INL/RPT-23-70807

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

January 2023

2022 Full Report

Idaho National Laboratory

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Revision 0

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Idaho National Laboratory
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EXECUTIVE SUMMARY

In 2014, the United States (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 2022 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 is equivalent to the number of males counted in 2011 during peak male attendance on 27 leks within the Sage-grouse Conservation Area (SGCA) (i.e., 316 males). The population trigger was set to trip if the three-year running average of males on those 27 leks (hereafter 'baseline leks') decreased ≥20% (i.e., ≤253 males).

In 2022, 246 males were counted on baseline leks during peak attendance—an 8.4% (*n* = 19) increase over 2021. Due to recent declines, however, the three-year running average moved 7.9% lower to 233 males, which resulted in the population trigger being tripped. The CCA stipulated that if the trigger tripped, USFWS would review DOE's sage-grouse management approach, after which the two agencies would meet to discuss what adjustments, if any, could be made to better protect the bird and its habitat.

Other key results from lek monitoring were as follows:

- Counts on six lek routes were up 24% from 2021.
- Three leks were downgraded to inactive status and a new lek was discovered in the southeastern part of the INL Site. With a net reduction of two active leks, 36 leks are currently classified active on or near the INL Site.
- 17 inactive leks that are not visited annually were surveyed to verify activity status. None were found occupied.

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 (*Artemisia* spp.). This habitat trigger will trip if there is a reduction of ≥20% (14,460 ha [35,731 ac]) of sagebrush habitat within the SGCA. Total sagebrush habitat area and distribution are monitored using aerial or satellite imagery and a geographic information system (GIS).

To monitor the condition of sagebrush-dominated lands, areas recovering from wildland fire, and potential effects from habitat threats, 75 annual vegetation plots were surveyed and are 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 greater than baseline cover values. Height for sagebrush and herbaceous functional groups were shorter in 2022 than the baseline. Trend analyses using functional group cover estimates indicated native perennial grasses remained near the upper end of their normal range of variability. Sagebrush cover continues to increase at a steady increment. While cover from introduced annual functional groups remained low, non-native crested wheatgrass (*Agropyron cristatum*) has been fractionally, but steadily, increasing.

- In areas that are not considered sagebrush habitat because they are recovering from wildland fire, the annual mean for cover estimates of the sagebrush functional group was greater than the baseline, while herbaceous functional group cover was comparative to the baseline. Heights for sagebrush functional group were taller, while herbaceous species were shorter in 2022 than the baseline. Trend analyses for native species indicated their cover remained within normal ranges. Non-native crested wheatgrass cover was consistent during the drier conditions over the past several years, while cheatgrass (*Bromus tectorum*) cover was low, it can significantly fluctuate in response to the weather conditions.
- There were no wildland fires on the INL Site in 2022. The total area of sagebrush habitat in the SGCA remains unchanged from 2021 at 71,358.8 ha (176,331.4 ac), representing a 1.3% decrease from the updated sagebrush habitat baseline.

Threat Monitoring

Raven Nest Surveys—Rather than survey INL Site infrastructure for common raven (*Corvus corax*) nests as has been done for the past eight years, biologists evaluated data from the eight-year dataset to identify and prioritize raven nesting hot spots. Prioritization was based on the likelihood that nesting ravens would prey upon sage-grouse nests in nearby sagebrush habitat. Thirty-three infrastructure-based hot spots were identified, and structures at the Environmental Breeder Reactor-I (EBR-I) were ranked at the highest priority for treating with nest deterrents. Medium-priority hot spots were at the Naval Reactors Facility (NRF), Advanced Mixed Waste Treatment Project (AMWTP), the Central Facilities Area (CFA) main gate, two sections of transmission lines southeast of the Specific Manufacturing Capability (SMC) facility, and a power line section northeast of NRF.

Infrastructure Expansion—There were 10 polygons mapped where infrastructure expansion removed sagebrush habitat and resulted in a loss. All the expansions were minor with a total combined area of 4.6 ha (11.4 ac) of sagebrush loss. All losses occurred outside the SGCA and do not impact the sagebrush habitat trigger. There was a total of 32.6 km (20.3 mi) of new linear features mapped within the SGCA or existing sagebrush habitat.

Threats to Habitat Condition—Livestock allotments and wildland fire footprints were assessed for potential effects as threats to habitat condition. Result summaries indicated a range of habitat condition across fire footprints and allotments surveyed but nearby analogous ungrazed and unburned areas had comparable ecological condition. Wildland fires have a greater immediate impact on sagebrush habitat condition than livestock and, while fire footprints are generally recovering to healthy native plant communities, these areas had a greater abundance of weedy species compared to intact sagebrush habitat. Non-native annual grass abundance can fluctuate in response to favorable precipitation amount and timing, and if weather events and patterns are related to climate change, then future conditions may lead to greater non-native vegetation cover potentially prolonging the development of sagebrush habitat sufficient to support sage-grouse.

Conservation Measures Associated with Habitat Restoration

In response to several 2020 fires and the 2019 Sheep Fire, INL continued implementing post-fire recovery plans in 2022. Noxious weed control efforts were ongoing along containment lines and within burned footprints. Additionally, sagebrush restoration efforts continued across three burned areas.

INL managed the planting of 100,000 sagebrush seedlings in the fall of 2022 in areas prioritized for restoration. Of the seedlings planted, 45,000 sagebrush seedlings were planted within the 2019 Sheep Fire burned area; 41,300 seedlings were planted within the 2020 Telegraph Fire burned area; and 13,700 seedlings were planted in burned areas of the 2007 and 2010 Twin and Middle Butte Fires. Monitoring revealed that approximately 13% of the seedlings planted in 2021 survived. Approximately 56% of seedlings planted in 2017 were still alive after five years.

Programmatically, INL has identified the need to update their fuels management, fire suppression, and wildland fire recovery approach and associated National Environmental Policy Act (NEPA) evaluation. The INL Fire Department is updating the current fuels management and fire suppression plan and the Natural Resources Group is drafting a new post-fire recovery framework. Combined, these documents will facilitate a more comprehensive and efficient planning and response effort for future wildland fires on the INL Site.

Synthesis

The sage-grouse population trigger for the INL Site tripped in 2022. This result was expected because sage-grouse abundance trends on the INL Site have loosely mirrored State-wide trends since 2013, and several Idaho Department of Fish and Game (IDFG) adaptive management triggers in lands adjacent to and overlapping the INL Site tripped in 2018 and 2019. An analysis conducted by an Idaho inter-agency team concluded that repeated wildfires were the most significant issue for sage-grouse across the region that includes much of the INL Site. This conclusion aligns with monitoring results from the INL Site, as large tracts of sagebrush-dominated plant communities have been lost to wildfire over the past 30 years. Other threats to sage-grouse and its habitats are monitored on the INL Site (cheatgrass, raven predation, livestock, infrastructure development), but no correlations have been observed between these threats and population abundance or habitat condition trends. Indeed, habitat condition—especially the abundance of invasive plants—appears to be most influenced by precipitation amount and timing.

The CCA and the dialog it has fostered between DOE and the UFSWS have helped DOE and its contractors take a proactive approach to conserving sage-grouse while still pursuing their missions. Benefits include strengthened relationships and sharing with natural resource partners, the implementation of procedures on the INL Site to reduce disruption of sage-grouse breeding, and a sagebrush mitigation program.

Proposed Changes to the CCA

During the 2022 CCA Stakeholders meeting, the USFWS recommended that DOE consider revising the CCA to keep it aligned with anticipated USFWS regulations and an upcoming Bureau of Land Management (BLM) Land Use Plan amendment.

Changes Made to the CCA in 2022

The following four proposals to amend the CCA were adopted in 2022.

1. Update the Habitat Trigger Baseline—The original baseline area for the sage-grouse habitat trigger was generated from a vegetation map completed in 2011 (Shive et al. 2011). There were a few reasons that justified updating the 2011 INL Site vegetation map; consequently, a new vegetation classification and map was published in 2019 (Shive et al. 2019). Beginning with the current report, the habitat trigger and analysis of sagebrush loss due to wildfire and infrastructure development is based on the most accurate and current vegetation data available (see Section 3.2.2).
2. Update Conservation Measure 1—Conservation Measure 1 was updated to emphasize the holistic approach to wildland fire recovery reflected in recent INL fire recovery plans. It now reads (new language in bold font):

   "Prepare an assessment for the need to restore the burned area. Based on that assessment, DOE would **evaluate and prioritize treatment options to meet habitat recovery objectives** in burned areas and reduce the impact of wildland fires >40 ha (99 acres). **Primary habitat recovery objectives include soil stabilization, cheatgrass and noxious weed control, maintaining a healthy herbaceous understory, and sagebrush restoration.**"

3. <u>Identify Priority Areas for Sagebrush Habitat Restoration Using Updated Criteria</u>—Priority restoration areas were recalculated to expand the potential area for planting sagebrush. Because lek status changes over time, all known leks (i.e., both active and inactive) were incorporated into the analysis in addition to using the most recent vegetation map to identify areas that could return to sagebrush habitat.

4. <u>Update Conservation Measure 9</u>—The language of Conservation Measure 9 and one of the supporting actions was changed to reflect the current reality at the INL regarding expansion and weed control in borrow sources and landfills. The measure now reads (new language in bold font):

   "Ensure that no net loss of sagebrush habitat occurs due to new borrow pit or landfill development **beyond the administrative boundaries. Current and new borrow sources are managed to control noxious and other invasive weed species.**"

   "Ensure adequate weed control measures are implemented throughout the life of **a** borrow source or landfill."

ACKNOWLEDGMENTS

This report was authored by Battelle Energy Alliance, LLC (BEA), and subcontractor staff from the Natural Resources Group. Quinn R. Shurtliff served as document editor and authored the sections on greater sage-grouse (see Section 2.1) and raven nest surveys (see Section 4.1). Kristin N. Kaser authored the sagebrush habitat condition trend (see Section 3.1) and the assessment of potential threats to sagebrush habitat (see Section 4.3), conducted the corresponding quantitative data analyses of each section, and managed the associated seasonal field crews. Jeremy P. Shive wrote the sections describing the changes to sagebrush habitat amount and distribution (see Section 3.2) and monitoring of the infrastructure footprint for expansion (see Section 4.2). Sue J. Vilord gathered updates from stakeholders and assembled a table listing progress made on CCA conservation measures (see Section 5.1.1). Amy D. Forman reported on post-fire recovery planning, implementation, and monitoring (see Section 5.2.1). Colby J. Kramer coordinated the sagebrush seedling planting and monitoring and authored the associated section (see Section 5.2.2). Bryan F. Bybee participated in and coordinated the greater sage-grouse lek surveys. Kurt T. Edwards supported all authors and task managers by archiving data and providing quality assurance and control, generating data queries, and producing figures. Brande M. Hendricks assisted with document formatting.

The Natural Resources Group recognizes and gives special thanks to each of the interns and technicians who made this field season successful. Sarah Baccus and Angélica Beltrán-Franco conducted the spring sage-grouse lek surveys. Sarah continued into the summer with Holly Forster, Ashton Buma, Austin Housley, and Nina Keck to complete the vegetation surveys. Sarah also assisted in collecting sagebrush seedling survivorship data.

RECOMMENDED CITATION

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ACRONYMS

AMT	Adaptive Management Team
AMWTP	Advanced Mixed Waste Treatment Project
ATR Complex	Advanced Test Reactor Complex
BEA	Battelle Energy Alliance, LLC
BLM	Bureau of Land Management
CCA	Candidate Conservation Agreement
CFA	Central Facilities Area
CFPP	Carbon Free Power Project
CITRC	Critical Infrastructure Test Range Complex
DOE	U.S. Department of Energy–Idaho Operations Office
EA	Environmental Assessment
EBR-I	Environmental Breeder Reactor-I
EC	Environmental Checklist
ECP	Environmental Compliance Permit
EIS	Environmental Impact Statement
F&SS	Facilities and Site Services
FAA	Federal Aviation Administration
GIS	geographic information system
GPS	Global Positioning System
HMA	Habitat Management Area
HS	Hot Spot
IDFG	Idaho Department of Fish and Game
INTEC	Idaho Nuclear Technology and Engineering Center
INL	Idaho National Laboratory
MFC	Materials and Fuels Complex
MPLS	males per lek surveyed
NAIP	National Agricultural Imagery Program
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NRF	Naval Reactors Facility
NSTR	National Security Test Range
PRA	Priority Restoration Area
RWMC	Radioactive Waste Management Complex

SGCA	Sage-grouse Conservation Area
SMC	Specific Manufacturing Capability
TAN	Test Area North
TREAT	Transient Reactor Test
U.S.	United States
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
WFMC	Wildland Fire Management Committee

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

1. INTRODUCTION, BACKGROUND, AND PURPOSE

In October 2014, the United States (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. This report, produced by the Battelle Energy Alliance, LLC (BEA), Natural Resources Group, documents year-end results of CCA monitoring tasks and DOE and INL contractor activities associated with CCA conservation measures. A summary of monitoring results in this report is provided each January to the USFWS and can be found under the heading *Sage-grouse Reports* at https://idahoeser.inl.gov/publications.html.

A primary purpose of this report is to update the 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). This trigger will trip if the average 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. This trigger will trip if total area falls below 57,840 ha (142,925 ac)—a 20% drop from the updated 2019 baseline of 72,300 ha (178,656 ac; see Section 3.2).

In 2022, the population trigger tripped for the first time, initiating an assessment process defined in the CCA. Details about lek counts and next steps prescribed by the CCA are described in Section 2.1 of this report.

This report and associated summary report (DOE 2023) inform 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.

Reports of related monitoring tasks described in Section 11.1 of the CCA (DOE and USFWS 2014) are grouped into three sections: Population Monitoring (Section 2), Habitat Monitoring (Section 3), and Threat Monitoring (Section 4). Section 5 reports how DOE, its contractors, and other stakeholders 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 the 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.

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2. POPULATION TRIGGER MONITORING

2.1 Task 1—Lek Counts and Lek Route Surveys

2.1.1 Introduction

The monitoring strategy outlined in the CCA (DOE and USFWS 2014, Section 11.1) included a task (Task 1) to track sage-grouse abundance on the INL Site, allowing DOE and USFWS to evaluate population trends relative to the population trigger. Counts from 27 leks located in the SGCA (hereafter 'baseline leks') are the basis of the population trigger (Figure 2-1). 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 trip if the three-year running average of peak male attendance at these baseline leks falls below 253, a 20% decrease from the 2011 value.

In addition to baseline lek counts, six lek routes are surveyed 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 25 years of sage-grouse monitoring on the INL Site, providing context to interpret short-term results derived from baseline lek monitoring. The CCA stipulated that after additional lek routes were established in 2017, DOE and USFWS would discuss if peak male attendance on routes should replace baseline leks as the basis for the population trigger. This proposal is currently under consideration.

Lastly, Task 1 monitoring includes surveys of a subset of inactive leks (hereafter 'rotational surveys') that are not visited annually because they are not baseline leks and are not assigned to lek routes. The goal is to revisit all inactive leks 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

Lek counts begin each year on or soon after March 20 and end about the first week of May; in 2022, the survey period was from March 21 to May 4. For lek routes, if the last scheduled survey produces the peak male count of the year, an additional survey is performed one week later to ensure the final count is lower than the seasonal peak. Counts occur from 30 minutes before until 90 minutes after sunrise and are not conducted during adverse weather (i.e., heavy precipitation and winds >19 km [12 mi] per hour). If sage-grouse are present at a lek, an observer tallies the number of visible males three or four times over a 5–10-minute period. If males flush as an observer approaches the survey location or previously unseen males flush during the count, that number is added to the subsequent high count. The highest tally is recorded as the lek count for the day. Visits to single leks are separated by at least seven days, and lek routes are visited every 7–10 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.

Lek routes are comprised of 3–10 leks each, totaling 38 active and inactive leks across the six routes (see Figure 2-1). During each survey, all leks on a route are visited on the same day, in the same order, and usually by the same observer during a field season. Three traditional routes have been surveyed annually since the mid-1990s (Lower Birch Creek, Tractor Flats, and Radioactive Waste Management Complex), and three additional routes established in 2017 have been surveyed in each of the following years (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.

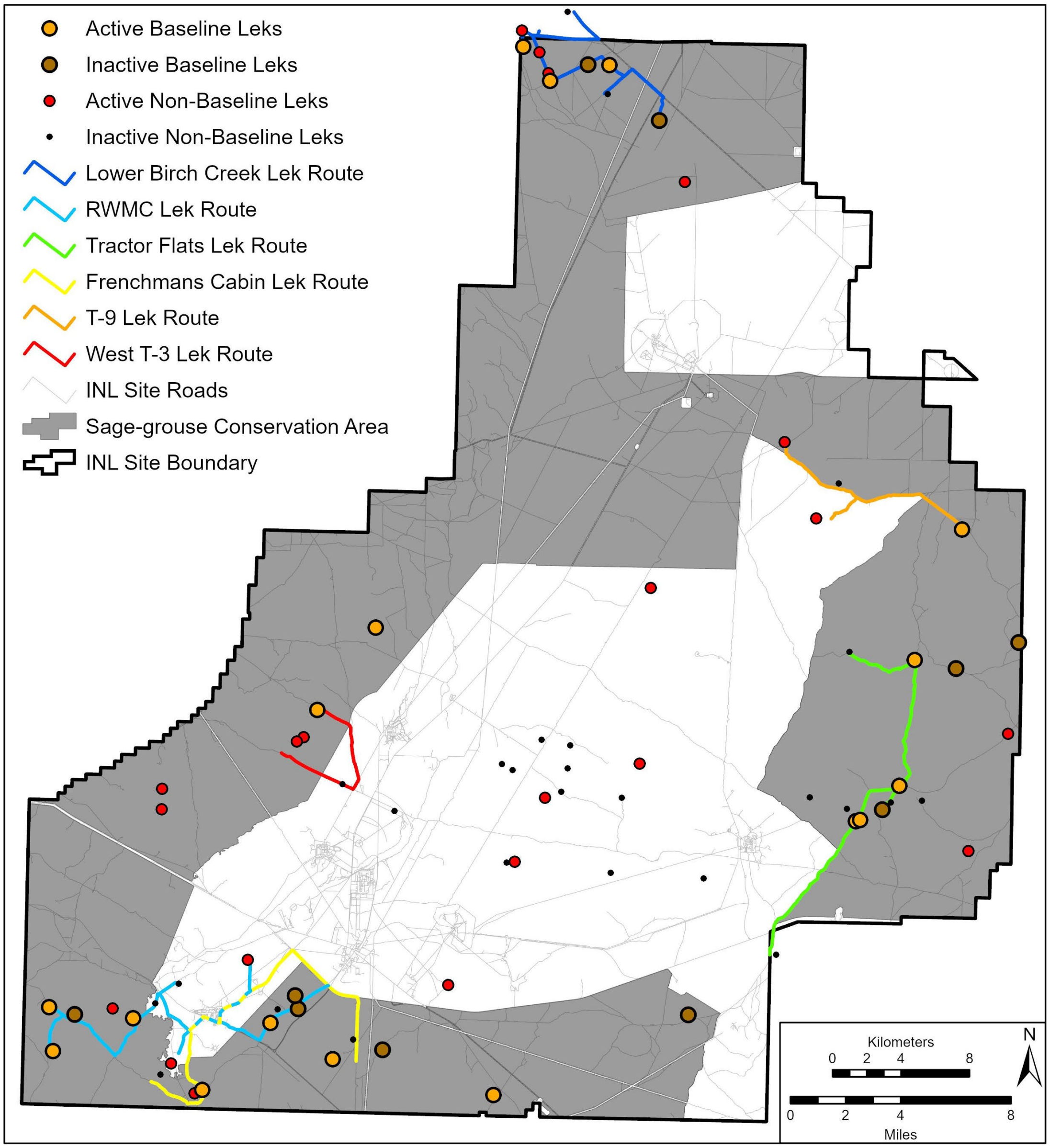

Figure 2-1. Sage-grouse leks surveyed on the Idaho National Laboratory Site in 2022. Lek activity designations (active vs. inactive) refer to lek status at the end of 2021. Inactive non-baseline leks include inactive leks assigned to lek routes (visited annually) and a subset of other inactive leks visited once every five years (rotational leks).

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

Lek Status

We classified a lek as active if two or more male sage-grouse were observed displaying on the lek in at least two of the previous five years (Connelly et al. 2000*a*, Whiting et al. 2014). Leks that did not meet these criteria were classified as inactive. If two or more males were observed displaying at a new location at least 400 m (437 yd) from a known lek, the location was assigned a lek number and classified as active in the current year. It will remain classified as active until at least four years of surveys without sage-grouse observations have accumulated within a five-year period. Following the field season, we examined data from the past five years for each lek and adjusted its activity status as necessary.

Dozens of inactive leks occur on the INL Site that are not baseline leks and are not assigned to a route. Over a five-year period, we survey 13–20 of these annually on a rotational basis, visiting each lek twice in April. Some inactive leks are visited more frequently because the Idaho Department of Fish and Game (IDFG) classifies them as priority leks for state-wide monitoring.

Analysis

Summary statistics were calculated separately for baseline leks and lek routes, although 19 baseline leks (50% of leks on routes) contributed to both summaries. Separating the two summaries is necessary because some baseline leks are isolated, and therefore counted singly, whereas others are part of lek routes (see Figure 2-1).

To evaluate current sage-grouse abundance relative to the critical threshold of 253 males, we identified peak male attendance for each baseline lek (i.e., the highest male count recorded during any visit after March 20) and summed individual peak counts across all 27 leks. The annual total 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 and Population Trigger

Summed peak attendance across the baseline leks in 2022 was 246 males—19 (8.4%) more than in 2021 (see Figure 2-2). This value is higher than the previous two years, but remains lower than any other year since 2011—the basis year for the population trigger. All 17 active baseline leks remained classified as such at the end of the 2022 field season; however, two are on the verge of being downgraded to inactive status and will be next year if males are not observed.

The three-year (2020–2022) running average of peak male attendance on baseline leks declined 7.9% to 233 males (SD = 11.0), falling below the population trigger threshold of 253 males. This was the fourth straight year that the three-year average has declined, and it resulted in the population trigger being tripped (see Figure 2-2). To return the running average to the population trigger threshold, the annual male count in 2023 would need to be at least 285 males—a 16% increase over the 2022 count.

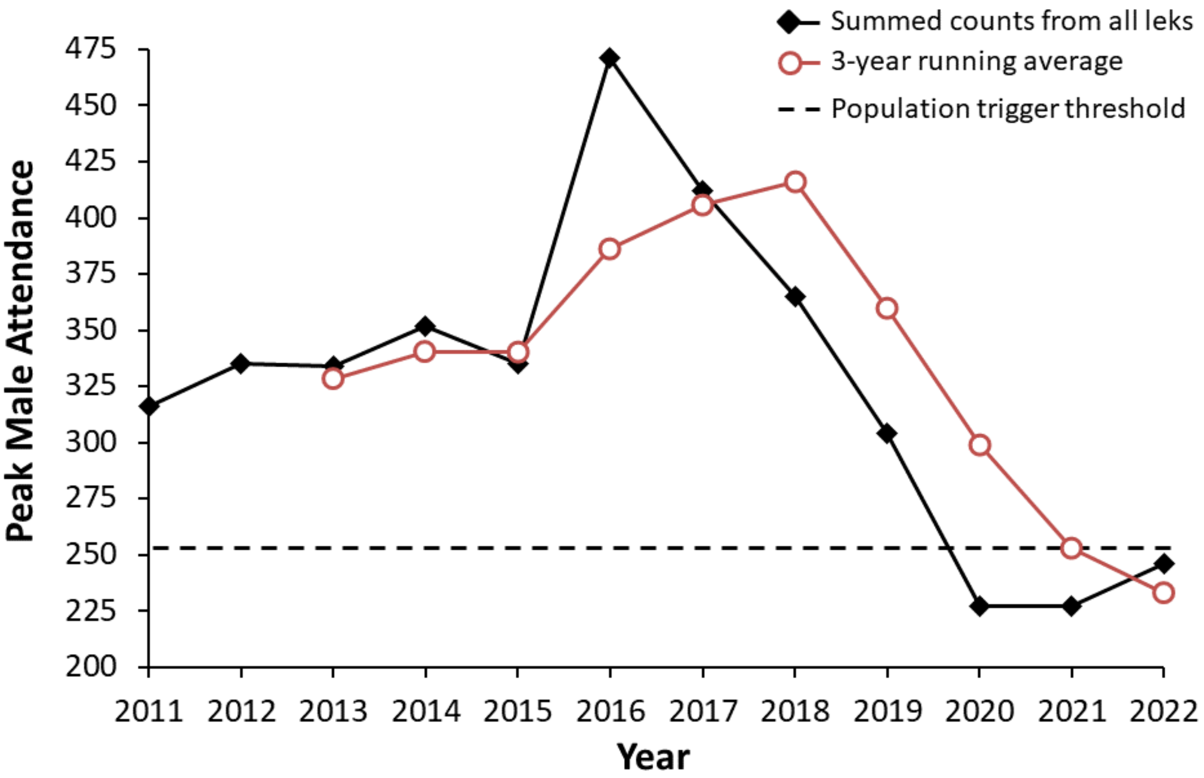

Figure 2-2. Peak male attendance of greater sage-grouse at baseline leks in the Sage-grouse Conservation Area. Black squares represent the annual sum of peak male attendance on all baseline leks.

The CCA outlines a process that DOE and USFWS agreed to follow if the population trigger threshold were crossed (DOE and USFWS 2014). The first step would be for the USFWS to "complete a thorough review" of DOE's sage-grouse management approach to help both parties determine the likelihood that DOE activities were responsible for population declines. Following the review, DOE and USFWS would meet to discuss potential conservation measures that could be newly implemented or adapted from the current set to address threats that are likely the most impactful to sage-grouse or its habitat on the INL Site. The parties may also consider renegotiating the SGCA boundary or adjusting the population trigger threshold.

Lek Routes

We surveyed lek routes five to seven times each (see Table 2-1). The sum of peak male attendance across all routes (275 males) and the MPLS values (7.2) were both 24% greater than in 2021 (male count = 23.9% greater; MPLS = 24.1% greater). The MPLS value was as high or higher in 2022 than in 2021 for each route except the Radioactive Waste Management Complex (RWMC) route. On that route, we counted one male less than in 2021. More males were counted on the T-9 route in 2022 than in any previous year (see Table 2-1). That contrasts with the other routes, which had counts in the middle to lower end of their five-year (for Frenchmans Cabin, T-9, and West T-3 routes) or ten-year (for Lower Birch Creek and Tractor Flats routes) ranges.

The increase observed in lek route counts (24%) from 2021 to 2022 (see Table 2-1) was notably different from the more moderate increase of 8.4% by baseline lek counts during the same period (see Figure 2-2). This difference is an artifact of the distinct methods used to calculate peak male attendance on lek routes and baseline leks. For example, in 2021, on the day of peak attendance for the Lower Birch Creek route, all 29 males observed were at a single baseline lek (i.e., 100% of the route total was at a baseline lek). By contrast, on the same route in 2022, males were distributed across six leks (three of which were baseline) on the day of peak male attendance, and only 62% of males counted on that day were at baseline leks. If 100% of counted males would have been at baseline leks, the year-end total of males at baseline leks from 2021 to 2022 would have increased 16.7% instead of 8.4%; thus, the trigger still would have tripped.

Rotational Surveys of Inactive Leks

In addition to routine surveys of active and inactive baseline and route leks, 17 inactive leks were visited twice each to verify status. Twelve of these had not been visited since 2017, and the remaining five were most recently surveyed in 2020 or 2021. No sage-grouse were observed at any of these leks, so each will retain its inactive status and will be visited again in five years or less.

Table 2-1. Lek route data from 2022 surveys on the Idaho National Laboratory Site and multi-year means for each route.

Lek Route	**2022 Peak Count**	**Multi-Year Mean* (Range; SD)**	**Leks Surveyed**	**Males per Lek Surveyed (MPLS)**	**MPLS % Change from 2021**	**Occupied Leks†**	**Surveys Performed**
Tractor Flats	58	69.6 (51–115; 19.4)	8	7.3	14.1	3	7
Radioactive Waste Management Complex	56	93.8 (28–141; 35.5)	9	6.2	−1.8	4	6
Lower Birch Creek	50	81.0 (29–133; 34.6)	10	5.0	72.4	5	5
West T-3	35	30.0 (16–49; 16.5)	4	8.8	83.3	3	6
T-9	48	35.4 (31–39; 3.2)	4	12.0	26.3	2	7
Frenchmans Cabin	28	30.6 (15–46; 11.4)	3	9.3	0.0	2	6
Total	275		38	7.2	24.1	19	

* For the first three routes, the 10-year mean (2012–2021) is displayed; for the last three, it is a 5-year mean (2017–2021).

† 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 the Natural Resources Group 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.

Changes of Lek Status

Three leks—INL 11, INL 152, and INL 164—were downgraded to inactive status following the 2022 field season (see Figure 2-3). None of these were baseline leks. Lek INL 11 is located outside the SGCA in Spreading Area B and is part of the RWMC route. It was occupied annually from 2001 through 2007, peaking at 39 males counted in a single visit, but by 2008, the lek had been abandoned. It was occupied again from 2015–2018 (up to 14 males) but has since been unoccupied. Lek INL 152 is within the SGCA but is not assigned to a route. It was discovered in 2013 and peaked at 17 males the following year but has not been occupied since 2018. Lek INL 164 was discovered in 2017 and was occupied again in 2019, peaking at 4 males. This lek is near a lek that has historically been the highest attended on the RWMC route, and it likely represented a satellite lek (Dalke 1963; Connelly et al. 2003).

When the 2022 field season began, 38 leks were classified as active on or near the INL Site. A new lek was discovered during the 2022 field season (INL 165; see Figure 2-3) and visited twice in the latter half of April. Peak male attendance on this lek was 22, which was the 7th highest count among the 34 leks where at least one male was observed. With the discovery of an active lek and the downgrading of three others to inactive status, the current number of known active leks on the INL Site is 36. This is the lowest number of active leks documented since 2010 when 34 leks were classified as such. Active leks peaked at 49 in 2013 and again in 2016, but have declined nearly every year since 2016 (one year the number did not change). The initial increase was likely a result of substantial efforts to discover new leks and the occupation of satellite leks as sage-grouse abundance increased (see Figure 2-2). Since 2016, sage-grouse abundance has decreased; thus, the trend in active leks is generally following the abundance trend.

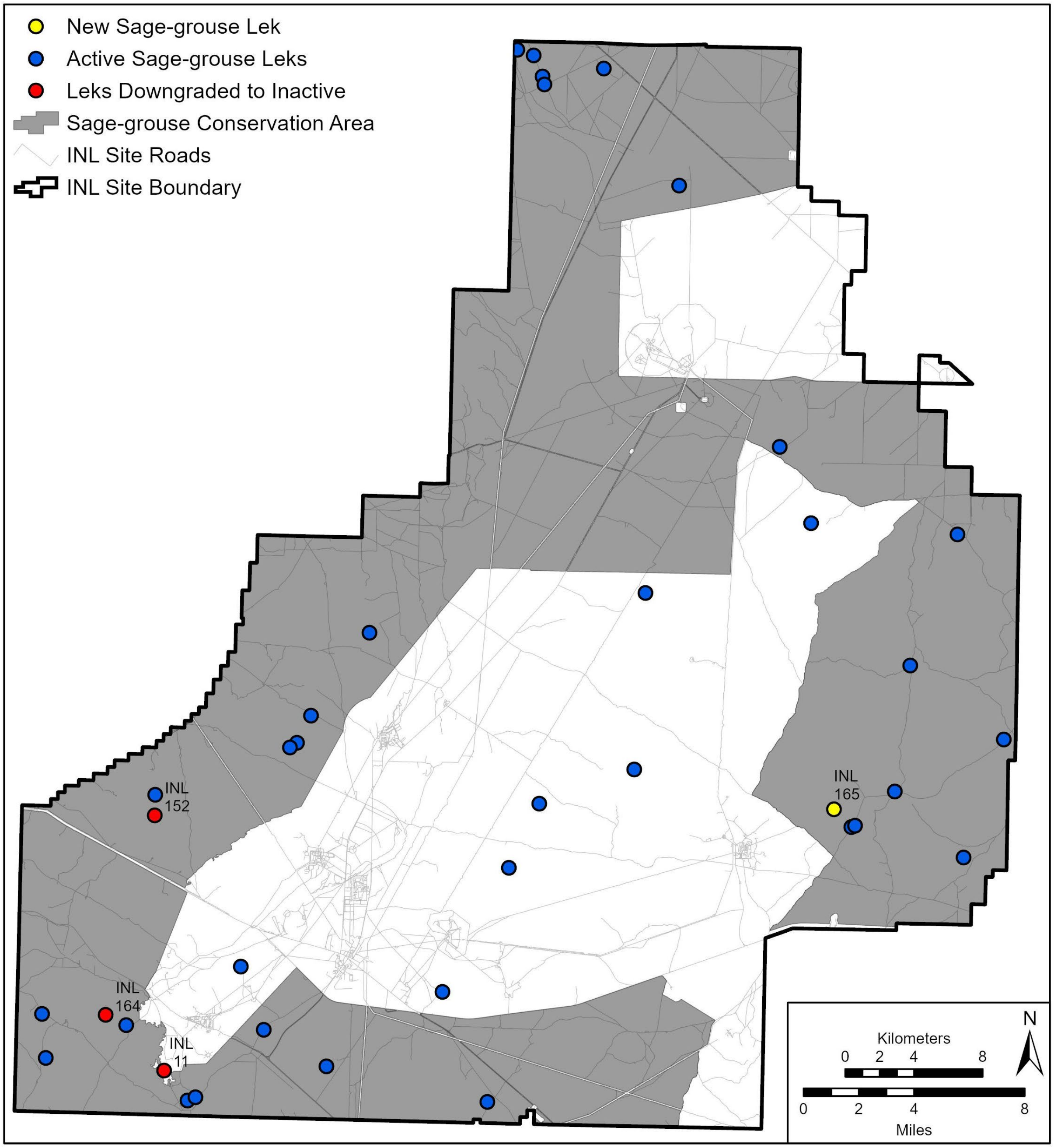

Figure 2-3. Sage-grouse lek designations and status updates on or near the Idaho National Laboratory Site following the 2022 field season.

3. 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 original baseline value of the habitat trigger was defined as the total area designated as sagebrush habitat within the SGCA at the beginning of 2013 (DOE and USFWS 2014). DOE and USFWS mutually agreed to adjust the sagebrush habitat trigger baseline in 2022 to incorporate the best available data. A new vegetation classification and map for the INL Site was published in 2019, which included updates to map class boundaries delineated at a finer scale to improve spatial accuracy (Shive et al. 2019). The newly established baseline value is estimated at 72,300 ha (178,656 ac). The sagebrush habitat trigger will be tripped if there is a loss of >14,460 ha (35,731 ac) 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 the 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 the ongoing assessment of habitat condition within polygons mapped as sagebrush habitat and facilitates the 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 (i.e., 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, imagery from burned areas may suggest there have been changes in vegetation classes or distribution of those classes several years post-burn, or sagebrush cover may be assessed using habitat condition monitoring data from plots located within that 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 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 (Shurtliff et al. 2019). 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 the 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 the spread of introduced weedy 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;
- Inform the process used to update the estimate of sagebrush habitat distribution.

Some analyses of the data collected for this task are designed to provide a summary of habitat condition on an annual basis and to identify trends in changes in condition over time. Other analyses are designed specifically to assess the potential impacts of wildland fire and livestock use. Because they focus on habitat condition with respect to threats, results and discussion of the second group of analyses are included in Section 4.3 under Threat Monitoring.

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 sage-grouse habitat condition monitoring 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 to increase sample sizes within burned areas, grazing allotments, and areas likely to be impacted by non-native plants. The most recent rotational plot sampling period was between 2018–2020.

The vegetation monitoring data metrics selected for collection at the sage-grouse habitat condition monitoring plots facilitate characterization of general habitat condition (Connelly et al. 2000*a*). The main purpose of collecting and summarizing these characterization 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 the characterization of compositional change in vegetation through time, and aids in assessing the effects of potential threats on habitat quality (see Section 4.1). The quantitative metrics sampled at each plot include vegetation cover by species, vegetation height for shrubs and herbaceous species, sagebrush density, frequency of juvenile sagebrush occurrence, and comprehensive species lists. A complete description of sample site selection, habitat condition metrics, and plot sampling methodology can be found in the study plan and sample protocol for this monitoring project (Shurtliff et al. 2016, see Appendix B).

Data Analyses

Data analyses for annual plots are two-fold; they include comparing annual habitat condition against baseline values and evaluating trends in habitat condition through time. Vegetation cover and height values are summarized according to vegetation functional groups (e.g., shrubs, grasses, forbs) and nativity (e.g., native, introduced). Sagebrush density and juvenile frequency are summarized and compared to baseline values each season. Trend analyses summarize cover data collected over 10 years (2013–2022) to assess changes in vegetative composition of functional groups, nativity, and habitat types 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*a*). Beginning in 2018, we transitioned to using locally derived habitat condition baseline values against which to evaluate the current year habitat condition data. These baseline values were collected over five years (2013–2017) from the 75 annual plots. The baseline values (hereafter 'baseline') 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*a*).

Precipitation data has been summarized from a Central Facilities Area (CFA) dataset using Thermoscreen records (https://niwc.noaa.inl.gov/climate.htm) by water year to evaluate available water to vegetation through the growing season. The water year is calculated by summing annual precipitation from October 1 through September 30 of the following year and the water year is denoted by the year in which it ends.

To evaluate trends in vegetative functional groups over the past 10 years, cover data were analyzed using One-way Repeated Measure of Analysis of Variance (Zar 1999) to ascertain statistically significant differences between years within each functional group type. Since 2019, five sagebrush plots have burned and they were reassigned to non-sagebrush habitat status. Data collected from those plots prior to burning were classified as sagebrush habitat whereas data collected after burning were then classified as non-sagebrush. Sample sizes were still more than adequate for meaningful interpretation of statistical results (Zar 1999). Significance was determined at the $\alpha = 0.05$ level. Multiple comparisons were evaluated using the pairwise multiple comparison Holm-Sidak method to determine the Minimum Significant Difference (Šidák 1967). The difference between means greater than the Minimum Significant Difference identifies the statistical significance between groups using the least squares means from a General Linear Model (SigmaPlot 14.5).

3.1.3 Results and Discussion

Current Habitat Condition

We collected data on 75 annual plots from May 24 through July 26, 2022. The annual plots are divided into two subgroups. There are 43 sagebrush habitat plots located within current sagebrush habitat polygons and 32 non-sagebrush plots located within map polygons where sagebrush has been lost to wildland fire (see Figure 3-1). The sagebrush habitat plots are in map 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 non-sagebrush plots have burned at least once since 1994 and have the potential to recover to a sagebrush habitat.

Annual Habitat Condition Summary

Annual cover, height, and sagebrush density metrics were compared against the baseline to evaluate the habitat condition on the INL Site for plots within the sagebrush habitat and plots in non-sagebrush areas (see Table 3-1 and Table 3-2). In 2022, sagebrush plots had substantially greater cover for the sagebrush functional group and for the perennial grass/forb functional group when compared to the baseline, but both functional groups had shorter average heights and sagebrush density was well below baseline in 2022. Cover for non-sagebrush plots was similar between this year and the baseline for the grass/forb functional group that provides greatest amount of vegetative cover to post-fire communities. Although sagebrush cover in the non-sagebrush plots remains low, the sagebrush functional group had greater cover in 2022 when compared to the baseline; nearly one percent in 2022 compared to baseline cover of less than a quarter of a percent. Perennial grass/forb height was considerably lower than baseline in 2022, but the few sagebrush individuals present in this functional group were much taller this year when compared to baseline. Sagebrush density between the baseline and the 2022 sample period was not notably different.

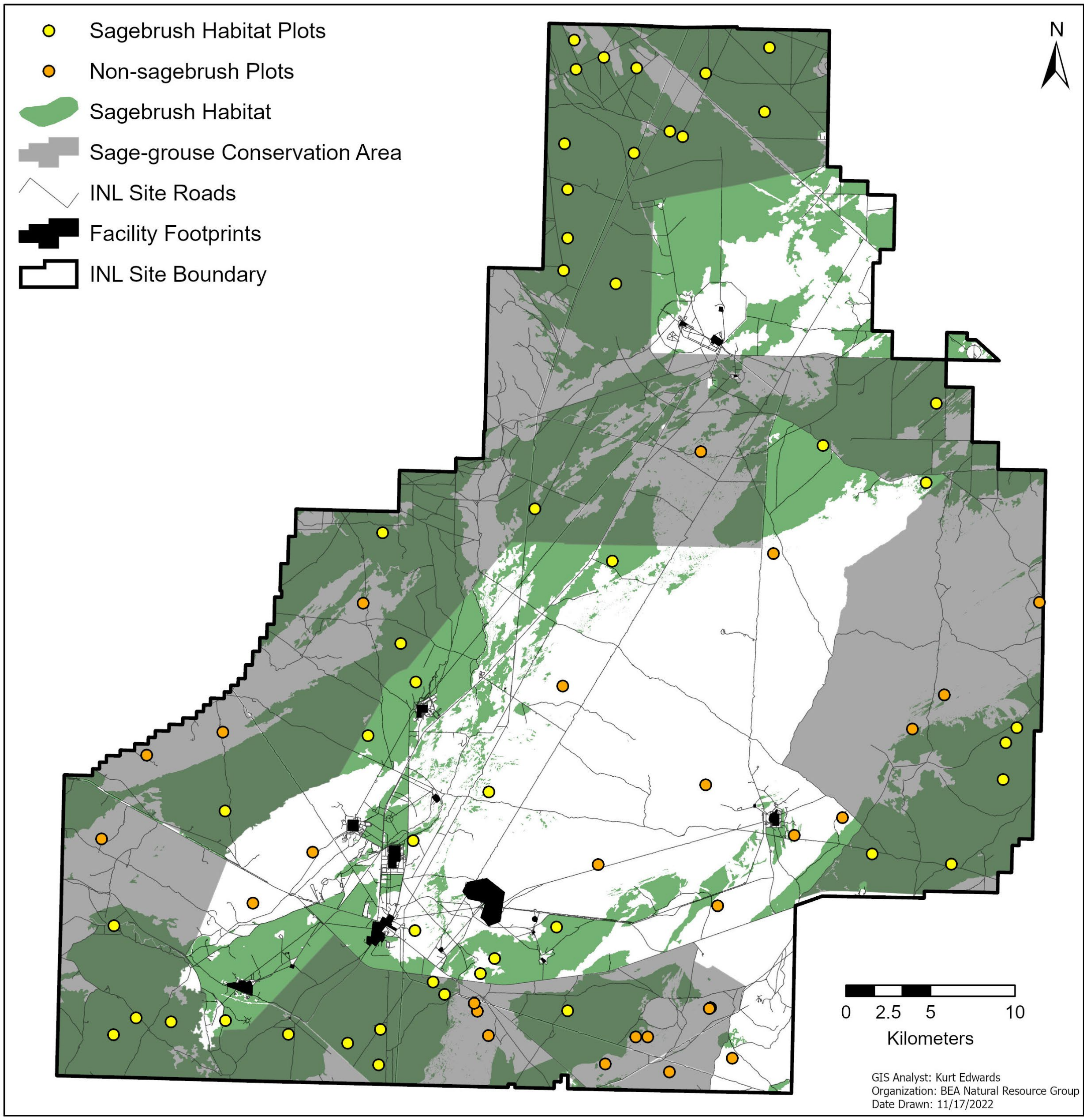

Figure 3-1. The 75 annual sage-grouse habitat condition monitoring plots sampled on the Idaho National Laboratory Site in 2022 to support the Candidate Conservation Agreement. Annual plots are displayed over sagebrush habitat and Sage-grouse Conservation Area polygons.

Table 3-1. Summary of vegetation measurements for the characterization of the condition of sagebrush habitat monitoring plots and non-sagebrush plots on the Idaho National Laboratory Site in 2022.

2022 Summary			
Sagebrush Habitat Plots (*n* = 43*)	Mean Cover (%)	Mean Height (cm)	Mean Density (individuals/m^2)
Sagebrush	24.93	45.73	2.78
Perennial Grass/Forb	16.81	19.07	
Non-sagebrush Plots (*n* = 32*)	Mean Cover (%)	Mean Height (cm)	Mean Density (individuals/m^2)
Sagebrush	0.95	44.76	0.10
Perennial Grass/Forb	19.30	23.32	
*Sample size difference from past sampling efforts.			

Table 3-2. Baseline values of selected vegetation measurements for the characterization of the 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)	Mean Cover (%)	SE	Mean Height (cm)	SE	Mean Density (individuals/m^2)	SE
Sagebrush	0.22	±0.05	33.54	±1.94	0.07	±0.01
Perennial Grass/Forb	19.73	±2.17	29.58	±3.81		

Cover: Sagebrush Habitat Plots

Cover by species is reported by nativity and vegetation functional group within sagebrush habitat plots and compared to the baseline (see Table 3-3). Overall, total vascular plant cover was greater in 2022 than baseline. The composition of functional groups that made up 2022 cover values were similar to baseline composition. Generally, native functional groups were more abundant than introduced functional groups and, of those, the shrub and native perennial graminoid functional groups contributed the greatest amount to total cover. The introduced annual and biennial functional group did have greater cover in 2022 when compared to the baseline, but contributed very little to the total vegetative cover.

The most abundant functional group in the sagebrush plots was native shrubs and sagebrush species (*Artemisia* spp.) contributed three quarters of cover to this functional group in 2022. 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*) was not recorded in 2022. The absence of this species from the dataset is more likely a field misidentification during one or more of the years during which the baseline was established rather than a loss of the species from the plots. Sagebrush identification in the field is challenging because sagebrush species hybridize and share key morphological characteristics across species (Shultz 2009). Green rabbitbrush (*Chrysothamnus viscidiflorus*) cover was slightly lower in 2022 than the baseline, but was the second most abundant shrub species following big sagebrush. Lastly, the shadscale saltbush (*Atriplex confertifolia*) and winterfat (*Krascheninnikovia lanata*) were present in some plots, but contributed minor cover overall.

The native perennial graminoid functional group was the second most abundant group within sagebrush habitat plots (see Table 3-3). Bottlebrush squirreltail (*Elymus elymoides*) and Sandberg bluegrass (*Poa secunda*) were the most abundant bunchgrasses in 2022 and in the baseline values. In

2022, the cover of these two species was double when compared to the baseline values and combined, they made up two thirds of the composition of the native perennial grass functional group. Indian ricegrass (*Achnatherum hymenoides*) had the third highest cover and was greater in 2022 when compared to the baseline. Bluebunch wheatgrass (*Pseudoroegneria spicata*), thickspike wheatgrass (*Elymus lanceolatus*), and several other common graminoid species provided cover in this functional group; they are often abundant where they occur, but contribute minor cover when averaged across the dataset.

Within sagebrush habitat plots, introduced functional groups remained a minor component of total vascular plant cover despite a two-fold increase in abundance from annual and biennial species in 2022 when compared to baseline values. The introduced perennial grasses functional group is composed of a single species, crested wheatgrass (*Agropyron cristatum*) and it had slightly greater cover in 2022 when compared to baseline. In 2022, cheatgrass (*Bromus tectorum*) cover was more than four times the baseline cover and it contributed to more than half the introduced functional group cover.

Cover: Non-sagebrush Habitat Plots

Within non-sagebrush plots, 2022 cover from native perennial graminoids and shrubs was similar to the baseline (see Table 3-4). Sandberg's bluegrass and bluebunch wheatgrass (*Pseudoroegneria spicata*) were the most abundant bunchgrasses in 2022 and in the baseline data. Within the shrub functional group, green rabbitbrush had the highest cover values in 2022 and in the baseline data. This result is to be expected because individuals of this species can resprout from underground structures, making them well-adapted to recovering quickly after wildland fire. Nearly all sagebrush species lack this ability, and therefore, generally contribute little cover to fire-affected habitats for decades after a wildland fire. In 2022, sagebrush cover remained low in non-sagebrush plots; however, cover from sagebrush species was four times greater than the baseline. Although the sagebrush cover is low relative to other species, a four-fold increase in 2022 over the baseline indicates that plots in non-sagebrush habitat are likely in the early successional stages of recovering to sagebrush steppe.

In 2022, total cover from introduced species was greater than baseline and the most abundant species within this functional group was cheatgrass, which composed nearly one third of total introduced cover composition. Cheatgrass cover can fluctuate dramatically from one growing period to the next (Forman and Hafla 2018; INL 2022*a*), and the amplitude of those fluctuations is much greater in non-sagebrush plots than in sagebrush habitat plots (INL 2022*a*). Cheatgrass is a non-native annual grass that is highly responsive to variable environmental conditions. It is invading the western U.S and changing ecosystem dynamics across much of the sagebrush steppe (Mealor et al. 2013). Though it does not yet dominate large expanses of the INL Site (Shive et al. 2019), it remains a concern and will continue to be closely monitored.

Table 3-3. Cover (%) for observed species† within 43 annual sagebrush habitat plots. Baseline cover values are compared to 2022 cover values by species and functional groups. Baseline values were generated from five years of data (2013–2017; *n* = 5).

Plant Species†	Baseline Cover (%)	2022 Cover (%)
Native		
Shrubs		
Artemisia tridentata	17.41	21.68
Chrysothamnus viscidiflorus	6.64	5.66
Artemisia tripartita	1.80	2.21
Artemisia arbuscula	1.16	*
Atriplex confertifolia	0.95	1.06
Artemisia nova	0.90	1.04
Krascheninnikovia lanata	0.72	0.67
Linanthus pungens	0.22	0.52
Eriogonum microthecum	0.10	0.11
Tetradymia canescens	0.04	0.07
Ericameria nauseosa	0.02	0.01
Others (*n* = 2, 1)	0.03	0.02
Total Native Shrub Cover	29.99	33.04
Succulents		
Opuntia polyacantha	0.10	0.10
Perennial Graminoids		
Elymus elymoides	2.15	5.63
Poa secunda	2.03	3.88
Achnatherum hymenoides	1.85	2.40
Pseudoroegneria spicata	1.21	0.83
Elymus lanceolatus	0.80	0.89
Hesperostipa comata	0.51	0.35
Pascopyrum smithii	0.21	*
Carex douglasii	0.11	0.24
Others (*n* = 1,0)	0.02	*
Total Native Perennial Graminoid Cover	8.88	14.23
Perennial Forbs		
Phlox hoodii	0.47	0.36
Schoenocrambe linifolia	0.24	0.04
Sphaeralcea munroana	0.12	*
Erigeron pumilus	0.04	0.09
Astragalus filipes	0.03	0.21
Arabis cobrensis	0.02	*
Astragalus lentiginosus	0.01	0.01
Ipomopsis congesta	<0.00	*
Others (*n* = 22, 14)	0.18	0.30
Total Native Perennial Forb Cover	1.11	1.02

Plant Species[†]	Baseline Cover (%)	2022 Cover (%)
Annual and Biennial Forbs		
Lappula occidentalis	0.34	0.62
Descurainia pinnata	0.27	1.14
Cordylanthus ramosus	0.15	0.02
Chenopodium leptophyllum	0.08	0.22
Others (*n* = 13, 5)	0.14	0.12
Total Annual and Biennial Forb Cover	0.99	2.11
Total Native Cover	**41.07**	**48.38**
Introduced		
Perennial Grasses		
Agropyron cristatum	1.34	1.57
Annual and Biennial Grasses and Forbs		
Alyssum desertorum	1.08	1.20
Bromus tectorum	1.02	4.56
Halogeton glomeratus	0.74	0.67
Others (*n* = 7, 2)	0.03	0.05
Total Introduced Annual and Biennial Cover	2.87	6.49
Total Introduced Cover	**4.21**	**8.06**
Total Vascular Plant Cover	**45.28**	**56.44**

* Species that were undetectable using the current sampling methodology.

[†] Appendix A provides a complete species list with scientific and common names.

Table 3-4. Cover (%) for observed species[†] within 32 annual non-sagebrush plots. Baseline values are compared to 2022 cover values by species and functional groups. Baseline values were generated from five years of data (2013–2017).

Plant Species[†]	Baseline Cover (%)	2022 Cover (%)
Native		
Shrubs		
Chrysothamnus viscidiflorus	10.72	9.93
Atriplex confertifolia	0.33	0.40
Artemisia tridentata	0.21	0.88
Tetradymia canescens	0.18	0.15
Eriogonum microthecum	0.07	0.01
Gutierrezia sarothrae	0.02	0.13
Artemisia tripartita	0.01	0.07
Others (*n* = 3, 6)	0.08	0.43
Total Native Shrub Cover	11.62	12.00

Plant Species[†]	Baseline Cover (%)	2022 Cover (%)
Succulents		
Opuntia polyacantha	0.10	0.14
Perennial Graminoids		
Pseudoroegneria spicata	4.82	3.77
Poa secunda	3.01	3.80
Hesperostipa comata	2.68	2.24
Achnatherum hymenoides	2.45	2.01
Elymus lanceolatus	2.08	2.68
Elymus elymoides	1.42	2.04
Pascopyrum smithii	0.84	0.55
Leymus flavescens	0.58	0.35
Carex douglasii	0.08	0.10
Others (n = 2, 1)	0.03	0.06
Total Native Perennial Graminoid Cover	17.98	17.58
Perennial Forbs		
Phlox hoodii	0.40	0.09
Sphaeralcea munroana	0.31	0.03
Crepis acuminata	0.29	0.09
Erigeron pumilus	0.15	0.12
Phlox aculeata	0.11	*
Phlox longifolia	0.10	0.08
Machaeranthera canescens	0.07	0.01
Schoenocrambe linifolia	0.07	0.01
Astragalus filipes	0.06	0.04
Pteryxia terebinthina	0.01	0.11
Astragalus lentiginosus	0.01	0.04
Others (n = 17, 9)	0.17	0.25
Total Native Perennial Forb Cover	1.75	0.88
Annual and Biennial Forbs		
Lappula occidentalis	0.26	0.28
Descurainia pinnata	0.11	0.70
Mentzelia albicaulis	0.09	0.38
Eriastrum wilcoxii	0.09	0.12
Others (n = 12, 6)	0.14	0.47
Total Native Annual and Biennial Cover	0.67	1.94
Total Native Cover	32.12	32.54

Plant Species[†]	Baseline Cover (%)	2022 Cover (%)
Introduced		
Perennial Grasses		
Agropyron cristatum	0.59	0.83
Perennial Forbs		
Carduus nutans	0.01	*
Others (n = 0, 1)	*	<0.00
Total Introduced Perennial Cover	0.60	0.83
Annuals and Biennial Grasses and Forbs		
Bromus tectorum	13.48	17.12
Salsola kali	1.78	1.61
Alyssum desertorum	1.40	1.77
Halogeton glomeratus	1.22	1.11
Sisymbrium altissimum	0.21	0.80
Descurainia sophia	0.06	0.09
Tragopogon dubius	0.01	0.05
Lactuca serriola	*	<0.00
Others (n = 1, 0)	0.01	0.02
Total Introduced Annual and Biennial Cover	18.17	22.58
Total Introduced Cover	18.78	23.41
Total Vascular Plant Cover	50.90	55.95

* 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 (see Table 3-5 and Table 3-6). Within the sagebrush plots, the composition, or portion of the sample, of the species measured indicates that the overall structure of the sagebrush habitat plots is that of a sagebrush overstory with an herbaceous understory that is dominated by the perennial grasses. In 2022, average height from the sagebrush functional group was almost two times greater than the height from other shrub species. Sagebrush species were measured more frequently within the shrub functional groups in sagebrush habitat plots, as indicated by the proportion of the sample measured. Within the herbaceous functional groups, perennial grasses were measured most frequently and they averaged nearly twice the height of other herbaceous functional groups. Every functional group was shorter on average in 2022 when compared to baseline height values; however, the difference was only notable for the annual grass functional group, which averaged half the baseline height. All other functional groups were only marginally shorter.

Cheatgrass, an invasive species, is the only species within the annual grasses functional group. Like cover, cheatgrass height is likely linked to annual weather condition and can be quite variable from year to year. Substantially shorter cheatgrass individuals in 2022 may indicate challenging growing conditions for this species. This result suggests the shrubs and perennial herbaceous functional groups likely contribute to a more stable and consistent habitat structure than cheatgrass.

Vegetation Height: Non-sagebrush Plots

In 2022, vegetation structure within the non-sagebrush plots was characterized by a shrub canopy dominated by species other than sagebrush and an herbaceous layer where perennial and annual grasses proportionately provided more herbaceous structure compared to herbaceous perennial and annual forbs (see Table 3-5 and Table 3-6). In 2022, mean height of the other shrub species functional group was greater than baseline, and the few sagebrush species recorded were also taller in 2022 when compared to baseline. All herbaceous functional groups were shorter in 2022 when compared to the baseline. Perennial grasses provided the tallest available herbaceous vertical structure and were the most frequently measured individuals on non-sagebrush plots in 2022.

Table 3-5. Vegetation height by functional group for 43 annual sagebrush habitat plots on the Idaho National Laboratory Site in 2022. Baseline values are compared to functional groups for height (cm) and were generated from five years of data (2013–2017; *n* = *5*).

Sagebrush Habitat Plots	Baseline		2022	
Functional Group	Mean Height (cm)	Proportion of Sample	Mean Height (cm)	Proportion of Sample
		Shrubs		
Sagebrush	47.81	0.72	45.73	0.73
Other Species	25.57	0.28	23.93	0.27
		Herbaceous		
Perennial Grasses	22.49	0.67	19.85	0.63
Perennial Forbs	9.98	0.12	8.81	0.05
Annual Grasses	18.95	0.04	11.36	0.13
Annual Forbs	9.09	0.17	7.94	0.19

Table 3-6. Vegetation height by functional group for 32 annual non-sagebrush plots on the Idaho National Laboratory Site in 2022. Baseline values are compared to functional groups for height (cm) and were generated from five years of data (2013–2017; *n* = *5*).

Non-sagebrush Plots	Baseline		2022	
Functional Group	Mean Height (cm)	Proportion of Sample	Mean Height (cm)	Proportion of Sample
		Shrubs		
Sagebrush	33.54	0.08	44.76	0.03
Other Species	26.82	0.92	34.76	0.97
		Herbaceous		
Perennial Grasses	31.49	0.55	24.01	0.49
Perennial Forbs	11.64	0.06	10.97	0.03
Annual Grasses	16.96	0.25	13.57	0.32
Annual Forbs	10.94	0.15	8.70	0.16

Sagebrush Density

To understand how general sagebrush population trends may affect habitat condition, baseline sagebrush density and juvenile frequency are compared to 2022 data from sagebrush plots and non-sagebrush plots (see Table 3-7). Overall, sagebrush habitat plots had lower densities and juvenile frequencies in 2022 when compared to the baseline values. Mean sagebrush density in 2022 was half of the baseline value and juvenile sagebrush frequency was lower than the baseline value in 2022. Baseline juvenile frequency values indicate that individuals occur in four out of 10 belt transects, whereas the number of belt transects containing juvenile sagebrush was one out of 10 belt transects in 2022.

Densities and juvenile frequencies for sagebrush in non-sagebrush plots were similar in 2022 compared to baseline values. Juvenile frequency values indicate individuals occur in about two out of 100 belt transects. As expected, sagebrush density and juvenile frequency remains low within non-sagebrush plots where habitats may potentially recover to sagebrush steppe.

Table 3-7. Sagebrush density (individual/m^2) and juvenile frequency from sagebrush habitat monitoring plots (n = 43) and non-sagebrush monitoring plots (n = 32) on the Idaho National Laboratory Site in 2022 compared to baseline values. Baseline values were generated from five years of monitoring data (2013–2017; n = 5).

Sagebrush Density	Sagebrush Habitat Plots		Non-sagebrush Plots	
	Baseline	2022	Baseline	2022
Mean Density (individuals/m^2)	5.19	2.78	0.07	0.10
Minimum Density (individuals/m^2)	0.43	0.65	0.00	0.00
Maximum Density (individuals/m^2)	47.60	7.50	0.74	0.65
Mean Juvenile Frequency	0.38	0.13	0.02	0.02

Precipitation

Long-term precipitation data are provided by National Oceanic and Atmospheric Administration (NOAA) at CFA and facilitate the interpretation of changes in habitat condition on the INL Site. Over the last two decades, there have been several years with precipitation well below average and total precipitation in those dry years has departed farther from the mean than it has in wet years (Forman and Hafla 2018; see Figure 3-2). Seasonality of precipitation has also departed from long term-averages since the initiation of habitat condition monitoring. Historically, April, May, and June are the wettest months on average (Clawson et al. 2018), but over the last ten years, August, September, and October have been substantially wetter than their long-term monthly averages (see Figure 3-3). If late summer and early fall seasons continue to be wetter than the spring season, some plant species and functional groups would certainly favor a shift in precipitation over others.

During 2022, recorded precipitation in winter, through spring, and into mid-summer was well below average, but a considerable amount of precipitation fell during an unseasonably wet late summer season, to bring the annual total slightly below the average (see Figure 3-3). The below average precipitation received during spring and early summer meant water was not available to species that require early season soil moisture, but more available to species that have peak growth periods later in the growing season. The continued deviation of precipitation patterns from the long-term averages highlights the potential implications of shifting weather patterns on ecological condition.

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. The lack of precipitation early in the spring likely affected biennials and annuals more than perennials because many biennial and annual species require spring moisture to complete their life cycles. Native perennial plants are well adapted to withstand a few growing seasons of harsh conditions and cover from these functional groups remained more stable this year despite two years of below average precipitation.

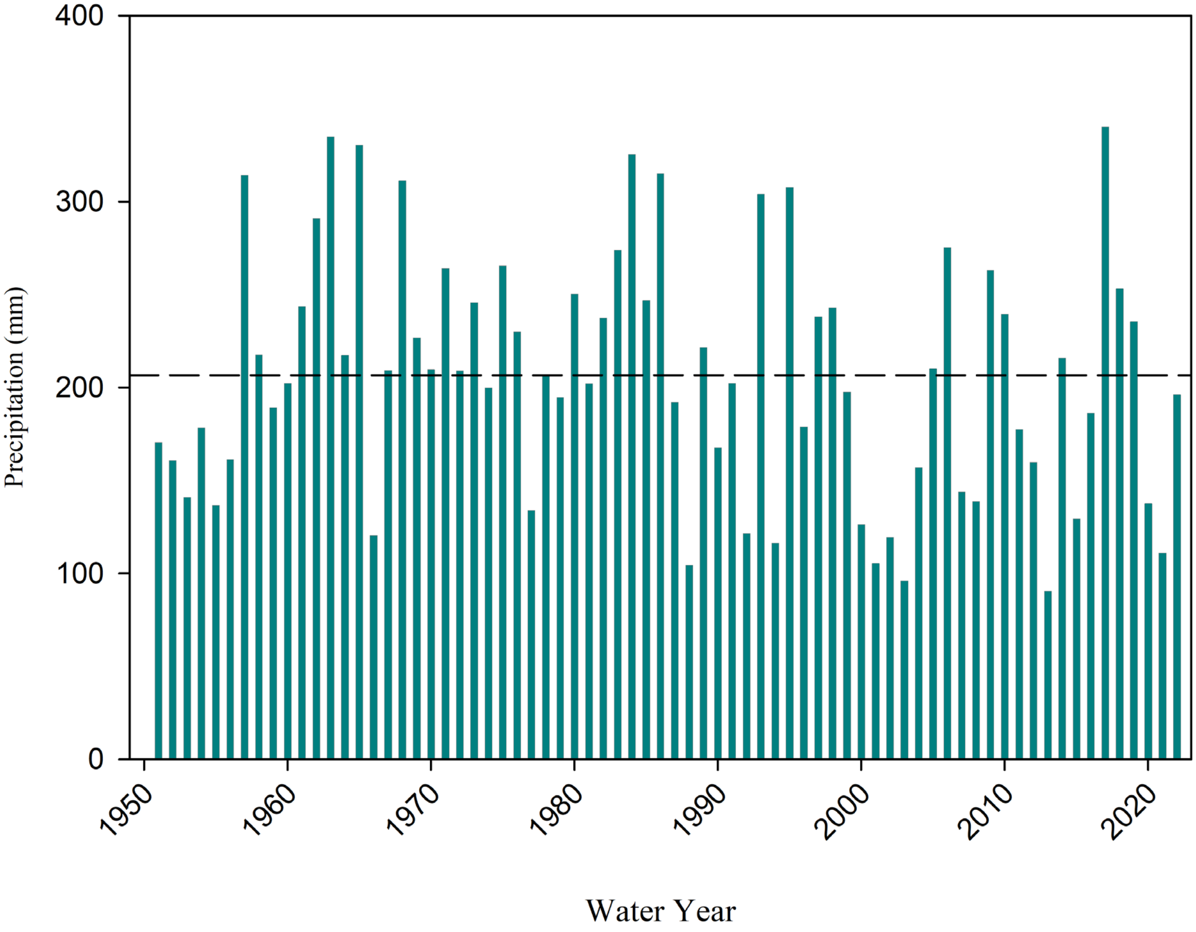

Figure 3-2. Total precipitation by water-year (October 1–September 31) from 1951 through 2022 at the Central Facilities Area, Idaho National Laboratory Site. The dashed line represents the mean annual

precipitation (206 mm).

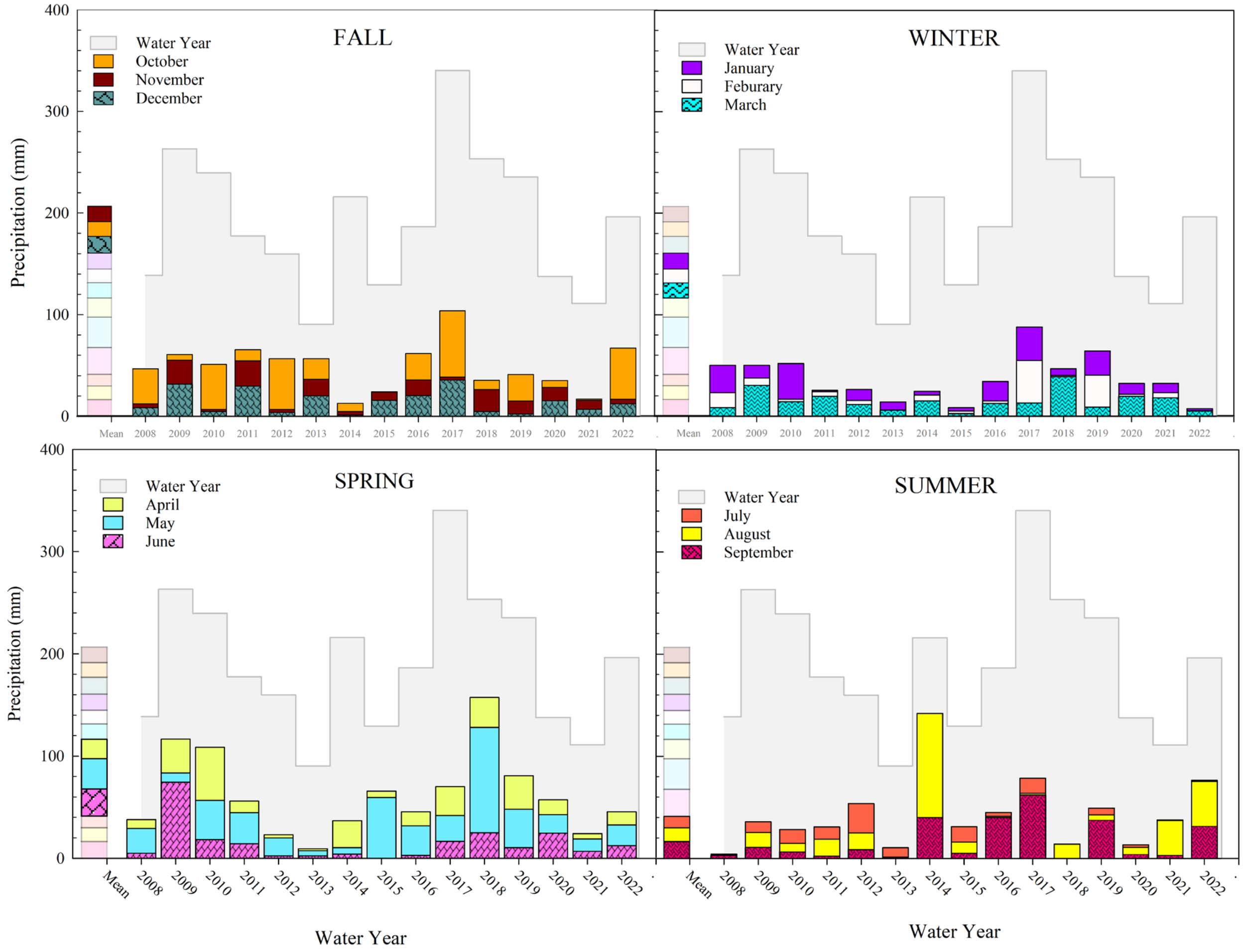

Figure 3-3. Precipitation is divided into four seasons spanning across the water-year (October 1–September 31). The monthly precipitation means are stacked to show the annual precipitation mean. The water year total precipitation is included in each seasonal panel. The National Oceanic and Atmospheric Administration collects precipitation data at the Central Facilities Area on the Idaho National Laboratory Site. Means are calculated from precipitation data collected between 1951 to 2022.

3.1.4 Habitat Condition Trend Analyses

Sagebrush Habitat Plots

Monitoring the condition of habitat spans ten consecutive years and analyzes cover data to evaluate plant functional groups trends to infer ecological status within the INL Site. From 2013–2022, cover trends differed among the native functional groups (see Figure 3-4). Cover from sagebrush species has generally trended upward and there is 4% greater cover in 2022 than 2013 (see Table 3-8). Nearly all sagebrush cover values in the last five years are significantly greater than sagebrush cover values in the first five years ($p < 0.001$). Other shrub species cover is fluctuating and changes from one year to the next are generally small relative to the total cover of this functional group. Native perennial grass cover has been fluctuating between the mid- to upper range of the data set over the past four years, but has significantly differed between the highest years and lowest years near an order of magnitude ($p < 0.001$; see Table 3-8). The years with the highest native perennial grass cover are significantly greater than the years with the lowest cover. The cover for native perennial forbs has fluctuated around 1% mean cover throughout the decade of monitoring. The three years with the highest cover are significantly greater than the three years with the lowest cover ($p < 0.001$). There does not appear to be a discernable directional trend in the cover of native annual and biennial forbs over the ten-year sample period. However, the two years with the highest cover were significantly greater than cover in nearly all other years ($p < 0.001$; see Table 3-8); this statement corrects an erroneous result reported in the previous year's full report (INL 2022*a*). In that report, we inaccurately reported that native annual and biennial forbs functional group had significantly less cover in 2020 than 2019.

Cover contributed by introduced functional groups has remained low on sagebrush habitat plots throughout the monitoring period (see Figure 3-5). Introduced perennial grass cover has remained consistently low since monitoring began (see Table 3-9). Cover for introduced annual grasses has fluctuated and ten-year cover values indicate no pattern or directional trend. Annual grass cover was significantly greater in years with the highest cover values than in years with the lowest cover values ($p < 0.001$). The cover for introduced annual forbs was also significantly greater in three years with the highest cover values than in the years with the lowest cover values ($p < 0.001$), though there does not appear to be a trend in the cover values of this functional group either.

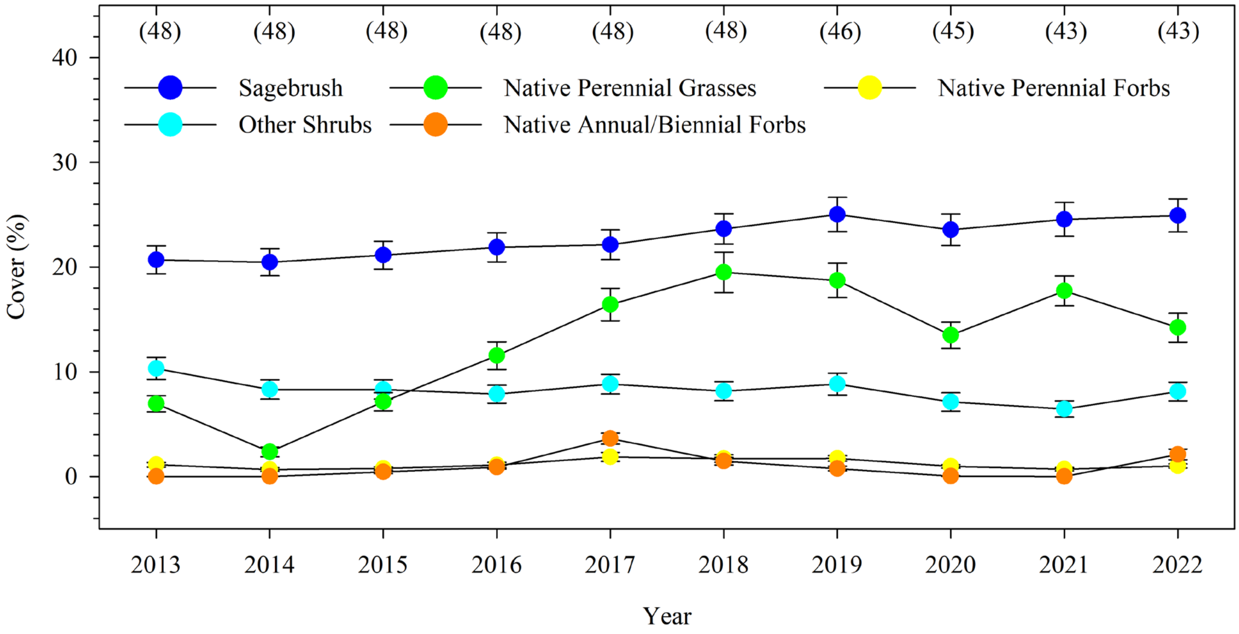

Figure 3-4. Sagebrush habitat plot cover separated into plant functional groups composed of native species on the Idaho National Laboratory Site from 2013 through 2022. Cover is the absolute mean. Error bars represent ±1 SE. Tick marks along the top denote sample size by year.

Table 3-8. Sagebrush habitat plot cover separated into plant functional groups composed of native species on the Idaho National Laboratory Site from 2013 through 2022. The Holm-Sidak method isolates the group's statistical Minimum Significant Difference by pairwise multiple comparisons using the least squares mean from a General Linear Model. The Minimum Significant Difference reported below corresponds to mean cover (%).

Sagebrush Habitat Plots: *Native Functional Groups* Mean Cover (%)					
Year	Sagebrush	Other Shrubs	Native Perennial Grasses	Native Perennial Forbs	Native Annual/Biennial Forbs
2013	20.7	10.3	7.0	1.1	0.0
2014	20.5	8.3	2.4	0.7	0.0
2015	21.1	8.3	7.1	0.8	0.4
2016	21.9	7.9	11.5	1.1	0.9
2017	22.1	8.8	16.4	1.9	3.6
2018	23.7	8.2	19.5	1.7	1.5
2019	25.0	8.8	18.7	1.7	0.8
2020	23.6	7.1	13.5	1.0	0.0
2021	24.6	6.5	17.7	0.7	0.0
2022	24.9	8.1	14.2	1.0	2.1
Minimum Significant Difference	2.4	1.7	3.5	1.0	1.2

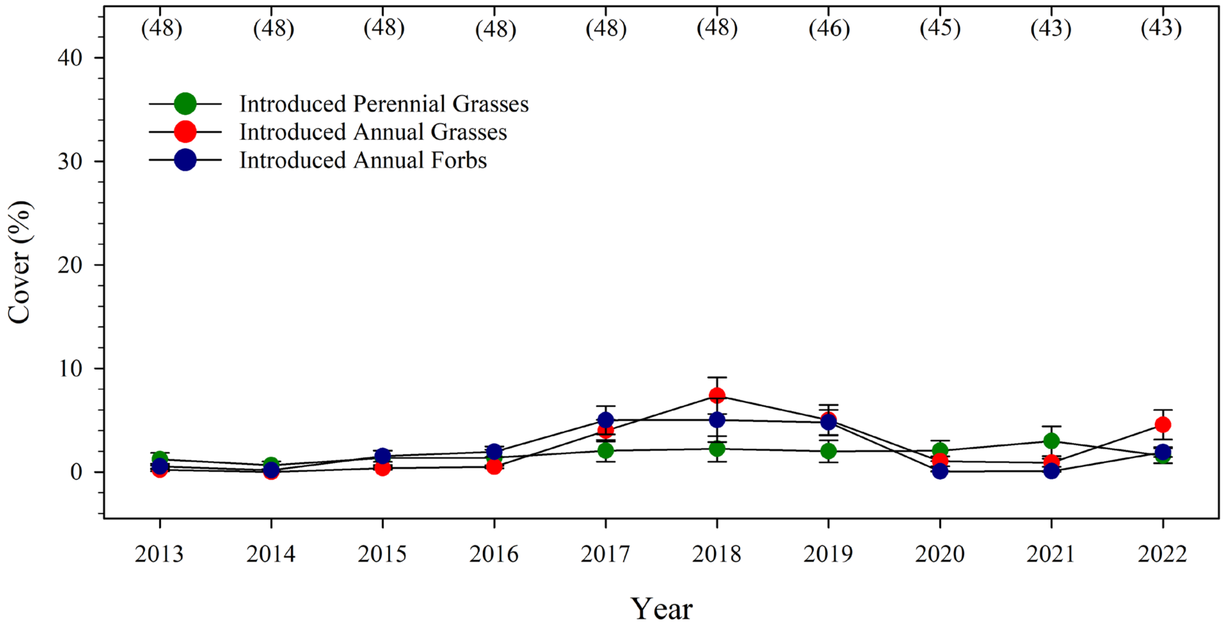

Figure 3-5. Sagebrush habitat plot cover separated into plant functional groups composed of introduced species on the Idaho National Laboratory Site from 2013 through 2022. Error bars represent ±1 SE. Tick marks along the top denote sample size by year.

Table 3-9. Sagebrush habitat plot cover separated into plant functional groups composed of introduced species on the Idaho National Laboratory Site from 2013 through 2022. The Holm-Sidak method isolates the group's statistical Minimum Significant Difference by pairwise multiple comparisons using the least squares mean from a General Linear Model. The Minimum Significant Difference reported below corresponds to mean cover (%).

Sagebrush Habitat Plots: *Introduced Functional Groups* Mean Cover (%)			
Year	Introduced Perennial Grasses	Introduced Annual Grasses	Introduced Annual Forbs
2013	1.2	0.2	0.5
2014	0.7	0.0	0.2
2015	1.4	0.4	1.5
2016	1.4	0.5	2.0
2017	2.1	4.0	5.0
2018	2.2	7.4	5.0
2019	2.0	5.0	4.8
2020	2.1	1.0	0.1
2021	3.0	0.9	0.1
2022	1.6	4.6	1.9
Minimum Significant Difference	2.3	3.5	3.0

Non-sagebrush Plots

The native perennial grasses and other shrubs functional groups generally lack directional cover trends and are substantially more abundant than both shrubby sagebrush species and native forb functional groups through the sample period in non-sagebrush plots (see Figure 3-6). Although sagebrush species cover has been below 1% since this sampling effort was initiated, cover has consistently increased each sampling period and cover during the most recent year was significantly greater than the first year ($P = 0.018$; see Table 3-10). The native perennial, biennial, and annual forb functional groups exhibit no discernable trends and abundance fluctuations appear to coincide with precipitation events, but have a relatively narrow range of variability.

The cover for introduced perennial grasses has consistently remained below 1% through the monitoring period and variation between and within years is narrow (see Figure 3-7). The cover from introduced annual forbs has increased since 2020 (see Table 3-11). Cover for introduced annual grasses has fluctuated substantially over the ten-year sample period. Although introduced annual grass cover in 2022 was greater than it was in 2021, it remains significantly lower than the three years with the greatest mean cover ($p < 0.001$; see Table 3-11).

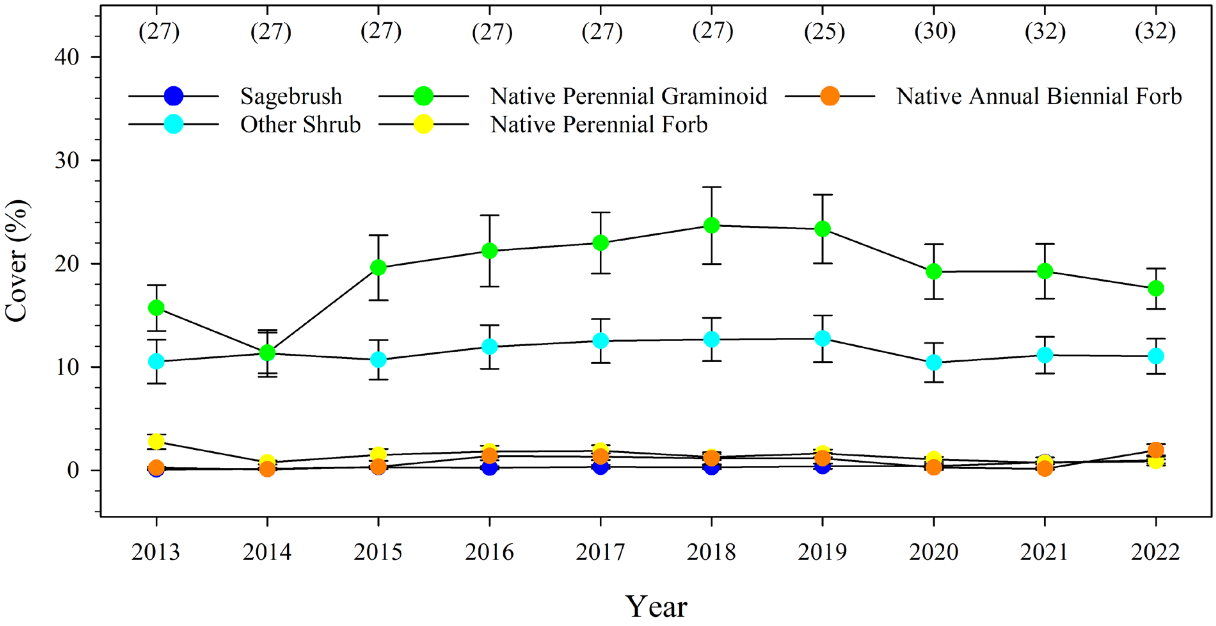

Figure 3-6. Non-sagebrush plot cover separated into plant functional groups composed of native species on the Idaho National Laboratory Site from 2013 through 2022. Error bars represent ± 1 SE. Tick marks along the top denote sample size by year.

Table 3-10. Non-sagebrush plot cover separated into plant functional groups composed of native species on the Idaho National Laboratory Site from 2013 through 2022. The Holm-Sidak method isolates the group's statistical Minimum Significant Difference by pairwise multiple comparisons using the least squares mean from a General Linear Model. The Minimum Significant Difference reported below corresponds to mean cover (%).

Non-sagebrush Plots: *Native Functional Groups* Mean Cover (%)					
Year	Sagebrush	Other Shrubs	Native Perennial Grasses	Native Perennial Forbs	Native Annual/Biennial Forbs
2013	0.1	12.3	15.7	2.8	0.2
2014	0.1	12.2	11.4	0.8	0.1
2015	0.3	12.6	19.6	1.5	0.3
2016	0.3	14.0	21.2	1.8	1.4
2017	0.3	14.7	22.0	1.9	1.3
2018	0.3	14.9	23.7	1.3	1.2
2019	0.4	15.2	23.3	1.6	1.2
2020	0.4	12.0	19.2	1.1	0.3
2021	0.8	11.8	19.6	0.7	0.1
2022	1.0	12.6	17.6	0.9	1.9
Minimum Significant Difference	0.9	N/A	7.6	1.7	1.7

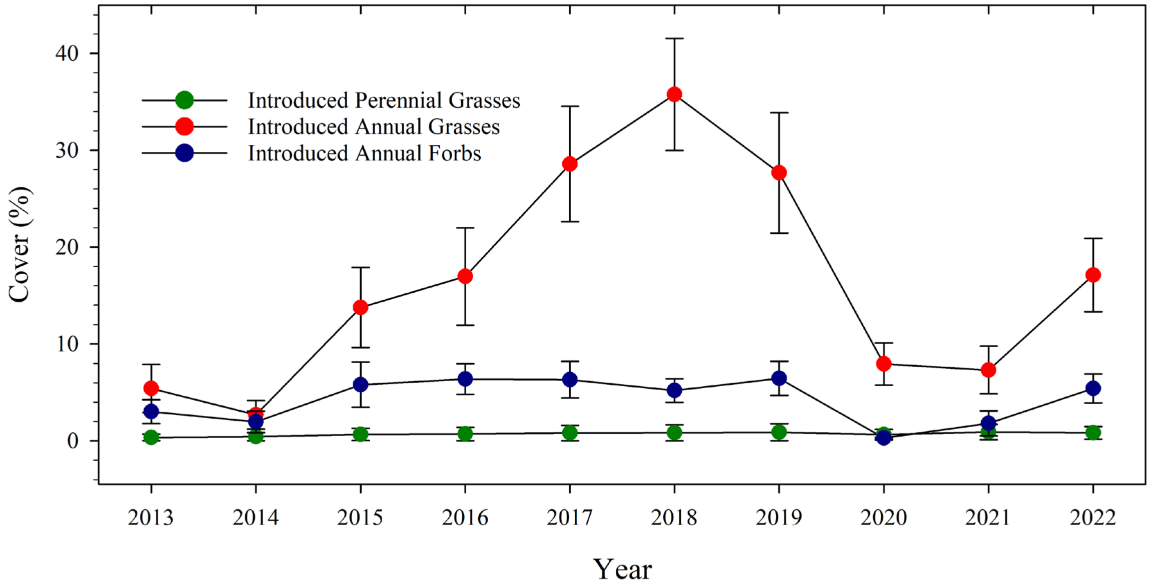

Figure 3-7. Non-sagebrush plot cover separated into plant functional groups composed of introduced species on the Idaho National Laboratory Site from 2013 through 2022. Error bars represent ±1 SE. Tick marks along the top denote sample size by year.

Table 3-11. Non-sagebrush plot cover separated into plant functional groups composed of introduced species on the Idaho National Laboratory Site from 2013 through 2022. The Holm-Sidak method isolates the group's statistical Minimum Significant Difference by pairwise multiple comparisons using the least squares mean from a General Linear Model. The Minimum Significant Difference reported below corresponds to mean cover (%).

Non-sagebrush Plots: *Introduced Species* Mean Cover (%)			
Year	Introduced Perennial Grasses	Introduced Annual Grasses	Introduced Annual Forbs
2013	0.4	5.4	3.0
2014	0.4	2.7	2.0
2015	0.7	13.8	5.8
2016	0.7	17.0	6.4
2017	0.8	28.6	6.3
2018	0.8	35.8	5.2
2019	0.9	27.7	6.5
2020	0.6	7.9	0.4
2021	0.9	7.3	1.8
2022	0.8	17.1	5.4
Minimum Significant Difference	N/A	9.8	6.0

3.1.5 Summary of Habitat Condition

In 2022, sagebrush habitat plots had greater cover, but plants tended to be shorter and sagebrush density was lower when compared to the baseline. In general, native functional groups were more abundant and had more species contributing to total vascular cover than introduced functional groups. Cover in introduced functional groups was twice baseline in 2022, but was a much smaller proportion of vascular cover than native functional groups. Perennial grass/forb species were the most abundant functional group in non-sagebrush plots in 2022. Species in this functional group had similar cover compared to baseline, but they were considerably shorter in 2022. Although non-sagebrush plots have few individual sagebrush, those that did occur contributed to greater cover, height, and density in 2022 when compared to the baseline. Introduced species cover was greater than the baseline in 2022 and largely the result of higher cover for a few species, crested wheatgrass, and cheatgrass. Non-native perennial crested wheatgrass cover is consistently within a narrow range of variability despite environmental conditions. Cheatgrass cover has been more variable, and it is likely able to fluctuate upward and downward (Forman and Hafla 2018) with a large range of annual variation (INL 2022a).

Total precipitation in 2022 was below the 70-year average and there was a considerable shift in precipitation timing when compared to historical patterns. Idaho's natural climate baseline patterns are shifting and local precipitation intensities are more evident in eastern Idaho than in other state-level regions (Abatzoglou et al. 2021). Precipitation intensities increased across the Northwest (USGCRP 2018) and the fraction of precipitation falling as snow has reduced (Nayak et al. 2010). Overall, characterizing the precipitation patterns received at CFA was similar to the Idaho Climate-Economy Impacts Assessment (Abatzoglou et al. 2021). Fall precipitation was considerably greater than the average, while winter and spring were below the average. The summer was characterized by drought conditions except for several late summer heavy rain events. Native perennial functional groups are likely more resistance to extended periods of drought conditions where ephemeral annual functional groups are more responsive to the intensity of discrete weather events. 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. It is not surprising that cover was greater for cheatgrass as precipitation timing likely disproportionately affected annual functional groups over other functional groups.

Sagebrush species are the most abundant functional group and, in general, have trended upward in sagebrush habitat plots on the INL Site. Native perennial grasses are a major functional group that has more than doubled in cover since monitoring began and has been fluctuating between the mid- to upper-range of variability over the past four years. Native perennial forb cover contributes little to total vascular cover, but since monitoring began in 2013, the years with above average precipitation had significantly greater abundance. Cheatgrass has been a minor component of INL Site plant communities for several decades; however, because cheatgrass appears to become much more abundant in plant communities affected by wildland fire, it is more likely to dominate non-sagebrush plant communities post-fire. Patterns from this analysis are consistent with other studies conducted on the INL Site (Forman and Hafla 2018). Intact sagebrush plant communities appear to be more resistant to cheatgrass dominance than recovering habitats. This pattern is particularly evident in years where weather patterns are favorable for the invasive non-native annual grass because non-sagebrush plots have substantially amplified cover fluctuations as compared to intact sagebrush habitat plots.

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

3.2.1 Introduction

Loss of sagebrush-dominated habitat has been identified as one of the primary causes of decline in sage-grouse populations (Idaho Sage-grouse Advisory Committee 2006; USFWS 2013). Direct loss of sagebrush habitat on the INL Site has occurred through several mechanisms, including wildland fire and infrastructure development. In the future, we expect the total area and extent of sagebrush habitat to change following wildland fires, as new facilities are developed on the INL Site, and as lands recover naturally or are restored. Changes in land cover can be determined using airborne or satellite imagery that is readily available at little or no cost. Natural Resources Group 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 (see 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 is also used to map 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 allows for modifying existing wildland fire boundaries and unburned patches of vegetation when mapping errors are observed on the ground.

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., the Bureau of Land Management [BLM]) 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 delineating new vegetation class boundaries within the burned area, the mapped fire boundaries first 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 recovering post-fire classes. 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 which vegetation classes establish immediately after a fire, especially during drought years. We allow for a couple growing seasons before identifying and delineating post-fire communities, and possibly longer if the years following fire were excessively dry and delayed normal reestablishment of vegetation communities. Field surveys also commence when a map polygon or burned area begins to show signs (i.e., via habitat condition monitoring data) that the current vegetation class has changed to another class and warrants reassignment. When it becomes available, either through the National Agricultural Imagery Program (NAIP) or from INL Site specific acquisitions, high resolution imagery is used as the source data layer to delineate new vegetation class boundaries within recent wildland fire boundaries.

The mapped wildland fire boundaries are used to directly calculate losses in sagebrush habitat. ArcGIS geoprocessing tools are used to clip and remove areas mapped as sagebrush habitat that have recently burned. In addition to documenting losses from wildland fire, any loss of sagebrush habitat from infrastructure expansion is also included in the summary of total sagebrush habitat removed. See Section 4.2 for additional details regarding methods and results from infrastructure expansion mapping.

After the CCA stakeholder meeting in February 2022, it was agreed upon that we would update the baseline for the sagebrush habitat trigger using the most recent vegetation map data available (see Section 6.3). The current vegetation map was published in 2019 (Shive et al. 2019) and served as an update to the previous vegetation map, which was used to establish the original sagebrush habitat layer defined in the CCA. The new vegetation map reduced the number of vegetation classes characterized on the INL Site and increased the mapping scale to capture finer scale details than the original map. The new map was published prior to the Sheep Fire and represented ground conditions as of early 2019. There were no major wildland fires between signing the CCA and the 2019 vegetation map update, so changes in sagebrush habitat largely resulted from improved mapping rather than real changes on the ground.

Using the 2019 map, the sagebrush habitat baseline area in the SGCA at the start of 2019 was 72,299.6 ha (178,656.2 ac). Because the new sagebrush habitat layer represented ground conditions at the start of 2019, additional edits needed to be made to bring the new layer in accordance with previously documented sagebrush habitat losses. All previously mapped sagebrush losses reported in the Infrastructure Expansion monitoring task (see Section 4.2) were removed to maintain consistency with previously reported CCA monitoring results. Sagebrush habitat losses from the 2019 Sheep Fire and the 2020 Fires were previously reported and removed from the original baseline layer. After the updated sagebrush habitat baseline was implemented in 2022, these same losses were maintained and removed to reflect current ground conditions. The area of sagebrush habitat in the SGCA prior to 2022 was 71,358.8 ha (176,331.4 ac), representing a 1.3% decrease from the updated sagebrush habitat baseline.

3.2.3 Results and Discussion

There were no fires that burned on the INL Site in 2022 (INL Fire Department Chief James Blair, personal communication, 2022). There were also no losses of sagebrush habitat from infrastructure expansion within the SGCA. Consequently, the sagebrush habitat trigger remains unchanged with no losses to report this year including those documented in Section 4.2.

The total area of sagebrush habitat in the SGCA on the INL Site remains unchanged from 2021 at 71,358.8 ha (176,331.4 ac; see Figure 3-8). 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 from new infrastructure development (DOE and USFWS 2014). There was 4.6 ha (11.4 ac) of sagebrush habitat loss reported in the Infrastructure Expansion task that all occurred outside the SGCA. After those losses are removed from the conservation bank, the current estimated area of sagebrush habitat remaining outside the SGCA is 28,306.5 ha (69,947 ac).

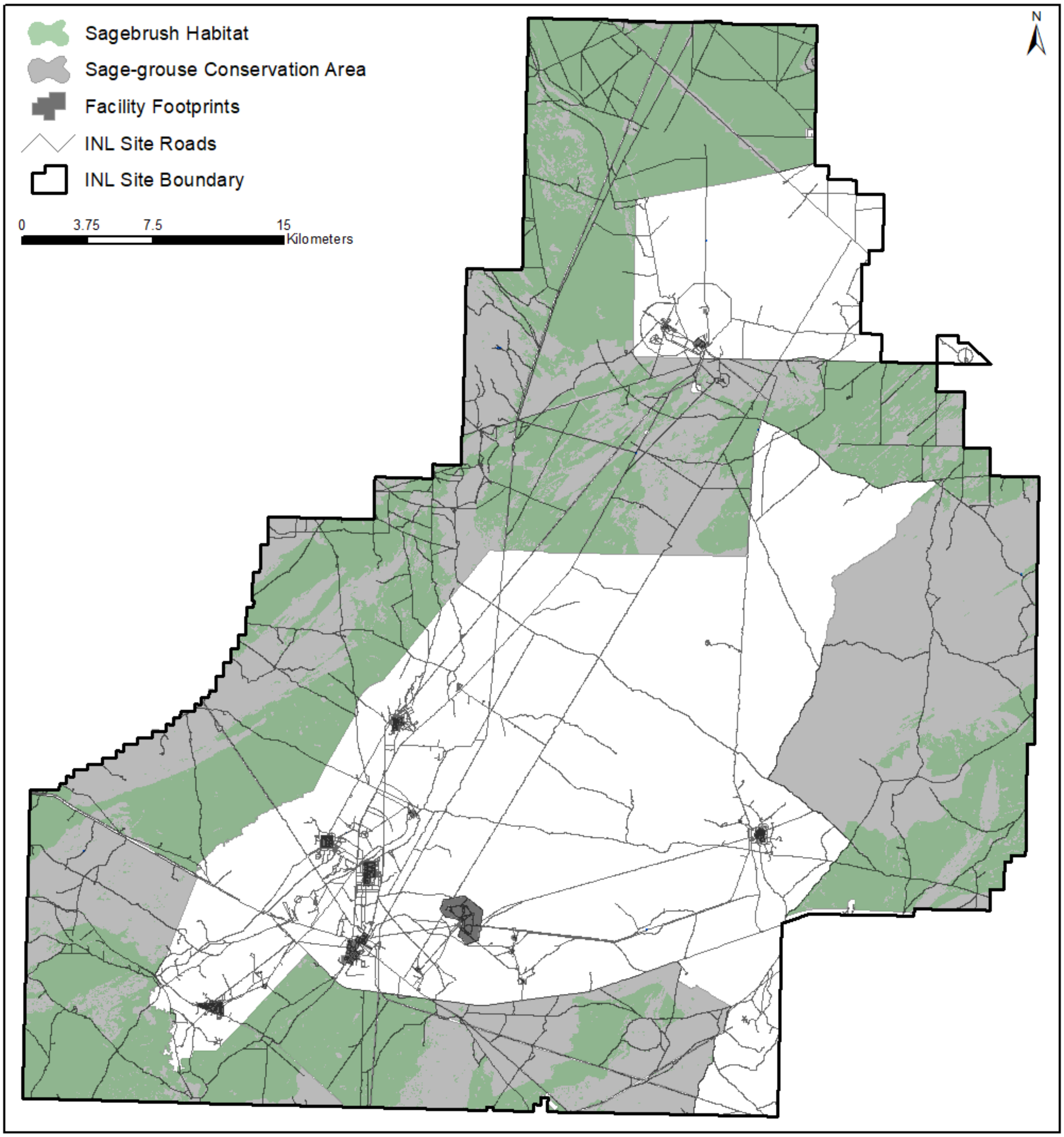

Figure 3-8. Current sagebrush habitat distribution within the Sage-grouse Conservation Area on the Idaho National Laboratory Site.

4. THREAT MONITORING

The CCA (DOE and USFWS 2014) identified and rated eight threats that potentially impact sage-grouse and its habitats on the INL Site (threat ratings updated in Shurtliff et al. [2019]). 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, raven predation, infrastructure development, wildland fire and subsequent habitat recovery, livestock, and annual grasslands. Habitats affected by wildland fires, within grazing allotments, or in concert are evaluated for potential impacts to their condition (see Section 4.3). 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, cheatgrass control is currently being addressed as a component of post-fire restoration by the INL Wildland Fire Management Committee (WFMC). Continued monitoring of the abundance and spatial distribution of cheatgrass (see Section 3.1) through CCA habitat condition monitoring is necessary to continue to understand the abundance of cheatgrass in areas that have not recently burned.

4.1 Task 4—Raven Nest Surveys

4.1.1 Introduction

Each spring for eight years (2014–2021), anthropogenic structures on the INL site were searched systematically for common raven nests (*Corvus corax;* INL 2022*a*) in support of DOE's efforts to document nesting trends of this native sage-grouse egg predator. During the study period, the number of raven nests reported each year ranged from 29 to 44, with the last year equaling the median value of 38 nests. Researchers therefore concluded that raven nesting on infrastructure on the INL Site was likely not trending upward (INL 2022*a*). Although this is seemingly a positive result, raven nesting trends do not directly address the question of whether current raven occupancy is impacting sage-grouse reproductive success on the INL Site. Such a question could only be answered by tracking sage-grouse nest success and raven nest abundance simultaneously. During a recent meeting among staff representing DOE, USFWS, and other CCA stakeholders, the USFWS encouraged DOE to assume ravens are likely impacting sage-grouse and to prioritize long-term, sustainable solutions to reduce raven nesting on infrastructure over continued monitoring and research.[2] Accordingly, BEA suspended raven nest surveys in spring 2022 and evaluated the eight-year dataset to identify raven nesting hot spots (hereafter 'hot spots' or HS) on power lines, towers, and at facilities. If hot spots could be prioritized based on the proximity to sage-grouse leks and sagebrush habitat, mitigation efforts could be selected strategically to produce the greatest positive benefit for sage-grouse.

Most raven pairs on the INL Site nest on human infrastructure, including power lines, towers, and platforms attached to buildings and other vertical structures (Howe et al. 2014). Of these, power transmission and distribution structures and poles are the most used as nest substrates (Howe et al. 2014; INL 2022*a*). Until recently, most high-voltage transmission line structures were comprised of two wooden poles connected by parallel wooden crossarms attached to opposite sides of the poles. This design produces stable platforms that readily support the large stick nests made by ravens. Most distribution line structures consist of single poles with one narrow wooden crossarm attached near the top; others have no crossarms. Neither of these are suitable for raven nesting, but where distribution lines change direction or terminate, double wooden crossarms have historically been used to provide additional support. Nearly all raven nests recorded on distribution lines during the eight-year study were on poles with double crossarms.

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[2] Minutes recorded by BEA staff on February 24, 2022. Comment was made by Jason Pyron, Conservation Partnerships—Branch Lead, USFWS.

4.2 Methods

Power lines on the INL Site are owned and maintained by BEA and two commercial utilities companies, Rocky Mountain Power and Idaho Power. For the past few years, when transmission structures required substantial maintenance or replacement, BEA Power Management replaced double wooden crossarms on transmission structures with a narrow (~10 cm wide [4 in.]) metal structure that attaches to one side of each pole[3] (see Figure 4-1). These metal crossarms are likely too narrow to support a raven nest, and thus, serve as a nest deterrent. The BEA Power Management program has also reduced nesting on distribution poles with double crossarms by installing inverted 'V' nest diverters (Power Line Sentry, LLC, Wellington, CO, USA) that span double crossarms. More recently, Power Management staff have begun replacing double crossarms with a single fiberglass crossarm, which is thought to eliminate the nesting potential of the structure.

In the current analysis, we identified raven nesting hot spots on power lines, towers, and at facilities, and we documented where retrofitted power line structures are presently installed. The primary objective was to prioritize hot spots and provide guidance to BEA and non-INL entities regarding where they could perform mitigation activities on infrastructure that would be most likely to produce a positive impact on sage-grouse nest success on the INL Site.

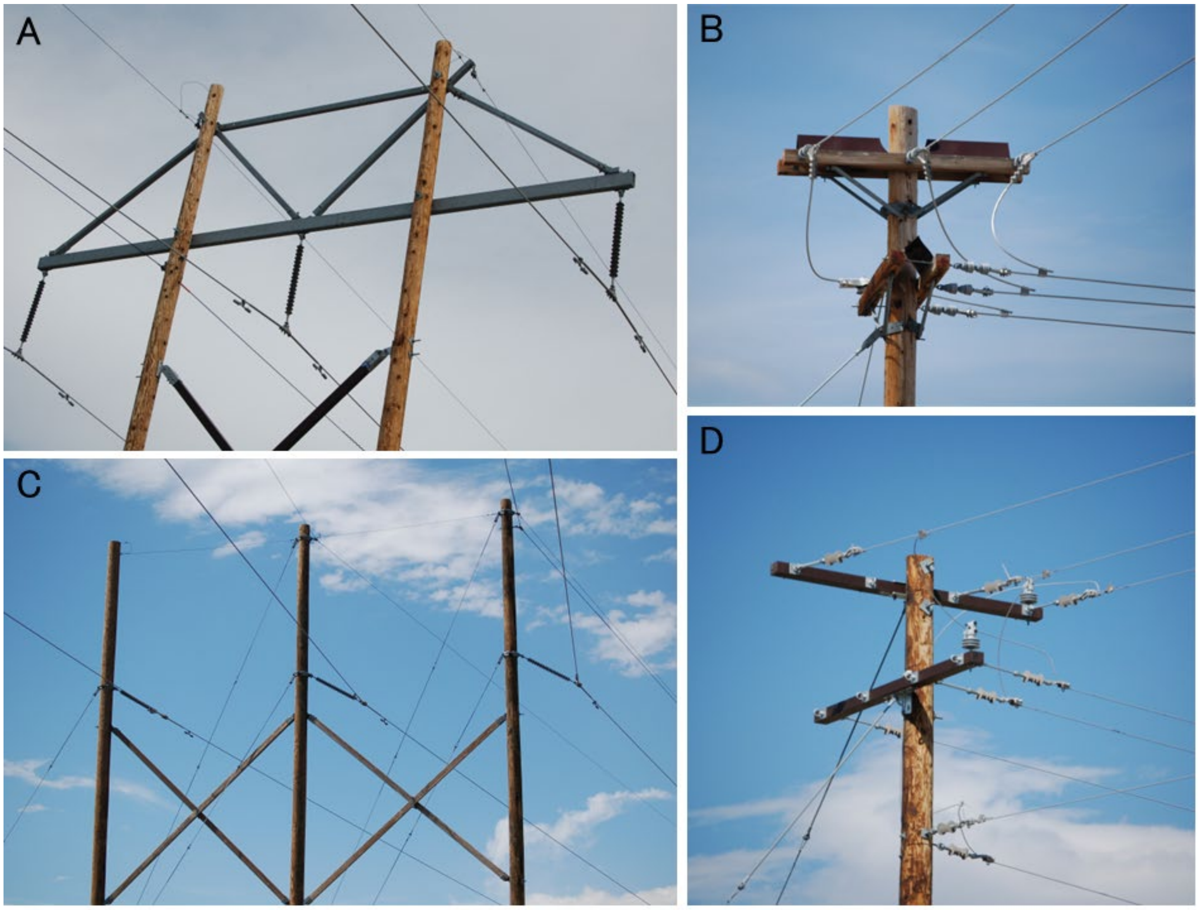

Figure 4-1. Transmission and distribution power lines retrofitted to eliminate raven nesting. A. single-side metal crossarm (transmission); B. inverted 'V' (distribution); C. three-pole structure without crossarms (transmission); and D. single fiberglass crossarms (distribution).

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[3] Personal communication from Kenneth Barnes, maintenance manager, BEA Power Management, to Quinn Shurtliff, June 28, 2022.

Field Methods

During four outings in June 2022 and one in September 2022, an observer drove a truck along each stretch of transmission and distribution lines that had been surveyed regularly in past years searching for retrofitted structures. GPS coordinates were taken at each retrofitted structure and the type of retrofitting was recorded. For transmission lines, structures were marked retrofitted if a single-side metal crossarm had replaced wooden double crossarms (see Figure 4-1). Where transmission lines change direction, three-pole structures are installed, and we characterized those without crossarms and those with single-side crossarms as retrofitted. Distribution poles were marked retrofitted if an inverted 'V' structure had been installed on double crossarms or if a single fiberglass crossarm was installed on a pole from which the line changed direction or terminated.

Nesting Hot Spot Analysis

To identify sections of power lines, towers, and facilities where ravens nested repeatedly across years (hereafter 'hot spots'), we combined nest locations from each year of the eight-year study and utilized a GIS to explore spatial relationships and distances between nests. Each nest substrate was labeled with a unique identifier, and many substrates—especially towers and those at facilities—supported multiple nests across years. Where nests in proximity were assumed to be renest attempts by the same breeding pair in the same year, only the last recorded nest location was used (INL 2022*a*).

The primary challenge in delineating hot spots, especially along linear features, is to determine a biologically meaningful distance threshold. Adjacent nest sites separated by a distance less than the threshold would be included in a cluster and those separated by a distance greater than the threshold would be excluded. Identification of a distance threshold was determined as follows. For each power line nest, we identified the distance from the nest to its nearest neighbors on either side using a GIS pairwise distance tool. Nests near the INL Site boundary only had one nearest-nest distance calculated. Where power lines approached each other or a facility, it was assumed that the nearest nests might be on adjacent structures, which we verified accordingly.

A similar exercise was completed for nests on non-linear structures (e.g., facilities, towers) with the aim to create a chain of nests, each linked by calculated distances to two other nests. The purpose was not to necessarily link to the two nearest nests; if so, a cluster of three nests would have linked to each other. Rather, the purpose was to determine if the nearest non-facility nest should be included in a cluster that included facility nests. If two nest structures occurred at a facility, the distance between them was calculated, as well as the distances from each to the nearest non-facility nest. Where three nest structures occurred at a facility, two distances were identified for the nest farthest from the other two (i.e., distance to the closest facility nest and to the closest non-facility nest). Next, distance from the second nest to the third nest was recorded, and then distance from the third nest to the closest non-facility nest was recorded, if not done previously when distances were calculated along the power line. Only one nest substrate was ever attributed to towers outside facilities, which were always relatively far from other infrastructure, so a single distance was calculated from the tower nest to the nearest power line or facility nest.

Next, all calculated inter-nest distances were listed in a worksheet and sorted from smallest to largest. The difference between each inter-nest distance and the next largest in the sorted list was calculated and the results were visualized in a graph. The first relatively large gap in the graphed differences was assumed to be an indicator of a natural break between nest clusters, and thus formed the basis for the distance threshold separating the hot spot from non-hot spot nests. For convenience as a metric, we rounded the threshold to the nearest 50 m (55 yd).

The primary biological assumption associated with a hot spot is that it represents an area within one or more raven breeding territories that was of sufficient quality to attract nesting over multiple years. We therefore created a minimum requirement that at least four nearby nests must be under the distance threshold to be considered a hot spot, and we labeled each with a unique identification number. This cut-off value helped maintain a focus on the largest raven nest clusters.

Nest Cluster Prioritization

Prioritization of nesting hot spots was based on potential impact of foraging ravens on nearby sage-grouse nest success. Potential impact was determined by estimating the distance breeding ravens would be likely to travel from their nest to forage, the proximity of hot spots to potential sage-grouse nesting habitat, and male sage-grouse attendance at nearby leks in 2022. Research has demonstrated that raven breeding pairs forage almost entirely within 2 km (1.2 mi) of their nest (Rösner and Selva 2005; Harju et al. 2018; Harju et al. 2021). Therefore, after identifying hot spots, we buffered them by 2 km (hereafter 'foraging buffer') and calculated the percentage of mapped sagebrush habitat (DOE and USFWS 2014; Section 3-2 this report) within each. A study on the INL Site conducted approximately 15 years ago found 61%, 35%, and 17% of nests of marked female sage-grouse were farther than 3 km (1.9 mi), 5 km (3.1 mi), and 7 km (4.3 mi), respectively, from the lek upon which the hen was captured (Howe et al. 2014; Q. Shurtliff, unpublished data). It was therefore assumed that if a lek was <5 km from the edge of a raven foraging buffer that encompassed sagebrush habitat (i.e., <7 km from the nearest raven nest in a hot spot), sage-grouse nests associated with the lek would have an elevated risk of being predated by ravens nesting within the hot spot.

Raven hot spots on INL-managed and non-INL managed infrastructure were rated high, medium, or low priority for proposing mitigating action to deter raven nesting. Those not meeting the criteria of low priority are not a priority for mitigating action because few if any sage-grouse are expected to nest within those foraging buffers. We assumed the more sagebrush habitat occurred within a foraging buffer, the greater the liklihood that sage-grouse reproductive success could be impacted by ravens nesting in the nearby hot spot. Female sage-grouse associated with leks located within the foraging buffers were considered highly likely to be negatively impacted by raven predation. Based on these assumptions, the following criteria were developed to rate hot spots:

- <u>High Priority</u>: One or more active leks occur within the 2-km raven foraging buffer and >50% of the buffer encompasses sagebrush habitat.
- <u>Medium Priority</u>: One or more active leks are within 5 km of a raven foraging buffer (but not within 2 km) and >50% of the buffer encompasses sagebrush habitat.
- <u>Low Priority</u>: One or more active leks are within 5 km of a raven foraging buffer and 5–50% of the buffer encompasses sagebrush habitat.

After hot spots were rated, those within each priority category were ranked based on the sum of peak sage-grouse male attendance in 2022 at each lek occuring within 7 km of the hot spot. We assumed that female abundance and nesting propensity near a lek was a function of male lek attendance and, consequently, the more males that attended a lek during the breeding season, the greater the liklihood that females would nest in sagebrush habitat within the nearest raven foraging buffer. Although within-category rankings were based solely on male sage-grouse attendance at leks, we also considered attributes such as proximity of a hot spot to other high-priority hot spots and the feasiblity of installing nest deterrents when making recommendations for mitigation.

4.1.3 Results and Discussion

Raven Hot Spots

Across all years, 296 raven nests were documented on 189 structures. Calculating distances between adjacent nests resulted in a list of 191 inter-nest distances. Most nests on power lines were linked by two distances to nests on either side; however, occasionally the non-linear constellation of nests at facilities or where power lines approached each other resulted in a nest serving as the adjacent nest for more than two nests. The smallest distance between any two adjacent nests was 6 m (20 ft) at the Environmental Breeder Reactor-I (EBR-I), whereas the largest was 11.3 km (7.0 mi; see Figure 4-2); the largest distances are not displayed for ease of interpretation. Eighty-seven nests had nearest-neighbor distances <633 m (692 yd), with the largest gap between sorted distances to that point being 47 m (51 yd). The next highest distance after 633 m was 761 m (832 yd)—a 128-m (140-yd) gap (i.e., no nearest-nest distances were found from 634 m to 760 m apart). Large gaps in distances began to appear regularly after 1,338 m (1,463 yd). We determined that the first large gap—between 633 m and 761 m—was an indicator of a break in natural clustering of nests. Therefore, we established a hot spot threshold at 650 m (711 yd) and identified hot spots whenever any group of four or more nests were found that each had nearest-neighbor distances <650 m.

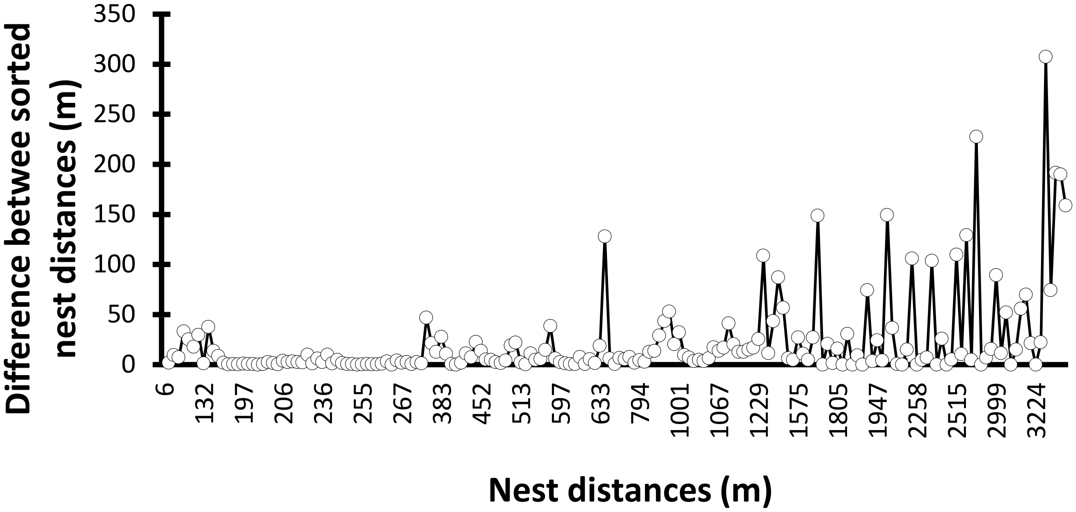


Figure 4-2. Representation of gaps between nest distances for all raven nests, used to identify a nesting hot spot threshold. The horizontal axis represents nearest-nest distances between raven nests on the Idaho National Laboratory Site. The vertical axis is the difference between nest distances when all were sorted from smallest to largest.

In total, 33 hot spots were identified, including 20 on power lines, nine at facilities, and four on towers outside of facilities (see Figure 4-3). Hot spots on power lines consisted of 4–10 nests each (mean = 5.8), while nine of the 20 were on INL lines. Facility hot spots consisted of 4–8 nests (mean = 5.7) and tower hotspots consisted of 4–6 nests (mean = 5.3). Facilities with hot spots included the Naval Reactors Facility (NRF) with eight nests on three structures; the Idaho Nuclear Technology and Engineering Center (INTEC) with eight nests on one structure; the Advanced Mixed Waste Treatment Project (AMWTP) with six nests on three structures; EBR-I with six nests on two structures; the U.S. Department of Agriculture (USDA) Sheep Station with six nests on five structures; the CFA main gate with five nests on one structure; the Advanced Test Reactor Complex (ATR Complex) with four nests on two structures; the Specific Manufacturing Capability (SMC) with four nests on two structures; and the Materials and Fuels Complex (MFC) with four nests on two structures. Facilities without a HS were the Critical Infrastructure Test Range Complex (CITRC) with three nests and CFA with one nest.

On the east side of the INL Site, a NOAA meteorological tower and a cellular tower each supported a raven nest for six years. On the west side of the INL Site, a NOAA meteorological tower supported nests for five years. A Federal Aviation Administration (FAA) tower located approximately 420 m (459 yd) from the southeast boundary of the INL Site supported raven nests for four years. Together, these four towers supported 21 nests over eight years.

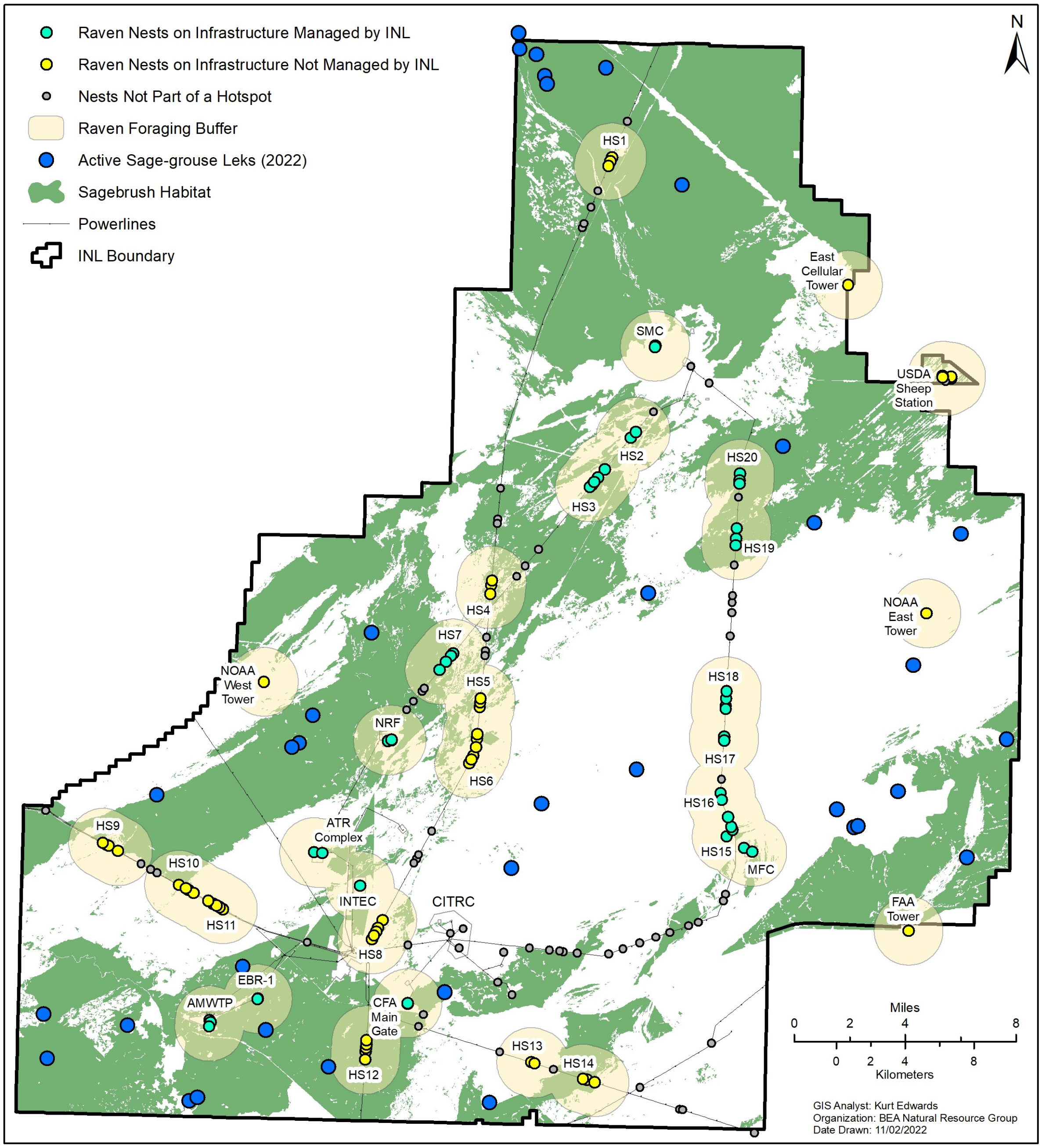


Figure 4-3. Location of raven nests documented from 2014 to 2021 relative to sage-grouse leks and sagebrush habitat. Raven nesting hot spots on power lines are identified with HS numbers and color coded based on whether the infrastructure is managed by Idaho National Laboratory (INL) or non-INL entities. A 2-km raven nest foraging buffer was overlaid onto the sagebrush habitat map to aid in hot spot prioritization.

Retrofitted Power Line Structures

We located 159 transmission line structures that had been retrofitted and now preclude ravens from nesting (see Figure 4-34). Nearly all transmission line retrofits ($n = 155$) consist of single-side metal crossarms. Three others consist of three-pole structures without crossarms, whereas one is a three-pole structure with a single-side wooden crossarm (see Figure 4-1). The greatest concentration of retrofitted transmission structures maintained by INL is between ATR Complex and the intersection of a commercial power line northeast of NRF (see Figure 4-4). Twenty-six of 89 structures (29%) are retrofitted along this stretch, including three of the seven structures within hot spot (HS) 7 (see Figure 4-3). Many of these were replaced because of damage caused by the 2019 Sheep Fire (Shurtliff et al. 2020). Forty-two of 81 transmission structures (47%) have been retrofitted on a 20.7-km (12.9 mi) Rocky Mountain Power line running northeast from near CFA to the intersection with an INL-managed transmission line. Included among the retrofits are all six of the structures within HS 8, seven of eight structures in HS 6, and the three structures comprising HS 5. For HS 5 and HS 6, one and two adjacent structures outside the hot spots, respectively, are also retrofitted. Additionally, Rocky Mountain Power has retrofitted 50 of 89 transmission structures (56%) on a 19.6-km (12.2–mi) stretch of line it owns that runs initially south, and then southeast from CFA toward the southeastern corner of the INL Site. Along one length of line, 15 consecutive structures spanning 3.3 km (2.0 mi) have been retrofitted. Along another stretch, 10 of 13 structures spanning 2.8 km (1.7 mi) are retrofitted.

We found 26 retrofitted distribution poles. Inverted 'V' fittings were attached to the top of 16 poles with double crossarms. On another 10 poles, double crossarms were replaced by single fiberglass crossarms. The highest number of retrofitted distribution poles were approximately 3–4 km (1.9–2.5 mi) southeast of the Critical Infrastructure Test Range Complex (CITRC; see Figure 4-4). In this region, 12 terminal and corner poles have been retrofitted, eliminating nearly all available nesting substrates. Two distribution poles that supported raven nests in the past are among those that have been retrofitted.

Hot Spot Prioritization and Mitigation

A hot spot at EBR–I was the only infrastructure ranked high priority for mitigating action to reduce the potential impact of raven predation on sage-grouse (see Table 4-1). The nesting substrates at EBR-I consist of a pair of large aircraft engines that supported six nests over eight years. The 2-km raven foraging buffer surrounding these nest sites was almost entirely comprised of sagebrush habitat, and it overlapped one and nearly two active sage-grouse leks. One lek is marked precisely at 2,040 m from the raven nest, but as with all GPS-marked lek locations, the point merely represents an estimate of the central area where male sage-grouse display. Therefore, in practical terms, the foraging buffer associated with the EBR–I hot spot overlaps two leks. Two other leks (excluding the one on the margin of the foraging buffer) are within 5 km of the foraging buffer. Adding overhead netting or mesh wire at the nest sites are two of several possible ways to exclude nesting.

Six hot spots on INL transmission lines and facilities and three hot spots on non-INL transmission lines were rated medium priority for mitigating action (Table 4-1). The top three highest ranking hot spots in this category were near leks with similar male sage-grouse attendance, and mitigation on any would be of roughly equal value, based on our criteria. Notable among these three is the hot spot at AMWTP. This facility is the most southwesternly infrastructure to provide nesting subsidies and it is adjacent to a large area of sagebrush habitat. If raven nesting were excluded here and at EBR-I, potential impacts to sage-grouse nesting as a result of INL Site infrastructure may be substantially reduced in this area. The hot spot associated with CFA main gate is another location that should be considered as a target for mitigating action, even though it is ranked fourth in its priority category. Only two leks are within 5 km of the foraging buffer, but one of those is only 250 m (273 yd) outside the foraging buffer. It would be relatively easy to eliminate raven nesting at the CFA main gate because ravens build nests approximately 3 m (10 ft) above the ground under the eves of a lean-to attached to the back of the badging office. Adding mesh wire under the eves would problably render these sites unusable for ravens.

Hot spots on four INL transmission lines and facilities, and seven non-INL transmission lines and towers, are low priority for mitigation action. Although MFC is the top-ranked INL infrastructure within this category, little sagebrush habitat remains within the foraging buffer. If any INL infrastructure in the low priority category were selected for mitigation, HS 3 may be the best candidate for retrofitting due to the amount of sagebrush habitat remaining within the foraging buffer. Regarding non–INL infrastructure, the FAA tower may be the best candidate for retrofitting within the low-priority category. Although only 28% of the buffer encompasses sagebrush, that percentage may be much higher if areas off the INL were considered (Figure 4-3). The tower is extremely tall (45.7 m [150 ft]), so deterring nesting may be challenging. However, if the owner of the tower were willing and able to apply a nest deterrent, the predation risk to a sizable number of female sage-grouse may be reduced.

It was surprising that more hot spots on INL infrastructure in the high- and medium-priority categories were on facilities than power lines, given that most infrastructure nests are on power lines each year (Howe et al. 2014). This is likely the result of large amounts of sagebrush having burned in the past 12 years in remote areas of the INL Site. This result highlights the fluid nature of an analysis based on the location of sagebrush habitat and sage-grouse leks. If large amounts of sagebrush habitat are lost in future fires, we recommend that this analysis be conducted again to determine where to focus mitigation actions to reduce the impact of raven predation.

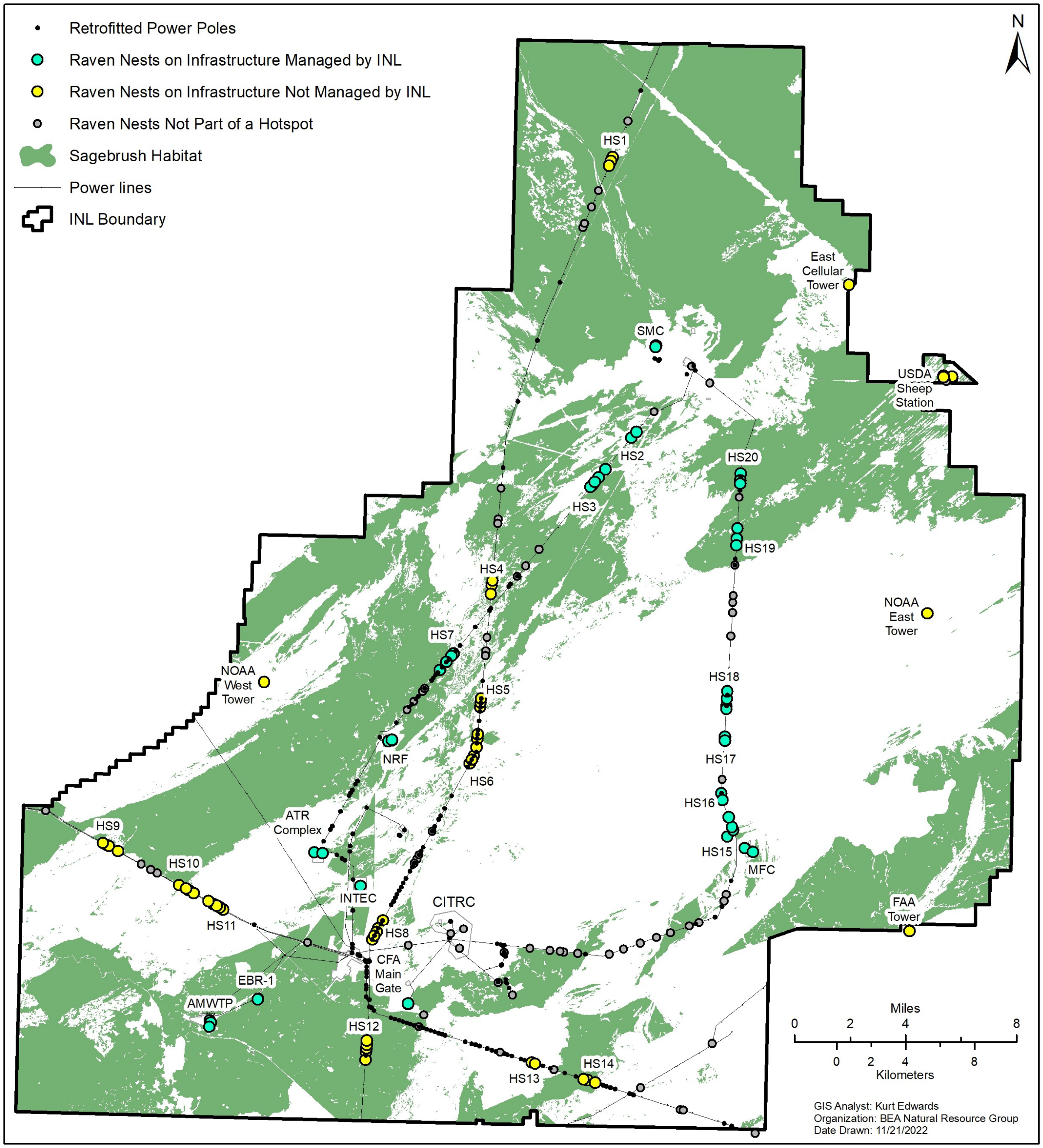


Figure 4-4. Retrofitted power transmission and distribution structures located during surveys of power lines on the Idaho National Laboratory Site.

Table 4-1. Prioritized raven nesting hot spots (HSs) on infrastructure managed by INL and other entities. 'Nearby leks' refer to the number of sage-grouse leks within five kilometers of the outer edge of the 2-km raven foraging buffer surrounding each hot spot. The number of sage-grouse (in the same column) is a sum of peak male attendance at all nearby leks in 2022. 'Sagebrush' refers to the proportion of the area within the foraging buffer mapped as sagebrush habitat. 'Retrofits' refers to the number of power line structures within a hot spot that are currently retrofitted. Within each priority level, hot spots (see Figure 4-3 for locations) are ranked by the number of sage-grouse listed in the second column under "INL" or "Non-INL."

	INL				Non-INL			
	Hot Spot	Nearby leks; # sage-grouse	Sagebrush (%)	Retrofits	Hot Spot	Nearby leks; # sage-grouse	Sagebrush (%)	Retrofits
High Priority	EBR-I	4 (1 in buffer); 42	91	–	–	–	–	–
Medium Priority	NRF	4; 49	61	–	HS 1	4; 43	92	–
	AMWTP	5; 43	84	–	HS 12	3; 25	99	1 of 6
	HS 19	3; 40	75	–	HS 14	1; 10	52	–
	CFA Main Gate	2 (1 is 250 m from buffer); 21	54	–	–	–	–	–
	HS 20	2; 19	89	1 of 4	–	–	–	–
	HS 7	1; 14	62	3 of 7	–	–	–	–
Low Priority	MFC	3; 47	15	–	FAA Tower	3; 50	28	–
	HS 3	1; 21	48	–	NOAA West Tower	4; 49	7	–
	HS 13	2; 16	16	–	HS 6	2; 14	21	8 of 9
	ATR Complex	2; 14	16	–	HS 9	1; 8	35	–
	–	–	–	–	HS 10	2; 8	26	–
	–	–	–	–	HS 8	1; 6	19	6 of 6
	–	–	–	–	HS 5	1; 3	28	3 of 3

Effectiveness of Power Line Retrofits

Because one of the aims of the current analysis is to provide guidance on where power line retrofits could be installed to exclude ravens from nesting and foraging in areas where sage-grouse are most likely to nest, it is worth noting that no raven or raptor nest (*Buteo* spp.) was ever successfully constructed and maintained on any retrofitted transmission or distribution structure during eight years of monitoring. In 2014, a single instance of a raven building a nest on a single-side metal crossarm on a commercial line was observed (see Figure 4-1), but when we returned twice more that season, no nest was present. Thus, it appears the substrate was too narrow to stably support the nest for the weeks required to lay eggs and raise a clutch to fledging. In June 2022, while documenting retrofitted power lines, we observed an active raven nest on the only unretrofitted structure within a 2.3-km (1.4 mi) stretch of 10 structures that includes HS 6. The first unretrofitted structure following this series of retrofitted structures held a hawk nest. Thus, both a raven and raptor had selected the only unretrofitted structures in a 2.5-km (1.6-mi) area upon which to build a nest. Based on these anectdotal evidences, we consider retrofitted transmission and distribution structures to be functionally nest proof.

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 (DOE and USFWS 2014). Infrastructure promotes habitat fragmentation and the 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 the 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 proposed footprint of the project. 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, soil stabilization or revegetation following the completion of a construction project fails to meet its objectives. If no overarching plan for soil stabilization or revegetation is developed, infrastructure may continue to slowly expand, without new structures and disturbances being considered as new or additional scope.

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 conditions for this monitoring task (unpublished data; Shurtliff et al. 2020). It is likely that many of these two-tracks were established by allotment 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.

The primary goal of this task is to update sagebrush habitat distribution (see Section 3.2) by identifying where expansion of infrastructure has removed sagebrush habitat within the SGCA and other areas of existing sagebrush habitat. For example, there has been approved expansion at facilities (e.g., MFC ponds) that was not present when the INL Site vegetation map was originally completed (Shive et al. 2011). Because the estimated amount of sagebrush habitat is generated from the vegetation map, areas like these are currently mapped as sagebrush habitat, which 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.

The availability of high resolution imagery collected across Idaho, 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 USDA NAIP collects digital imagery across the State of Idaho every two years. The publicly available image dataset consists of four spectral bands (i.e., blue, green, red, and near-infrared) usually collected at 1-m spatial resolution. Occasionally the State will contribute additional funds to have higher resolution imagery collected. 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).

4.2.2 Methods

The GIS analysis workflow for this task includes four 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; (3) delineate all new infrastructure footprints and digitize linear features; and (4) modify sagebrush habitat polygons where expansion has removed sagebrush.

The most recent Idaho NAIP imagery was acquired on cloud-free days from June to September 2021 and served as the basemap dataset for this monitoring task. The imagery was collected as a four-band color-infrared multispectral dataset with a spatial resolution of 0.6 m (2 ft).

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 occurs at fine map scales (i.e., 1:1,000 or less) so minor changes on the landscape, such as a new set of vehicle two-tracks, are more easily detected. GIS analysts 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. Anytime a potential location was identified by an analyst, it was marked for a secondary review.

Once each GIS analyst 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 were 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 editing tools to create the most current sagebrush distribution on the INL Site, which was then used to evaluate current habitat status against the baseline (see Section 3.2).

After the annual CCA stakeholder meeting in February 2022, it was agreed that we would update the sagebrush habitat baseline using the most recent vegetation map of the INL Site (Shive et al. 2019). The first step of incorporating the new sagebrush habitat layer to replace the original data layer was to account for any sagebrush habitat losses reported in 2019—the last time this task was conducted. All the mapped sagebrush habitat losses previously reported were removed to maintain consistency and verify that all past infrastructure expansion was included in the new layer. There were also some small patches of sagebrush habitat that were manually removed around previously documented sagebrush losses that are artifacts of the most recent vegetation mapping effort. The last vegetation map was produced at a 1:6,000 scale, but sagebrush losses are delineated at a finer scale (i.e., 1:1,000) to more accurately document losses. The difference in mapping scales can result in small slivers of polygons that may overlap non-sagebrush habitat. Anytime these small mapping errors were encountered near areas of mapped sagebrush loss, they were manually edited to improve the accuracy of the sagebrush habitat layer.

4.2.3 Results

Ten polygons were mapped where infrastructure expansion removed sagebrush habitat and resulted in a loss. All the expansions were minor with a total combined area of 4.6 ha (11.4 ac) of sagebrush loss. All losses occurred outside the SGCA and do not impact the sagebrush habitat regulatory trigger. Two of the mapped polygons resulted from gravel pit expansions (one that has expanded beyond administrative boundaries), one was an area adjacent to a gravel pit where sagebrush appears to be mostly removed, one was from mowing along the eastern perimeter of MFC, and the remaining six polygons were located at the NRF facility where one new pad was expanded, a perimeter road was widened, and a new parking lot was constructed. The largest mapped polygon removed 1.8 ha (4.3 ac) of sagebrush habitat where the Idaho Transportation Department gravel pit, located off U.S. Highway 20/26, was expanded (see Figure 4-5). The second largest sagebrush loss was mapped at the MFC facility where mowing along the eastern roadway adjacent to the fence line removed sagebrush habitat. The total loss from this activity was 1 ha (2.65 ac; Figure 4-6).

Figure 4-5. An example of mapped sagebrush habitat loss from an expanded gravel pit on the Idaho National Laboratory Site. The transparent green overlay represents mapped loss of sagebrush habitat.

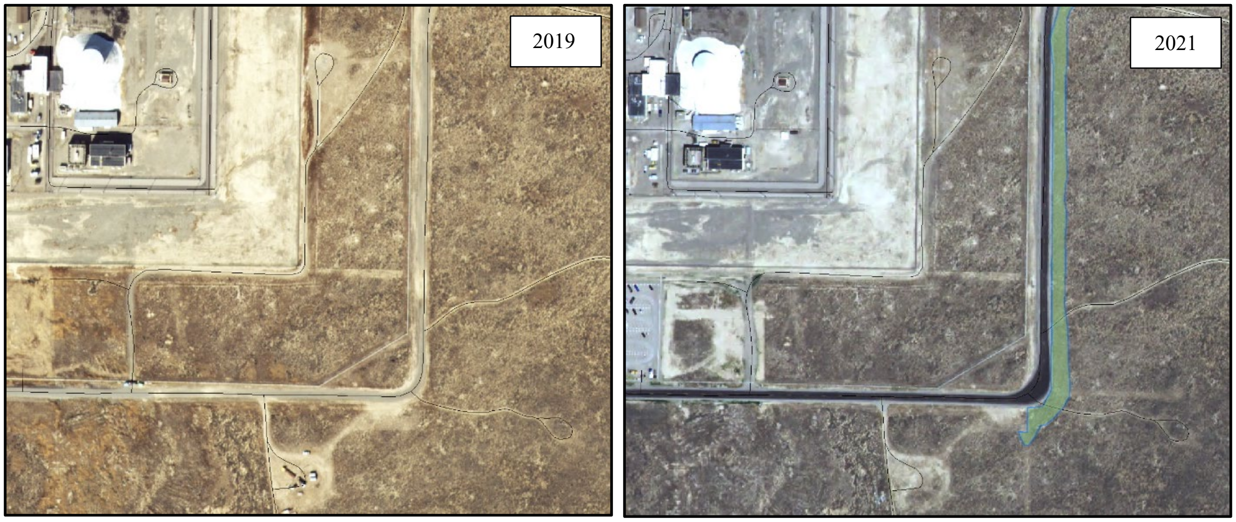


Figure 4-6. An example of sagebrush habitat loss from facility perimeter mowing on the Idaho National Laboratory Site. The transparent green overlay represents mapped loss of existing sagebrush habitat. The mapped loss at this location extends further north outside the extent of the image, and only a subset of the mapped area is presented.

There was a total of 32.6 km (20.3 mi) of new linear features mapped within the SGCA and/or existing sagebrush habitat (see Figure 4-7). The majority of new linear features consisted of spurs that dead-end or short cuts that were created between two existing roads. The longest linear feature mapped was a segment of the new Raghorn power line that was 3.7 km (2.3 mi), but it only partially overlapped with the existing sagebrush habitat outside the SGCA. The longest linear feature mapped within the

SGCA was 2.7 km (1.7 mi) and appears to be an access road that intersects existing roads on the INL Site and continues offsite to the east onto BLM lands. To maintain connectivity to the existing road network, this feature was mapped in multiple segments, which totaled 4.7 km (2.9 mi) within the SGCA (see Figure 4-8). These linear features are wider than a normal two-track (i.e., approximately 7-9 m) and it is unclear who was responsible for creating them or what their intended purpose was.

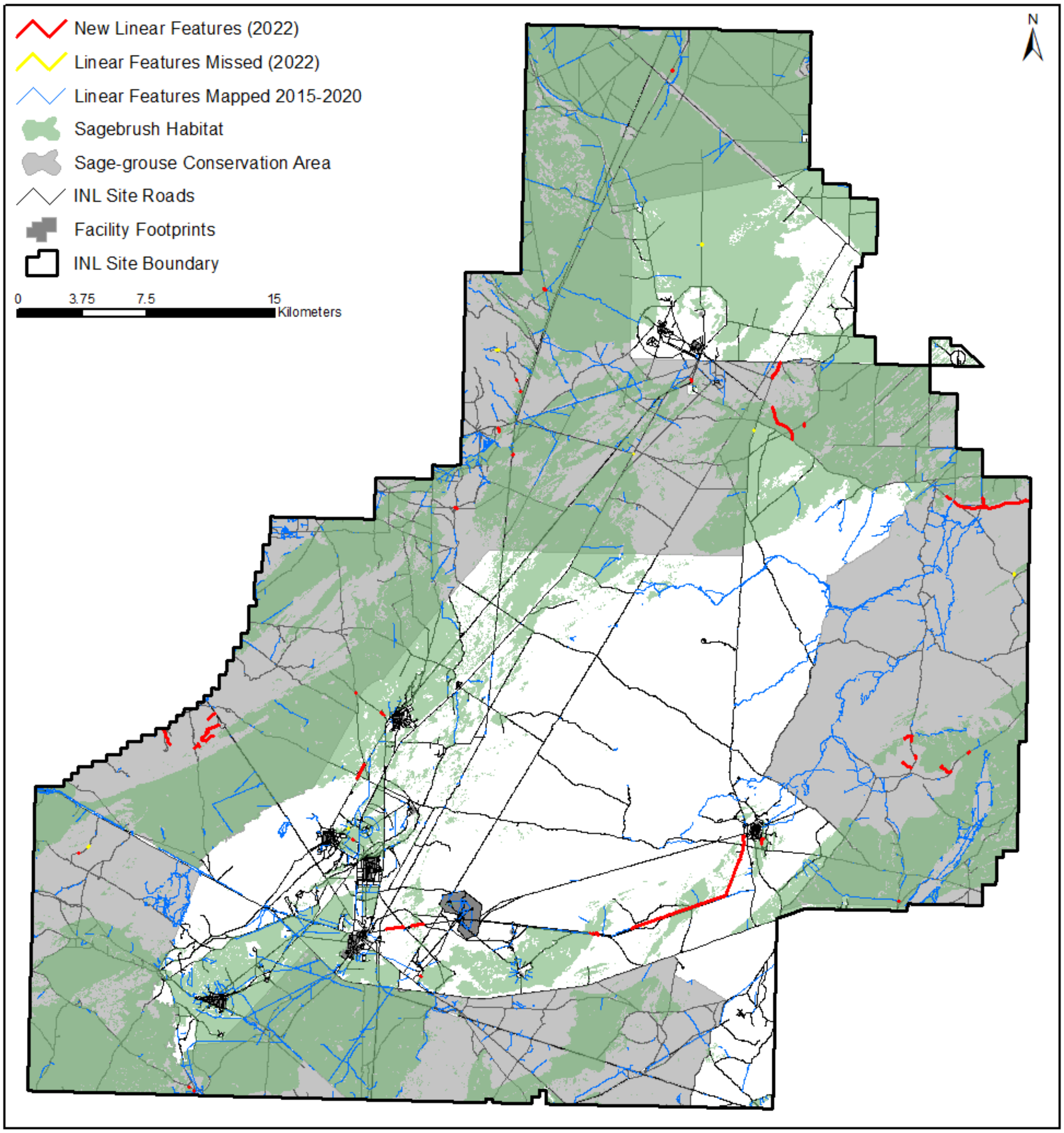


Figure 4-7. Two-track linear expansion mapped within the Sage-grouse Conservation Area or overlap with existing sagebrush habitat on the Idaho National Laboratory Site. The slightly darker green areas are where sagebrush habitat are coincident with the Sage-grouse Conservation Area.

Additionally, 0.8 km (0.5 mi) of linear features mapped this year within the SGCA and/or existing sagebrush habitat, but after cross-referencing these features with the previous 2019 NAIP dataset, we recognized these features were present, but not captured, during the last review process (see Figure 4-7). 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 differ between image tiles and the shadows cast by lower sun angles sometimes help illuminate linear features better, improving our ability to detect them. It is important to consider that while some of the newly observed two-track linear features are truly new, some of the other linear features mapped may be historic two-track roads that have only recently become more recognizable in imagery. Additional new linear features were identified on the INL Site in 2022; however, only features that are within or partially within either the SGCA or existing sagebrush habitat were included in this report.

4.2.4 Discussion

The mapped distance of new linear features was substantially less than 2020, which was the last time this monitoring was conducted, when 238.3 km (148.1 mi) of new features were reported (Shurtliff et al. 2021). The majority of new linear features reported in 2021 were associated with the 2020 wildland fire season and were created during firefighting or post-fire clean-up activities. There was only a slight increase in the total distance of linear features mapped from 2021 as compared to what was found in 2016 and 2018 where 7.4 km (4.6 mi) and 9.6 km (6 mi) were mapped, respectively (Shurtliff et al. 2017; Shurtliff et al. 2019). It is important to note that the expansion of new linear features this year includes sections of the Raghorn power line and from regions developed at the Carbon Free Power Plant site. While these areas both contributed to the mapped increase in linear features, they were both authorized infrastructure projects and not unexpected.

The 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. Continued monitoring with high resolution imagery will help us better understand the longevity of mapped two-track features, as well as what the implications may be to existing sagebrush habitat and recovering post-fire vegetation communities.

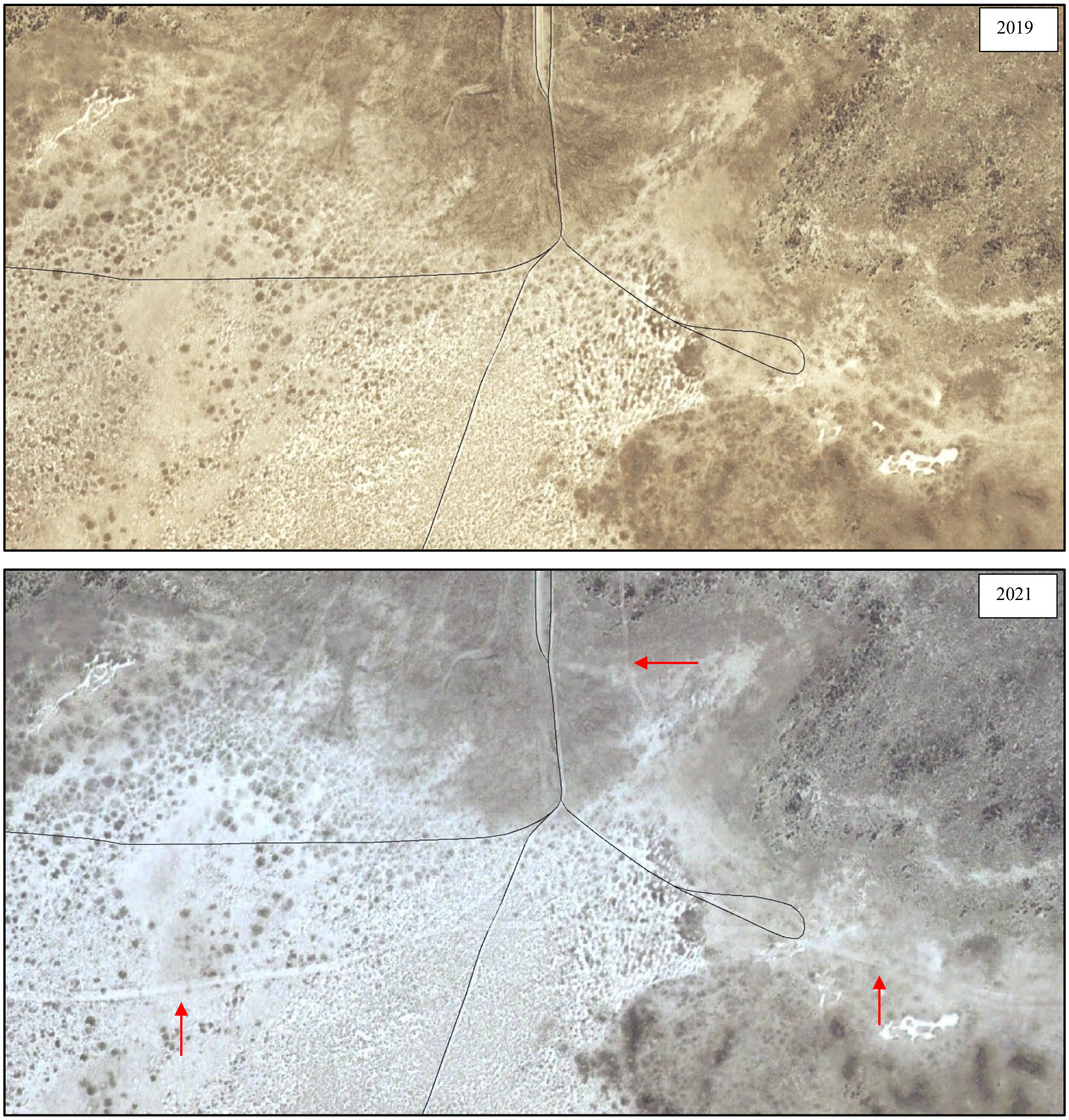


Figure 4-8. An example of new linear features mapped in the Sage-grouse Conservation Area on the Idaho National Laboratory Site between 2019 and 2021. The two arrows in the lower half of the 2021 image denote a portion of the longest linear feature mapped this year. The arrow on the upper half of the 2021 image shows another new linear feature identified as a standard two-track road. In comparison, the two-track linear feature is thinner than the new linear feature below it.

4.3 Task 5—Assessment of Potential Threats to Sagebrush Habitat

4.3.1 Introduction

Wildland fire is ranked as a high-level threat and livestock operations is ranked as a low-level threat to sage-grouse and their habitats on the INL Site (DOE and USFWS 2014). Vegetation condition is a component of monitoring and is reported annually to support the CCA; see Section 3.1 for annual monitoring results. Once every five years, potential impacts to habitat condition from threats like wildland fire and grazing impacts are evaluated. Initial analyses to support this task were completed in 2021 (INL 2022*a*), but those results suggested more detailed analyses would be useful for interpreting the potential effects of threats on habitat condition. Results from those detailed analyses are included in this section.

Habitat condition data are used to assess the potential effects of wildland fire and livestock opperations on habitats at the INL Site by comparing vegetation abundance among fire footprints and differences among grazing allotments through time. Data were organized into two distinct sample periods over the ten years in which habitat condition monitoring was collected. Vegetation monitoring plots are distributed such that the number of plots in each burned area, allotment, or combination thereof are roughly proportional to the amount of area they occupy (see Figure 4-9 and Figure 4-10). For example, the Twin Buttes Allotment is the largest allotment on the INL Site and the 2010 Jefferson Fire resulted in one of the largest burned areas on the INL Site, so there are more plots located in those areas than there are plots located in smaller allotments or burned areas. During the second sample period, the 2019 Sheep Fire burned a fifth of the vegetation monitoring plots, located in the interior of the INL Site. Prior to the Sheep Fire, a portion of these plots were sagebrush habitat while the others were recovering from previous wildland fires and all but two plots were unable to be sampled due to the Sheep Fire. The analyses accounted for the dynamic habitat status of each vegetation monitoring plot based on wildland fire activity.

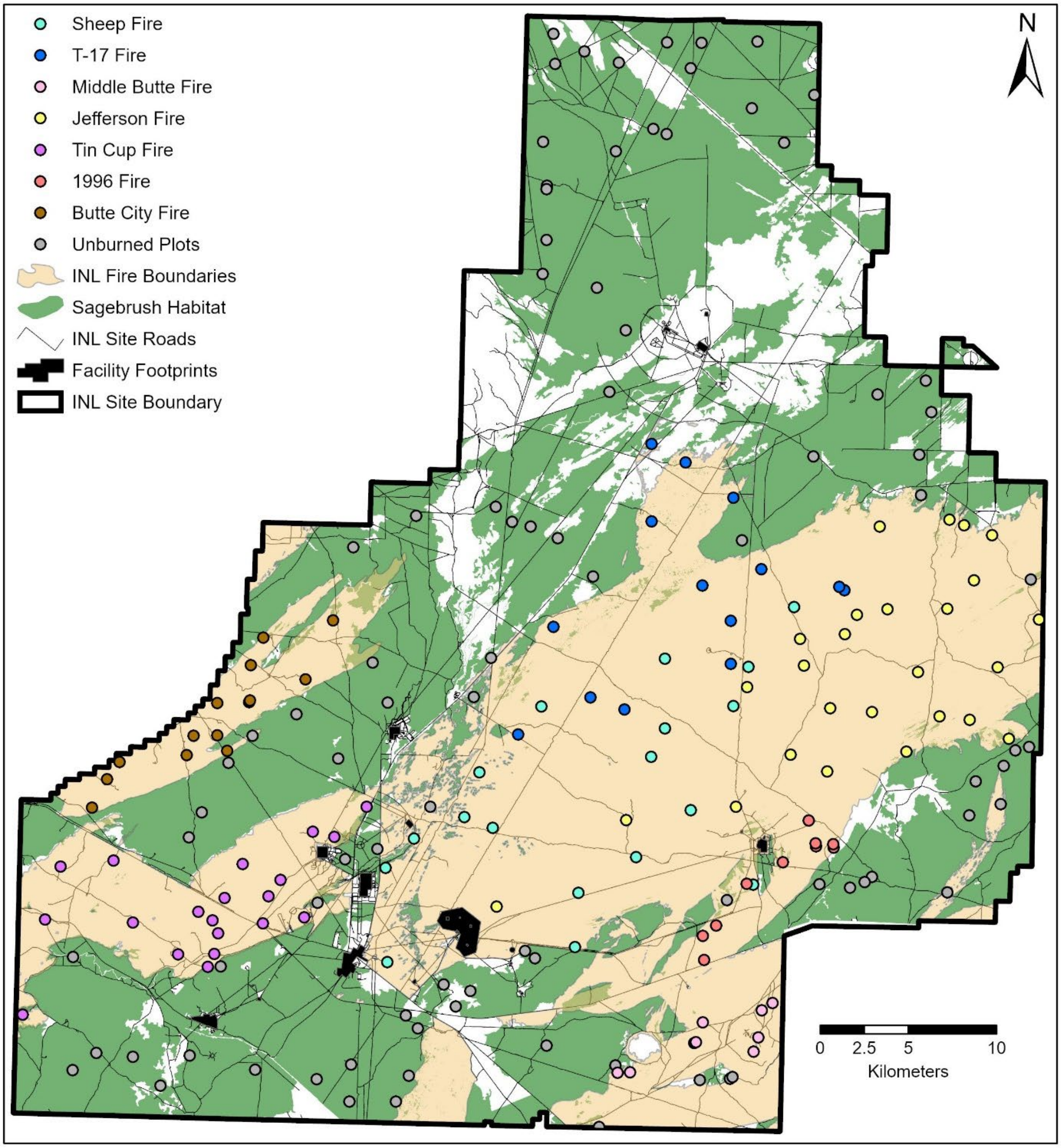
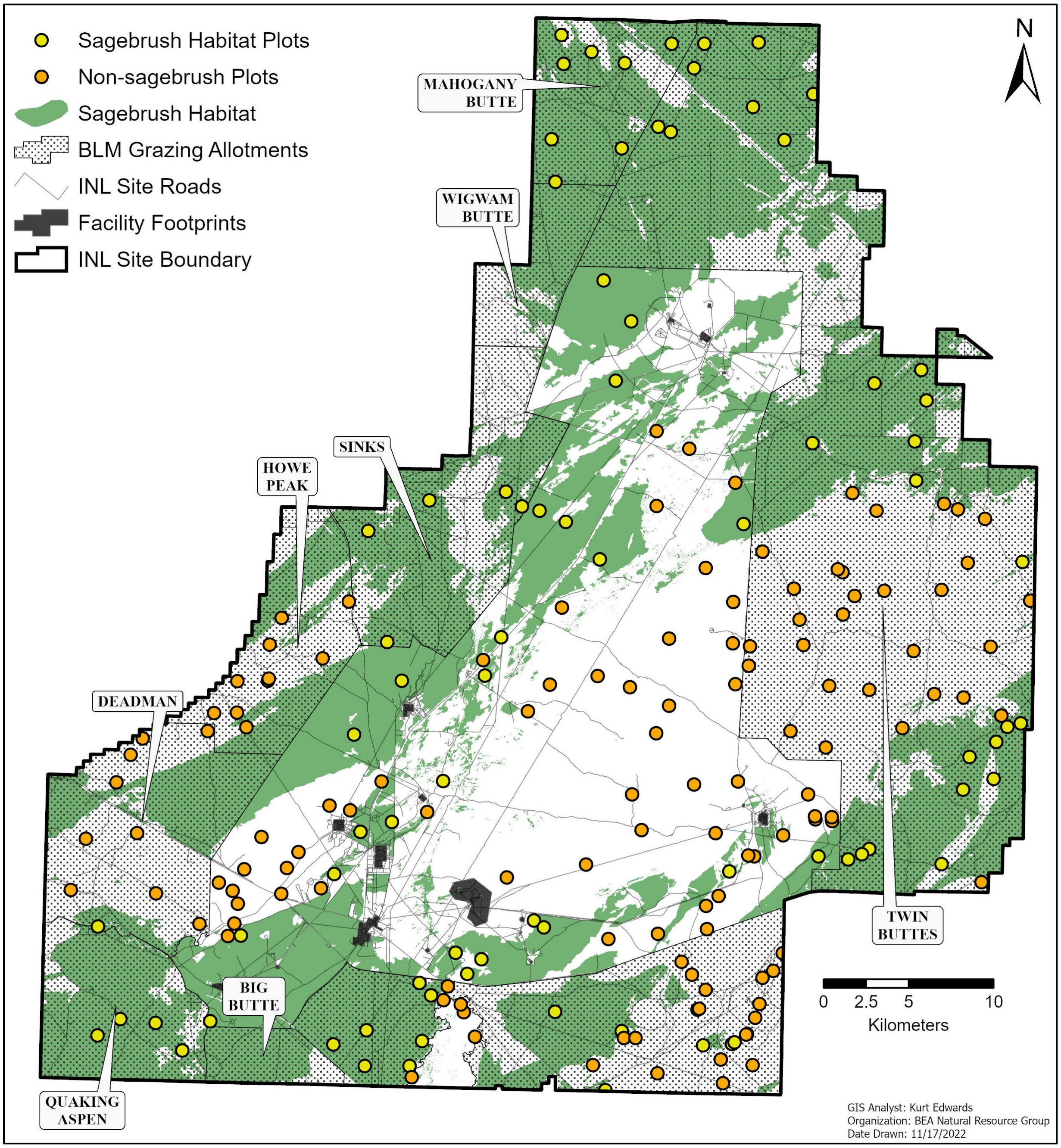


Figure 4-9. Distribution of sage-grouse habitat condition monitoring plots sampled on the Idaho National Laboratory Site with respect to areas burned since 1994.



GIS Analyst: Kurt Edwards
Organization: BEA Natural Resource Group
Date Drawn: 11/17/2022

Figure 4-10. Distribution of sage-grouse habitat condition monitoring plots sampled on the Idaho National Laboratory Site with respect to boundaries of grazing allotments administered by the Bureau of Land Management.

4.3.2 Methods

In 2013, there were 225 permeant habitat condition monitoring plots established across the INL Site and they are allocated into groups that are sampled on either an annual or rotational basis. There are 75 annual plots and an additional 150 rotational plots and the roational plots are subdivided into three subsets of 50 plots and each set of 50 plots is sampled per year over a three-year sample period. Sample period one for the rotational plots occurred from 2013–2015 and data collected from the annual plots in 2015 were also included in the analyses. Sample period two for the rotational plots occurred from 2018–2020 and analyses from this second period also include data from the annual plots collected in 2020. 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; see Appendix B).

Data from both sample periods were used to address progress toward habitat recovery in seven specific burned areas and the potential effects of livestock operations on habitat condition in burned and unburned areas. Cover is summarized by plant species and then grouped into vegetation functional groups (e.g., shrubs, perennial grasses, introduced forbs, etc.). Comparisons are made among plots potentially affected by fire and/or livestock through time using those functional group abundance values. Sample periods from burned areas were compared with unburned habitat and with one another using Two-way Repeated Measure of Analysis of Variance (One Factor Repetition) and Holm-Šidák (Šidák 1967) tests for all pairwise comparisons. The same statistical approach was used to compare functional groups within allotments and ungrazed areas outside of allotments.

4.3.3 Results and Discussion

Wildland Fire Threat Analysis

Ecological condition can be assessed by comparing composition of the plant community in terms of the ratio of native to introduced herbaceous species. Results from analyses using rotational plots suggested all functional groups were spatially and temporally dynamic, indicating there is a range of ecological condition among fire footprints (see Figure 4-11). Resprouting shrubs (i.e., ‘other shrubs’ functional group) and native perennial grasses functional groups dominated post-fire plant communities. Introduced annual grasses were abundant, but did not necessarily dominate in burned areas. The native perennial grasses functional group increased significantly between sample periods across most fire footprints and in unburned areas ($P < 0.001$) and cover was significantly greater in almost all the more recent burns when compared to older burn footprints or unburned areas ($P < 0.001$). Cover from the native perennial forb functional group cover was generally greater in the second sample period than the first sample period and it exhibited a significant increase from less than 1% to over 7% cover in unburned habitat ($P < 0.001$). Cover from the introduced annual grasses functional group increased from the first to the second sample period ($P < 0.001$) and increased significantly across four of the seven fire footprints (see Figure 4-11).

In addition to the ratio of native to introduced species, metrics like stability, diversity, and total non-native abundance also contribute to the interpretation of overall ecological condition of an area. Unburned areas generally have the lowest variation in total cover from one time period to another when compared with fire footprints (see Figure 4-11). Variation in total cover can be used as an indicator of stability, though responsiveness of cover within some functional groups to edaphic factors is also an important component of ecosystem health and function. Herbaceous functional groups were more abundant in more recent burns than in older burns. Resprouting shrubs cover tended to be greater in footprints of older wildland fire footprints than in footprints from more recent fires. These differences reflect the stage of recovery with respect to the time since the area burned.

Among the older burns addressed by this monitoring task, the 1996 Fire had significantly greater cover from the other shrub functional group as compared to other fire footprints and unburned areas ($P < 0.001$) and similar cover of native perennial grasses to unburned areas. The 1996 Fire footprint and unburned areas had significantly lower native perennial grass cover than other burned areas. The 1994 Butte City Fire had the second greatest abundance of other shrub functional group compared to other areas and cover values between sample periods were nearly equal for other shrub and native perennial grasses functional groups. The 2010 Middle Butte Fire had increases in the other shrub and native perennial grasses functional group cover while introduced functional group cover was similar between sample periods (see Figure 4-11). Native functional group cover values were comparatively similar between sample periods in the 2000 Tin Cup Fire, but cover for introduced annual grasses significantly increased between sample periods ($P < 0.001$).

Trends from the 2010 Jefferson Fire were more reflective of those in the more recent fires evaluated in this monitoring task. The 2010 Jefferson Fire had a significant increase in the cover of introduced annual grasses from sample period one to sample period two ($P = 0.031$). Native species are abundant in the 2019 Sheep Fire, but native perennial grass cover significantly decreased in sample period two ($P < 0.017$). However, it is likely premature to assess ecological condition based on monitoring data that were largely collected one growing season post wildland fire. Perennial grass cover can take several growing seasons post-fire to recover to pre-fire values, especially under sub-optimal abiotic conditions. Although non-native annual grass cover was lower on the Sheep Fire than on other burned footprints, it was not significantly so. Historical INL Site data sets indicate abundance of introduced species is often reduced for the first few years post-fire (Forman and Hafla 2018). In summary, the 1996 Fire and 2010 Middle Butte Fire areas have improved, but the 1994 Butte City Fire area has sub-optimal conditions, while the 2010 Jefferson Fire appears to have consistent vegetation condition when comparing composition between both sample periods.

Native functional groups generally had greater cover in unburned than burned areas. Substantial increases in native perennial grasses across all monitoring plots suggest differences in weather conditions between the sample periods is likely influencing their abundance. In recovering habitats, the other shrub and native perennial functional group cover trends are likely related to time since fire because there appears to be an inverse relationship between the cover values of each group. Annual trend analyses indicate introduced annual grass cover can greatly increase if favorable weather conditions are present in recovering habitat, but wildland fire markedly decreases abundance for several seasons post-fire (Forman and Hafla 2018) or under precipitation scenarios that do not favor the reproductive biology of introduced annual grasses, such as cheatgrass (see Figure 3-7). Cover from the introduced annual grasses functional group has a large range of annual variability but, while increases in cover between sample periods is concerning, it does not appear to be at the expense of native functional group abundance.

Results from these detailed analyses indicate that changes in the amount and timing of precipitation over the past decade appear to affect the ecological condition of recovering burned areas. In particular, the data continue to suggest that non-native annual productivity improves with late-summer and early fall precipitation in burned areas. Blew and Forman (2010) found that seasonal changes in precipitation timing may also reduce sagebrush recruitment in burned areas. A combination of increased non-native annual cover and reduced sagebrush recruitment would likely impact the time required for burned areas to develop sagebrush cover sufficient to support sage-grouse. If unusual precipitation events are related to climate change, then climate change may pose a concern for post-fire habitat recovery. For this reason, it will be important to continue to monitor post-fire recovery and to continue to explore strategies for facilitating habitat recovery on the INL Site.

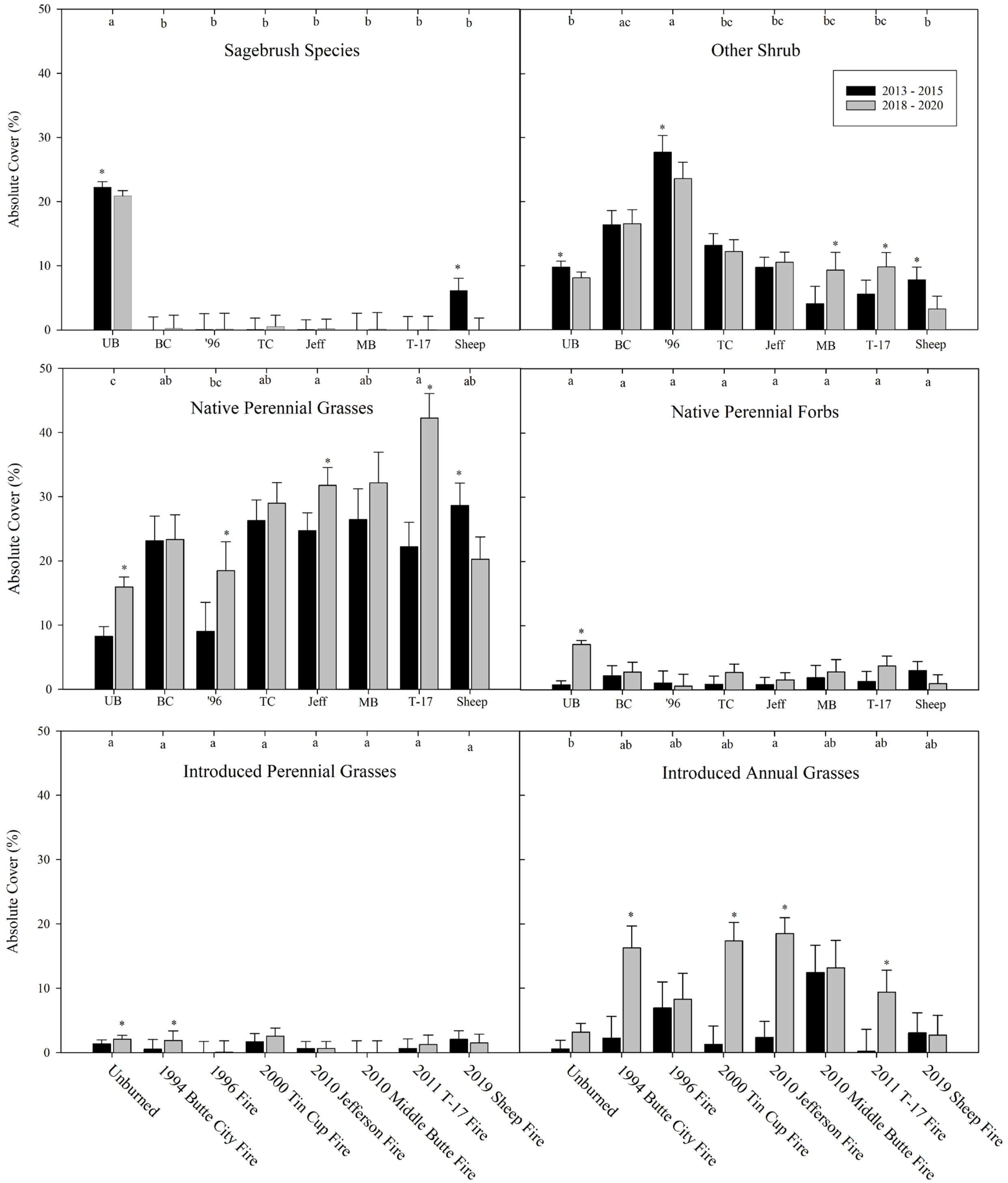


Figure 4-11. Cover by functional group for monitoring plots comparing unburned sagebrush habitat plots to seven wildland fires on the Idaho National Laboratory Site. The significance of pairwise multiple comparison results are indicated between wildland fires at $\alpha \leq 0.05$ by letters (a, b, etc.) and between sample periods at $\alpha \leq 0.05$ by an asterisk. Sample size is n = 89, 14, 10, 20, 27, 9, 14, and 17, respectively.

Livestock Use Threat

To address the potential effects of livestock on the condition of either current sagebrush habitat or non-sagebrush (burned) habitat at the INL Site, vegetation compostion was compared among several allotments and with areas outside of the allotments (see Figure 4-10). Because fire changes vegetation composition so markedly, these analyses were divided into current sagebrush habitat (see Figure 4-12) and areas that are in fire footprints (see Figure 4-13). Although areas of specific, localized degradation were observed in several allotments (often related to supplemental water, salt locations, and trailing routes), results from vegetation composition analyses indicated some changes in abundance patterns over time, but these were detected in all areas, inside and outside of allotments. Large areas within several of the allotments on the INL Site are not used by livestock, likely because they are difficult to access. Therefore, ecological condition in allotments may be a consequence of abiotic conditions and a lack of use as it is from specific grazing practices prescribed in allotments across the INL Site. Overall, fire appears to have had a greater immediate impact on sagebrush habitat than livestock use, but concentrated livestock use of recovering habitat likely facilitates patches of invasive species in habitats with lower invasion resilience.

Livestock Use Threat Analysis: Sagebrush Condition

Within current sagebrush habitat (see Figure 4-12), cover from the sagebrush functional group was comparable across areas outside of allotments and all allotments except for Twin Buttes ($P < 0.001$), which had significantly greater cover than areas outside of allotments. Between sample periods, sagebrush cover in areas outside of allotments decreased significantly from the first sample period to the second ($P = 0.036$). There was no significant cover difference between any of the allotments and ungrazed areas for the resprouting shrub (i.e., ‘other shrub’) functional group, but cover significantly decreased from the first sample period to the second ($P = 0.010$) within the ungrazed plots. Native perennial grasses functional group cover was not significantly different between allotments and ungrazed areas, but cover did significantly increase from the first sample period to the second period across all areas (Non-allotment $P < 0.001$; Twin Buttes $P < 0.001$; Mahogany Buttes $P < 0.001$; Quaking Aspen $P = 0.031$; Sinks $P < 0.001$). Introduced perennial grass cover increased slightly and the difference between sample periods was significant in the Twin Buttes Allotment ($P < 0.023$). Cover from the introduced annual grasses functional group was generally greater in the second sample period than the first, but the difference was only significant in the Twin Buttes Allotment ($P < 0.001$). Overall, cheatgrass contributed very little to overall vegetative cover within the sagebrush habitat.

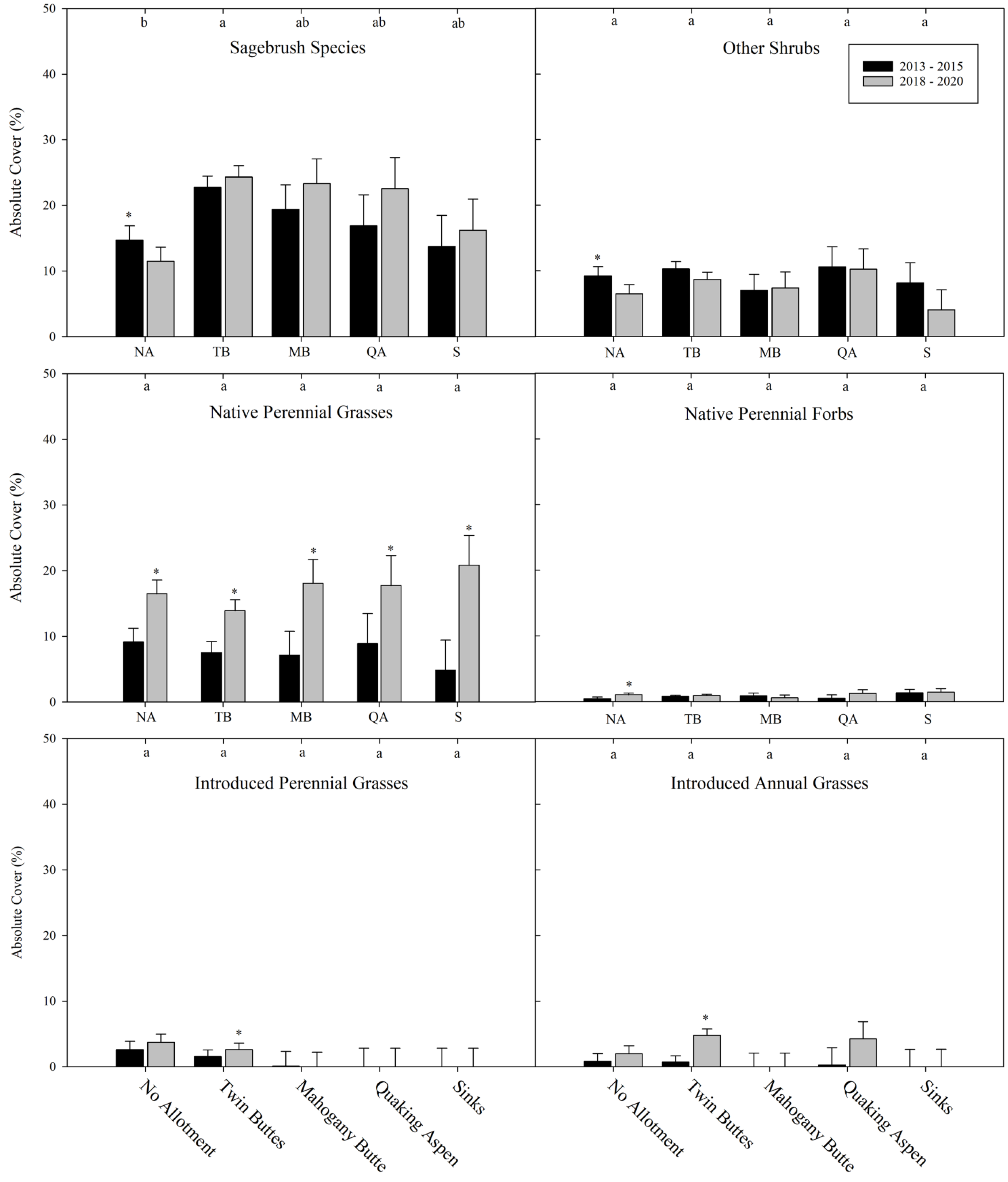


Figure 4-12. Cover by functional group for monitoring plots comparing four allotments with plots outside of allotments in unburned sagebrush habitat on the INL Site. Pairwise multiple comparison procedures indicate significant differences between allotments by letters (a, b, etc.) at $\alpha \leq 0.05$ and an asterisk between sample periods at $\alpha \leq 0.05$. Sample size is n = 24, 38, 8, 5, and 5, respectively.

Livestock Use Threat Analysis: Non-sagebrush Condition

Within non-sagebrush habitat, each functional group was not significantly different among allotments and the analogous ungrazed areas (see Figure 4-13). While the sagebrush functional group cover averaged less than 1%, the Twin Buttes Allotment had a statistically significant increase from sample period one to two, which may indicate early habitat recovery. Cover within the other shrub functional group was generally consistent between sample periods, but there was a significant increase in the Twin Buttes Allotment from the first to the second period. The native perennial grasses functional group cover significantly increased from sample period one to sample period two within the ungrazed area and in the Twin Buttes Allotment ($P = 0.007$, $P = 0.031$). While the Howe Peak Allotment had significantly greater introduced perennial grass cover in the second sample period than in the first sample period, the difference is likely driven by a single monocultural plot and there were no significant differences detected between allotments or ungrazed areas. Cover within the introduced annual grasses functional group increased significantly in nearly all allotments and ungrazed areas from the first to second sample period ($P < 0.001$) except for the Dead Man Allotment. Habitats recovering from wildland fires generally have greater cover from introduced species than unburned areas and the magnitude of fluctuation in cheatgrass cover values are more variable from one year to the next within burned areas compared to intact sagebrush habitat (see Figure 4-11). The significant increase in cheatgrass cover is likely amplified in the burned areas because the lack of sagebrush cover reduces invasion resistance. It should be noted that cheatgrass abundance is strongly related to precipitation amount and timing. Precipitation patterns were likely more favorable for cheatgrass germination and establishment in the second sample period than the first, so this result may represent a fluctuation rather than a directional trend.

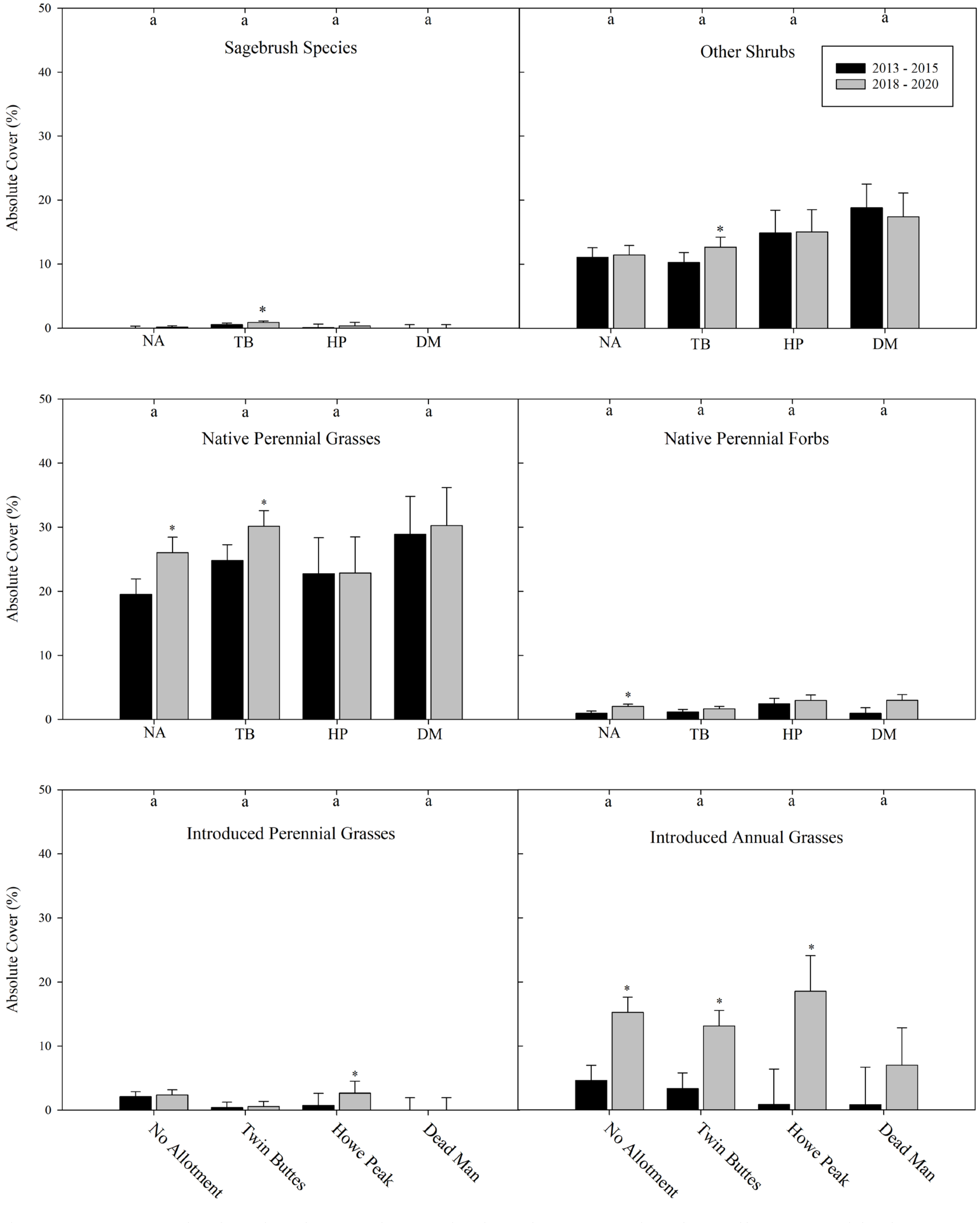


Figure 4-13. Cover by functional group for monitoring plots comparing three allotments with plots outside of allotments in burned and recovering, non-sagebrush vegetation on the INL Site. Pairwise multiple comparison procedures indicate significant differences between allotments by letters (a, b, etc.) at α ≤ 0.05 and an asterisk between sample periods at α ≤ 0.05. Sample size is *n* = 56, 52, 10, and 9, respectively.

5. IMPLEMENTATION OF CONSERVATION MEASURES

5.1 Summary of 2022 Implementation Progress

The CCA identifies eight threats to sage-grouse and its habitats on the INL Site and 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 (see Table 5-1) summarizes actions and accomplishments associated with each conservation measure that DOE, its contractors, and stakeholders achieved during 2022 to reduce threats to sage-grouse and its habitats on the INL Site.

Table 5-1. Accomplishments in 2022 for each CCA conservation measure.

<table>
<tr><td>Threat:</td><td>Wildland Fire</td></tr>
<tr><td>Objective:</td><td>Minimize the impact of habitat loss due to wildland fire and firefighting activities.</td></tr>
<tr><td>Conservation Measures:</td><td>(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 ac).</td></tr>
<tr><td colspan="2">Conservation Measure 1—Accomplishments in 2022:
<u>BURN ASSESSMENT</u>—No fires occurred on the INL Site in 2022 (Personal Communication with James Blair, INL Fire Chief 10/03/2022).
Associated Actions that Addressed the Wildland Fire Threat:
<u>WILDLAND FIRE PREPAREDNESS</u>—In order to slow wildland fire and provide for a better defense area, fire breaks/buffers have been created and are routinely maintained around facilities and along major roadways. In 2022, BEA Facilities and Site Services (F&SS) mowed 6–12 m (20–40 ft) firebreaks along 190 km (118 mi) of roadways and around 27 facilities and other infrastructure.
<u>UPDATE THE INL APPROACH TO FULES MANAGEMENT, FIRE SUPRESSION, AND FIRE REOCOVERY</u>—To better address preparedness, response, and recovery from wildland fires, the INL Fire Department is updating an existing plan for fuels management and fire suppression and the Natural Resources Group is drafting a fire recovery framework for the INL Site. A new Environmental Assessment (EA) will evaluate the proposed actions contained in both plans.
<u>POST-FIRE ADAPTIVE MANAGEMENT</u>—Areas within the Twin Buttes and Deadman grazing allotments that were burned by the 2019 Sheep Fire, and the 2020 Telegraph and Lost River Fires, were reopened to grazing during the 2022 spring and fall grazing seasons (Personal Communication with Jordan Hennefer, Rangeland Management Specialist, BLM, November 2, 2021).
<u>SAGEBRUSH REESTABLISHMENT</u>—INL planted 45,000 seedlings within the 2019 Sheep Fire area and 41,300 seedlings in the 2020 Telegraph Fire to support habitat restoration efforts. Weed control efforts continue in recently burned areas. A subset of sagebrush seedlings planted in 2021 and 2017 were revisited in 2022, and 1-year and 5-year survivorship was assessed (Section 5.2.2).</td></tr>
<tr><td>Threat:</td><td>Infrastructure Development</td></tr>
<tr><td>Objective:</td><td>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.</td></tr>
<tr><td>Conservation Measures:</td><td>(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.</td></tr>
</table>

Table 5-1. (continued).

Conservation Measure 2—Implementation of Best Management Practices in 2022:

Multiple projects in FY 2022 adopted and implemented best management practices outside facility footprints to minimize the impacts to both seasonal and potential habitats on the INL Site.

The following infrastructure projects were designed so that the total distance of habitat edge caused by construction activities was minimized:

- Test Area North (TAN)-691 maintenance and vehicle-storage building (Environmental Compliance Permit [ECP] INL-20-035 R3) was sited immediately adjacent to the SMC fence.
- The new Power Management Building (ECP INL-21-053) was sited within CFA's administrative boundary adjacent to existing roads and power infrastructure.
- The new TAN Utility Corridor (ECP INL-22-009 R1) was sited adjacent to linear disturbances, such as power line infrastructure and fences.
- The ATR Complex Parking Lot Refurbishment and Expansion project (ECP INL-22-045) was sited within and around the existing ATR parking lot.
- The TAN Fire Station Training Pad (ECP INL-22-062) was sited in areas disturbed by the construction of the TAN fire station.
- The Consolidated Training Facility at the Live Fire Range Complex (ECP INL-22-078) was sited immediately adjacent to the existing range, roads, and power infrastructure.
- The Transient Reactor Test (TREAT) Operation and Maintenance Modular Office Building (ECP INL-22-093) was sited adjacent to existing TREAT infrastructure.

The following infrastructure projects were co-located with existing infrastructure and/or were sited in areas dominated by non-native grasses and other exotic species:

- The Electric Vehicle Charging Station Installation at CFA (ECP INL-20-018 R1) was placed in previously disturbed areas within the CFA administrative boundary.
- Infrastructure associated with the Cyprus Yeti project (ECP INL-21-087 R1) was sited within the previously developed Bode test bed.
- The Radiological Response Training Range – New City Landscape Training Pad (ECP INL-21-139) was sited within the previously defined administrative area of the T-28 south borrow pit.
- Areas Associated with USG #121 Test (ECP INL-22-022) were sited only in previously disturbed footprints.
- The GANNETT project (ECP INL-18-059 R3) was sited in areas dominated by crested wheatgrass.
- The PBF-622 and PBF-623 Fiber Optic Cable Installation (ECP INL-18-113 R3) took place in areas already covered by asphalt.
- The TREAT upgrade of 721, 721A, and 724 Electrical Distribution System Power Feed project (ECP INL-22-092) sited new infrastructure within existing power infrastructure corridors.

Best Management Practices employed by INL Power Management Activities in 2022 (ECP INL-21-067 R1) included the installation of avian protection devices where possible. Additionally, the Carbon Free Power Project (CFPP) Site Characterization revision 4 (ECP INL-19-067 R4) installed perch deterrents on their meteorological tower.

Nine projects conducted activities during FY 2022 that had the potential to impact sagebrush habitat. Following project activities, an assessment to determine total area impacted will be required, and results will be reported in a future CCA Annual Report, Compensatory Mitigation Section.

- <u>COMPENSETORY MITIGATION</u>: In addition to sagebrush seedlings planted in support of Conservation Measure 1, 11,400 sagebrush seedlings paid for by projects through compensatory mitigation were planted in areas burned by the Middle Butte Fire and the Twin Buttes Fire. These sagebrush seedlings were paid for by the Raghorn power line project (DOE/EA-2097). An additional 2,300 seedlings were paid for by F&SS to round the total number of seedlings planted in 2022 to 100,000 (see Section 5.2.2). Additionally, INL has developed and issued a Program Requirements Document entitled, "Evaluation, Determination, and Implementation of Sagebrush Compensatory Mitigation Commitments" (INL 2022*b*) to guide the INL Management and Operations Contractor through a sagebrush compensatory mitigation process.

Table 5-1. (continued).

<table>
<tr><td colspan="2">**Conservation Measure 3—Accomplishments in 2022:**
Two projects initiated infrastructure development within the SGCA in 2022. DOE was consulted on the preferred siting for each location. As required by the CCA, DOE consulted with the USFWS on how to minimize impacts to sage-grouse. The two projects were the USGS Geotechnical Drilling for USGS 153 (ECP INL-22-025) and the Water Reactor Researcher Test Facility Test Pad Improvements (ECP INL-21-143).</td></tr>
<tr><td>Threat:</td><td>Annual Grasslands</td></tr>
<tr><td>Objective:</td><td>Maintain and restore healthy, native sagebrush plant communities.</td></tr>
<tr><td>Conservation Measures:</td><td>(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]).</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>Threat:</td><td>Livestock</td></tr>
<tr><td>Objective:</td><td>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.</td></tr>
<tr><td>Conservation Measures:</td><td>(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.</td></tr>
<tr><td colspan="2">**Conservation Measure 6—Accomplishments and Disturbances in 2022:**
LEK DISTURBANCE: During the 2022 sage-grouse lek counts, biologists did not observe livestock on any of the leks between March 20 and May 15.
COMMUNICATION & COLLABORATION: DOE and BLM continued to collaborate on updating their Memorandum of Understanding for management of land currently occupied by the INL Site. DOE and INL supported BLM in initiating restoration of a section of Birch Creek where herbaceous understory has been lost and erosion is a concern, as well as repairing a section of road that has experienced widening by off-road travel. INL and BLM have also collaborated on spraying noxious weeds in infested areas of the INL Site.
RANGELAND IMPROVEMENTS: DOE supported a 2019 decision made by BLM to permit installation of an underground pipe to maintain water troughs in the Deadman and Quaking Aspen allotments and to construct a fence in the Deadman Allotment. An EA (DOI-BLM-ID-I010-2021-0008-EA) for the project has been completed and the legal appeal dismissed by the court. The water distribution portion of the project will allow for a more reliable water source resulting in better livestock distribution and less road traffic. The fencing portion of the project will restrict cattle from entering the Big Lost River channel and culturally sensitive areas (Personal Communication with Jordan Hennefer, Rangeland Management Specialist, BLM, 10/10/2022). Fencing will include high visibility markers and be wildlife-friendly.</td></tr>
<tr><td>Threat:</td><td>Seeded Perennial Grasses</td></tr>
<tr><td>Objective:</td><td>Maintain the integrity of native plant communities by limiting the spread of crested wheatgrass.</td></tr>
<tr><td>Conservation Measure:</td><td>(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.</td></tr>
</table>

Table 5-1. (continued).

Conservation Measure 7—Accomplishments in 2022: BEAs Natural Resources Group assisted projects by recommending a project-specific native perennial seed mix list for revegetation work. It is mandatory that all seed mixes exclude crested wheatgrass seed.	
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 2022: INL complied with seasonal and time-of-day restrictions associated with sage-grouse. Per "Idaho National Laboratory Gravel/Borrow Pits (Overarching) Environmental Checklist (EC)" (ECP INL-19-155), 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. The borrow sources at Adams Boulevard, Lincoln Boulevard, Monroe Boulevard, Ryegrass Flats, T-12, and T-28 South are covered by this EC. **Conservation Measure 9—Accomplishments in 2022:** No new borrow pits or landfills were opened in 2022. Historically, sage-grouse leks have been observed in three borrow pits: T-12, Adams Blvd., and Ryegrass Flats. The T-12 and Adams Blvd Pits were closed during the spring of 2022; however, source material was removed from the Ryegrass Flats borrow pit after 9 a.m. and before 6 p.m., complying with seasonal restrictions. 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 EA for Silt/Clay Development and Use (DOE-EA-1083). Although no borrow pits were expanded beyond the defined boundary in 2022, an expansion beyond the defined boundary of T-12 pit was proposed by the Subsurface Disposal Area Borrow Source Actions (EC ICP-22-004) located at the T-12 pit and Adams Blvd. pit. Any expansion of gravel or borrow pits that would disturb surface soil or vegetation also requires a Cultural Resource Review by the Cultural Resource Management Office and Biological Resources Review by the Natural Resources Group. INL F&SS 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 NOAA to opportunistically reduce raven nesting on power lines and towers and at facilities. (11) Instruct 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.

Table 5-1. (continued).

<table>
<tr><td colspan="2">Conservation Measure 10—Accomplishments in 2022:
During 2022, 18 transmission structures on the west loop between CFA and TAN were retrofitted with avian protection devices that preclude nesting. In total, avian protection devices, all of which are not relevant to deter raven nesting, have been installed on 28.5% of distribution structures and 9.9% on transmission structures (Email Communication with Amy Wasia, Power Maintenance, October 20, 2022).
Conservation Measure 11: Completed</td></tr>
<tr><td>Threat:</td><td>Human Disturbance</td></tr>
<tr><td>Objective:</td><td>Minimize human disturbance of sage-grouse courtship behavior on leks and nesting females within the SGCA and 1 km (0.6 mi) lek buffers.</td></tr>
<tr><td>Conservation Measures:</td><td>(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 lb) 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.</td></tr>
<tr><td></td><td>(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.</td></tr>
<tr><td colspan="2">Conservation Measures 12 and 13—Accomplishments in 2022:
The CFPP site is located within the SGCA. Multiple site characterization activities took place between April 1 and June 30. All activities were approved by DOE following consultation with USFWS on how to mitigate risks to sage-grouse.
All unmanned aerial vehicle flights conducted at the Unmanned Aerial System runway or at the National Security Test Range (NSTR) met all CCA requirements by conducting flights above 305 m (1,000 ft), after 9 a.m. and before 6 p.m., or beyond the 1 km (0.6 mi) sage-grouse active lek buffer distance. All other overflights planned their flight paths to avoid sage-grouse leks and lek buffers.
Detonations of explosives greater than 1,225 kg did not occur at the NSTR between 9 p.m. and 9 a.m. from March 15 to May 15.
No meteorological, sound detection and ranging, or other cell towers were erected within 1 km (0.6 mi) of a sage-grouse lek or the SGCA during 2022.</td></tr>
</table>

5.2 Reports on Projects Associated with Conservation Measures

Since the CCA was signed, DOE and its contractors have implemented activities on an as-needed or recurring basis to reduce impacts to sage-grouse habitats and to support the objectives of all Conservation Measures.

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

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 a medium-level threat to sage-grouse in the CCA. Cheatgrass is currently the primary introduced annual grass of concern on the INL Site. Although cheatgrass 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.

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 EA (DOE 2003), which was drafted after four notable fires. The CCA represented the next major effort to address the effects of wildland fire on natural resources and it included a conservation measure by which DOE committed to prepare an assessment evaluating the need for post-fire restoration and present options for hastening sagebrush reestablishment on fires larger than 40 ha (99 ac; see Table 5-1).

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), which prompted the development of the first ecological resources recovery plan for the INL Site since the CCA was signed. The recovery plan was designed to address the CCA wildland fire conservation measure and to comply with the INL Wildland Fire EA (DOE 2003). This plan was phased for implementation over five years and allowed the WFMC flexibility in prioritizing recovery actions based on available funding and other wildland fire management priorities.

Several natural resource recovery goals were identified within the Sheep Fire Ecological Resources Post-Fire Recovery Plan (Forman et al. 2020). These recovery goals incorporated results of the ecological impacts assessment and they were organized into four primary recovery objectives: (1) soil stabilization for erosion and weed control on containment lines immediately post-fire; (2) cheatgrass and noxious weed control within the larger burned area; (3) native herbaceous recovery; and (4) sagebrush habitat restoration. To achieve natural resource recovery goals, a number of treatment options were provided within each recovery objective. The structure and organization of the plan, as well as the process of prioritizing treatment actions, were useful to the WFMC for identifying which treatment actions to implement. Therefore, subsequent post-fire ecological recovery plans continue to utilize this framework. Occasionally, restoration activities are also completed in areas impacted by wildland fires that occurred more than five years ago, for which the wildland fire recovery plan has expired or for which a plan was never drafted. This section of the report contains a summary of the existing fire recovery plans, ongoing restoration actions, and initial monitoring results for all wildland fires requiring ecological resource recovery plans within the past five years and for older wildland fires with any ongoing treatment activity.

2020 – Multiple Fires

Fire Summary and Post-Fire Restoration Planning

In 2020, there were five wildland fires on the INL Site larger than 1,000 m^2 (0.25 ac), and they ranged in size from 11 ha (27.1 ac) to 677.9 ha (1,675.1 ac). 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-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. 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 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 Forman et al. (2021) for a more thorough description of the 2020 INL Site fires, including discussion of timing, conditions, location, fire boundaries, and estimates of sagebrush habitat lost.

An ecological resources post-fire recovery plan was completed for the four fires (Forman et al. 2021). The WFMC met to review the 2020 Wildland Fires Ecological Resources Recovery Plan and prioritize several of the restoration options provided therein. Most emergency soil stabilization actions were completed immediately after the 2020 wildland fires, prior to completion of the plan. Additional post-fire recovery actions prioritized by the committee included noxious weed treatment throughout the burned areas of each fire and sagebrush seedling planting to expedite habitat recovery in the Telegraph Fire.

Emergency Stabilization and Noxious Weed Control

A soil stabilization recommendation that is still outstanding includes monitoring temporary fire suppression access roads for natural recovery and considering signage and replanting if necessary. This recommendation will require evaluation after a few growing seasons to determine whether it is necessary.

In 2022, weeds were monitored and sprayed with an appropriate chemical by certified applicators in the Howe Peak Fire, Telegraph Fire, and Lost River Fire. Spraying efforts focused on rush skeletonweed (*Chondrilla juncea*) because it was identified as being of particular concern by neighboring stakeholder agencies. Musk thistle (*Carduus nutans*) is also widespread throughout post-fire plant communities at the INL Site and was addressed during the 2022 growing season as well. Canada thistle (*Cirsium arvense*), black henbane (*Hyoscyamus niger*), Russian knapweed (*Acroptilon repens*), and spotted knapweed (*Centaurea stoebe*) were much less abundant, but were also identified and treated within the areas affected by the 2020 wildland fires.

Cheatgrass Control

There were no specific recommendations related to cheatgrass treatment made in the 2020 Wildland Fires Ecological Resource Recovery Plan. Cheatgrass was a substantial component of the plant community prior to wildland fire in two of the 2020 fires, increasing the likelihood of post-fire cheatgrass dominance. Cheatgrass treatment was not recommended in the Howe Peak Fire because areas at high risk of post-fire cheatgrass dominance are adjacent to agricultural properties that could be impacted by inadvertent chemical drift. In the Lost River Fire, the areas at high risk of post-fire cheatgrass dominance are used regularly by livestock. Livestock water and supplements would need to be moved before cheatgrass treatment would be effective at this location. Cheatgrass treatments were not considered for the Telegraph and Cinder Butte Fires because cheatgrass was a minor component of the pre-fire plant community.

Sagebrush Habitat Restoration

The area burned in the Telegraph Fire was dominated by sagebrush with a diverse, native understory prior to the fire. It is also in proximity to an active sage-grouse lek and was used extensively by radio-collared sage-grouse pre-fire (BLM unpublished data). Planting sagebrush, where logistically feasible, would improve habitat value in proximity to the active lek, would provide some habitat connectivity across the burned area, and could shorten natural recovery times in areas adjacent to the planting by increasing potential sagebrush seed sources. In contrast, because of current herbaceous conditions or the context of the area surrounding the fire, sagebrush seedling planting is not likely to make a substantial impact toward improving sagebrush habitat, increasing habitat connectivity, or reducing habitat recovery time on the Howe Peak Fire, Lost River Fire, and Cinder Butte Fire. See Forman et al. (2021) for more detailed discussion.

Sagebrush seedling planting on the Telegraph Fire was completed in October 2022 using local seed collected in November 2020. Approximately 41,300 seedlings were planted where there weren't abundant unburned islands and access was reasonable. See Section 5.2.2 for additional detail.

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. Based on post-fire delineation of aerial imagery collected the following September, it burned an estimated 40,403 ha (99,839 ac). A post-fire ecological resources recovery plan was developed and the WFMC prioritized several recovery actions addressing emergency stabilization, noxious weed control, areas at high risk for cheatgrass dominance, and hastening the recovery of sagebrush habitat. For details about the Sheep Fire, the post-fire ecological assessment, and the recovery options recommended to facilitate wildland fire recovery, see Forman et al. (2020). In 2022, ongoing recovery actions included noxious weed control and sagebrush habitat restoration.

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 EA (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.

During a post-Sheep Fire scoping meeting in 2019, local stakeholders raised a concern about rush skeletonweed invading recently burned areas on the INL Site, as this noxious weed is becoming increasingly problematic in adjacent rangelands. Noxious weed control is an annual land management task across the INL Site; however, the Sheep Fire burned area has been a primary focus since 2020. Noxious weed control will continue to be implemented through the Sheep Fire Ecological Resources Post-Fire Recovery Plan and other INL Site weed control programs.

Cheatgrass Control

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 treatment 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. 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, INL began addressing processes and work controls necessary to perform this type of work and sprayed some initial test patches in 2021.

Additional NEPA evaluations will be required before pre-emergent chemicals can be aerially applied to cheatgrass at the INL Site. However, F&SS applied Indaziflam (Esplanade SC©) to high priority cheatgrass treatment areas within the Sheep Fire footprint. In September 2021, cheatgrass was sprayed in a swath extending 6.1 m (20 ft) on each side of the road for a total of 8 km (5 mi) along sections of T-3 and T-24, resulting in 9.7 ha (24.0 ac) receiving application. Though restrictions on off-road travel prevented applying chemical throughout the entire prioritized treatment area with a vehicle, sufficient area was treated to test the use of the chemical and application methodology and evaluate their efficacy in the coming years.

Sagebrush Habitat Restoration

In the winter of 2019/2020, DOE worked with stakeholders to aerially seed 10,100 ha (25,000 ac) of the Sheep Fire within and adjacent to the SGCA. Unfortunately, monitoring efforts in 2020 and 2021 found no seedlings that could be attributed to the aerial seeding effort. Additional details about the aerial seeding and initial monitoring efforts can be found in the Sheep Fire Ecological Resources Post-Fire Monitoring Report (Forman et al. 2020).

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. In 2020, the WFMC directed DOE's Environmental Surveillance, Education, and Research Program to develop a plan for planting sagebrush seedlings in high priority restoration areas on the Sheep Fire in 2021 and 2022. Six areas were identified as a high priority for sagebrush seedling planting in the Sheep Fire. The proposed planting sites were selected based on CCA priority restoration areas, logistics and access, ecological condition of the recovering herbaceous plant community, and agency stakeholder input (Kramer et al. 2021). Local sagebrush seed was collected in the fall of 2020 and in 2021 and it was delivered to a greenhouse to grow seedlings. A total of 45,000 seedlings were planted in the Sheep Fire in October 2021 and another 45,000 were planted in October 2022. Section 5.2.2 contains additional information about planting rates and site conditions.

Pre-2018 – Older Fires

There is ongoing treatment activity on several older wildland fires for which recovery plans were not written or have expired. Noxious weeds continue to be treated and monitored across the INL Site, and previously burned areas are typically prioritized because areas lacking sagebrush tend to be less resilient to weed invasion. Occasionally, sagebrush is also planted in areas that burned more than five years ago. The reasons for planting older burned areas may vary but are often related restoring important habitat. In 2021, for example, sagebrush was planted in the 2010 Jefferson Fire as part of a collaborative partnership with IDFG and Pheasants Forever to improve sage-grouse wintering habitat. In 2022, approximately 12,000 sagebrush seedlings were purchased as compensatory mitigation for construction of the Raghorn powerline. These seedlings were planted in October of 2022 in an area between East Butte and Middle Butte. Most of the area had burned in the 2007 Twin Buttes Fire and slightly more than half of the area burned again in the 2010 Middle Butte Fire. This area was selected for compensatory mitigation because it is in the SGCA and there were active sage-grouse leks nearby prior to these wildland fires. See Section 5.2.2 for a map of the planted area, as well as additional planting details.

Programmatic Changes to Facilitate Treatment and Improve Ecological Recovery

Emergency wildland fire response and associated soil stabilization actions are addressed in the INL Wildland Fire EA (DOE 2003); however, many of the post-fire recovery options presented in the Sheep Fire Ecological Resources Post-Fire Recovery Plan and the INL 2020 Wildland Fires Ecological Resources Recovery Plan are not. Currently each non-emergency post-fire recovery action is subject to additional NEPA review. Although this approach was adequate at the time the 2003 EA was signed, there have been changes in fire frequency and land cover over the past twenty years, making this approach to wildland fire recovery less effective. A much larger portion of the INL Site has burned since the 2003 INL Wildland Fire EA was implemented, and the resulting vegetative changes across the INL landscape require different fire preparedness and suppression strategies than have been used in the past. Recent sagebrush habitat loss has also resulted in an increased focus on the importance of habitat protection.

Given the changing ecological conditions at the INL Site and the number of post-fire recovery actions that were recommended by the WFMC after the Sheep Fire and the 2020 Fires, INL has identified the need to update their wildland fire recovery approach and associated NEPA assessment. This would facilitate a more comprehensive and efficient planning and response effort for fuels management, fire suppression, and post-fire restoration in the future. The INL Fire Department and the Natural Resources Group were tasked with scoping the fire management and ecological restoration tools considered appropriate for use in preparation for and in response to future fires.

The INL Natural Resources Group is developing a generalized post-fire ecological resources recovery framework that will include all post-fire restoration actions that should be considered to improve post-fire recovery, including emergency post-fire stabilization and ongoing habitat restoration. Through a series of internal stakeholder meetings, the restoration options included in the framework were discussed and approved by several INL and DOE technical professionals representing a range of organizations that may be involved in drafting and implementing specific post-fire recovery plans. The recovery framework along with updates to INL's Wildland Fire Management Plan (PLN-14401) will be evaluated in a new EA. Not all actions would be appropriate on all fires and an evaluation of post-fire ecological impacts will still be required to determine which actions may be appropriate for each fire. However, developing a generalized framework that has been evaluated through the NEPA process will substantially improve the restoration options available and the efficiency of implementing them.

5.2.2 Sagebrush Seedling Planting for Habitat Restoration—Conservation Measure 1 and 2

Introduction

The objective of Conservation Measure 1 is to minimize the impact of habitat loss due to wildland fire and firefighting activities and the objective for Conservation Measure 2 is to minimize the impact of habitat loss due to infrastructure development and disturbance (see Table 5-1). The CCA includes three related strategies for addressing sagebrush habitat loss. The first is periodic seedling planting to address legacy habitat loss from fires that occurred prior to signing the CCA. The second strategy is developing a post-fire ecological recovery plan that includes reestablishing sagebrush for each new wildland fire. These two strategies relate directly to Conservation Measure 1. The final strategy for minimizing sagebrush habitat losses on the INL Site includes compensatory mitigation for infrastructure development, which relates directly to Conservation Measure 2. To address potential impacts from infrastructure development on sagebrush habitat distribution, DOE has a no-net-loss sagebrush habitat goal (DOE and USFWS 2014). It states that for every acre of sagebrush or potential sagebrush habitat that is impacted, BEA will contribute funds to replant approximately 1,000 seedlings as compensatory mitigation (INL 2022b). Seedlings from all funding sources are grown concurrently and planted in priority restoration areas identified in the CCA (DOE and USFWS 2014) and in post-fire ecological recovery plans.

The Natural Resources Group oversees the planting of sagebrush seedlings and monitors survivorship to evaluate the effectiveness. The target density at which seedlings are planted varies depending on the project restoration goals, and the actual planting density can vary due to weather conditions, topography, planting conditions, travel, and planter ability. The intent of this sagebrush restoration project 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. To achieve this target, planting rates on the INL Site range from approximately 198 to 494 seedlings/hectare (80 to 200 seedlings/acre).

Methods

Desert Sage Farms, LLC, located in Oakley, ID, provided 100,000 sagebrush seedlings grown from seed collected on the INL Site in 2020. Seedlings were funded and acquired through two of the three strategies above. The first strategy continued post-fire recovery efforts outlined in the fire specific recovery plans for the Sheep Fire (hereafter 'Sheep Fire Planting;' Kramer et al. 2021) and the Telegraph Fire (hereafter 'Telegraph Fire Planting;' Forman et al. 2021). Planting site selections under this first strategy are driven by the wildland fire boundary, priority restoration areas, existing datasets showing where habitat existed prior to burning, and logistical constraints, such as accessibility (Kramer et al. 2021, Forman et al. 2021). The second strategy that is used is compensatory mitigation due to infrastructure development on the INL Site where seedlings are planted in priority restoration areas (see Table 5-1). The 2022 planting under this strategy (hereafter 'Middle Butte and Twin Buttes Fire Planting') was located within portions of the 2010 Middle Butte Fire and the 2007 Twin Buttes Fire and was chosen to distribute planting efforts to other parts of the INL Site and for its accessibility. Information about growing the seedlings, and details about the planting process, are described in the Sheep Fire Sagebrush Seedling Planting Plan (Kramer et al. 2021), as well as the 2020 Wildland Fire Ecological Post-Fire Recovery Plan (Forman et al. 2021). In 2022, MP Forestry of Medford, OR, installed the seedlings over a five-day period using a hodad and traveling on foot from existing roads (see Figure 5-1).

Figure 5-1. Planting crew from MP Forestry planting big sagebrush (*Artemisia tridentata)* seedlings on the Idaho National Laboratory Site during October 2022.

In addition to planting seedlings in 2022, monitoring was completed on seedlings planted in previous years. Survivorship of seedlings planted in Fall 2021 was determined by revisiting and evaluating the condition of individual seedlings one year after planting. During the Fall 2021 planting, we collected GPS locations of the seedlings funded by INL, and GPS locations of the seedlings funded by IDFG. In September 2022, those seedlings were revisited, and we determined if each seedling was healthy, stressed, dead, or missing. Stressed individuals are considered alive, while missing individuals are considered dead for assessment purposes. After five years, seedlings will again be revisited to evaluate the planting's longer-term survivorship.

To evaluate five-year survivorship, seedlings planted in the Fall of 2017 were revisited in the Fall of 2022. In September of 2022, seedlings initially assessed in 2018 were revisited, regardless of whether they were determined missing or dead on the initial revisit. Each revisited seedling was determined to be healthy, stressed, dead, or missing to determine five-year survivorship. Found seedlings were also evaluated for the presence of reproductive structure.

Results and Discussion

On October 12–17, 2022, 100,000 sagebrush seedlings were planted on 378.7 ha (935.7 ac), across three different locations (see Figure 5-2). For each planting location, the total number of seedlings planted, acres planted, and the density at which seedlings were planted, is presented in Table 5-2. For future monitoring, at least 500 seedling locations were marked at each of the planting locations.

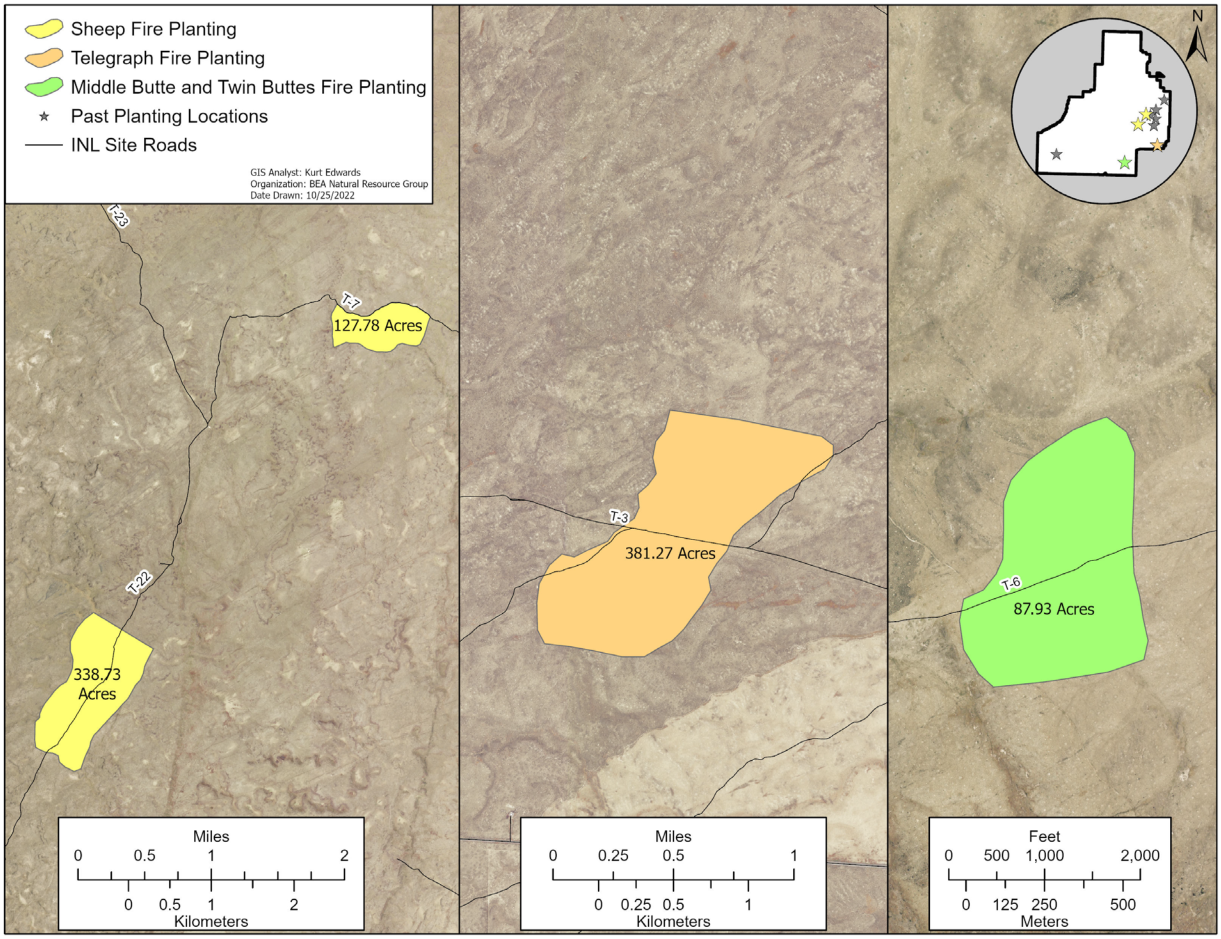


Figure 5-2. Areas planted with big sagebrush (*Artemisia tridentata)* seedlings in 2022 with reference to previous years plantings on the Idaho National Laboratory Site.

Since 2015, sagebrush seedling planting on the INL Site has now been completed on 988.7 ha (2,443.1 ac). Over the past eight years, a total of 255,750 seedlings have been planted from multiple funding sources, including DOE, BEA, the Idaho Governor's Office of Species Conservation, and IDFG.

Survivorship surveys of the INL-funded seedlings planted in 2021 found 25 seedlings were healthy, 4 were stressed, 10 were dead, and 461 were missing. Survivorship surveys of the IDFG-funded seedlings planted in 2021 found 123 seedlings were healthy, 8 were stressed, 2 were dead, and 354 were missing. Assuming the missing seedlings were dead, approximately 13.3% of all seedlings planted in 2021 survived the first year. This result is higher than the 2019 and 2020 plantings, but remains much lower than the plantings between 2015 and 2018 (see Figure 5-3).

Table 5-2. The number of seedlings, acres planted, and seedling density for each sagebrush seedling planting location in 2022 on the Idaho National Laboratory Site.

Planting Location	Seedlings Planted	Hectares (Acres) Planted	Seedlings / Hectare (Acre)
Sheep Fire Planting	45,000	188.8 (466.5)	38.8 (96)
Telegraph Fire Planting	41,300	154.18 (381.3)	43.7 (108)
Middle Butte and Twin Buttes Fire Planting	13,700	35.6 (87.9)	63.1 (156)
All Locations	100,000	378.7 (935.7)	NA

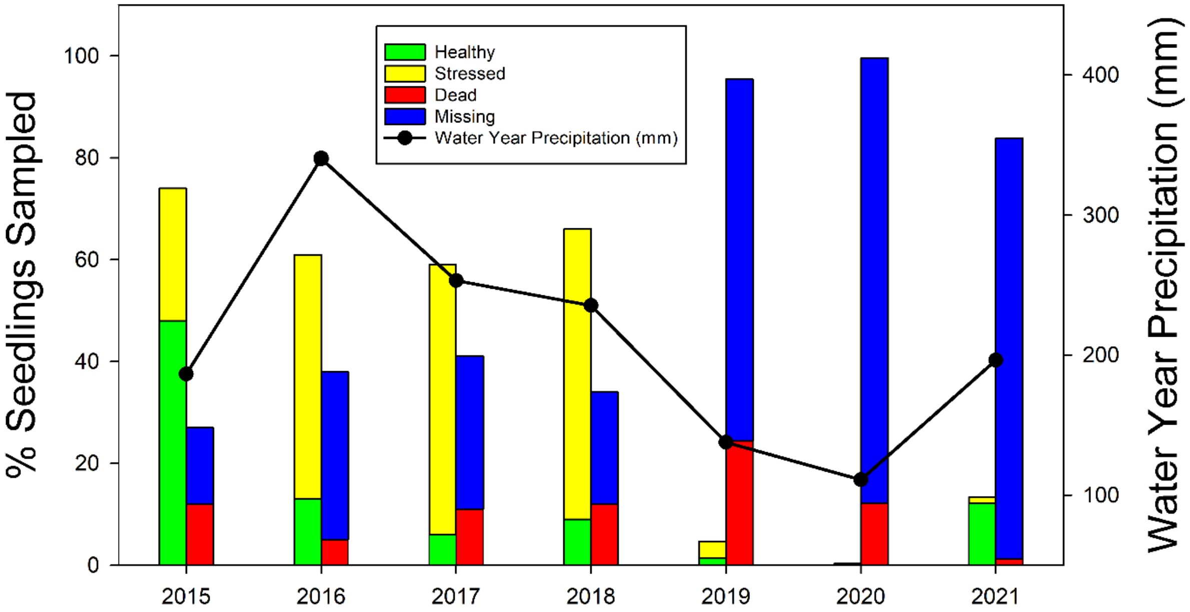


Figure 5-3. Sagebrush seedling survivorship one year after planting on the Idaho National Laboratory Site. Seedlings planted in 2015 and 2016 were within the Tin Cup Fire boundary, seedlings planted in 2017 through 2020 were planted within the Jefferson Fire boundary, and seedlings planted in 2021 were within the Jefferson Fire and the Sheep Fire boundaries. The yellow and green bar represents the observed living seedlings. The blue and red bar represents seedlings presumed to be dead. The black dots indicate the total water year precipitation. Water year is calculated as precipitation received in October of the planting year to September of the following year.

The water year precipitation (e.g., October of the planting year to September of the following year) following the 2021 seedling plantings was relatively higher following the previous two planting years, but remains lower than previous planting years (see Figure 5-3). In 2021, monthly precipitation was atypical in both timing and amount compared to the long-term monthly averages (see Figure 3-3). An unseasonably wet fall in 2021 followed by intermittent precipitation through the winter, spring, and summer, more than likely extended periods of time with little to no precipitation. The dryer than average growing season was followed by wetter than average late summer and early fall in 2022 compared to long-term monthly averages (see Figure 3-3). The 2021 seedling survivorship was greater than the past two seasons and could be attributed to the wetter-than-average Fall of 2021 that likely supplied available water to seedlings during a critical stage in their development. However, precipitation patterns do not appear to provide average moisture consistently that is needed for seedlings to establish. Low seedling survivorship could be due to many variables, but it appears that sustained deviations in both precipitation timing and lower-than-average accumulation are likely contributing factors to the past three years of low seedling survivorship. When comparing the notable difference of the seedling survivorship between INL (~6%) and the IDFG (~27%) funded seedlings in 2021, it appears that the condition of the planting site and the differing methods utilized by growers could be additional variables contributing to survivorship. The INL-funded seedlings in 2021 were planted in an area that burned two years prior and were grown in the Desert Sage Farms, LLC, greenhouse, whereas the IDFG-funded seedlings in 2021 were planted in an area that burned ten years prior and were grown in the North Fork Native Plants greenhouse.

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, prior to the three most recent plantings, sagebrush establishment one-year post planting on the INL Site was above average, with an average survivorship of 65% (2015–2018). It is unfortunate that the 2019, 2020, and 2021 plantings have 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 or approaches to increase the success of future planting efforts.

To evaluate five-year survivorship, 500 seedlings planted in the Fall of 2017 were revisited in the Fall of 2022. We relocated 280 seedlings, of which 268 were healthy and 12 were stressed, out of 500 individuals. This means that over the last five years, 280 (56%, $n = 500$) of the marked seedlings continue to grow after five years. Initial results of the 2017 planting found that 59% ($n = 597$) of the seedlings had survived to the Fall of 2018 (Shurtliff et al. 2018). Similar survivorship rates between one-year and five-year monitoring efforts suggests plantings only require one year of ideal conditions to become established and persist. In addition to revisiting seedlings for condition and survivorship, we took note of individuals that had begun developing reproductive structures. Of the observed surviving seedlings, 145 (52%) had developed reproductive structures. Some seedlings were noted to have several smaller sagebrush individuals surrounding them, which suggests the recruitment of seedlings is occurring around the planted individuals and the planted seedlings have become a seed source. 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 a sage-grouse habitat (Shurtliff et al. 2016).

One of the reasons that DOE continues to plant seedlings over a relatively small area each year, rather than 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 in burned areas fluctuates from year to year (Colket 2003; Blew and Forman 2010), and in many years, few or no seeds may germinate and survive the summer (Forman et al. 2020; Brabec et al. 2015). The decision from DOE to plant containerized seedlings in old burns instead of broadcasting or drilling seeds was justified previously, because high survivorship of seedlings was consistently achieved. After recent years of lower survivorship, alternative seeding and planting methods are being evaluated to determine if they can be successful options or alternatives to the current annual sagebrush seedling planting efforts (Forman et al. 2020). INL has begun exploring alternative methods of seeding sagebrush seed through mechanical means with assistance from multiple agency stakeholders, though any seeding method is less likely to be successful under drought conditions.

6. SYNTHESIS AND ADAPTIVE MANAGEMENT RECOMMENDATIONS

6.1 Trends and Threats in a Regional Context

Trends in annual sage-grouse counts on INL baseline leks and lek routes have loosely mirrored results from state-wide lek counts since 2013. Both State and INL counts increased to a peak in 2016, and then declined annually for several consecutive years. State-wide counts reached a low point in 2019, but in the past two years (2020–2022) they increased 27% (Kemner 2022). Similarly, INL counts declined through 2020, but they increased in 2022 (i.e., baseline leks were up 8% and lek routes were up 24% compared to 2021). Despite the recent increase, the three-year running average on the INL Site continued its multi-year decline, tripping the population trigger. This outcome was not surprising because three of four BLM Habitat Management Areas (HMAs) for sage-grouse that overlap the INL Site (i.e., Mountain Valleys Priority, Desert Priority, and Desert Important areas [see Figure 6-1]) tripped the IDFG hard triggers in 2018 or 2019 (Governor's Sage-grouse Task Force 2012; Kemner 2022).

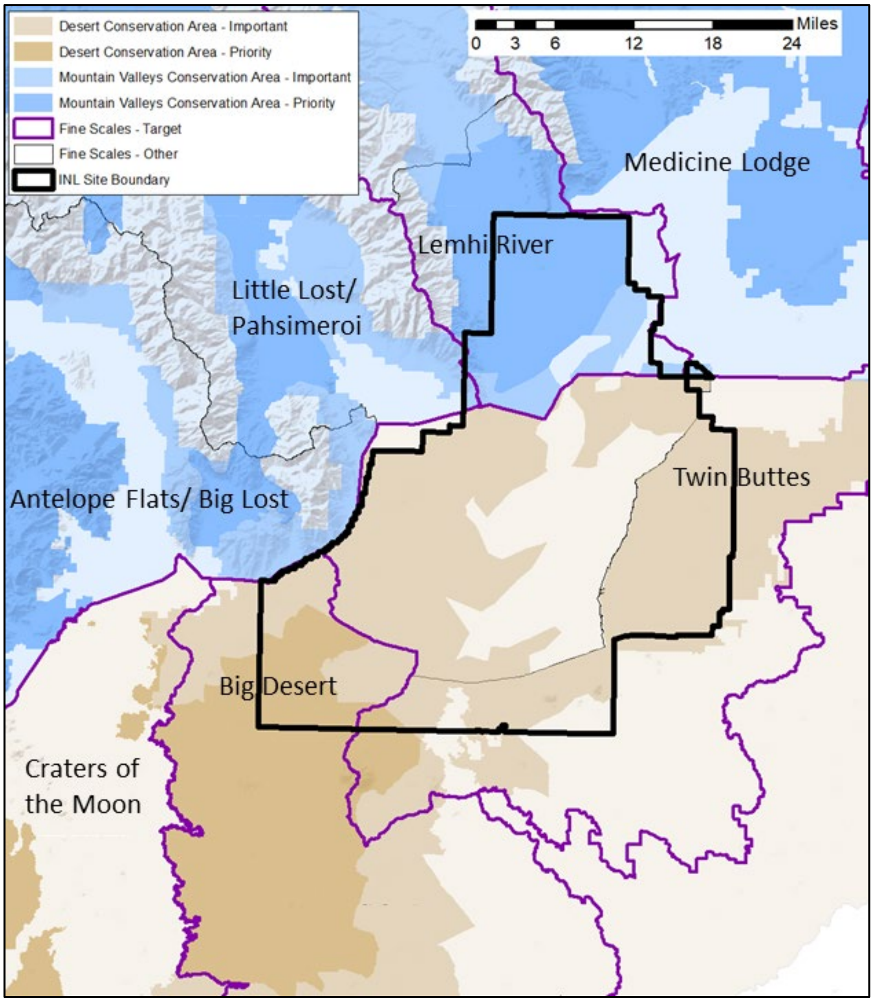


Figure 6-1. Regional Bureau of Land Management (BLM) Habitat Management Areas (HMAs) for sage-grouse. Fine-scale areas within each HMA are identified, and those that were experiencing substantial population declines when a causal factor analysis was performed are outlined in purple. This figure was adapted from Ellsworth et al. (2019) using data provided by Bonnie Claridge, Idaho BLM, in January 2021.

An inter-agency Idaho Adaptive Management Team (hereafter ‘AMT’) completed a preliminary causal factor analysis for HMAs that tripped adaptive management triggers in 2018 and 2019 (Ellsworth et al. 2019). The analysis was a multi-step process wherein the AMT analyzed vegetation transect data, fire history, and raven occurrence probability for fine-scale areas within each HMA (see Figure 6-1). They also held multi-agency meetings with local biologists to explore possible causes of sage-grouse population declines. In the Twin Buttes fine-scale area, which encompasses much of the INL Site and stretches from the western edge of the Sand Creek area north of Rexburg to the Big Desert area, the AMT determined that repeated wildfires were the most significant issue for sage-grouse. In the adjacent Big Desert fine-scale area, sagebrush cover was lower than in all other fine-scale areas examined, and the AMT concluded that this lack of cover was “certainly” due to the impacts of wildfire. For the Lemhi River fine-scale area, which includes the Lower Birch Creek lek route on the INL Site (see Figure 2-1), the ATM was unable to identify specific issues related to population decline. They noted, however, that population declines in the fine-scale area were limited to northern lek routes, which are or are not on or near the INL Site.

Monitoring results from the INL Site presented in this and previous CCA reports largely support the findings of the AMT. Large tracts of sagebrush-dominant plant communities have been lost to wildfire over the past 30 years in the portion of the INL Site that falls within the Twin Buttes fine-scale area, and in none has sagebrush recovered sufficiently to reclassify the burned area as sage-grouse habitat. Cheatgrass increasingly exacerbates the wildfire threat in much of the western portion of the sage-grouse range (Balch et al. 2013); however, on the INL Site, only 4% of the landscape is dominated by cheatgrass. Fortunately, a cheatgrass-driven fire cycle is not yet prevalent, but the need is urgent to reduce the spread of cheatgrass as much as possible, especially following a fire. This understanding has prompted DOE to pursue options for treating cheatgrass and other weeds within recent fire scars and to continue to work with partners to restore sagebrush habitat in areas strategically selected to maximize benefits to sage-grouse.

No fires have been documented in the northern portion of the INL Site since record-keeping began in 1994, and like the AMT, we lack evidence to explain why the Lower Birch Creek route in that area has declined. When the causal factor report was produced, MPLS on the Lower Birch Creek route was above the 22-year median (2019 = 9.4 MPLS; median = 8.6 MPLS). Since then, MPLS has dropped to 5.0 and was lower in 2021 and 2022 than in all but two of the past 25 years. Meaningful analysis is limited because there is only one lek route in the area, but it is unlikely that livestock grazing on the INL Site is having a substantial effect (Shurtliff et al. 2017) and the availability of infrastructure for raven nesting near sage-grouse breeding areas is limited in the northern part of the INL Site (see Figure 4-3). Furthermore, there have been no new DOE projects or activities in the area in recent years.

When DOE and USFWS begin discussions about how to proceed now that the population trigger has tripped, it may be useful to consider that monitoring of likely threats to sage-grouse and its habitats over the past 10 years has produced no evidence suggesting that a specific threat has disproportionately affected sage-grouse abundance on the INL Site. Collectively, these threats could be suppressing survivorship or reproductive success, but if they are, the effects on abundance are likely similar to those at the regional and state level. In addition, portions of the INL Site provide important wintering, breeding, and early brood-rearing habitat, but most sage-grouse leave the INL Site during the summer (Whiting et al. 2014) where they may be affected by influences outside the control of DOE.

The CCA and resulting relationship between DOE and USFWS have helped DOE and its contractors take proactive, focused measures to conserve sage-grouse while still pursuing its mission. The agreement and conservation measures therein have also been the impetus for strengthening relationships with natural resource partners to collaborate on projects relevant to sage-grouse. For example, during the past eight years, DOE has worked regularly with partners to restore sagebrush and treat weeds. DOE regularly shares habitat data with BLM when allotments are reassessed, and BLM invites Natural Resources Group ecologists to participate in grazing allotment assessments on the INL Site. Procedures have been implemented to prohibit human disturbance at leks from people and equipment. A mechanism has been created that allows projects to pay a compensatory mitigation fee when they remove sagebrush so seedlings can be planted in strategic locations to maximize benefits to sage-grouse. There are, of course, weaknesses and shortcomings in the CCA, but improvements have been adopted (see Section 6.3) as local monitoring results, evolving scientific understanding, and changing circumstances necessitate. One emerging challenge is that the CCA does not adequately address potential impacts of some of the projects being considered because these projects are substantially different than those envisioned when the CCA was being developed nearly a decade ago.

6.2 Proposed Changes to the CCA

The USFWS recently recommended that DOE consider revising the CCA to maintain its alignment with an upcoming BLM Land Use Plan amendment. A revision would be timely because projects and circumstances on the INL Site are expanding beyond the initial considerations of the CCA. Furthermore, the CCA has been in effect for over eight years, during which time numerous changes have been adopted. These changes are documented in Section 6 of each annual CCA report, but there is no mechanism for updating the CCA document that is available to contractors, and therefore, it is difficult for them to maintain awareness of all amendments.

6.3 Adopted Changes

During the annual CCA stakeholders meeting held February 24, 2022, in Idaho Falls, DOE proposed and the USFWS agreed to make the following changes to the CCA.

1. Update the Habitat Trigger Baseline—The original baseline area for the sage-grouse habitat trigger was generated from a vegetation map completed in 2011 (Shive et al. 2011). There were a few reasons that justified updating the 2011 INL Site vegetation map; consequently, a new vegetation classification and map was published in 2019 (Shive et al. 2019). The new map eliminated two-class map complexes by increasing the mapping scale, which resulted in a more accurate distribution of sagebrush-dominated map classes. Therefore, beginning with the current report, the habitat trigger and analysis of sagebrush loss due to wildfire and infrastructure development is based on the most accurate and current vegetation data available (see Section 3.2.2).
2. Update Conservation Measure 1—Conservation Measure 1 was developed to address the wildland fire threat. In the CCA, it reads,

   > 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).

The original language of this measure specifies treatments to hasten *sagebrush* reestablishment. However, recent INL fire recovery plans (Forman et al. 2020; 2021) and comparable stakeholder agency fire recovery plans describe a more holistic approach to wildland fire recovery. Recent plans and a new fire recovery framework identify four objectives that include soil stabilization, cheatgrass and noxious weed control, and maintaining a healthy herbaceous understory in addition to sagebrush restoration. Therefore, DOE and USFWS revised Conservation Measure 1 as follows (new language in bold font):

Prepare an assessment for the need to restore the burned area. Based on that assessment, DOE would **evaluate and prioritize treatment options to meet habitat recovery objectives** in burned areas and reduce the impact of wildland fires >40 ha (99 acres). **Primary habitat recovery objectives include soil stabilization, cheatgrass and noxious weed control, maintaining a healthy herbaceous understory, and sagebrush restoration.**

3. <u>Identify Priority Areas for Sagebrush Habitat Restoration Using Updated Criteria</u>—Priority Restoration Areas (PRAs) were recalculated to expand the potential area for planting sagebrush. When PRAs were originally identified, only active sage-grouse leks were incorporated into the analysis. However, the distribution of active leks changes over time and some of the leks active in 2011 are currently inactive. Assuming lek status will continue to change and inactive leks could once again become active, especially if sagebrush returns to the area, we used all 124 lek locations regardless of current activity status. We also used vegetation data from the most recent vegetation map (Shive et al. 2019) to identify areas that could return to the sagebrush habitat in the future (i.e., green rabbitbrush shrublands and native perennial grasslands). The new set of PRAs expands the total area and distribution of the potential sagebrush planting area, but it is also important to note that additional criteria will be considered during the restoration area site selection process (e.g., lek persistence and density, likelihood of success, and accessibility).

4. <u>Update Conservation Measure 9</u>—Conservation Measure 9 was designed to reduce threats to sage-grouse habitat from landfills and borrow sources. The measure currently reads:

   "Ensure that no net loss of sagebrush habitat occurs due to new borrow pit or landfill development."

   To achieve this measure, the CCA outlined three actions DOE would take, the third of which is to: "ensure adequate weed control measures are implemented throughout the life of an active borrow source or landfill."

   As currently written, any expansion of a borrow source or landfill that removes sagebrush would result in a measurable loss, which would affect the habitat trigger if the expansion occurred in the SGCA. If outside the SGCA, the CCA requires that DOE senior management approve the expansion because it would affect the no-net-loss goal for sagebrush.

   DOE proposed that the language of Conservation Measure 9 and the third supporting action quoted above be changed because neither reflect the current reality on the INL Site. An administrative boundary is maintained around each borrow pit and landfill that pre-dates the CCA. Therefore, if sagebrush is removed within this boundary, the loss would not be counted against the habitat trigger. Although noxious and invasive weed control is listed as a supporting action, DOE desired to emphasize this action by including it in the conservation measure description. Further, a correction is necessary because currently BEA controls weeds in both active and inactive borrow sources. The adapted Conservation Measure and supporting action will now read as follows (new language in bold font):

> "Ensure that no net loss of sagebrush habitat occurs due to new borrow pit or landfill development **beyond the administrative boundaries. Current and new borrow sources are managed to control noxious and other invasive weed species.**
>
> "To achieve Conservation Measure 9, DOE will:"
>
> - [bullet 1 remains the same]
> - [bullet 2 remains the same]
> - "Ensure adequate weed control measures are implemented throughout the life of **a** ~~an active~~ borrow source or landfill."

6.4 Work Plan for Upcoming Year

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. Natural Resources Group work plan for 2023.

CCA Monitoring Task	Schedule and Changes for 2023
1. Lek Counts and Lek Route Surveys	Continue to monitor all active leks and a rotational subset of inactive leks.
4. Raven Nest Surveys	Undetermined.
5. Sagebrush Habitat Condition Trends	Sample all annual and rotational set I monitoring plots (*n* = 125). Update annual habitat condition analyses. Continue to explore cover trend analyses.
6. Monitoring to Determine Changes in Sagebrush Habitat Amount and Distribution	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	Idaho NAIP imagery will be available again in 2024, and we will systematically review the INL Site to document evidence of expansion of linear features and losses of sagebrush habitat from new project footprints and expansions.

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Appendix A

Table A- 1. A complete list of all species documented on the 75 annual habitat monitoring plots (43 sagebrush plots and 32 non-sagebrush plots) in 2022. Nomenclature follows the U.S. Department of Agriculture PLANTS National Database (2022).

Scientific Name	Common Name
Achnatherum hymenoides	Indian ricegrass
Agoseris glauca	pale agoseris
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 holboellii	Holboell's rockcress
Arabis lignifera	desert rockcress
Arenaria franklinii	Franklin's sandwort
Artemisia nova	black sagebrush
Artemisia tridentata	big sagebrush
Artemisia tridentata Nutt. ssp. wyomingensis	Wyoming big sagebrush
Artemisia tripartita	threetip sagebrush
Astragalus calycosus	Torrey's milkvetch
Astragalus convallarius	lesser rushy milkvetch
Astragalus curvicarpus	curvepod milkvetch
Astragalus filipes	basalt milkvetch
Astragalus lentiginosus	freckled milkvetch
Astragalus purshii	woollypod milkvetch
Atriplex confertifolia	shadscale saltbush
Atriplex falcata	sickle saltbush/ Nuttall saltbush
Balsamorhiza sagittata	arrowleaf balsamroot
Bassia scoparia	kochia/ summer cypress/ burningbush
Bromus tectorum	cheatgrass
Calochortus bruneaunis	Bruneau mariposa lily
Camissonia andina	Blackfoot River evening primrose
Carduus nutans	nodding plumeless thistle/ musk thistle
Carex douglasii	Douglas' sedge
Castilleja angustifolia	northwestern Indian paintbrush
Ceratocephala testiculata	bur buttercup/ curveseed butterwort
Chaenactis douglasii	Douglas' dustymaiden
Chenopodium leptophyllum	slimleaf goosefoot/ narrowleaf goosefoot
Chondrilla juncea	rush skeletonweed/ hogbite
Chrysothamnus viscidiflorus	yellow rabbitbrush/ green rabbitbrush
Comandra umbellata	bastard toadflax
Cordylanthus ramosus	bushy bird's beak
Crepis acuminata	tapertip hawksbeard
Cryptantha interrupta	Elko cryptantha
Cryptantha scoparia	Pinyon Desert cryptantha
Delphinium andersonii	Anderson's larkspur/ desert larkspur

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 caespitosum	matted buckwheat
Eriogonum cernuum	nodding buckwheat
Eriogonum microthecum	shrubby buckwheat/ slender buckwheat
Eriogonum ovalifolium	cushion buckwheat
Gayophytum diffusum	spreading groundsmoke
Gnaphalium palustre	western marsh cudweed
Grayia spinosa	spiny hopsage
Gutierrezia sarothrae	broom snakeweed
Halogeton glomeratus	saltlover
Hesperostipa comata	needle and thread grass
Ionactis alpina	Lava aster
Ipomopsis congesta	ballhead gilia
Iva axillaris	povertyweed
Krascheninnikovia lanata	winterfat
Lactuca serriola	prickly lettuce
Lappula occidentalis	flatspine stickseed
Lappula squarrosa	European stickseed
Lepidium perfoliatum	clasping pepperweed
Leymus cinereus	basin wildrye
Leymus flavescens	yellow wildrye
Linanthus pungens	granite prickly phlox
Lomatium dissectum	fernleaf biscuitroot
Lomatium foeniculaceum	desert biscuitroot
Lupinus argenteus	silvery lupine
Lupinus pusillus	rusty lupine/ small lupine
Lygodesmia grandiflora	largeflower skeletonplant
Machaeranthera canescens	hoary tansyaster
Mentzelia albicaulis	whitestem blazingstar
Oenothera pallida	pale evening primrose
Opuntia polyacantha	plains pricklypear
Packera cana	woolly groundsel
Pascopyrum smithii	western wheatgrass
Penstemon cyaneus	blue penstemon
Penstemon deustus	hot rock penstemon/ scabland penstemon
Penstemon pumilus	Salmon River beardtongue
Phacelia glandulifera	sticky phacelia
Phacelia hastata	silverleaf phacelia
Phlox hoodii	Hood's phlox/ spiny phlox

Scientific Name	Common Name
Phlox longifolia	longleaf phlox
Poa secunda	Sandberg bluegrass
Pseudoroegneria spicata	bluebunch wheatgrass
Psoralidium lanceolatum	lemon scurfpea
Pteryxia terebinthina	turpentine wavewing
Purshia tridentata	antelope bitterbrush
Salsola tragus	prickly Russian thistle
Schoenocrambe linifolia	flaxleaf plainsmustard
Sisymbrium altissimum	Jim Hill mustard/ tall tumblemustard
Sphaeralcea munroana	Munro's globemallow/ whitestem globemallow
Stanleya viridiflora	green princesplume
Stenotus acaulis	stemless mock goldenweed
Taraxacum officinale	common dandelion
Tetradymia canescens	spineless horsebrush
Tetradymia spinosa	shortspine horsebrush
Townsendia florifer	showy Townsend daisy
Tragopogon dubius	yellow salsify
Zigadenus venenosus	meadow deathcamas

USDA, NRCS. 2022. The PLANTS Database (http://plants.usda.gov, November 1, 2022). National Plant Data Team, Greensboro, NC 27401-4901 USA.

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