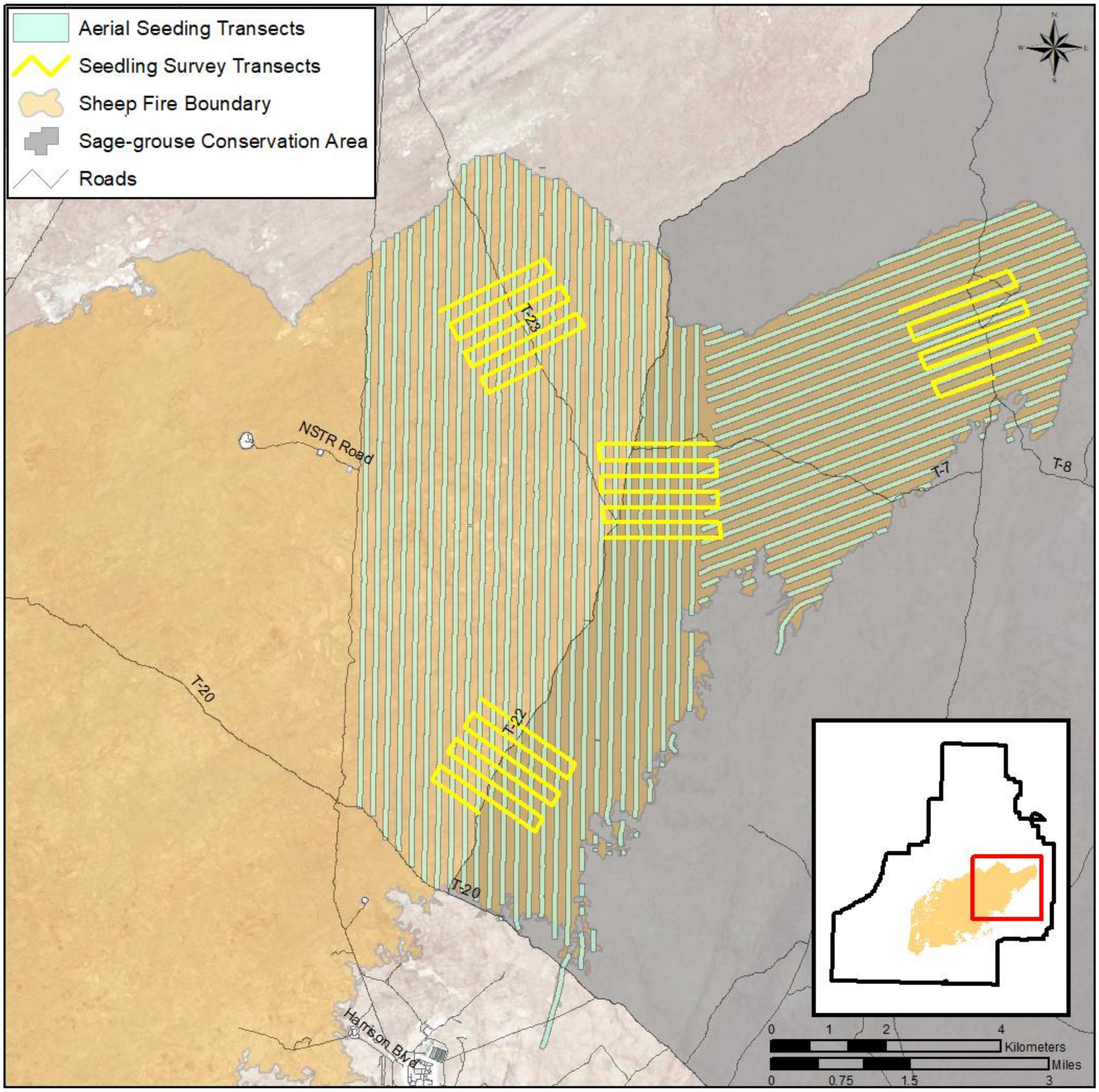

Figure 5-3. Flight lines for sagebrush seed aerial application on the Idaho National Laboratory Site, completed in February 2020 and survey transects used to assess germination and establishment of sagebrush seed; surveys were completed in August 2020.

Precipitation during several spring and summer months in 2020 were below long-term averages. The inherent uncertainty associated with aerial seeding combined with unfavorable precipitation patterns likely led to poor conditions for germination and establishment. Seed can remain viable for a few years and conducive weather conditions in 2021 could still result in some germination. Nevertheless, the Sheep Fire Ecological Resources Post-Fire Recovery Plan suggested replanting areas where seed did not establish with seedlings and that seedlings should be placed strategically where they can provide the greatest habitat benefit. Seedlings can be used to improve high priority habitat and/or habitat connectivity. The WFMC has directed ESER to develop a plan for planting sagebrush seedlings in high priority restoration areas on the

Sheep Fire in 2021 and DOE authorized the collection of enough local sagebrush seed to support this and other seedling planting efforts on the INL Site over the next few years. Approximately 18 kg (40 lbs.) of hand-stripped seed were collected in October and were shipped to a U.S. Forest Service Seed Extractory for cleaning and storage.

2020 – Multiple Fires

Fire Summary and Implementing Lessons Learned

The four 2020 wildland fires for which the WFMC requested an ecological assessment and fire recovery plan were the Howe Peak Fire, the Telegraph Fire, the Lost River Fire, and the Cinder Butte Fire. These fires were ignited between July 2, 2020 and August 18, 2020 and all were controlled and/or contained within a few days of ignition. Two of the fires were caused by lightning and two were human caused. All four of these fires were partially or entirely within the SGCA and sagebrush habitat was lost in three of the four fires. See Section 3.2 more a thorough description of the 2020 INL Site fires, including discussion of timing, conditions, location, fire boundaries, and estimates of sagebrush habitat lost.

Compared to past INL Site and other regional fires that ignited and burned under similar conditions, the amount of area impacted by the 2020 fires was relatively small. In general, the INL wildland fire plan incorporates a balanced fire management approach that ensures, to the extent possible, the protection of improved laboratory assets in a manner that minimizes effects on natural, cultural, and biological resources. As sagebrush habitat continues to be lost and protecting remaining habitat becomes increasingly important, the INL Fire Department and WFMC have continued to increase focus on maintaining sagebrush habitat in terms of both avoiding losses and restoring burned habitat. In 2020, the INL Fire Department applied a lot of effort toward Sheep Fire lessons learned that were geared around improving their coordination and deployment of dozer/support resources and a new dozer boss function to improve containment line construction. INL also invested in a tactical tender that allowed firefighters to engage initial attack more aggressively, but also safely. These measures proved effective in improving fire suppression performance during the initial attack period and minimizing fire size. As always, the INL Fire Department also appreciated the assistance received from BLM and other support agencies in aggressively addressing fires on the INL Site.

Emergency Stabilization and Post-Fire Restoration Planning

During the fall of 2020, the INL completed emergency stabilization actions on the fires that burned the previous summer. These actions include recontouring containment lines on the fires where they were used, reseeding with native seed, and spraying noxious weeds, especially in disturbed soils on and around containment lines. Additionally, the ESER Program will complete an ecological resources post-fire recovery plan for four fires, as requested by the WFMC. The post-fire recovery plan for the 2020 fires will include an assessment the ecological impacts of four 2020 fires and it will address the same four primary recovery objects as the Sheep Fire Ecological Resources Post-Fire Recovery Plan. The post-fire recovery plan for the 2020 fires will also include several options for meeting recovery objectives and an implementation approach that can be phased based on restoration priorities and available funding.

5.2.2 Conservation Measure 2—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 (see Table 5-1, Section 5.1). In 2015, DOE began implementing an annually recurring task that would facilitate planting at least 5,000 sagebrush seedlings each fall 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.

The ESER program oversees the planting of sagebrush seedlings from all sources and monitors survivorship to evaluate the effectiveness of the task for DOE and BEA. The goal of this restoration project is to plant at least 80 sagebrush seedlings per acre, resulting in a coverage of ≥25 ha (63 acres) per year (Shurtliff et al. 2016), although the acreage planted can be highly variable due to weather conditions, topography, planting conditions, travel, planter ability and number of seedlings being planted. Typical sagebrush density planting rates in sage-grouse habitat is one to three plants per square meter, meaning that a hectare normally contains 9,884-29,652 sagebrush plants (4,000–12,000 per acre). The intent of this sagebrush restoration task is not to plant sagebrush at densities that typify sage-grouse habitat, but rather to establish sagebrush seed sources over larger priority areas to shorten the time interval between a fire and the reestablishment of sagebrush habitat.

Methods

Desert Sage Farms LLC, located in Oakley, ID, provided sagebrush seedlings grown from seed collected on the INL Site in 2018. Information about growing the seedlings, and details about procedures followed during the planting process, are described in the 2015 CCA Annual Report (Shurtliff et al. 2016). The only change in 2020 was that we used 6 in. conetainers instead of 10 in. conetainers. In 2020, a total of 20,000 seedlings were planted on 46.5 ha (114.8 acres) over two days by MP Forestry of Medford, OR (Figure 5-4).

Figure 5-4. Planting crew from MP Forestry planting their way back to the trucks for a restock on sagebrush seedlings on the Idaho National Laboratory Site. October 2020.

Although potential planting sites are located in the priority restoration areas to the extent possible, other practical factors often determine the final site selection. Logistical constraints, such as accessibility due to weather and road condition, may also be factors in selecting seedling locations. The area chosen for restoration in 2020 was on the northeastern edge of the Jefferson Fire, south of Highway 33 (Figure 5-5). This area is within the SGCA as well as within the priority restoration area identified in the 2014 CCA (DOE and USFWS 2014). We chose this site to continue to establish a more contiguous sagebrush corridor, because of its proximity to sage-grouse leks, its importance to sage-grouse winter range, and to continue rehabilitation on the Jefferson Fire.

In addition to planting seedlings in 2020, survivorship of seedlings planted in fall 2019 was determined by revisiting and evaluating the condition of individual seedlings one year after planting. During the fall 2019 planting, we collected sub-meter GPS locations for nearly 5% of the seedlings planted. In September 2020, we revisited those seedlings and determined if each seedling was healthy, stressed, or dead (Figure 5-6, Figure 5-7). After five years, seedlings will again be revisited, and longer-term survivorship will be assessed.

In order to evaluate longer-term survivorship, seedlings planted in the fall of 2015 were revisited in the fall of 2020. During the fall of 2015, we collected sub-meter GPS locations for nearly 10% of seedlings planted and assessed the initial survivorship in the fall of 2016. In September of 2020, we revisited those same seedling locations again, regardless if they were determined missing or dead on the initial revisit. We assessed whether each seedling was healthy, stressed or dead five years post-planting.

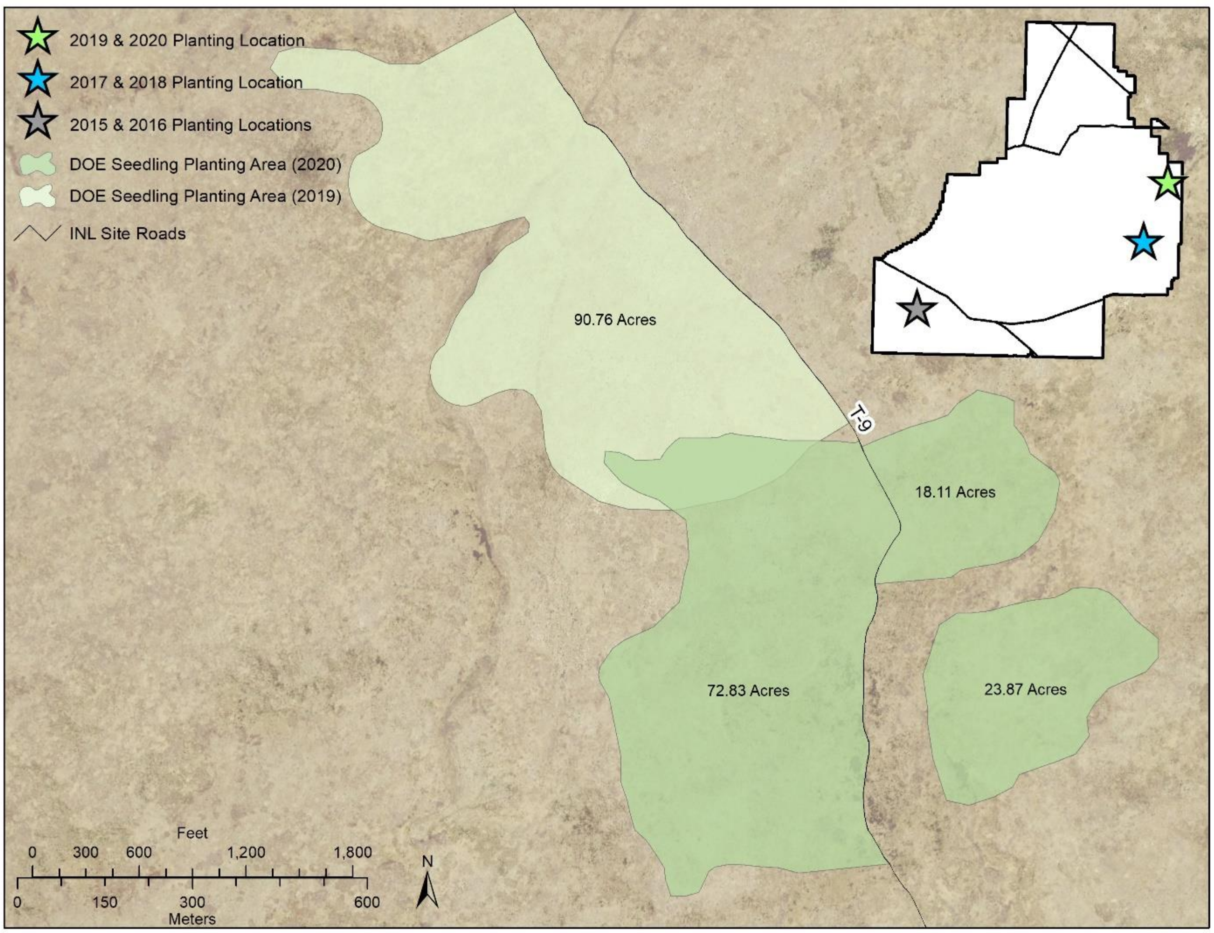

Figure 5-5. Areas planted with big sagebrush seedlings in 2020 with reference to previous years plantings on the Idaho National Laboratory Site.

Results and Discussion

On October 7, and 8, 2020, 20,000 sagebrush seedlings were planted on 46.5 ha (114.8 acres), resulting in a seedling density of ~430 seedlings per ha (~174 seedlings per acre) in the northeast part of the INL Site (Figure 5-5). We marked the locations of 540 (2.7%) seedlings for future monitoring. This planting density deviated from the desired density (80 seedlings per acre [Shurtliff et al. 2016]) due to observed lower survivorship of the adjacent 2019 planting and restrictive landforms such as lava flows where seedlings could not be planted. Although the INL Site had relatively lower temperatures following the planting, 2020's dry trend continued and precipitation in the area was not observed until 17 days post planting. Lack of precipitation created unfavorable conditions for initial establishment of the seedlings.

Sagebrush restoration has now been initiated on 218.4 ha (539.7 acres). Over the past five years, a total of 72,000 seedlings have been planted from all funding sources, including DOE, BEA, and the Idaho Governor's Office of Species Conservation. This exceeds the 5-year objective of habitat restoration efforts by 60.6 ha and 47,000 seedlings (Shurtliff et al. 2016). There were no seedlings planted to mitigate potential sagebrush loss by BEA project activities in 2019 nor 2020.

To quantify 2019 seedling survivorship and condition, we revisited 500 sagebrush seedlings in September 2020. Survivorship surveys found 16 (3.2%) seedlings were healthy, 7 (1.4%) were stressed, 122 (24.4%) were dead, and 355 (71%) were missing (Figure 5-6). Assuming the missing seedlings were dead, a total of 4.6% of the seedlings survived the first year. For comparison, years 2015-2019 are shown in Figure 5-6.

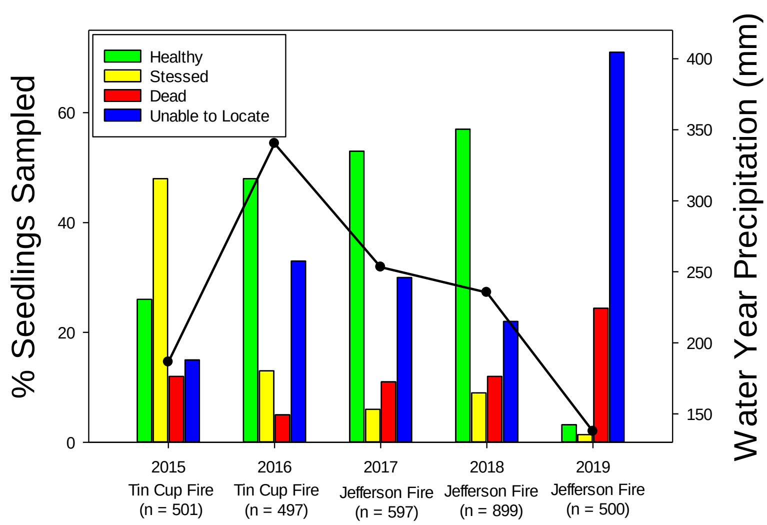

Figure 5-6. Sagebrush seedling survivorship each year since 2015. The black line and dots indicate the fluctuations in water year precipitation levels (October of planting year to September following year.)

As shown in Figure 5-6, the water year associated with the 2019 seedling planting was dramatically lower than any other planting year. In previous reports, annual precipitation numbers have been summarized by calendar year. To better understand the low survivorship of the seedlings planted in 2019, we summarized precipitation data according to water year. Water year is calculated by summing annual precipitation from October, the month the seedlings are planted to the following September, the general timeframe for survivorship monitoring. Water year is a better metric for interpreting survivorship because it more closely reflects the water available to that year's seedlings for establishment and development. In 2020, precipitation was atypical in both timing and amount, and it was the driest water year since the first planting in 2015. Winter, spring, and summer precipitation were not ideal for helping the seedlings to establish. While the cause of low survivorship is ultimately unknown due to many variables, the low precipitation would appear to be a large contributing factor to the low survivorship of the 2019 seedlings.

Figure 5-7. Examples of sagebrush seedling health conditions. Left: dead seedling. Right: healthy seedling.

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%; Dettweiler-Robinson et al. 2013). Thus, in the previous four years of planting (2015-2018), sagebrush establishment one-year post planting on the INL Site is at or above average even when the missing plants are considered dead. It is unfortunate that the 2019 planting has deviated from this trend of successful plantings, but it can provide an opportunity to better inform the planting process and allow us to explore new techniques in order to increase the success of future planting efforts.

Survivorship of seedlings planted in fall 2015 was also assessed in September of 2020. To quantify 2015 seedling survivorship and condition, we revisited the same 501 seedlings that were previously revisited in August of 2016. We relocated 283 seedlings, of which 219 (44%) were healthy, 32 (6%) were stressed, and 32 (6%) were dead. This means over the last 5 years 251 (50%) of the marked seedlings survived. In addition to revisiting seedlings for condition and survivorship, we assessed the number of individuals that have begun developing reproductive structures. Out of the 251 surviving seedlings, 101 have developed reproductive structure. Some seedlings were noted to have several smaller sagebrush individuals surrounding them, which suggests new, naturally occurring seedlings are beginning to establish around the planted individuals. This evidence supports the chosen method of planting at a density to establish sagebrush seed sources in priority areas to shorten the time interval between a fire and the reestablishment of sage-grouse habitat (Shurtliff et al. 2016).

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 is 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 (Figure 5-8) in old burns 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 low. However, alternative seedling/planting methods are being evaluated and may be utilized in the future, depending on survivorship outcomes. All proposed seeding efforts will help DOE determine if such methods can be successful supplements and/or alternatives in addition to the current annual sagebrush seedling planting efforts.

Figure 5-8. Examples of a typical seedling installation process and a healthy recently planted sagebrush seedling on the Idaho National Laboratory Site.

6.0 SYNTHESIS AND ADAPTIVE MANAGEMENT RECOMMENDATIONS

6.1 Sage-Grouse and Sagebrush Habitat Trends

The IDFG monitors sage-grouse populations in Idaho by dividing all sage-grouse habitats into four Conservation Areas (CAs) and further distinguishing areas within the CAs as Priority or Important Habitat Management Areas (HMAs; Governor's Sage-grouse Task Force 2012; Figure 6-1). Hence, there are eight HMAs across the state. Adaptive management triggers can be tripped for any HMA if the current 3-year average of male counts on lek routes declines 10% (soft trigger) or 20% (hard trigger) compared to 2011 counts (other criteria are also considered; Governor's Sage-grouse Task Force [2012], BLM [2019]).

T he INL Site falls within the Desert CA and the Mountain Valleys CA. In 2019 and 2020, hard triggers were tripped in the Desert Priority and Important HMAs and in the Mountain Valleys Priority HMA (a soft trigger was also tripped in the Mountain Valleys Important HMA in 2019). Over the past five years (2016-2020), the 3-year lek count average declined 38% to 45% on each of the three HMAs in which hard triggers were tripped (Moser 2020). During the same period, the 3-year running average of lek counts on the 27 baseline leks on the INL Site declined 23%. Although we do not analyze baseline lek counts in the same way that the IDFG analyzes lek routes, the concordant direction of recent trends on the INL Site and across regional HMAs suggests the decline in lek counts on the INL Site is not a local anomaly.

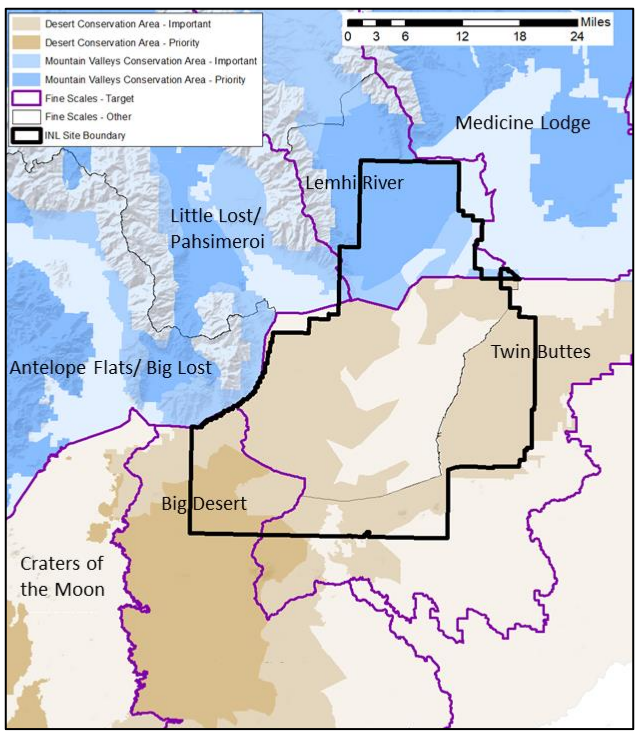

Figure 6-1. Two Idaho Conservation Areas (Desert and Mountain Valleys), with emphasis on Important and Priority Habitat Mangement Areas within each. Fine-Scale Areas are named, and those experiencing substantial population declines are outlined in purple. Figure was adapted from Ellsworth et al. (2019) using data provided by Bonnie Claridge, Idaho BLM, in January 2021.

An inter-agency Idaho Adaptive Management Team (hereafter Adaptive Management Team) recently completed a preliminary causal factor analysis for HMAs that tripped hard and soft adaptive management triggers in 2018 and 2019. To do so, they examined "fine-scale areas" that have had precipitous lek count declines, and they talked with local experts to understand what might have caused these declines. The Adaptive Management Team identified a fine-scale area called Twin Buttes (includes nearly all the INL Site and stretches from the western edge of the Sand Creek area north of Rexburg to the Big Desert area) as one of those areas that had experienced precipitous declines in lek counts. The Adaptive Management Team determined that repeated wildfires were the most significant issue in the Twin Buttes area. During multi-agency meetings held in Idaho Falls and Burley, local biologists identified other potential impacts within the region including the detrimental role of cheatgrass, agricultural practices, and a lack of a full complement of forb and grass species in sagebrush communities (Ellsworth et al. 2019).

On the INL Site, wildland fire continues to be the single greatest threat to sage-grouse due to its potential to rapidly remove sagebrush habitat from the landscape. Even though the INL Site lost virtually no sagebrush habitat to wildland fires between 2012 and 2019, declining lek counts since 2016 are likely attributable to cumulative impacts of fires on the INL Site and across the region over the last 25 years. Compounding the negative effects of sagebrush habitat loss, areas recovering from wildland fires are threatened by non-native annual grasses and are at greater risk of being dominated by cheatgrass, as demonstrated by the ESER habitat monitoring program. Fortunately, intact sagebrush habitat on the INL Site appears to be resistant to cheatgrass dominance and is generally in good condition.

Growing evidence indicates high raven abundance impacts sage-grouse reproduction through nest predation and avoidance of otherwise good nesting habitat by female sage-grouse (e.g., Coates et al. 2020, Dinkins et al. 2012). The Adaptive Management Team examined regional raven occurrence probabilities developed by O'Neil et al. (2018), which indicated there was a higher probability of raven occurrence in the Medicine Lodge and Lemhi River areas than in the Twin Buttes area. This suggests sage-grouse may experience relatively less impacts from raven predation in the latter area (Ellsworth et al. 2019). A more recent modeling exercise predicted that in the northern, southwestern, and east-central areas of the INL Site, sage-grouse reproduction is likely being impacted by raven predation (Coates et al. 2020). No data are available to confirm this prediction, and although we don't know what impact ravens have on sage-grouse on the INL Site, annual monitoring by ESER suggests their impact is not increasing.

Concerns for the future of sage-grouse in Eastern Idaho are justified given the substantial amount of sagebrush that has burned in recent years. It is possible, however, that recent declines in sage-grouse populations from loss and degradation of sagebrush habitats are being exacerbated by broad-scale climatic and environmental factors that have historically resulted in cyclic population trends in Idaho (Rich 1985, Row and Fedy 2017). If regional sage-grouse abundance is naturally cyclic, and if regional threats do not overwhelm that trajectory to break the cycle, we may find in the next three or four years that lek counts stabilize.

6.2 Proposed Changes

No changes to the CCA were proposed in 2020, but two proposals made in 2019 are still being considered by the USFWS. The first proposal was that the basis of the population trigger be changed from 27 SGCA baseline leks to the six lek routes, or perhaps to all active leks (either in the SGCA or the entire INL Site). The CCA anticipated a change to the current "interim population trigger" once new lek routes were created. The second proposal was to update the estimated area of sagebrush habitat in the SGCA, which is the basis for the habitat trigger. The ESER program updated the INL Site vegetation classification and map in 2019, resulting in a refined estimate of sagebrush habitat in 2011 that was 8% lower than the original estimate.

6.3 Adopted Changes

The USFWS and DOE made no changes to the CCA or associated monitoring tasks in 2020.

6.4 Work Plan for Upcoming Year

The following table (Table 6-1) describes activities or changes that are planned for the upcoming year. The purpose of this table is to highlight activities and analyses that will be different than the regular annual activities associated with each task.

Table 6-1. ESER work plan for 2021.

Task	Schedule and Changes for 2021
1. Lek Counts and Lek Route Surveys	• Continue to monitor all active leks and a rotational subset of inactive leks.
4. Raven Nest Surveys	• No changes to the surveys are anticipated.
5. Sagebrush Habitat Condition Trends	• Sample all annual monitoring plots (*n* = 75). • Update annual habitat condition analyses. • Continue to explore cover trend analyses. • Report results on rotational plot analyses.
6. Monitoring to Determine Changes in Sagebrush Habitat Amount and Distribution	• No work to be conducted on this task inside recently burned area until this region has a few years to naturally reestablish. New wildland fires will be mapped when imagery becomes available to document sagebrush habitat loss as needed.
8. Monitoring Expansion of the Infrastructure Footprint within the SGCA and Other Areas Dominated by Big Sagebrush	• No planned activities. This task will be updated again after the 2021 Idaho NAIP imagery becomes available in 2022.

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APPENDIX A.

A complete list of all species documented on the 75 annual habitat monitoring plots (45 sagebrush plots and 30 non-sagebrush plots) in 2020. Nomenclature follows the U.S. Department of Agriculture PLANTS National Database (2020).

Scientific Name	Common Name
Achnatherum hymenoides	Indian ricegrass
Agropyron cristatum	crested wheatgrass
Aliciella leptomeria	sand gilia
Allium acuminatum	Hooker's onion/ tapertip onion
Allium textile	textile onion
Alyssum desertorum	desert alyssum/ desert madwort
Arabis cobrensis	sagebrush rockcress
Arabis holboellii	Holboell's rockcress
Arabis lignifera	desert rockcress
Artemisia arbuscula	low sagebrush/ little sagebrush
Artemisia nova	black sagebrush
Artemisia tridentata	big sagebrush
Artemisia tridentata Nutt. ssp. tridentata	basin big sagebrush
Artemisia tripartita	threetip sagebrush
Astragalus calycosus	Torrey's milkvetch
Astragalus curvicarpus	curvepod milkvetch
Astragalus filipes	basalt milkvetch
Astragalus lentiginosus	freckled milkvetch
Astragalus purshii	woollypod milkvetch
Atriplex canescens	fourwing saltbush
Atriplex confertifolia	shadscale saltbush
Atriplex falcata	sickle saltbush/ Nuttall saltbush
Balsamorhiza sagittata	arrowleaf balsamroot
Bromus tectorum	cheatgrass
Calochortus bruneaunis	Bruneau mariposa lily
Carduus nutans	nodding plumeless thistle/ musk thistle
Carex douglasii	Douglas' sedge
Castilleja angustifolia	northwestern Indian paintbrush
Chaenactis douglasii	Douglas' dustymaiden
Chenopodium leptophyllum	slimleaf goosefoot/ narrowleaf goosefoot
Chondrilla juncea	rush skeletonweed
Chrysothamnus viscidiflorus	yellow rabbitbrush/ green rabbitbrush
Comandra umbellata	bastard toadflax
Cordylanthus ramosus	bushy bird's beak
Crepis acuminata	tapertip hawksbeard
Cryptantha circumscissa	cushion cryptantha
Cryptantha interrupta	Elko cryptantha
Cryptantha scoparia	Pinyon Desert cryptantha
Cymopterus acaulis	biscuit-root/ plains springparsley

Scientific Name	Common Name
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 pumilus	shaggy fleabane
Eriogonum microthecum	shrubby buckwheat/ slender buckwheat
Eriogonum ovalifolium	cushion buckwheat
Gayophytum diffusum	spreading groundsmoke
Grayia spinosa	spiny hopsage
Grindelia squarrosa	curlycup gumweed
Gutierrezia sarothrae	broom snakeweed
Halogeton glomeratus	saltlover
Hesperostipa comata	needle and thread grass
Ipomopsis congesta	ballhead gilia
Krascheninnikovia lanata	winterfat
Lactuca serriola	prickly lettuce
Lappula occidentalis	flatspine stickseed
Leymus cinereus	basin wildrye
Leymus flavescens	yellow wildrye
Linanthus pungens	granite prickly phlox
Lomatium foeniculaceum	desert biscuitroot
Lupinus argenteus	silvery lupine
Machaeranthera canescens	hoary tansyaster
Mentzelia albicaulis	whitestem blazingstar
Oenothera caespitosa	tufted evening primrose
Opuntia polyacantha	plains pricklypear
Orobanche corymbosa	flat-top broomrape
Packera cana	woolly groundsel
Pascopyrum smithii	western wheatgrass
Penstemon deustus	hot rock penstemon/ scabland penstemon
Phacelia glandulifera	sticky phacelia
Phacelia hastata	silverleaf phacelia
Phlox hoodii	Hood's phlox/ spiny phlox
Phlox longifolia	longleaf phlox
Pleiacanthus spinosus	thorn skeletonweed
Poa secunda	Sandberg bluegrass
Potentilla glandulosa	sticky cinquefoil
Pseudoroegneria spicata	bluebunch wheatgrass
Psoralidium lanceolatum	lemon scurfpea
Pteryxia terebinthina	turpentine wavewing
Purshia tridentata	antelope bitterbrush
Salsola kali	Russian thistle

Scientific Name	Common Name
Schoenocrambe linifolia	flaxleaf plainsmustard
Sisymbrium altissimum	Jim Hill mustard/ tall tumblemustard
Sphaeralcea munroana	Munro's globemallow/ whitestem globemallow
Stanleya viridiflora	green princesplume
Taraxacum officinale	common dandelion
Tetradymia canescens	spineless horsebrush
Tetradymia spinosa	shortspine horsebrush
Tiquilia nuttallii	Nuttall's crinklemat
Townsendia florifer	showy Townsend daisy
Tragopogon dubius	yellow salsify

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