INL/RPT-25-82779

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

January 2025

2024 Full Report

Idaho National Laboratory

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Revision 0

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2024 Full Report

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Idaho National Laboratory
Idaho Falls, Idaho 83415

http://www.inl.gov

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EXECUTIVE SUMMARY

In October 2014, the U.S. Department of Energy, Idaho Operations Office and the U.S. Fish and Wildlife Service entered into the Candidate Conservation Agreement for Greater Sage-grouse (*Centrocercus urophasianus*) on the Idaho National Laboratory Site (DOE-ID and USFWS 2014). As mandated by this Candidate Conservation Agreement (CCA), a report is produced annually with the primary purposes of (1) documenting current year monitoring activities and results in support of the CCA, (2) addressing greater sage-grouse (hereafter, sage-grouse) population and habitat regulatory triggers in the context of those results, and (3) documenting 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 (i.e., 316 males) within the Sage-grouse Conservation Area (SGCA). 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 2024, 502 males were counted on baseline leks during peak attendance, a 65.1% (n = 198) increase over 2023. This resulted in an increase of the three-year running average to 351 males (35.5%) which exceeds the population trigger threshold by 98 males.

The peak male attendance on six lek routes was up 60.3% from 2023. One lek was upgraded to active status. Thirty-five leks are currently classified active on or near the INL Site. Twenty-one inactive leks that are not visited annually were surveyed to verify activity status, two males were observed at one of these leks during one visit.

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.) as established in 2013 and modified in 2019 to 72,300 ha (178,656 ac). 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.

There were five wildland fires that burned on the INL Site in 2024, however, the Dry Channel Fire was the only fire to meet the size criteria for mapping. The Dry Channel Fire and fire suppression activities removed 35.1 ha (86.8 ac) of sagebrush habitat in SGCA. The current estimated area of sagebrush habitat in the SGCA is 71,322.2 ha (176,240.9 ac) representing a 1.4% decrease from the habitat baseline.

There was no sagebrush habitat loss from wildland fire outside the SGCA in 2024, although infrastructure expansion (see Section 4.2) was responsible for the removal of 29.4 ha (72.6 ac). The current area of sagebrush habitat outside the SGCA is 28,056.7 ha (69,329.6 ac).

The condition of sagebrush habitat and recovering habitat are monitored by surveying 75 annual vegetation plots. The plots are distributed across both sagebrush and recovering habitat types. Within sagebrush habitat plots, sagebrush cover is trending upward, native species are dominant and provide six times more cover compared to introduced functional groups. The cover from native perennial grasses is above average but appears to be returning to within normal ranges of variation. Introduced annual grasses remain a minor component of intact sagebrush habitat across the INL Site. Within plant communities recovering from wildland fire, cover from native functional groups is higher than cover from introduced functional groups, but patches where weedy invasive species dominate are common. Sagebrush species cover is relatively low but is trending upward. Cheatgrass (*Bromus tectorum*) cover is near the middle of its range of variability in 2024, but fluctuates from one year to the next, without a directional trend.

Threat Monitoring

Common ravens (*Corvus corax*; hereafter, ravens) are effective nest predators of sage-grouse and raven abundance has been linked to declines in sage-grouse lek trends and nest survival. Ravens nest on multiple anthropogenic structures on the INL Site including buildings, equipment, and power infrastructure. To prevent nesting on power infrastructure, INL Power Management replaces double crossarms of transmission or distribution line poles with a single crossarm made of either wood or fiberglass. Three H-frame transmission structures were retrofitted with single crossarms in 2024. The total number of INL-owned H-frame transmission structures now retrofitted on the INL Site is 66. Additionally, two raven nests were removed, one from a transmission structure in May and one from the shelter structure located at CFA Gate 1 in September. These nest removals were conducted in compliance with the Migratory Bird Treaty Act.

There were 30 polygons mapped where infrastructure expansion removed sagebrush habitat resulting in a loss. The total mapped sagebrush loss was 31.1 ha (76.9 ac). Three of the mapped polygons fell within the SGCA accounting for 1.7 ha (4.3 ac) of loss from the current habitat trigger area.

There was a total of 18.8 km (11.7 mi) of new linear features mapped within the SGCA or existing sagebrush habitat. In addition to the new two-track linear features, 3 km (1.8 mi) of older two-tracks were mapped, because when cross-referenced to previously collected National Agriculture Imagery Program imagery, these features were found to be present in older imagery but not mapped during the last review.

Threats to Habitat Condition—Data to support this task are collected on a rotational basis over the span of five years. Analyses are completed at the end of each rotation of data collection and results are expected to be reported in 2027.

Conservation Measures Associated with Habitat Restoration

There is one active fire recovery plan for which INL continues to implement treatments and monitor post-fire conditions. An additional fire recovery plan will be drafted for the 2024 Dry Channel Fire and treatments will be prioritized by the INL Wildland Fire Management Committee. In 2024, the Natural Resources Group finalized a Wildland Fire Recovery Framework to standardize and streamline the process of developing natural resource recovery plans for the INL Site. Sagebrush planting continued in multiple fire footprints and included a seeding effort in support of a multiagency Bipartisan Infrastructure Law project to improve sage-grouse habitat in the greater Tractor Flats area that was affected by the 2010 Jefferson Fire.

INL managed the planting of 19,050 sagebrush seedlings in fall of 2024 in areas prioritized for restoration. All seedlings were planted in burned areas of the 2007 and 2010 Twin and Middle Butte Fires. Monitoring revealed that approximately 17.6% of seedlings planted in 2023 survived. Approximately 12% of seedlings planted in 2019 were still alive after five years.

Synthesis

Summed peak male attendance across the baseline leks in 2024 was 502 males—198 (65.1%) more than in 2023. This upward trend was observed throughout Idaho, Oregon and Wyoming which suggests that populations increased in many areas range wide. Sage-grouse populations vary between high and low abundances on six to ten-year cycles and populations on the INL Site, in the State of Idaho, and in many places across the range, are clearly in the upward portion of this cycle after a low (nadir) from 2020–2021. Heavy snowpack, like what occurred in the winter of 2022–2023 has a positive, but lagged effect on sage-grouse populations. It is important to note that a single major increase in males on lek does not indicate recovery. Since sage-grouse populations cycle naturally, population trend estimates should not be calculated year to year but instead should be calculated peak-to-peak or nadir-to-nadir, otherwise estimates may indicate false declines or increases. Overall, sage-grouse populations are still declining throughout their range and accurate trend estimates for the INL Site cannot be evaluated until the population reaches the next peak and then begins naturally cycling downward again.

Sage-grouse habitat condition and distribution is monitored in some places in Idaho, but not at a scale and frequency that would facilitate direct comparison of State and INL Site habitat trends. However, a report published in 2020 by a multi-stakeholder team in Idaho estimated that landscape sagebrush cover immediately south and east of the INL Site was approximately the same as on the INL Site. The team reported two other relevant findings. First, they identified the Tractor Flats area on the INL Site as a regionally important wintering area for sage-grouse, which prompted the sagebrush habitat restoration efforts discussed above. Second, they recommended that land managers prioritize cheatgrass control where it could negatively affect habitat. Although cheatgrass is locally abundant in some areas on the INL Site, post-fire monitoring has demonstrated that most burned areas are dominated by native, perennial plants. Because cheatgrass has become dominant in localized areas, INL and agency stakeholders are pursuing Bipartisan Infrastructure Law funding to treat cheatgrass in these areas before it becomes sufficiently dominant at a scale widespread enough to alter the fire regime on the INL Site.

Proposed and Adopted Changes to the CCA

No changes to the CCA were proposed or adopted during 2024.

ACKNOWLEDGEMENTS

Information and data in this document were collected, analyzed, and reported by the Battelle Energy Alliance Natural Resources Group and their interns. Bryan F. Bybee, Samuel R. Williams, Colby J. Kramer, Kristin N. Kaser, Sarah A. Baccus, and Terrah M. Owens performed greater sage-grouse lek surveys, and the latter two authored the population monitoring section (Section 2.0). Stephanie M. Magee, Nina Keck, Carole-Lynna Benhamou, Elizabeth White, Emily “Gus” Jensen, Rylee Bloxham and Jordan Moser completed sampling for habitat condition and assisted in collecting sagebrush seedling survivorship data. Kristin N. Kaser analyzed the habitat data and summarized results for sagebrush habitat condition (Section 3.1) and potential threats to sagebrush habitat (Section 4.3). Jeremy P. Shive wrote the sections describing changes to sagebrush habitat amount and distribution (Section 3.2) and monitoring of the infrastructure footprint for expansion (Section 4.2). Colby J. Kramer gathered updates from internal organizations and assembled a table listing progress made on CCA Conservation Measures (Section 5.1). He also coordinated the sagebrush seedling planting and monitoring and authored the associated section (Section 5.2.2). Amy D. Forman reported on post-fire recovery planning, implementation, and monitoring (Section 5.2.1). Terrah M. Owens summarized efforts to deter raven nesting (Section 4.1) and she, Samuel R. Williams, and Amy D. Forman produced the synthesis of results (Section 6.1). Kurt T. Edwards supported all authors with data collection processes, data management, and producing map figures for the document. Brande M. Hendricks assisted with document formatting. Samuel R. Williams served as document editor.

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TABLES

ACRONYMS

BEA	Battelle Energy Alliance
BIL	Bipartisan Infrastructure Law
BLM	Bureau of Land Management
CCA	Candidate Conservation Agreement
CFA	Central Facilities Area
DOE-ID	U.S. Department of Energy, Idaho Operations Office
EA	Environmental Assessment
EC	Environmental Checklist
ECP	Environmental Compliance Permit
FC	Frenchmans Cabin
GIS	Geographic Information System
IDFG	Idaho Department of Fish and Game
INL	Idaho National Laboratory
LBC	Lower Birch Creek
MFC	Materials and Fuels Complex
MSD	minimum significant difference
NAIP	National Agriculture Imagery Program
NEPA	National Environmental Policy Act
NRG	Natural Resources Group
NSTR	National Security Test Range
PLS	pure live seed
RWMC	Radioactive Waste Management Complex
SGCA	Sage-grouse Conservation Area
TF	Tractor Flats
UAS	Unmanned Aerial Systems
USFWS	U.S. Fish and Wildlife Service
WFMC	Wildland Fire Management Committee

1.0 INTRODUCTION, BACKGROUND, AND PURPOSE

In October 2014, the United States Department of Energy, Idaho Operations Office (DOE-ID) and the U.S. Fish and Wildlife Service (USFWS) entered into the Candidate Conservation Agreement for Greater Sage-grouse (*Centrocercus urophasianus*) on the Idaho National Laboratory Site (DOE-ID and USFWS 2014). This Candidate Conservation Agreement (CCA) includes monitoring tasks that occur on that Idaho National Laboratory Site (INL) that are designed to track greater sage-grouse (hereafter, sage-grouse) abundance and habitat indicators, key threats, and Conservation Measures intended to reduce these threats. This report, produced by the Battelle Energy Alliance (BEA) Natural Resources Group (NRG), documents year-end results of CCA monitoring tasks and DOE-ID and INL contractor activities associated with CCA Conservation Measures. A summary of this report (DOE-ID 2025) is provided each January to the USFWS and can be found at https://inl.gov/environmental-publications/.

The primary purpose of this report is to update sage-grouse population and habitat estimates as they apply to adaptive regulatory triggers established in the CCA. If a regulatory trigger is tripped, a responsive action by DOE-ID and USFWS will be initiated (DOE-ID and USFWS 2014, Section 9.4.3). The two triggers and criteria that define them are:

1) Population Trigger: The three-year running average of peak male attendance, summed across 27 baseline 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.

2) 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).

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

This report and associated summary report (DOE-ID 2025) inform a continuing dialogue between DOE-ID 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.

2.0 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-ID and USFWS 2014, Section 11.1) included a task (Task 1) to track sage-grouse abundance on the INL Site, allowing DOE-ID 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 of the baseline leks in 2011. 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 baseline value.

In addition to baseline lek counts, six lek routes are surveyed annually, three routes have been surveyed since the late 1990s and three routes were established in 2017, to evaluate long-term sage-grouse abundance trends. Surveying a cluster of leks in the same order in a single 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, Garton et al. 2007, DOE-ID 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 relatively short-term results derived from baseline lek monitoring.

Lastly, the Task 1 monitoring strategy 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, helps maintain accurate records of the number and location of active leks on the INL Site.

2.1.2 Methods

2.1.2.1 Field Methods

The primary goal each year is to survey all known active leks on the INL Site. Lek routes are surveyed ≥ 4 times, baseline leks and active leks not on a route are surveyed ≥3 times, and rotational inactive leks are surveyed ≥2 times. Lek counts begin each year on or soon after March 20 and typically end about the first week of May. Counts occur from 30 minutes before until 90 minutes after sunrise and are not conducted during adverse weather (e.g., heavy precipitation or 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 if previously unseen males flush during the count, that number is added to the subsequent high count during the lek visit. 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. Counts continue weekly on lek routes until there is a decrease in male attendance, indicating that the peak male count was reached the prior week.

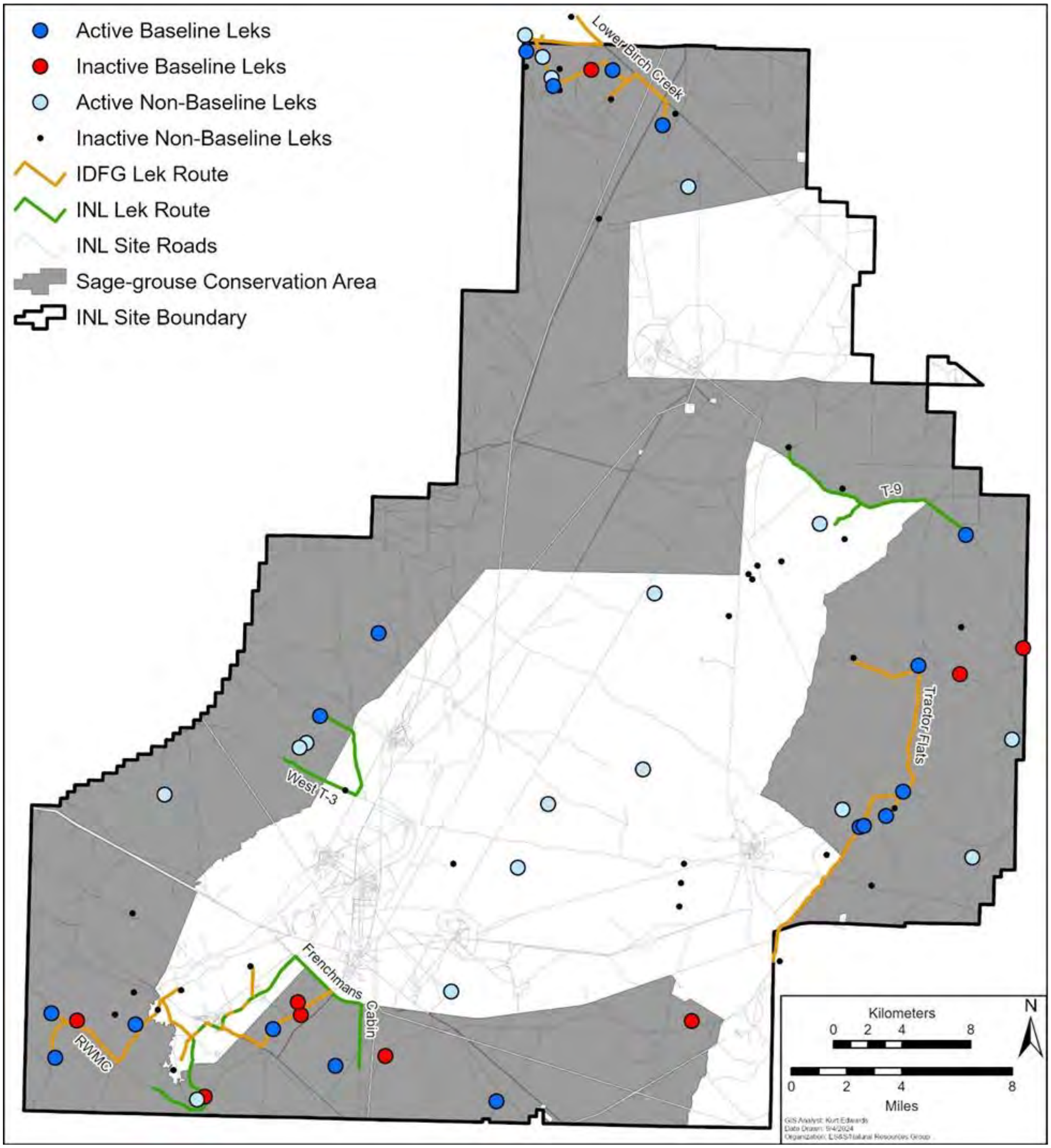

Figure 2-1. Greater sage-grouse (*Centrocercus urophasianus*) leks surveyed on or near the Idaho National Laboratory Site in 2024. Lek activity designations (active vs. inactive) refer to lek status at the end of 2024. Inactive non-baseline leks include inactive leks assigned to lek routes (visited annually) and a inactive rotational leks visited once every five years.

Lek routes are comprised of 3-10 leks each, encompassing 38 active and inactive leks across the six routes (Figure 2-1). During each survey, all leks on a route are visited during the two-hour morning window, in the same order, and usually by the same observer during a field season. Three routes established by the Idaho Department of Fish and Game (IDFG), Lower Birch Creek (LBC), Tractor Flats (TF), and Radioactive Waste Management Complex (RWMC), have been surveyed annually since the mid-1990s. Three additional routes established by INL have been surveyed since 2017—West T-3 (hereafter, T-3), T-9, and Frenchmans Cabin[1] (FC). The TF and LBC routes each include a lek located off the INL Site within 1.6 km (1 mi) of the boundary.

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 a set of these annually on a rotational basis. Some inactive leks are visited more frequently because IDFG classifies them as priority leks for state-wide monitoring.

Lek Status

Leks were classified 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, Whiting et al. 2014). Leks with attendance 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 new 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 lek activity status as necessary.

2.1.2.2 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 baseline leks are used in the calculation of the population trigger while lek routes allow for a comparison in regional observations and long-term population trends.

To evaluate current sage-grouse abundance relative to the population 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 baseline leks. The annual total was then averaged with the preceding two years to produce a three-year running average—the population trigger metric (DOE-ID and USFWS 2014).

We assessed long-term abundance trends by examining peak male attendance for each of the six lek routes from 2011–2024. Additionally, we assessed potential bias from survey effort (number of leks counted each year) by comparing annual peak male attendance for all leks surveyed (baseline, route, and rotational) to the annual survey effort.

2.1.3 Results and Discussion

2.1.3.1 Baseline Leks and Population Trigger

Summed peak attendance across the baseline leks in 2024 was 502 males—198 (65.1%) more than in 2023 (Figure 2-2). This value is the highest recorded on the INL Site since 2011, the baseline year for the population trigger.

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

The three-year (2022–2024) running average of peak male attendance on baseline leks increased 35.5% to 351 males, exceeding the population trigger threshold of 253 males (Figure 2-2). Surveys of baseline leks accounted for 34.6% (n = 27) of all leks surveyed and 54.3% (n = 19) of active leks in 2024. These leks accounted for 60.5% of the total sage-grouse observed on the INL Site in 2024.

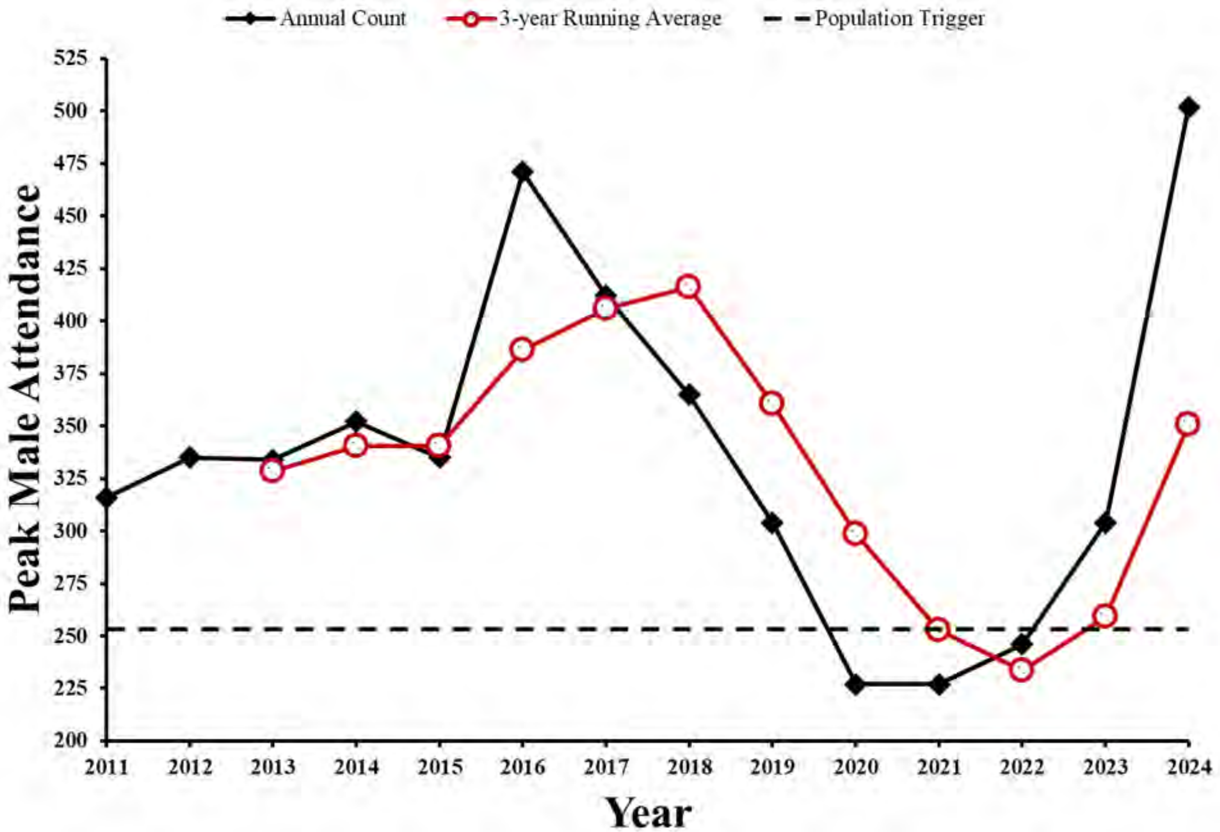

Figure 2-2. Peak male attendance of greater sage-grouse (*Centrocercus urophasianus*) at 27 baseline leks within the Sage-grouse Conservation Area on the Idaho National Laboratory Site from 2011 to 2024.

2.1.3.2 Lek Routes

Beginning this year, we will no longer report population trends on lek routes using males per lek surveyed. Instead, we will be reporting the peak male attendance for each route. While the males per lek surveyed metric reflects similar patterns as peak male attendance, it is highly sensitive to the number of leks surveyed and is averaged across active and inactive leks. Reporting peak male attendance allows us to account for survey effort, better assess population trends, and determine if specific leks are driving those trends. Additionally, it allows for a much more straightforward comparison to regional trends reported by the State of Idaho.

We surveyed lek routes four to seven times each. The sum of peak male attendance across all routes increased in 2024 to 500 males (60.3%). All routes increased compared to 2023, with the TF, RWMC, and T-3 routes exhibiting notable increases of 92.7%, 74.7%, and 165.6%, respectively (Table 2-1). In 2024, peak male attendance on the TF and RWMC routes nearly reached or exceeded those from the last sage-grouse population peak in 2016 (Figure 2-3, Table 2-1).

Peak male attendance on the LBC route is -58.6% lower than the 2016 peak and the number of active leks has decreased from seven to four. No significant infrastructure or wildfire activity occurred near the LBC route between 2016 and 2024. The entire LBC route lies within the Mountain Valleys Priority Habitat Management Area designated by the State of Idaho in 2015. Idaho did not issue a sage-grouse population report in 2024 but the 2023 report indicated that this management area has tripped a hard population trigger every year since 2018. Therefore, declines on the LBC route likely reflect regional trends in the sage-grouse population for the Mountain Valleys Priority Habitat Management Area and not direct impacts from operations on the INL Site. The T-3, T-9, and FC routes were started one year after the last population peak but peak male attendance on both the T-3 and T-9 routes have exceeded their 2017 starting values. The FC route is -21% lower than in 2017 (Figure 2-3, Table 2-1).

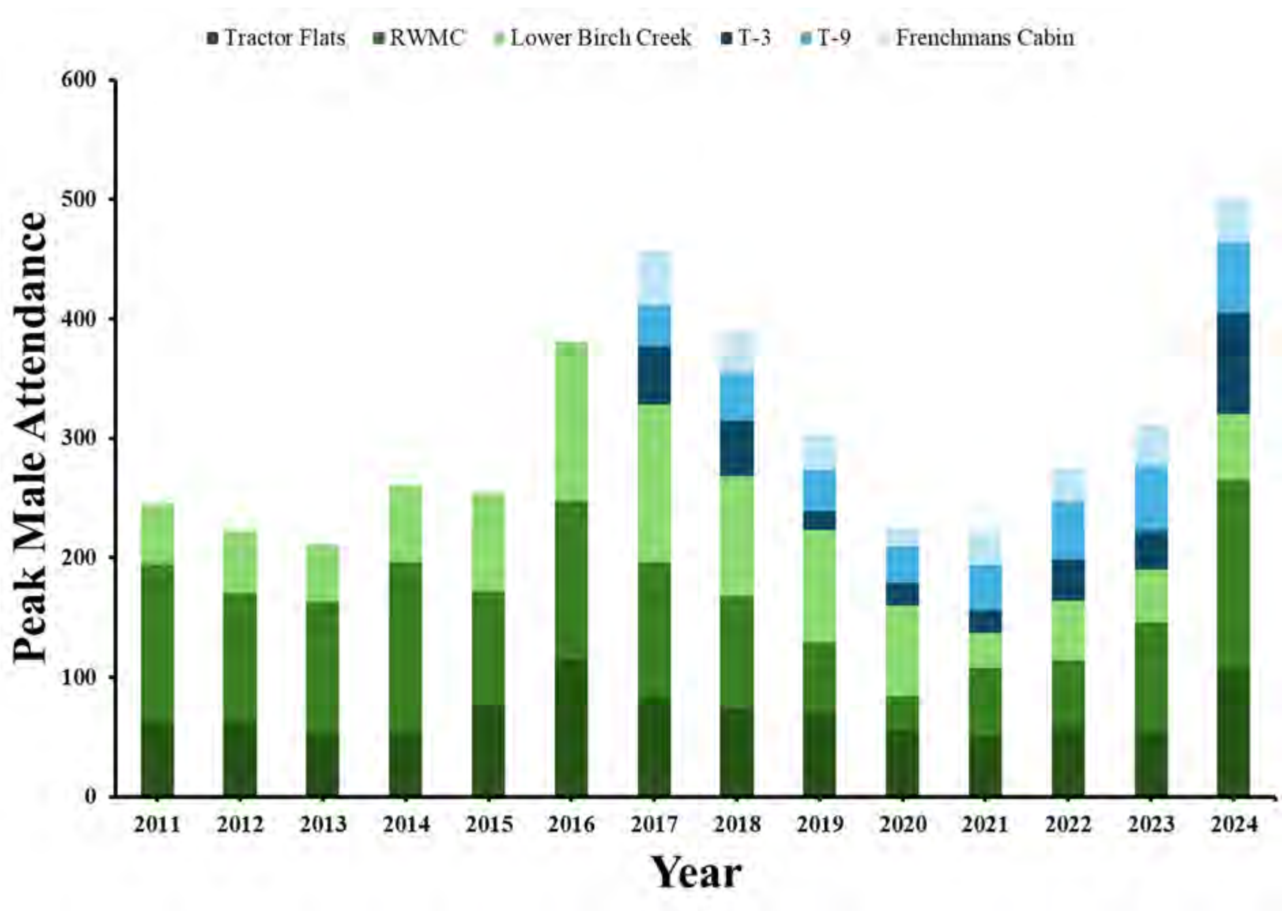

Figure 2-3. Peak male attendance of greater sage-grouse (*Centrocercus urophasianus*) on all lek routes at the Idaho National Laboratory Site from 2011 to 2024. The T-3, T-9, and Frenchmans Cabin routes began in 2017.

Table 2-1. Historical data of peak male attendance of greater sage-grouse (*Centrocercus urophasianus*) and annual percent change on lek routes on the Idaho National Laboratory Site from 2011 to 2024. Precent changes exceeding -50% from the previous year are highlighted in red and those exceeding 50% are highlighted in green.

	IDFG Lek Routes						INL Lek Routes*							
Year	**TF[1]**	**Δ%**	**RWMC[2]**	**Δ%**	**LBC[3]**	**Δ%**	**T-3**	**Δ%**	**T-9**	**Δ%**	**FC[4]**	**Δ%**	**Total**	**Δ%**
2011	63		132		50								245	
2012	63	0.0	107	-18.9	52	4.0							222	-9.4
2013	53	-15.9	110	2.8	48	-7.7							211	-5.0
2014	55	3.8	141	28.2	64	33.3							260	23.2
2015	76	38.2	96	-31.9	82	28.1							254	-2.3
2016	115	**51.3**	133	38.5	133	**62.2**							381	**50.0**
2017	84	-27.0	112	-15.8	132	-0.8	49		34		46		457	
2018	74	-11.9	94	-16.1	100	-24.2	47	-4.1	39	14.7	36	-21.7	390	-14.7
2019	69	-6.8	60	-36.2	94	-6.0	16	**-66.0**	35	-10.3	28	-22.2	302	-22.6
2020	56	-18.8	28	**-53.3**	76	-19.1	19	18.8	31	-11.4	15	-46.4	225	-25.5
2021	51	-8.9	57	**103.6**	29	**-61.8**	19	0.0	38	22.6	28	**86.7**	222	-1.3
2022	58	13.7	56	-1.8	50	**72.4**	35	**84.2**	48	26.3	28	0.0	275	23.9
2023	55	-5.2	91	**62.5**	44	-12.0	32	-8.6	55	14.6	35	25.0	312	13.5
2024	106	**92.7**	159	**74.7**	55	25.0	85	**165.6**	59	7.3	36	2.9	500	**60.3**

Δ% percent change when compared to the prior year; values in green or red indicate a ± change ≥ 50%

[1]Tractor Flats

[2]Radioactive Waste Management Complex

[3]Lower Birch Creek

[4]Frenchmans Cabin

[*]INL Lek Routes began in 2017

2.1.3.3 Rotational Surveys of Inactive Leks and Changes in Lek Status

In addition to routine surveys of active and inactive baseline and route leks, 21 rotational inactive leks were visited in 2024. These leks were each visited twice, and no sage-grouse were observed except on lek INL 26, which has been vacant since 2006, where two male sage-grouse were observed (Figure 2-4). While this lek is still classified as inactive after the 2024 survey season, any detection of two or more males at the lek within the next four years will upgrade this lek to active status. INL 26 will be added to the 2025 inactive rotational lek list and be visited twice to assess the occupancy of the lek.

One lek, INL 21, a baseline lek on the Tractor Flats lek route, changed status this season (Figure 2-4). The peak male sage-grouse attendance was four in 2024 and two in 2021, making this lek active; it was last active in 2016. Of the 27 baseline leks, 18 are currently active (Figure 2-1). There are 35 total leks classified as active, one more than in 2023 (Figure 2-4). However, males were counted on four leks located on the T-9, FC, and RWMC lek routes that were classified as inactive at the beginning of the 2024 season. Leks INL 54, INL 112, INL 11, and INL 35 may change status in the future if two or more males are observed at these locations in the next four years (Figure 2-4).

2.1.3.4 Site-wide Population and Survey Effort

The sum of peak male attendance for all leks surveyed on the INL Site in 2024 was 829. Mean survey effort between 2011 and 2024 was 79 leks (range 67–93) with 78 leks surveyed in 2024. The number of leks surveyed between 2011 and 2017 varied as discovery and historical lek surveys were completed in an initial effort to inventory all leks present on the INL Site. Survey effort has been largely consistent since 2018 (mean = 73, range 67–78), and fluctuations are due to the number of rotational leks that are scheduled to be surveyed each year and spring weather conditions. The survey effort since 2011 has documented the cyclical nature of sage-grouse populations (Figure 2-5) which mirrors with regional trends reported by the State of Idaho (Kemner 2023). Despite this consistent effort and a record high count in 2024, the number of leks classified as active has steadily declined on the INL Site from a high of 49 in 2013 to a low of 34 in 2023 (Figure 2-5). This decline may be an artifact of a time-lag as inactive leks become active during population peaks or it may be a result of leks becoming inactive after wildfire events and those birds moving to active leks in higher quality habitat.

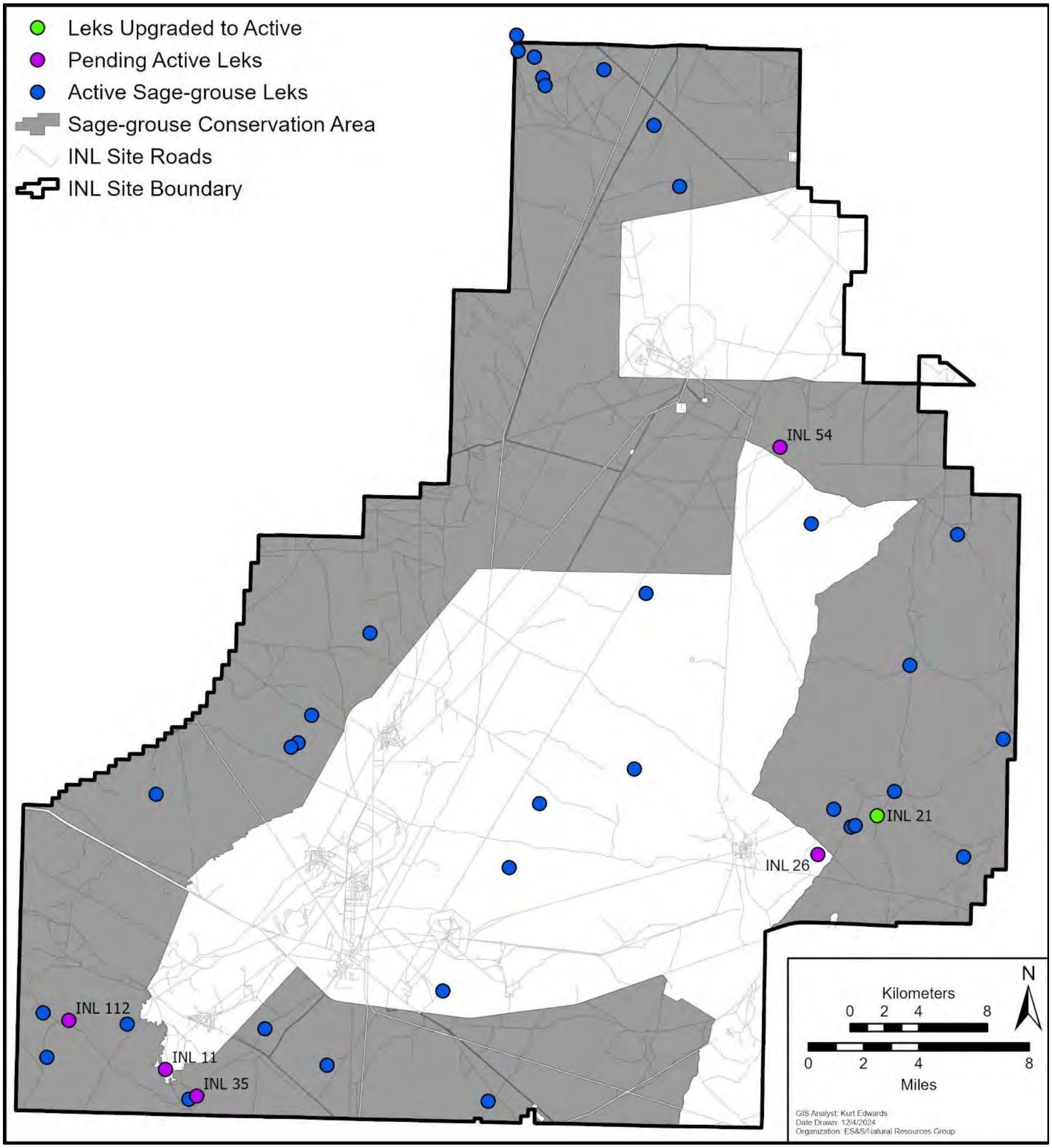

Figure 2-4. Greater sage-grouse (*Centrocercus urophasianus*) lek designations and status updates on or near the Idaho National Laboratory Site following the 2024 field season.

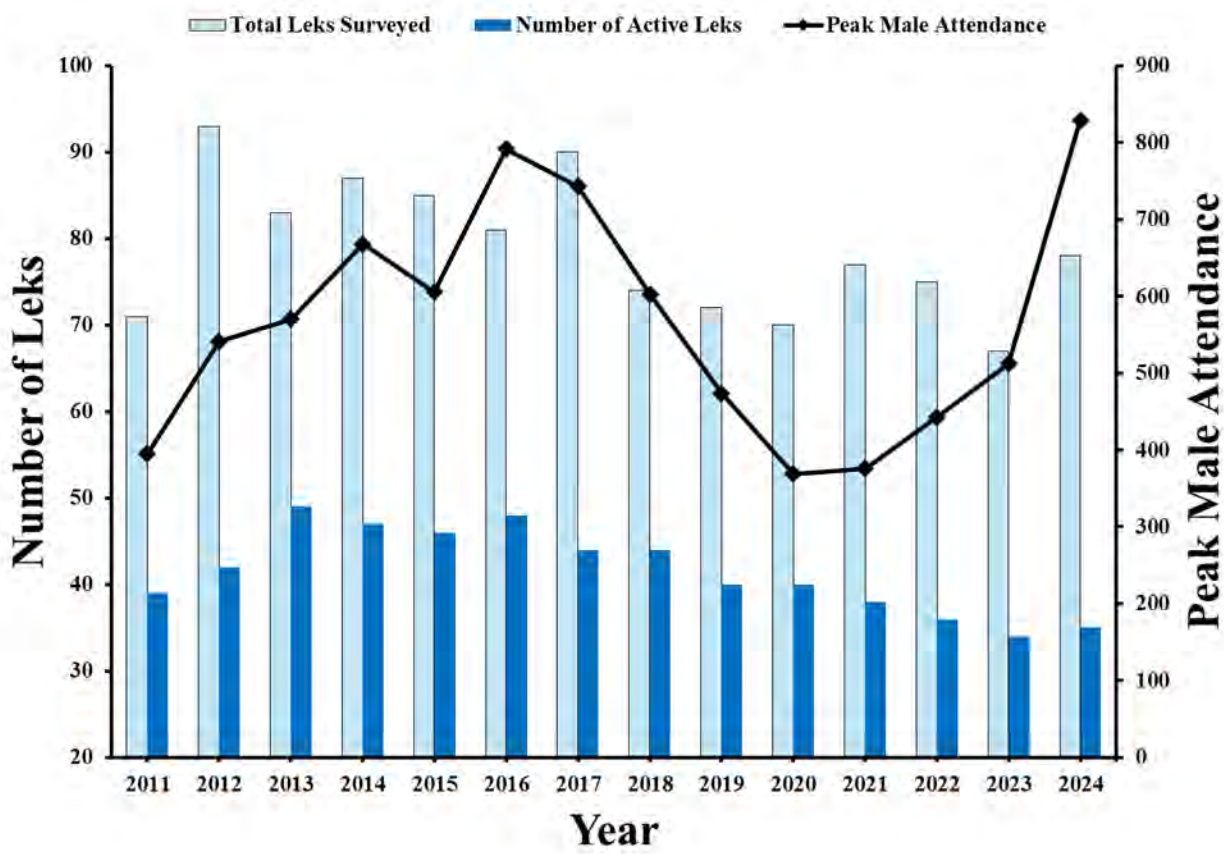

Figure 2-5. Lek survey effort, lek activity status, and peak male attendance of greater sage-grouse (*Centrocercus urophasianus*) for all leks surveyed on or near the Idaho National Laboratory Site from 2011 to 2024. Leks are classified as active if two or more male sage-grouse were observed displaying on the lek in at least two of the previous five years.

2.1.4 Conclusions

The three metrics described above are used to comprehensively assess the health of sage-grouse populations present on the INL Site. The three-year average of peak male attendance from baseline leks is used to evaluate how the current sage-grouse population within the SGCA compares to the baseline population of 2011 as established as a trigger in the CCA. Using peak male attendance for all leks surveyed provides a broader picture of sage-grouse meta-populations on the INL Site, including for those leks located in less suitable habitat (i.e. habitat recovering from wildland fire). It can also be used to evaluate the influence of survey effort on annual counts. Counts from lek routes allow for a more direct comparison between the population on the INL Site and populations across the State of Idaho. This regional context is important when assessing tripped triggers since sage-grouse that occupy the INL Site also use habitat outside of the INL Site boundary. Even though these three metrics inform different facets of population monitoring, all three currently exhibit a similar pattern, indicating that they are tracking the cyclic nature of the INL Site sage-grouse population.

3.0 HABITAT TRIGGER MONITORING

All vegetation-based estimates of sagebrush habitat distribution for the CCA were initially determined using a vegetation map completed in 2010 (Shive et al. 2011). Sagebrush habitat was designated by selecting all map polygons assigned to stand-alone big sagebrush or low sagebrush classes, and all map class complexes where one of the two classes was either a big sagebrush or low sagebrush class. Areas designated as sagebrush habitat may change over 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-ID and USFWS 2014). DOE-ID and USFWS mutually agreed to adjust the sagebrush habitat trigger baseline in 2022 to incorporate the best available vegetation 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, DOE-ID can respond by altering the boundary of the SGCA to include more sagebrush habitat and initiate further restoration efforts on Priority Restoration Areas at the INL Site.

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 all current sagebrush habitat, particularly 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 conditions within polygons mapped as sagebrush habitat and facilitates comparison of current year sagebrush habitat on the INL Site with baseline values. Data collected to support this task may also be used in Task 6 to document gains in sagebrush habitat as recovering habitat polygons transition back into sagebrush map classes or to support map class polygon reassignments based on other plant community compositional shifts.

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

Together, these two monitoring tasks provide the basis for maintaining an accurate map of vegetation classes and an assessment of habitat condition on the INL Site. For example, imagery of burned areas may show changes in vegetation class boundaries immediately or several years post-burn, or sagebrush cover may be evaluated 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

The CCA identified monitoring habitat condition as an integral component of the monitoring program because it provides information about the quality of available habitat and informs adaptive management actions to conserve habitat types important to sage-grouse on the INL Site. This monitoring effort is intended to detect changes in habitat condition, and results from this task help guide the designation process used to determine the distribution of sagebrush habitat which informs the habitat trigger. Vegetation monitoring data are collected each year to accomplish this task. The quality of habitats available to sage-grouse is determined by 1) annual habitat condition assessment, and 2) habitat condition trend analysis, while 3) precipitation pattern summaries help to identify potential drivers for changes in overall habitat condition.

1) Annual habitat condition assessment is used to compare annual habitat condition metrics against the INL Site habitat condition baseline ranges (hereafter, baseline) to determine if current habitat conditions metrics are within acceptable ranges of variability. Because Connelly et al. (2000) recognized regional habitat guidelines are too broad to form the basis for finer scale habitat management, they recommended local habitat baselines be established to define the range of variation appropriate to local areas. In 2018, an INL Site specific baseline was established for making these comparisons.

2) Habitat condition trend analyses are used to evaluate changes in vegetation composition and structure since this monitoring effort began in 2013. Species cover data are summarized by plant functional groups and results are used to track changes in habitat condition that could affect habitat use by sage-grouse. Results from these analyses are also used to evaluate habitat decline and/or recovery of sagebrush habitat impacted by wildland fire or other disturbances.

3) Precipitation data can be used to understand changes in habitat condition within the context of local weather patterns. Long-term precipitation data from 1950 to the current year are used to evaluate total yearly accumulation and seasonal patterns are evaluated using monthly totals. Because precipitation is one of the major drivers of change in semi-arid systems (Anderson and Inouye 2001), patterns in precipitation are used to interpret changes in annual habitat condition and longer-term habitat condition trends.

Habitat condition data analyses are used to assess the condition of both intact sagebrush habitat and recovering habitat types. Vegetation metrics are sampled using permanent monitoring plots which were allocated by vegetation type. Sagebrush habitat plots are located within sagebrush vegetation map classes and recovering habitat plots are located primarily within post-fire vegetation map classes dominated by other shrub species and perennial grasses. While sagebrush abundance may take up to a century to recover to pre-burn cover values, it is important to monitor these areas because recovering plant communities will eventually become sagebrush habitat. In addition, recovering habitats that are in good ecological condition provide resources for seasonal sage-grouse use (Germino et al. 2023).

3.1.2 Methods

3.1.2.1 Sampling

Data are sampled on 75 vegetation monitoring plots distributed between two habitat types: sagebrush and recovering habitat (Figure 3-1). In previous reports, recovering sagebrush plots have been referred to as non-sagebrush plots. The terminology has been updated to more accurately reflect the importance of these plots as a component of the larger sagebrush steppe landscape at the INL Site. Plots in sagebrush habitat and recovering habitat types were stratified using the Shive et al. (2011) INL Site vegetation map. An initial selection of 48 plots were chosen from intact sagebrush plant communities to represent the existing sagebrush habitat type and 27 plots were chosen from plant communities that have burned but have the potential to recover to functional sagebrush habitat. The number of plots per vegetation type is expected to change over time because plots are reclassified to reflect shifts between habitat types, primarily from wildland fire events.

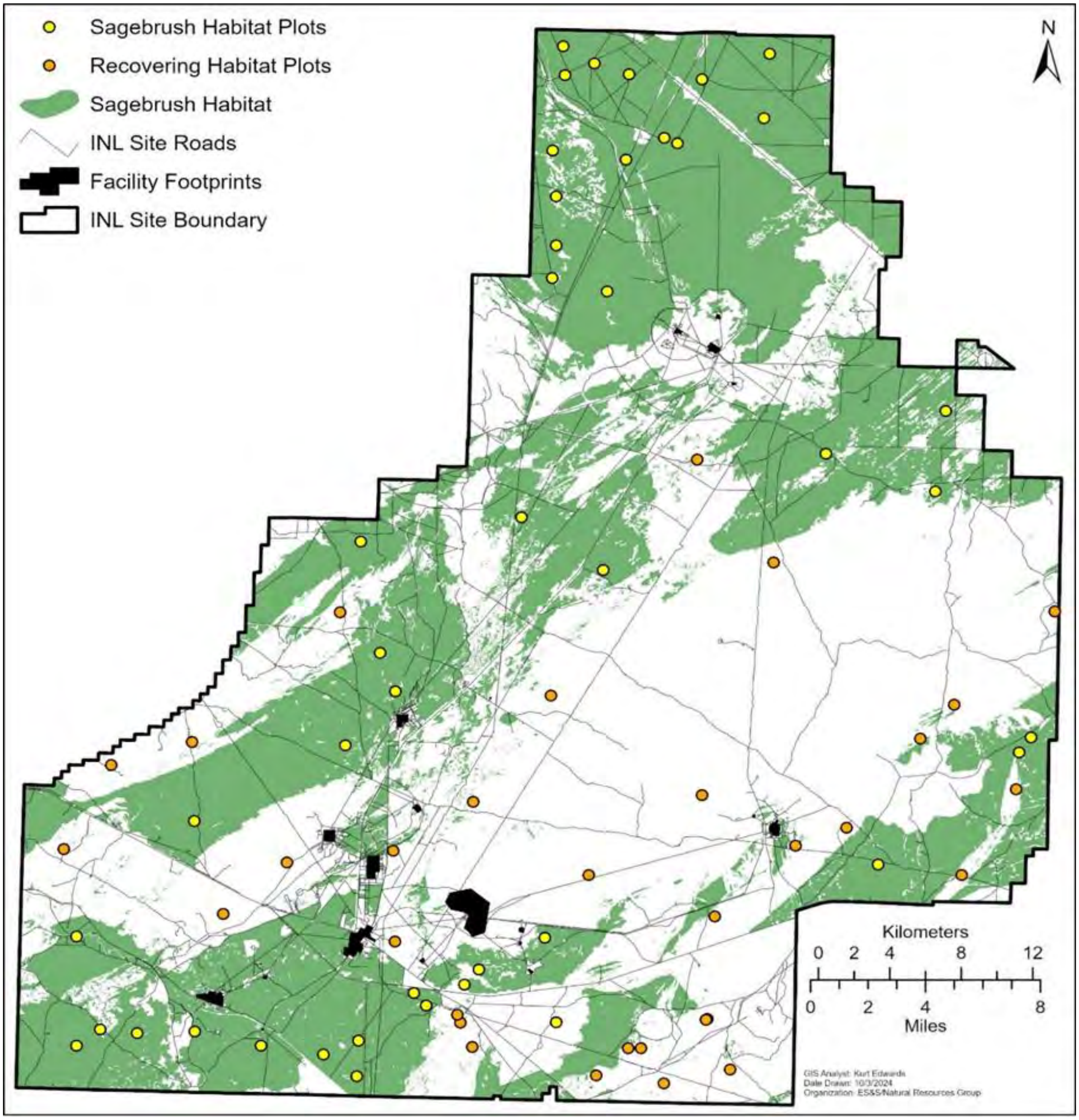

Figure 3-1. The 75 annual sagebrush habitat condition monitoring plots sampled on the Idaho National Laboratory Site in 2024 to support the Candidate Conservation Agreement in relation to sagebrush habitat.

Vegetation data are sampled within 20 x 20 m (21.9 x 21.9 yd) vegetation monitoring plots, along four interior transect lines. The data metrics collected along the transect lines are vascular foliar cover by species, vascular height by species, sagebrush density, and sagebrush juvenile frequency. Cover data are collected using a point-frame, heights are collected by measuring individuals, and sagebrush density and juvenile frequency are collected by counting within belt transects and denoting the presence or absence of juvenile sagebrush. A complete species list is collected within the plot. Photographs are taken of a 1 x 1 m (1.1 x 1.1 yd) photo-frame and of the surrounding landscape. A dichotomous plant community key is used to determine the vegetation class within the plot. Signs of use by sage-grouse, signs of grazing, and other disturbances are also noted.

For the complete description of sample site selection, plot sampling methodology, and vegetation monitoring plot diagram, please review the study plan and sample protocol in Appendix B from Shurtliff et al. (2016).

3.1.2.2 Data Analysis

There are three main categories of data analyses completed to support this task. The first set of analyses is the annual habitat condition assessment, the second set of analyses is longer-term habitat condition trends, and the third set of analyses are precipitation summaries. Results for annual habitat condition assessment and trends analyses are summarized by habitat type, either sagebrush or recovering habitat. Results for the precipitation analyses include long-term precipitation summaries and total monthly precipitation over the past decade.

Annual habitat condition is assessed by comparing the summary cover, height, and sagebrush density values from the current year to corresponding baseline values for sagebrush and recovering habitat types. Results are summarized at two levels of detail. First, mean annual cover and height for sagebrush and perennial grass/forb functional groups and density for sagebrush species are compared to baseline values within each habitat type. Second, to better understand any changes from previous sample periods, cover by species, height by functional group, and more detailed sagebrush juvenile sagebrush frequency results are provided. The INL Site specific baseline mentioned above was established in 2018 by averaging habitat condition results over five consecutive years for sagebrush and recovering habitat plots from annual monitoring plots (Shurtliff et al. 2019). To determine whether annual summary values deviate from baseline values, each metric is compared to the baseline range of variability ($\bar{x} \pm 1$ SE).

Trend analyses are used to summarize cover data and evaluate directional changes in habitat condition from 2013 through the current season for both sagebrush and recovering habitat plots. Cover data are summarized by habitat type, nativity, and plant functional group. The mean cover for each functional group is compared across sample years using One-way Repeated Measure of Analysis of Variance (Zar 1999). Habitat monitoring plots impacted by wildland fire have been reallocated to recovering habitat plots and have changed the overall sample sizes within each habitat type; however, they remain adequate for meaningful interpretation of statistical results (Zar 1999). Significance was determined at the $\alpha = 0.05$ level. Multiple pairwise comparisons were evaluated using the Holm-Šidák method (Šidák 1967).

Annual precipitation totals are summarized from 1951 through the current year to provide historical context and total monthly precipitation has been summarized over the last decade to provide a more recent context about the seasonality and timing of precipitation. Precipitation data are from the Central Facilities Area (CFA, available at [https://niwc.noaa.inl.gov/climate.htm]) and are summarized by water year. The total precipitation of a water year is calculated by summing annual precipitation from October 1 of the previous year through September 30 of the current growing season. Monthly precipitation totals are presented in seasonal blocks; fall (October, November, December), winter (January, February, March), spring (April, May, June), and summer (July, August, September).

3.1.3 Results

3.1.3.1 Annual Habitat Condition Assessment

We collected data on 43 sagebrush habitat plots and 32 recovering habitat plots for a total of 75 annual habitat condition monitoring plots from May 20 through August 1, 2024 (Figure 3-1). A broad overview of habitat condition in sagebrush habitat and recovering plots is presented in Table 3-1. Within sagebrush habitat plots, cover for the sagebrush and perennial grass/forb functional groups was above the baseline range, while sagebrush density was well below the baseline range in 2024. Within the recovering habitat plots, cover and height for the perennial grass/forb functional groups were within the baseline ranges. For the sagebrush functional group within the recovering habitat plots, cover, height, and density were above the baseline ranges.

Table 3-1. Average cover, height, and sagebrush density values for sagebrush (n = 43) and recovering (n = 32) habitat plots on the Idaho National Laboratory Site during 2024. Baseline ranges represent five years of vegetation monitoring data (2013–2017) from sagebrush (n = 48) and recovering (n = 27) habitat plots. Colors indicate when the 2024 summary value is greater than (green), less than (red), or within (black) the baseline range of ± 1 Standard Error (SE) around the baseline mean ($\bar{x}$).

	Cover (%)		**Height (cm)**		**Density (individuals/m^2)**	
Sagebrush Habitat	Baseline ($\bar{x}$ ±1 SE)	2024	Baseline ($\bar{x}$ ±1 SE)	2024	Baseline ($\bar{x}$ ±1 SE)	2024
Sagebrush	20.94 – 21.60	25.45	46.83 – 48.79	47.91	3.39 – 6.99	2.96
Perennial Grass/Forb	7.73 – 12.79	14.45	17.03 – 24.37	20.88	— - —	—
Recovering Habitat						
Sagebrush	0.17 – 0.27	1.32	31.60 – 35.48	49.95	0.06 – 0.08	0.16
Perennial Grass/Forb	17.80 – 22.14	20.22	25.96 – 33.58	27.88	— - —	—

Sagebrush Habitat Plots

In 2024, total vascular cover was above the baseline range and both total native cover and total introduced cover were above their baseline ranges (Table 3-2). Native functional groups contributed six times more cover than introduced functional groups. Both total native shrub and perennial graminoids (grasses and sedges) cover were above their baseline ranges and introduced annual and biennial cover was also greater than its baseline range.

Table 3-2. Absolute cover (%) for observed species within 43 annual sagebrush habitat plots on the Idaho National Laboratory Site. Baseline cover ranges are compared to 2024 cover values by species and functional groups. Baseline means and ranges were calculated from five years of data (2013–2017). Colors indicate when the 2024 cover is greater than (green), less than (red), or within (black) the baseline range of ± 1 Standard Error (SE) around the baseline mean ($\bar{x}$) for the corresponding plant functional group. If the baseline cover and current year cover values of a species are both less than 0.05%, these values are summed up and reported under the 'others' category within their respective functional group. A dash (—) indicates that species were undetectable using the point-frame sampling method.

Scientific Name	Common Name	Baseline Cover (%)	2024 Cover (%)
Native Shrubs			
Artemisia tridentata	big sagebrush	17.41	22.24
Chrysothamnus viscidiflorus	green rabbitbrush	6.64	4.90
Artemisia tripartita	threetip sagebrush	1.80	2.22
Artemisia arbuscula	low sagebrush	1.16	—
Atriplex confertifolia	shadscale saltbush	0.95	1.12
Artemisia nova	black sagebrush	0.90	0.99
Krascheninnikovia lanata	winterfat	0.72	0.52
Linanthus pungens	granite prickly phlox	0.22	0.20
Eriogonum microthecum	shrubby buckwheat	0.10	0.09
Tetradymia canescens	spineless horsebrush	0.04	0.06
Others (n = 3, 2)		0.05	0.06
Total Native Shrub Cover		**29.99** (±0.339)	**32.39**
Native Succulents			
Opuntia polyacantha	plains pricklypear	0.10	0.11
Others (n = 1, 0)		<0.00	—
Total Native Succulent Cover		**0.10** (±0.004)	**0.11**
Native Perennial Graminoids			
Elymus elymoides	bottlebrush squirreltail	2.15	4.19
Poa secunda	Sandburg bluegrass	2.03	3.23
Achnatherum hymenoides	Indian ricegrass	1.85	1.94
Pseudoroegneria spicata	bluebunch wheatgrass	1.21	1.23
Elymus lanceolatus	thickspike wheatgrass	0.80	0.71
Hesperostipa comata	needle and thread	0.51	0.31
Pascopyrum smithii	western wheatgrass	0.21	—
Carex douglasii	Douglas's sedge	0.11	0.25
Others (n = 1, 0)		0.02	—
Total Native Perennial Graminoid Cover		**8.88** (±0.177)	**11.85**

Table 3-2. continued.

Scientific Name	Common Name	Baseline Cover (%)	2024 Cover (%)
Native Perennial Forbs			
Phlox hoodii	Hood's phlox	0.47	0.49
Schoenocrambe linifolia	flaxleaf plainsmustard	0.24	<0.00
Sphaeralcea munroana	Munro's globemallow	0.12	—
Erigeron pumilus	shaggy fleabane	0.04	0.06
Astragalus filipes	basalt milkvetch	0.03	0.28
Others (n = 25, 18)		0.21	0.20
Total Native Perennial Forb Cover		**1.11** (±0.079)	**1.04**
Native Annuals and Biennials Forbs			
Lappula occidentalis	flatspine stickseed	0.34	0.14
Descurainia pinnata	western tansymustard	0.27	0.15
Cordylanthus ramosus	bushy bird's beak	0.15	0.01
Chenopodium leptophyllum	slimleaf goosefoot	0.08	—
Others (n = 13, 4)		0.14	0.01
Total Native Annual and Biennial Forb Cover		**0.99** (±0.079)	**0.32**
Total Native Cover		**41.07** (±3.500)	**45.71**
Introduced Perennial Grasses			
Agropyron cristatum	crested wheatgrass	1.34	1.55
Others (n = 0, 0)		—	—
Total Introduced Perennial Grass Cover		**1.34** (±0.223)	**1.55**
Introduced Annuals and Biennials			
Alyssum desertorum	desert alyssum	1.08	1.54
Bromus tectorum	cheatgrass	1.02	3.46
Halogeton glomeratus	saltlover	0.74	0.33
Others (n = 7, 1)		0.03	<0.00
Total Introduced Annual and Biennial Cover		**2.87** (±1.588)	**5.34**
Total Introduced Cover		**4.21** (±1.793)	**6.89**
Total Vascular Plant Cover		**45.28** (±5.230)	**52.60**

The native shrub functional group provided the most cover in sagebrush habitat plots in 2024. Big sagebrush (*Artemisia tridentata*) contributed the most cover by species and green rabbitbrush (*Chrysothamnus viscidiflorus*) provided the second most cover. The native perennial graminoids functional group was dominated by bottlebrush squirreltail (*Elymus elymoides*), Sandberg bluegrass (*Poa secunda*), and Indian ricegrass (*Achnatherum hymenoides*). Cover from native forbs, both perennial and annual, was low in 2024, but these functional groups continue to contribute substantial diversity to sagebrush habitat.

Within the introduced species functional groups, crested wheatgrass (*Agropyron cristatum*) cover in 2024 was at the upper end of its baseline range. Cheatgrass (*Bromus tectorum*) provided the most cover of the introduced species, but it contributed relatively little to total vascular cover in sagebrush habitat plots.

The mean height values for all perennial functional groups were comparable to baseline means (Table 3-3). In 2024, both the mean height values and the proportions of shrubs and perennial grasses functional groups in the samples were similar to their baseline values. However, the proportion of perennial forbs was lower in 2024 compared to the baseline. Annual grasses were shorter than baseline in 2024 but contributed a larger proportion of the sample than baseline. Annual forbs were shorter in 2024 but were similar to the baseline in the proportion of the sample they represent.

Table 3-3. Mean vegetation height by functional group for 43 annual sagebrush habitat plots on the Idaho National Laboratory Site in 2024. Baseline mean height (cm) values are summarized by functional groups and were calculated from five years of data (2013–2017).

	Baseline		2024	
Functional Group	**Height (cm)**	**Proportion of Sample**	**Height (cm)**	**Proportion of Sample**
Shrubs				
Sagebrush	47.81	0.72	47.91	0.74
Other Species	25.57	0.28	25.17	0.26
Herbaceous				
Perennial Grasses	22.49	0.67	21.29	0.66
Perennial Forbs	9.98	0.12	10.34	0.03
Annual Grasses	18.95	0.04	11.35	0.15
Annual Forbs	9.09	0.17	5.42	0.16

In 2024, sagebrush habitat plots had lower mean sagebrush densities but greater minimum densities when compared to the baseline means (Table 3-4). The frequency of juvenile sagebrush species in 2024 was comparable to baseline values where, on average, juvenile sagebrush was present in four out of 10 belt transects.

Table 3-4. Sagebrush density (individuals/m2) and juvenile frequency from sagebrush habitat plots (n = 43) on the Idaho National Laboratory Site in 2024 compared to baseline values. The baseline density mean ($\bar{x}$) is ± 1 Standard Error (SE) and values were calculated from five years of monitoring data (2013– 2017).

	Baseline	**2024**
Density ($\bar{x}$ ±1 SE)	3.39 – 6.99	2.96
Minimum Density	0.43	0.98
Maximum Density	47.60	6.65
Juvenile Frequency ($\bar{x}$)	0.38	0.40

Recovering Habitat Plots

In 2024, total vascular cover was within the baseline range for recovering habitat plots (Table 3-5). Both total native cover and total introduced cover were within their respective baseline ranges. Native functional groups contributed two times more cover than cover from introduced functional groups. Total native shrub cover and total native annual and biennial forb cover were above their baseline ranges. Total native perennial graminoid cover contributed about a third to the total vascular cover, but cover remained within its baseline range. Total cover from native perennial forbs was below baseline in 2024, but this functional group contributed the greatest amount of diversity to recovering habitat plots. In 2024, total introduced perennial grass cover and forb cover was above baseline but contributed less than 2% to overall vascular cover. The total introduced annual and biennial cover was within its baseline range, but it contributed more than a third to the total vascular cover.

Table 3-5. Absolute cover (%) for observed species within 32 recovering habitat plots. Baseline cover ranges are compared to 2024 cover values by species and functional groups. Baseline ranges were calculated from five years of data (2013–2017). Colors indicate when the 2024 cover is greater than (green), less than (red), or within (black) the baseline range of ± 1 Standard Error (SE) around the baseline mean ($\bar{x}$) for the corresponding plant functional group. If the baseline cover and current year cover values of a species are both less than 0.05%, these values are summed and reported under the 'others' category within their respective functional group. A dash (—) indicates that species were undetectable using the point-frame sampling method.

Scientific Name	Common Name	Baseline Cover (%)	2024 Cover (%)
Native Shrubs			
Chrysothamnus viscidiflorus	green rabbitbrush	10.72	10.63
Artemisia tridentata	big sagebrush	0.33	1.32
Atriplex confertifolia	shadscale bush	0.21	0.43
Tetradymia canescens	spineless horsebrush	0.18	0.25
Eriogonum microthecum	shrubby buckwheat	0.07	0.05
Krascheninnikovia lanata	winterfat	0.02	0.07
Artemisia tripartita	threetip sagebrush	0.01	0.11
Others (n = 2, 5)		0.06	0.08
Total Native Shrub Cover		**11.62** (±0.408)	**12.94**
Native Succulents			
Opuntia polyacantha	plains pricklypear	0.10	0.11
Others (n = 0, 0)		—	—
Total Native Succulent Cover		**0.10** (±0.017)	**0.11**
Native Perennial Graminoids			
Pseudoroegneria spicata	bluebunch wheatgrass	4.82	2.72
Poa secunda	Sandburg bluegrass	3.01	3.21
Hesperostipa comata	needle and thread	2.68	3.14
Achnatherum hymenoides	Indian ricegrass	2.45	2.46
Elymus lanceolatus	thickspike wheatgrass	2.08	3.18
Elymus elymoides	bottlebrush squirreltail	1.42	1.68
Pascopyrum smithii	western wheatgrass	0.84	0.79

Table 3-5. continued.

Scientific Name	Common Name	Baseline Cover (%)	2024 Cover (%)
Leymus flavescens	yellow wild rye	0.58	0.63
Carex douglasii	Douglas's sedge	0.08	0.08
Others (n = 2, 1)		0.03	0.01
Total Native Perennial Graminoid Cover		**17.98** (±1.979)	**17.91**
Native Perennial Forbs			
Phlox hoodii	Hood's phlox	0.40	0.30
Sphaeralcea munroana	Munro's globemallow	0.31	0.01
Crepis acuminata	taper tip hawksbeard	0.29	0.13
Erigeron pumilus	shaggy fleabane	0.15	0.28
Phlox aculeata	sagebrush phlox	0.11	—
Phlox longifolia	longleaf phlox	0.10	0.05
Machaeranthera canescens	hoary tansyaster	0.07	0.04
Schoenocrambe linifolia	flaxleaf plainsmustard	0.07	0.02
Astragalus filipes	basalt milkvetch	0.06	0.02
Psoralidium lanceolatum	lemon scurf pea	0.02	0.06
Pteryxia terebinthina	turpentine wavewing	0.01	0.10
Others (n = 17, 9)		0.21	0.14
Total Native Perennial Forb Cover		**1.75** (±0.322)	**1.16**
Native Annuals and Biennials Forbs			
Lappula occidentalis	flatspine stickseed	0.26	0.53
Descurainia pinnata	western tansymustard	0.11	0.20
Mentzelia albicaulis	whitestem blazingstar	0.09	0.20
Eriastrum wilcoxii	Wilcox's woollystar	0.09	0.01
Gnaphalium palustre	western cudweed	<0.00	0.26
Others (n = 11, 5)		0.14	0.05
Total Native Annual and Biennial Forb Cover		**0.67** (±0.280)	**1.25**
Total Native Cover		**32.12** (±2.607)	**33.38**
Introduced Perennial Grasses and Forbs			
Agropyron cristatum	crested wheatgrass	0.59	1.15
Other (n = 1, 0)		0.01	—
Total Introduced Perennial Grass and Forb Cover		**0.60** (±0.089)	**1.15**
Introduced Annuals and Biennials			
Bromus tectorum	cheatgrass	13.48	14.49
Salsola tragus	prickly Russian thistle	1.78	0.48
Alyssum desertorum	desert alyssum	1.40	1.86
Halogeton glomeratus	saltlover	1.22	0.42
Sisymbrium altissimum	tall tumblemustard	0.21	0.99

Table 3-5. continued.

Scientific Name	Common Name	Baseline Cover (%)	2024 Cover (%)
Descurainia sophia	herb sophia	0.06	0.04
Others (n = 2, 2)		0.01	0.03
Total Introduced Annual and Biennial Cover		**18.17** (±5.414)	**18.31**
Total Introduced Cover		**18.78** (±5.496)	**19.46**
Total Vascular Plant Cover		**50.90** (±8.001)	**52.83**

The species with the greatest cover within the native perennial graminoid functional group were Sandberg bluegrass, thickspike wheatgrass (*Elymus lanceolatus*), needle and thread (*Hesperostipa comata*), and Indian ricegrass. Within the shrubs functional group, green rabbitbrush had the most cover, while big sagebrush, despite having nine times less cover than green rabbitbrush, had the second greatest cover among the shrub species.

Cheatgrass was the most abundant introduced species, contributing more than a quarter of the total vascular cover within recovering habitat plots in 2024. Desert alyssum (*Alyssum desertorum*) and crested wheatgrass were the only two introduced species with more than one percent absolute cover, while all other introduced species had below one percent absolute cover.

Shrubs were substantially taller than the baseline in 2024 (Table 3-6). Green rabbitbrush dominated the shrub functional group, providing the greatest structural composition to recovering habitat, as indicated by the proportion of sample contributed by these species. The mean height for the herbaceous perennial functional groups was shorter than the baseline and they were smaller proportions of sample when compared to the baseline. The mean height for the herbaceous annual functional groups were shorter in 2024 but they were a larger proportion of the sample when compared to the baseline.

Table 3-6. Mean vegetation height by functional group for recovering habitat plots (n = 32) on the Idaho National Laboratory Site in 2024. Baseline mean height (cm) values are summarized by functional groups and were calculated from five years of data (2013–2017).

	Baseline		2024	
Functional Group	**Height (cm)**	**Proportion of Sample**	**Height (cm)**	**Proportion of Sample**
Shrubs				
Sagebrush	33.54	0.08	49.95	0.10
Other Species	26.82	0.92	29.75	0.90
Herbaceous				
Perennial Grasses	31.49	0.55	27.91	0.47
Perennial Forbs	11.64	0.06	10.34	<0.00
Annual Grasses	16.96	0.25	11.01	0.37
Annual Forbs	10.94	0.15	9.06	0.17

Recovering habitat plots had substantially greater densities of mature sagebrush individuals and juvenile sagebrush frequencies in 2024 when compared to the baseline (Table 3-7). In 2024, mean juvenile frequency was 12 juvenile sagebrush per 100 belt transects, which is six times greater than the baseline value of two juvenile sagebrush per 100 belt transects.

Table 3-7. Mature sagebrush density (individuals/m2) and juvenile frequency from recovering monitoring plots (n = 32) on the Idaho National Laboratory Site in 2024 compared to baseline values. The baseline density mean (x̄) is ± 1 Standard Error (SE) and values were calculated from five years of monitoring data (2013– 2017).

	Baseline	2024
Density (x̄ ±1 SE)	0.07 (±0.01)	0.16
Minimum Density	0.00	0.00
Maximum Density	0.75	0.74
Juvenile Frequency (x̄)	0.02	0.12

3.1.3.2 Habitat Condition Trend Analysis

Sagebrush Habitat Plots

From 2013–2024, cover trends differed among native functional groups (Figure 3-2) in sagebrush habitat plots. Cover from sagebrush species has trended upward in the last seven years, and there was 5% greater sagebrush cover in 2024 than in 2013 (Figure 3-2, Table A-1). Differences in sagebrush cover over the past 12 years are significant ($p < 0.001$), and results of pairwise multiple comparisons indicate that mean cover values from the latter part of the sample period are significantly greater than mean cover values from the early part of the sample period ($p = 0.03$, Table A-1). When excluding sagebrush species cover, the remaining cover from the other shrub species was the third most abundant functional group in 2024 but cover from this functional group was significantly lower than when monitoring began in 2013, apart from two years (i.e. 2017 and 2019; $p = 0.03$, Table A-1). Cover of native perennial graminoids significantly differed between the highest years and lowest years by nearly an order of magnitude (i.e. 2018 and 2014; $p < 0.001$, Table A-1), but there was no directional trend in cover for this functional group (Figure 3-2). The cover of native perennial forbs between 2017 – 2019 was significantly greater than the lowest mean cover year in 2014 ($p < 0.001$, Table A-1), but this functional group has been considerably less relative to the other plant functional groups (Figure 3-2). The cover from native annuals and biennials was bimodal with a peak in 2017–2018 and another from 2022–2023 (Figure 3-2). Cover from this group was significantly greater in 2017 than in all other years ($p = 0.003$, Table A-1). Although the relative cover of native perennial forbs and annual and biennial functional groups is considerably lower compared to dominant functional groups in sagebrush habitat plots, changes in their abundance is important to the diversity within the sagebrush steppe ecosystem (Figure 3-2).

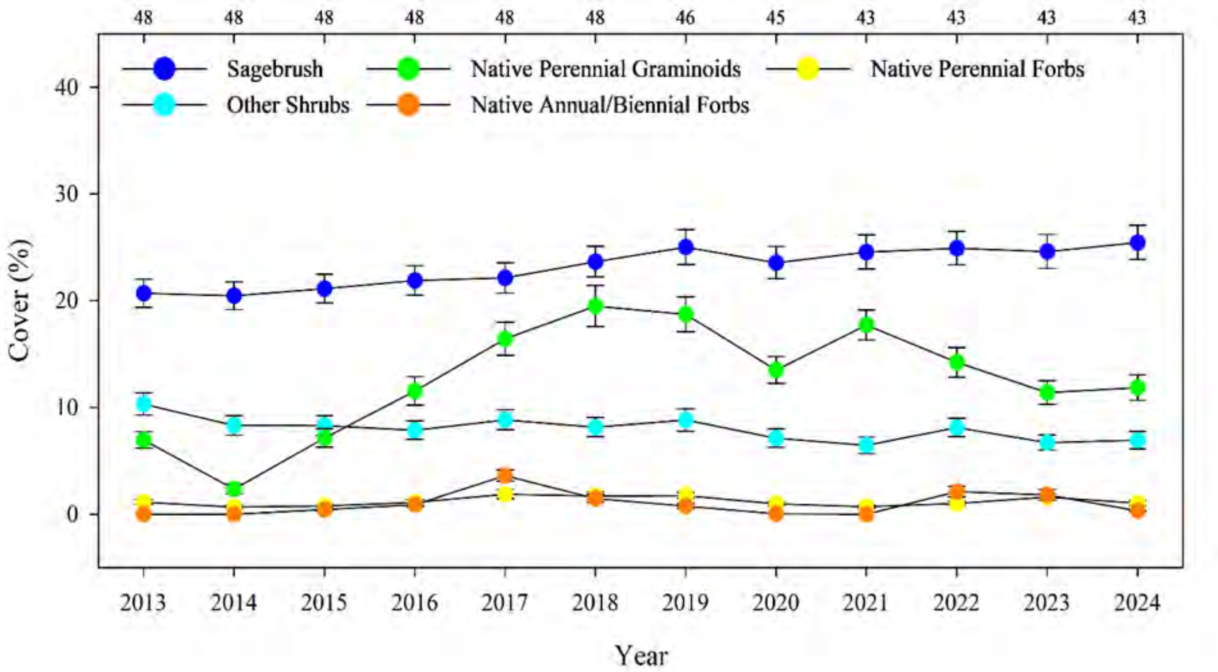

Figure 3-2. Cover from sagebrush habitat plots summarized by native plant functional groups on the Idaho National Laboratory Site from 2013 through 2024. Cover is the absolute mean ($\bar{x}$). Error bars represent ±1 Standard Error (SE). Sample size is denoted along the top at corresponding tick marks.

Cover contributed by introduced functional groups has remained low on sagebrush habitat plots throughout the monitoring period (Figure 3-3). Introduced annual grass cover was significantly greater in years with the highest cover values than in years with the lowest cover values ($p < 0.001$, Table A-2) but the years with the highest cover values tended to be in the middle of the sample period (Figure 3-3) and 2024 cover was significantly lower than 2018 cover ($p = 0.03$, Table A-2). Introduced annual forb cover was significantly greater in the four years with the highest cover values than in the years with the lowest cover values ($p < 0.001$, Table A-2), but annual fluctuations do not indicate directional trends (Figure 3-3).

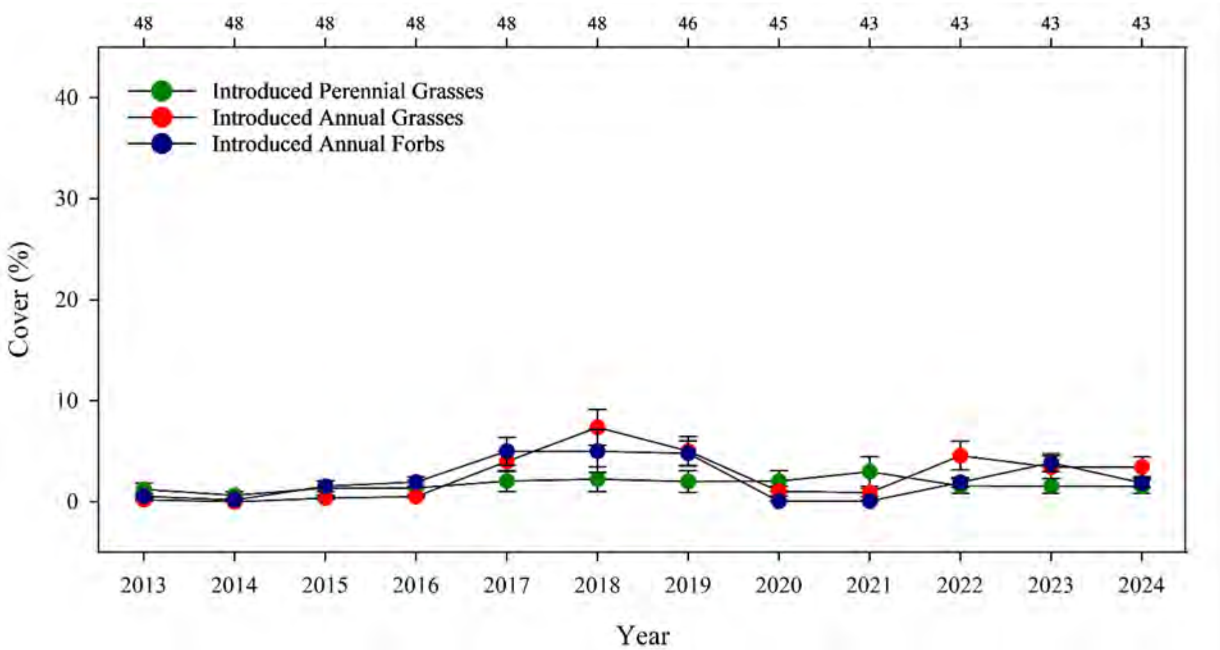

Figure 3-3. Cover from sagebrush habitat plots summarized by introduced plant functional groups on the Idaho National Laboratory Site from 2013 through 2024. Cover is the absolute mean ($\bar{x}$). Error bars represent ±1 Standard Error (SE). Sample size is denoted along the top at corresponding tick marks.

Recovering Habitat Plots

Within the recovering habitat plots, cover from sagebrush species has been increasing since 2013 and was significantly greater in 2024 than in 2013 ($p = 0.01$, Figure 3-4, Table A-3). Native perennial grasses have been the most abundant native functional group throughout the monitoring period, and cover fluctuates from one sample period to the next, but it is not changing directionally (Table A-3). Shrubs other than sagebrush have consistently been the second most abundant functional group throughout the monitoring period, and cover has remained relatively stable with no significant differences from one sample period to another (Figure 3-4, Table A-3). The cover from the native perennial forb functional group has been significantly lower in the last five years when compared to 2013 ($p = 0.01$, Table A-3). The cover from native annual and biennials was significantly greater in 2022 than in 2014 ($p = 0.04$, Table A-3) but has since declined (Figure 3-4).

Introduced perennial grass cover has remained low and stable throughout the sample period (Figure 3-5). Cover from introduced annual forbs was significantly lower in 2024 compared to the peak in 2023 ($p = 0.002$, Figure 3-5), but annual fluctuations do not appear to be directional. Cover from introduced annual grasses was significantly lower in 2024 than in the three years with the greatest mean cover from 2017 to 2019 ($p < 0.001$, Table A-4), and cover from this group remains as likely to decrease or increase from one sample year to the next within the recovering habitat plots (Figure 3-5).

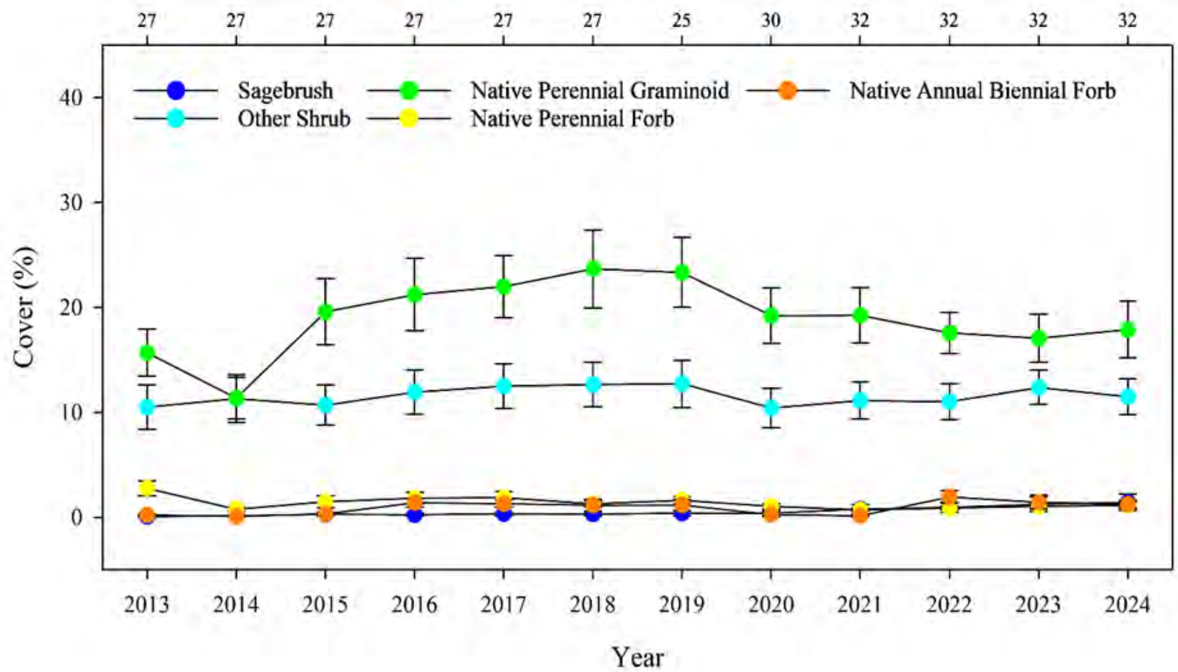

Figure 3-4. Cover from recovering habitat plots summarized by native plant functional groups on the Idaho National Laboratory Site from 2013 through 2024. Cover is the absolute mean (x̄). Error bars represent ± 1 Standard Error (SE). Sample size is denoted along the top at corresponding tick marks.

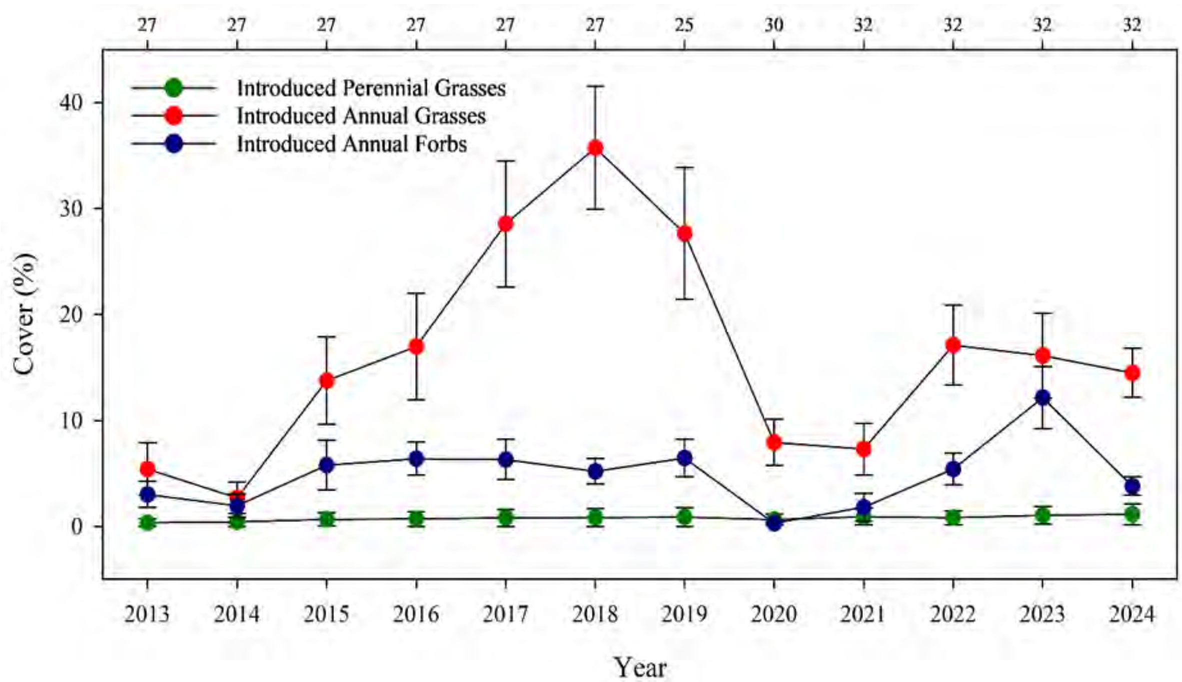

Figure 3-5. Cover from recovering habitat plots summarized by introduced plant functional groups on the Idaho National Laboratory Site from 2013 through 2024. Cover is the absolute mean (x̄). Error bars represent ±1 Standard Error (SE). Sample size is denoted along the top at corresponding tick marks.

3.1.3.3 Precipitation Analysis

Total precipitation for 2024 was similar to the 73-year average (Figure 3-6) but seasonal precipitation timing has departed from the long-term seasonal averages over the last decade (Figure 3-7). Precipitation in August, September, and October has been much higher than average several times in the past ten years and precipitation in June and July has been much lower than average several times in the past ten years (Figure 3-7). These monthly deviations from average suggest a shift to less precipitation in the early summer and more precipitation in the late summer and fall months.

During the 2024 water year, the fall season was close to average; precipitation in October was nearly twice the long-term average, November received average precipitation, and December received only 10% of its long-term average. Winter precipitation was twice the long-term average precipitation, due to a very wet February and higher than average precipitation in March. The spring months were below average and only a fraction of the average monthly precipitation fell in June. Summer season precipitation began below average with a very dry July, but precipitation increased to near average in August and was higher than average in September.

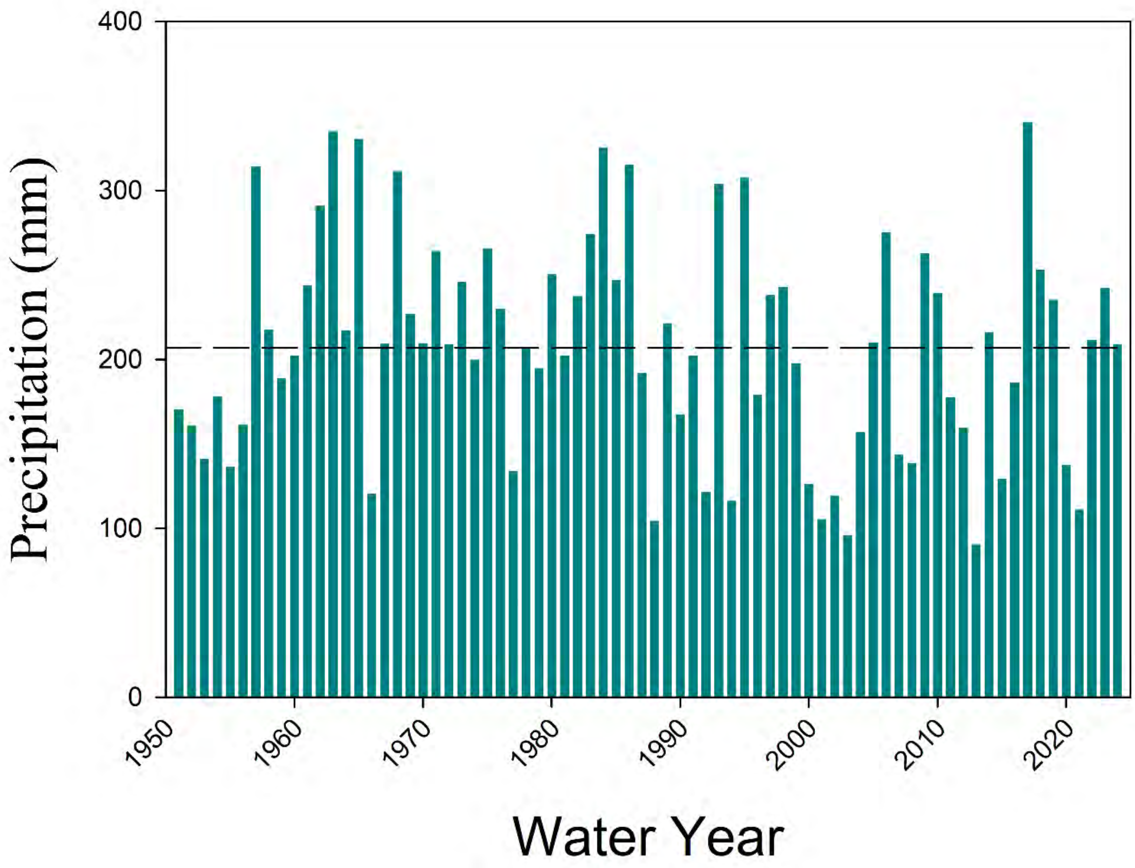

Figure 3-6. Total precipitation by water year (October 1–September 30) from 1951 through 2024 at the Central Facilities Area, Idaho National Laboratory Site. The dashed line represents the mean annual precipitation (207 mm).

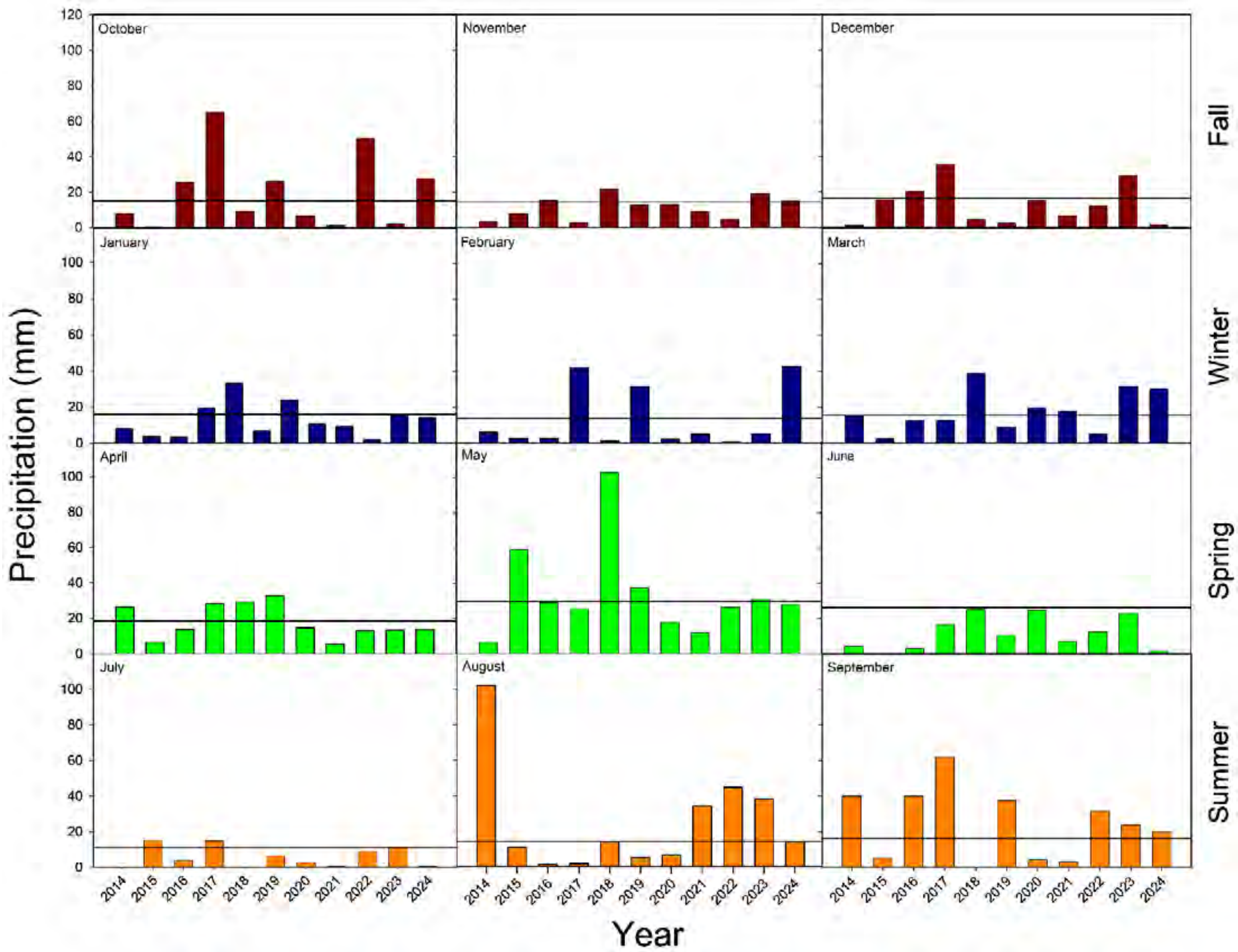

Figure 3-7. Monthly precipitation totals, organized by water year (October 1–September 30), from 2013 to 2024. Means are depicted with a solid line and were calculated from precipitation data collected between 1951 to 2024. Data are from the Central Facilities Area on the Idaho National Laboratory Site and were provided by the National Oceanic and Atmospheric Administration.

3.1.4 Discussion

Within sagebrush habitat plots, sagebrush species dominated the shrub canopy, and native herbaceous functional groups dominated the understory over introduced groups. Both the shrub and native perennial grass groups were within acceptable ranges of variability for height when habitat condition summaries were compared to baseline ranges. Sagebrush density was below its baseline range, indicating that there are fewer sagebrush individuals. Drought conditions in late spring and early summer were unfavorable for mass germination events, which likely contributed to this reduction in sagebrush density. The density baseline range includes counts of immature seedlings from mass germination events in 2016 and 2017 in addition to juvenile and mature sagebrush individuals. Because most seedlings from mass germination events die within their first few years, they have been removed from density counts in 2024 for a more accurate measure of juvenile and mature sagebrush density. However, this measurement discrepancy will likely persist within the sagebrush density baseline range until the data set becomes more temporally comprehensive.

Introduced functional groups remain a very minor component of sagebrush habitat on the INL Site. The most abundant introduced species was cheatgrass, but it was much less abundant than total native graminoid cover. Fall precipitation appears to influence the fluctuating trends of cheatgrass abundance where cheatgrass is more abundant in years with above average fall precipitation compared to years with below average fall precipitation. Cheatgrass is an invasive annual grass that is highly responsive to precipitation timing. It has invaded the western U.S and changed the ecosystem dynamics across much of the sagebrush steppe (Mealor et al. 2013). However, the low relative cover of cheatgrass across monitoring plots on the INL Site suggests intact sagebrush habitat appear to have some resistance to a shift toward cheatgrass dominance (INL 2024). In conclusion, sagebrush habitat was in good overall ecological condition on the INL Site in 2024.

The trend for sagebrush species indicates that the abundance of these species has slowly increased since 2013 and it has remained the most abundant functional group (Figure 3-2) across sagebrush habitat plots. Abundance of native perennial graminoids trended upward after relief from severe drought conditions in 2013 but abundance values have since returned to within the normal range of variation (Figure 3-2). Total cover from the other shrub functional group, which excludes cover from sagebrush species, has been lower than cover from native perennial graminoids since 2015 and the difference between the functional groups has been significant since 2019. The decrease in native annual and biennial forbs over the past few years is connected to precipitation patterns as cover from species in this group spikes in years with average or above average precipitation compared to years with dry summer conditions as seen this year in June and July.

Ecological condition varies across recovering habitat due to differences in the fire frequency, distribution, and microsite characteristics of monitoring plots. In general, total cover from native species was greater than cover from introduced species and native perennial graminoids and non-sagebrush shrubs were the most abundant native functional groups. While sagebrush species are uncommon within these areas, the cover, height, and density of species in this functional group were substantially greater than their baseline ranges in 2024 (Table 3-1). Sagebrush abundance has been trending upward as cover has generally increased since this monitoring effort began in 2013, and cover in 2024 was significantly greater than that first year (Table A-3). These gains in sagebrush abundance are an important early sign of habitat recovery. However, sagebrush cover is not high enough to provide optimal habitat for sage-grouse because it is still considerably below general habitat guidelines (Connelly et al. 2000).

Plant species capable of resprouting from underground structures are among the first species to reestablish after a wildland fire on the INL Site (INL 2023). Recovering habitats are dominated by native perennial grasses and green rabbitbrush as these species are capable of resprouting following wildland fire, unlike sagebrush species, which are killed by fire. There are a variety of other shrub species found in recovering habitats, which are collectively important to habitat diversity and recovery even though they each contribute relatively little to the overall cover. Patterns in cover trends of native perennial forb, native biennial and annual forb, and introduced annual forb functional groups appear to coincide with precipitation events because all groups significantly declined in 2024, likely in response to the dry summer conditions. Although cheatgrass does not yet dominate large expanses of the INL Site (Shive et al. 2019, Shive 2024), it is more abundant overall and has greater annual fluctuations in abundance in recovering habitat than in sagebrush habitat. Because the risk of a shift towards cheatgrass dominance is greater in plant communities recovering from wildfire, it is important to continue to monitor recovering habitat conditions and to implement effective conservation management strategies when necessary to maintain the ecological integrity of these habitats (Boyd et al. 2024).

Patterns in long-term precipitation data indicate that within the past two decades there have been more years with precipitation below the long-term average than years with precipitation above the long-term average, and that total precipitation in dry years has departed farther from the average than it has in wet years (Forman and Hafla 2018; Figure 3-6). Historically, April, May, and June are the wettest months on the INL Site on average (Clawson et al. 2018), but over the last ten years, August, September, and October have been substantially wetter than long-term monthly averages (Figure 3-7). If late summer and early fall seasons continue to be wetter than spring and early summer, this shift in precipitation timing and amount would certainly favor some plant species and functional groups over others and highlights the potential implications of shifting weather patterns on recovering habitat condition. For example, above average precipitation in September and October makes soil moisture more available to weedy species that have peak growth periods later in the growing season like saltlover and Russian thistle (*Salsola tragus*) or to winter annuals like cheatgrass.

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. 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. NRG geographic information system (GIS) analysts routinely compare new imagery as it becomes available with results from the most current vegetation classification and mapping project. Ground-based point surveys and changes in plant species cover and composition documented through Task 5 (Section 3.1) are also used to provide spatial information to assist with periodic map updates needed to monitor the habitat trigger in the CCA.

A 20% loss of sagebrush habitat from the 2013 baseline has been identified as a habitat trigger in the CCA (DOE-ID 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 and allows for modifying existing wildland fire boundaries and unburned patches of vegetation to more accurately reflect post-fire sagebrush distribution.

There were two different mapping updates made in 2024 to support this task. First, the existing vegetation map (Shive et al. 2019) was updated to reestablish vegetation map classes in the areas recovering from wildland fires that occurred in 2019-2023. Secondly, sagebrush habitat distribution was updated to identify annual losses incurred from the 2024 Dry Channel Fire. In addition to documenting losses from fire, there was additional sagebrush habitat removed this year from infrastructure expansion.

There were five wildland fires that occurred on the INL Site in 2024. On May 25, the Highway 33 Fire started on the north side of the highway. The fire was found smoldering in light grass and quickly extinguished burning about 0.1 ha (0.25 ac). On June 26, the Dry Channel Fire started east of State Highway 22 from a reported lightning strike. A water tender and Bureau of Land Management (BLM) resources were used to aid in suppression while dozers bladed a containment line around the perimeter of the fire which burned an estimated 57.5 ha (142 ac). The Kyle Canyon Fire started on July 27 where grass was found smoldering around a single juniper tree. A line was dug around the hot spot and direct suppression with water and foam was employed limiting the burned area to less than 0.4 ha (1 ac). On August 8, the Portland Ave Fire was caused by a downed power line near the Antelope Substation. The fire was initially stomped out by INL Protective Force and burned less than 0.1 ha (0.25 ac). On October 3, the Highway 33 Mile Post 29 Fire was found burning roadside in a small patch of light fuels. The fire was quickly extinguished and only burned about 0.1 ha (0.25 ac).

3.2.2 Methods

The first map update in 2024 was related to reestablishing vegetation map classes in recovering wildfires. There were some patches of unburned sagebrush that were mapped immediately following fires in 2019 and 2020, but the 2023 Idaho National Agriculture Imagery Program (NAIP) imagery now shows the patches to be reduced in area and in some cases no longer present. Experience from previous post-fire mapping on the INL Site indicates there can be heat killed shrubs that maintain a charred canopy architecture and display the characteristic rough texture in imagery indicative of intact sagebrush stands. However, after a few years those shrubs can lose structural integrity, as remnant trunks and branches begin to decompose, they no longer resemble shrublands in imagery. In these cases, the unburned sagebrush patches in the map were edited to remove the non-shrub area, or the entire polygon was deleted when no shrubs were visible. Although less common, occasionally an unburned patch of sagebrush habitat mapped after the fire underestimated the extent and those patch boundaries were expanded based on the 2023 imagery. These edits resulted in a slight modification to the previous sagebrush habitat area totals reported in 2023. For additional map update information regarding mapping methods and map accuracy results, see Shive 2024.

The second map update address habitat losses from 2024 wildfires. Documentation of current sagebrush habitat area and distribution on the INL Site results from updates to the vegetation map following a standardized process. 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., BLM) using a variety of methods such as collecting Global Positioning System 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 polygons representative of the recovering post-fire classes. It can be difficult to assess which vegetation classes establish immediately after a fire, especially during drought years. Identifying and delineating post-fire communities occurs after a couple growing seasons, and possibly longer if the years following fire were excessively dry and delayed normal reestablishment of vegetation communities. Recovering wildland fires are sampled to identify the vegetation classes present across the burned area. 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 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 drone imagery served as the basemap dataset used to delineate the burned area of the Dry Channel Fire. Given the spatial resolution of the drone imagery and amount of detail captured, the burned area was mapped at 1:500 scale to accurately delineate the perimeter of the fire and the unburned patches of vegetation. Once the burned area was mapped and updated, the boundary was intersected with the existing sagebrush habitat layer to calculate the area of sagebrush removed from the fire. ArcGIS geoprocessing tools were used to clip and remove areas mapped as sagebrush habitat that have recently burned.

For changes in habitat distribution related to wildfires within the 2024 season, the Dry Channel Fire was the only fire to meet the criteria for mapping and development of a post-fire recovery plan. On November 6, high resolution imagery was collected via drone across the area impacted by the Dry Channel Fire. The drone was a Quantum Systems Trinity F90+ eVTOL fixed-wing mapping platform. The onboard sensor was a Sony RX1 RII 42-megapixel RBG digital camera. The spatial resolution of the imagery was 1.7 cm (0.67 in) and all individual tiles were mosaicked into a single image dataset and orthorectified using Pix4D Mapper software version 4.6.4.

In addition to documenting losses from wildland fire, any loss of sagebrush habitat from infrastructure expansion was 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.

3.2.3 Results

Following the vegetation map updates (Shive 2024), sagebrush habitat in the SGCA prior to the 2024 losses remained basically unchanged (i.e., there was an increase of 0.2 ha following the vegetation map update) and there is 71,359 ha (176,332 ac). The redefined area of sagebrush habitat outside the SGCA is now 28,086.1 ha (69,402.2 ac) which is a slight reduction (i.e., < 1%) from the 2023 total, prior to the mapping update. It is important to note that the reduction to the 2023 total area is not from new losses of sagebrush habitat, but rather a more accurate mapping of the unburned patches.

The Dry Channel Fire resulted in a patchy burn across the fire footprint with numerous unburned patches of vegetation left following the fire. The total mapped burned area was 46 ha (113.7 ac) and there was a smaller area outside the fire where 708 m^2 (0.2 ac) was bladed and removed vegetation. The combined area impacted from the fire and fire suppression activities removed 35.1 ha (86.8 ac) of sagebrush habitat (Figure 3-8).

The majority of area burned within the Dry Channel Fire represented sagebrush habitat, although there were two additional map classes present pre-fire. The Cheatgrass Ruderal Grassland class was present along old stream channels associated with the historic Birch Creek drainage. There was also the Indian

Ricegrass Grassland and Gardner's Saltbush (Winterfat) Shrubland class mapped in an area modified by a historic homestead on the southern end of the Dry Channel Fire.

At the start of the 2024 fire season there was 71,359 ha (176,332 ac) of sagebrush habitat in the SGCA. The Dry Channel Fire removed 35.1 ha (86.8 ac), and results from the Infrastructure Expansion task documented an additional 1.7 ha (4.3 ac) of sagebrush habitat loss in the SGCA (See Section 4.2). The current estimated area of sagebrush habitat in the SGCA is 71,322.2 ha (176,240.9 ac) representing a 1.4% decrease from the updated habitat baseline (Figure 3-9; INL 2023).

The sagebrush habitat outside of the SGCA is considered a "conservation bank" that could be incorporated into the SGCA to replace lost sagebrush habitat resulting from wildland fire or new infrastructure development (DOE-ID and USFWS 2014). There was no sagebrush habitat loss from wildland fire outside the SGCA in 2024, although infrastructure expansion (see Section 4.2) was responsible for the removal of 29.4 ha (72.6 ac). At the start of 2024, the estimated area of sagebrush habitat remaining outside the SGCA was 28,086.1 ha (69,402.2 ac). After the new losses are removed, the current area of sagebrush habitat outside the SGCA is 28,056.7 ha (69,329.6 ac).

The mapping results this year continue to support the action of acquiring high-resolution imagery after a fire to more accurately map the fires and make ecological evaluations. The area of the fire based on the outer containment line boundary overestimated the actual burned area. Understanding the presence and distribution of unburned patches of sagebrush habitat inside a fire can assist with post-fire restoration where sagebrush seeding and planting can be strategically placed to connect unburned patches of habitat.

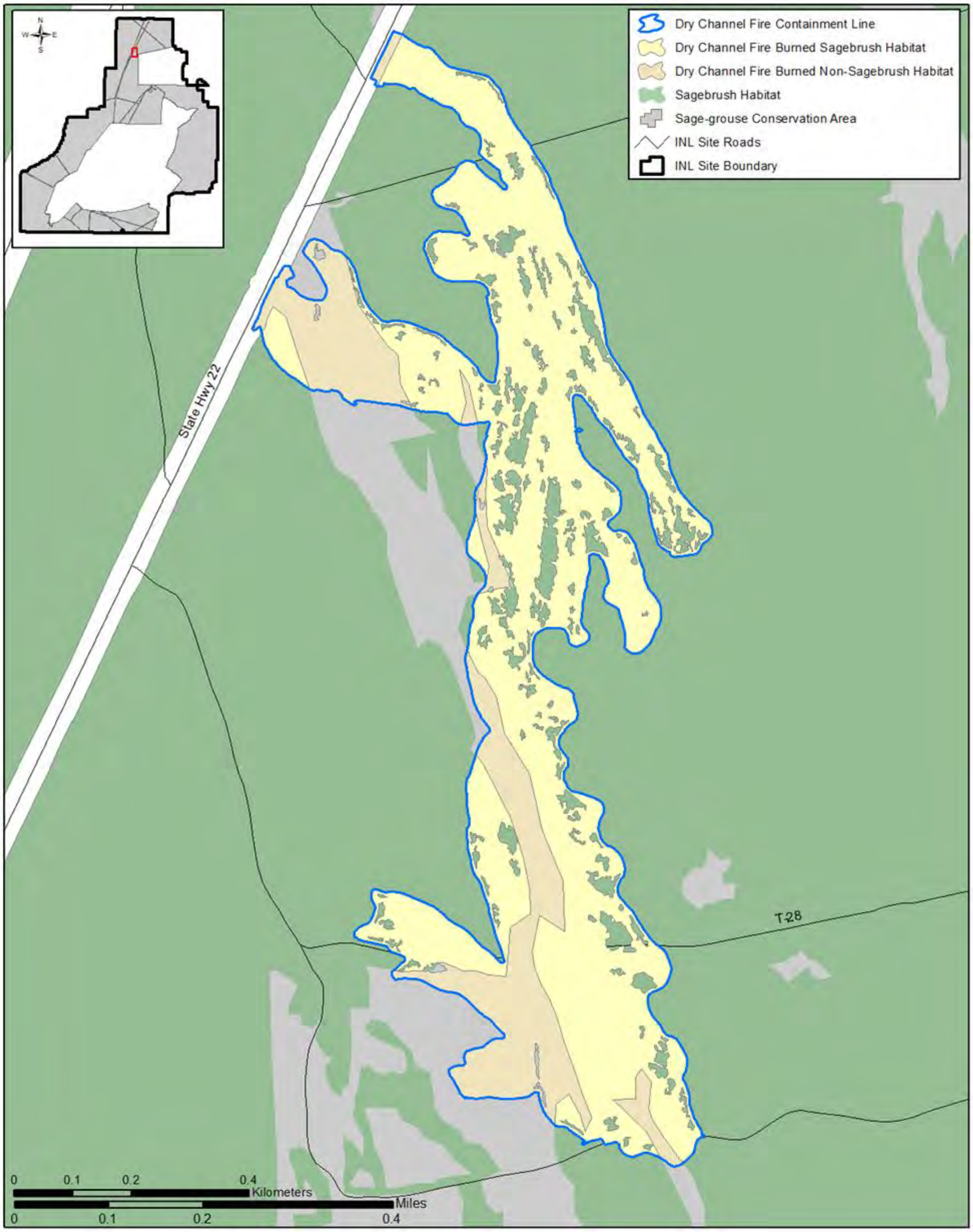

Figure 3-8. The 2024 Dry Channel Fire burned area footprint on the Idaho National Laboratory Site. All the sagebrush habitat displayed in the figure is within the Sage-grouse Conservation Area.

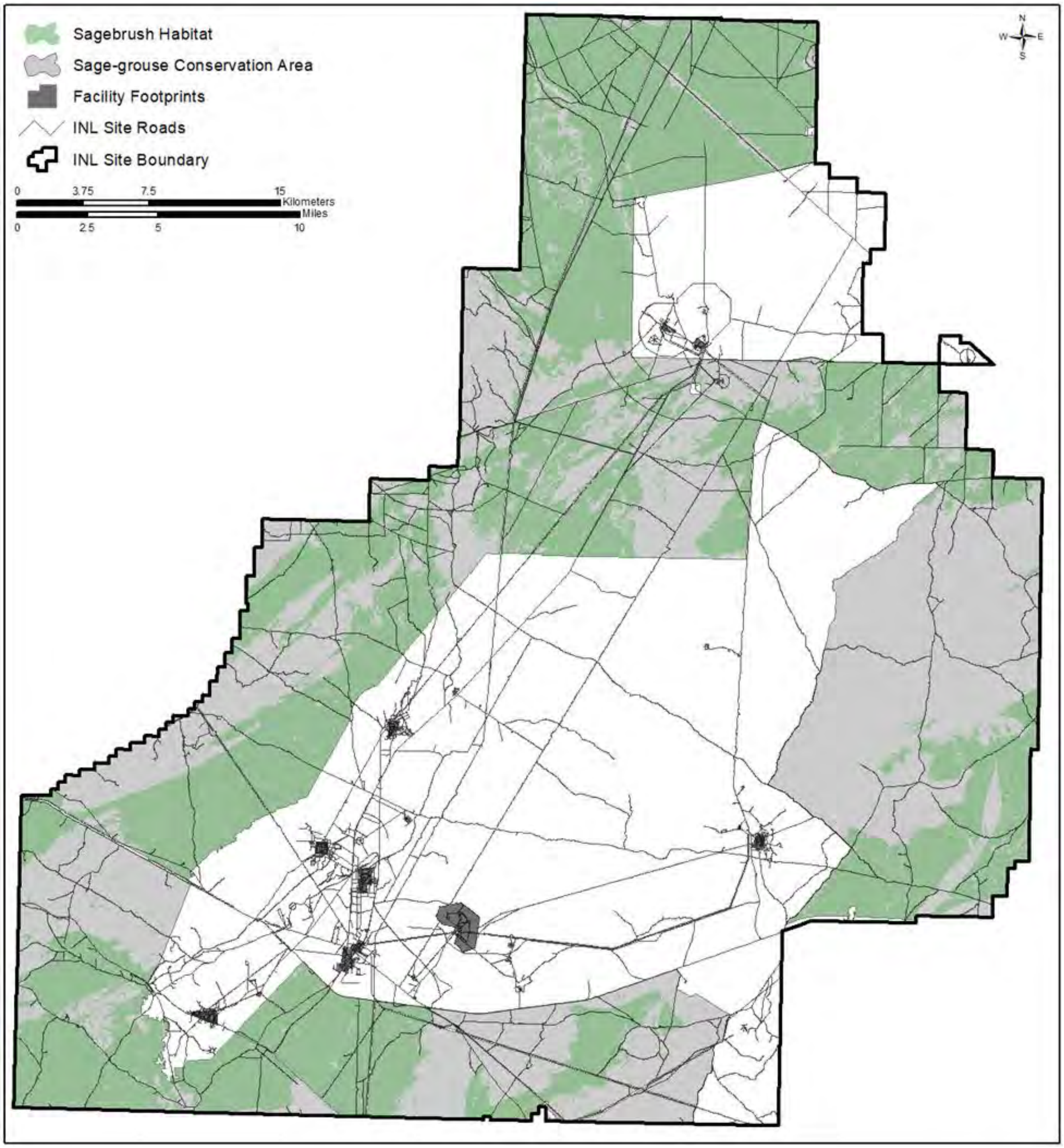

Figure 3-9. Current sagebrush habitat distribution within the Sage-grouse Conservation Area on the Idaho National Laboratory Site.

4.0 THREAT MONITORING

The CCA identified and rated eight threats that potentially impact sage-grouse and its habitat on the INL Site (ratings updated in Shurtliff et al. 2019). Most are addressed by Conservation Measures DOE-ID has implemented or continues to implement (see Section 5.0). Others, including raven predation, infrastructure development, wildland fire, livestock, and annual grasslands, have been or are currently monitored regularly to inform DOE-ID of changing conditions and to allow evaluation of results after mitigation or other treatments are applied.

Section 4 summarizes results of threats that are regularly monitored and provides updates on actions taken by DOE-ID and its contractors to reduce threats. Raven predation and infrastructure development are addressed in Sections 4.1 and 4.2. The condition of habitat affected by wildland fires and livestock grazing are evaluated in Section 4.3. 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 of cheatgrass (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—Address Raven Predation

4.1.1 Introduction

Common ravens (*Corvus corax*; hereafter, ravens) are effective nest predators of sage-grouse (Coates et al. 2008, Coates and Delehanty 2010, Lockyer et al. 2013). Raven predation is considered a medium-ranked threat to sage-grouse on the INL Site because raven abundance has been linked to declines in sage-grouse lek count trends (Peebles et al. 2017) and nest survival (Gibson et al. 2018, Kohl et al. 2019, Coates et al. 2020, Owens et al. In Review). Due to concentrated foraging around nests, breeding ravens likely have a larger impact on nest survival of sensitive species like sage-grouse than non-breeding or transient individuals (Brussee and Coates 2018, Sanchez et al. 2021). Therefore, the management of raven nests is a possible tool for conserving local sage-grouse populations.

Ravens nest on multiple anthropogenic structures on the INL Site including buildings, equipment, and power infrastructure (Coates et al. 2014, Howe et al. 2014, INL 2024, Shurtliff and Whiting 2021). Nests on buildings and infrastructure may be removed during the breeding season when they pose health or safety risks as permitted by the Migratory Bird Treaty Act. Nests may also be removed after the conclusion of breeding season to deter future nesting attempts. To prevent nesting on power poles, three types of nest deterrent devices are used on the INL Site – inverted ‘V’ structures that are placed along the double crossarms of distribution line poles (Figure 4-1 [A]), a pyramid cap which is placed on the top of the pole when crossarms are not available (Figure 4-1 [B]), or replacing double crossarms of transmission or distribution line poles with a single crossarm made of either wood or fiberglass (Figure 4-1 [C]). Retrofitting of existing power infrastructure is directed by INL Power Management and generally occurs when maintenance is required for specific poles. Approximately 32% of transmission structures (n = 282) do not support nesting because they are either a single vertical structure (Figure 4-1 [D]) or are a multi-pole structure that lacks crossarms.

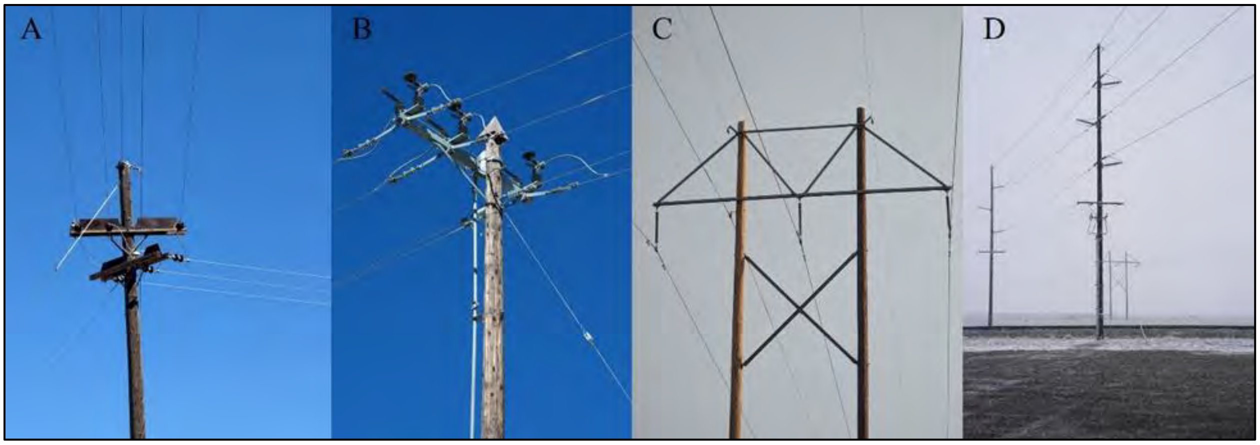

Figure 4-1. Nest deterrents used on power infrastructure maintained by Idaho National Laboratory Power Management located on the Idaho National Laboratory Site including inverted ‘V’ structures (A) and pyramid caps (B) on distribution poles, single crossarms on H-frame transmission structures (C) and vertical transmission structures that do not support nesting (D).

4.1.2 Activities to Reduce or Deter Raven Nesting

4.1.2.1 Retrofits of Electrical Power Transmission Lines

H-frame transmission structures are comprised of 2–3 poles which are individually tracked by INL Power Management. Three H-frame transmission structures were retrofitted with single crossarms in 2024. The total number of H-frame transmission structures now retrofitted on the INL Site is 66. The number of structures varies annually on the INL Site as they are removed from or added to the landscape.

4.1.2.2 Removal of Raven Nests

Two raven nests were removed in 2024. One nest was removed from a transmission structure in May because debris from the nest was causing power outages. This removal was completed after consultation with USFWS and was agreed upon take under DOE-ID’s Migratory Bird Treaty Act permit. A second nest was removed in September after the conclusion of breeding season from the shelter structure located at CFA Gate 1. This nest was in the crossbeams of a corner underneath the structure.

4.1.3 Future Raven Nest Monitoring

Raven nest monitoring on anthropogenic structures will begin again in 2025. INL-owned facilities, towers, and power infrastructure will be surveyed for active raven nests annually during sage-grouse nesting season. This monitoring effort will track spatial and temporal trends in the breeding raven population to assess the risk ravens pose to the sage-grouse population.

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 a medium-ranked threat to sage-grouse on the INL Site (DOE-ID and USFWS 2014). Infrastructure promotes habitat fragmentation, and construction of new infrastructure disturbs soil. If proper controls are not in place, soil disturbance can facilitate the introduction and spread of invasive weeds, which in turn can increase the risk of wildland fire. Weeds may also replace native plants and reduce plant diversity in localized areas, which impacts habitat condition.

Prior to the start of an INL Site construction project that may affect undeveloped land, a National Environmental Policy Act (NEPA) analysis is conducted on the proposed footprint of the project. NEPA approved projects that remove sagebrush habitat can offset long-term impacts through the implementation of best management practices and compensatory mitigation, however short-term losses are likely. Evidence from remotely sensed images of the INL Site suggests that sometimes infrastructure footprints expand beyond what was originally reviewed during the NEPA process. 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 condition 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 during 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 have been approved expansions at facilities (e.g., Materials and Fuels Complex [MFC] ponds) that were not present when the last INL Site vegetation map was published (Shive et al. 2019). Changes in sagebrush habitat distribution are generated from the vegetation map, and areas like these were originally mapped as sagebrush habitat, which is not reflective of current ground conditions and needs to be updated periodically. Updates like these represent losses that have been evaluated through the NEPA process and mitigated using best management practices.

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. New linear features can provide vehicle access to formerly undisturbed areas. Vehicle use 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 devoid 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 U.S. Department of Agriculture 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 around 1 m spatial resolution. Occasionally, the State will contribute additional funds to have higher resolution imagery collected

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, and (3) delineate all new infrastructure footprints and digitize linear features, and (4) modify sagebrush habitat polygons where expansion has removed sagebrush.

Idaho NAIP imagery was collected from June through August 2023. The data vendor flew a Cessna 441 Conquest II using a Leica Geosystems ContentMapper digital camera, and image post-processing was conducted using FlightPro 6.1.0 software. The 2023 Idaho NAIP imagery is a multispectral dataset with four spectral bands including three covering the visible region of the electromagnetic spectrum, and an additional band in the near-infrared region: red band 580-660 nm, green band 480-590 nm, blue band 420-510 nm and near-infrared band at 720-850 nm.

The 2023 Idaho NAIP imagery has a spatial resolution of 0.6 m (2 ft) with 8-bit (i.e., 0-255) radiometric resolution. The raw image tiling scheme is aligned with 3.75’ x 3.75’ quarter quadrangles formatted to the Universal Transverse Mercator 12N projection using the North American Datum of 1983. Individual image tiles were mosaicked into a seamless basemap dataset allowing image properties (e.g., pixel range stretch) to be adjusted across the dataset rather than each tile.

Two GIS analysts systematically zoom into regions of the INL Site and look for evidence of surface disturbance throughout the SGCA and within sagebrush habitat outside of the SGCA. Occasionally, image properties are 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 scan 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 is identified by an analyst, it is marked for a secondary review.

Once each GIS analyst thoroughly reviews the entire INL Site, all potential infrastructure expansion locations are reconciled into a single list for final review. The monitoring task lead investigates each marked location and determines if the feature warrants delineation. Whenever infrastructure expansion removes sagebrush habitat, or linear features are observed, the area of disturbance and total linear distance are manually delineated using editing tools within a GIS. The new polygon and line features are managed within a geodatabase to maintain accurate area and length statistics. Lastly, all sagebrush habitat polygons are manually updated using GIS editing tools to create the most current sagebrush distribution on the INL Site, which is then used to evaluate habitat status against the baseline (see Section 3.2).

4.2.3 Results

There were 30 polygons mapped where infrastructure expansion removed sagebrush habitat resulting in a loss. The total mapped sagebrush loss was 31.1 ha (76.9 ac). Three of the mapped polygons fell within the SGCA accounting for 1.7 ha (4.3 ac) of loss from the current habitat trigger area. See Section 3.2 for more information regarding the status of the sagebrush habitat trigger.

The location that had the largest amount of sagebrush habitat loss was the expansion of the T-12 gravel pit where 9.6 ha (23.7 ac) was removed following a pit boundary expansion (Figure 4-2). The T-12 gravel pit boundary expansion was authorized, and the reported losses were not from mowing and grubbing outside the official pit boundary. The second largest mapped loss was associated with a new water line installed underground between CFA and the main gun range, which also included a mowed area adjacent to the existing parking area, that removed 7.1 ha (17.5 ac) of sagebrush habitat. This project was also approved and had the appropriate NEPA review prior to the removal of sagebrush habitat. Ten of the mapped polygons were all associated with the underground fiber optic line installed along U.S. Highway 20/26.

There was expansion documented at the Adams Blvd gravel pit where sagebrush habitat was removed outside the official pit boundary (Figure 4-3). There was a total of 2.4 ha (6 ac) of sagebrush habitat that was removed primarily on the east side adjacent to the gravel pit boundary. There was also minor expansion outside the Monroe Blvd gravel pit where an access road to recently excavated area removed 0.02 ha (0.05 ac) of sagebrush habitat.

Figure 4-2. Sagebrush habitat loss from the expanded T-12 gravel pit at the Idaho National Laboratory Site. The green overlay represents the mapped loss of sagebrush habitat.

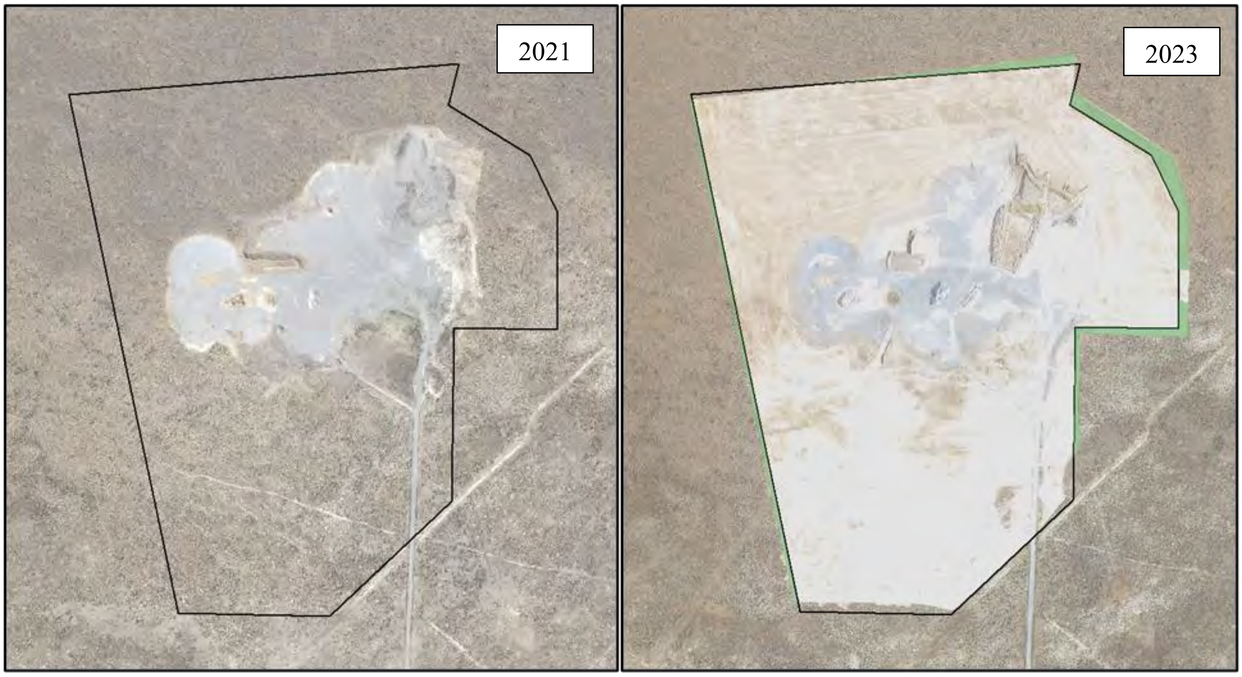

Figure 4-3. Sagebrush habitat loss from the expanded Adams Blvd gravel pit at the Idaho National Laboratory Site. The black line shows the extent of the offical pit boundary and the green overlay represents the mapped loss of sagebrush habitat.

During the most recent update to the INL Site vegetation map (Shive 2024), there were a few locations outside the burned areas that were opportunistically updated. There was previously sagebrush habitat mapped as present in areas where obvious changes on the landscape have occurred. This includes recent infrastructure expansion at the Naval Reactor Facility that removed sagebrush habitat where new parking lots and construction staging areas have been created. Because those areas were already corrected during the vegetation map update, the removal of additional area mapped as sagebrush habitat is presented in the updated sagebrush habitat area reported in Section 3.2.

There was a total of 18.8 km (11.7 mi) of new linear features mapped within the SGCA or existing sagebrush habitat (Figure 4-4). New linear features consisted of spurs and side loops from existing roads (Figure 4-5), access roads for site characterization at the Carbon Free Power Plant project area, an access road between RWMC and the Adams Blvd gravel pit, and some shortcuts between existing two-track roads. The longest single linear feature mapped was 2.9 km (1.8 mi) and is a recently mowed corridor connecting the RWMC facility with the Adams Blvd gravel pit.

There were numerous access roads created during the underground fiber optic line installation process. The primary access roads that connect to existing highways were mapped but some of the lesser used access roads were not mapped as linear features because in some cases the density of tracks has effectively removed all vegetation, and the degraded area was mapped as sagebrush loss. In other cases, many of the less used access roads are expected to recover and it is unlikely they will see further use because there are other more established road options in the vicinity (Figure 4-6).

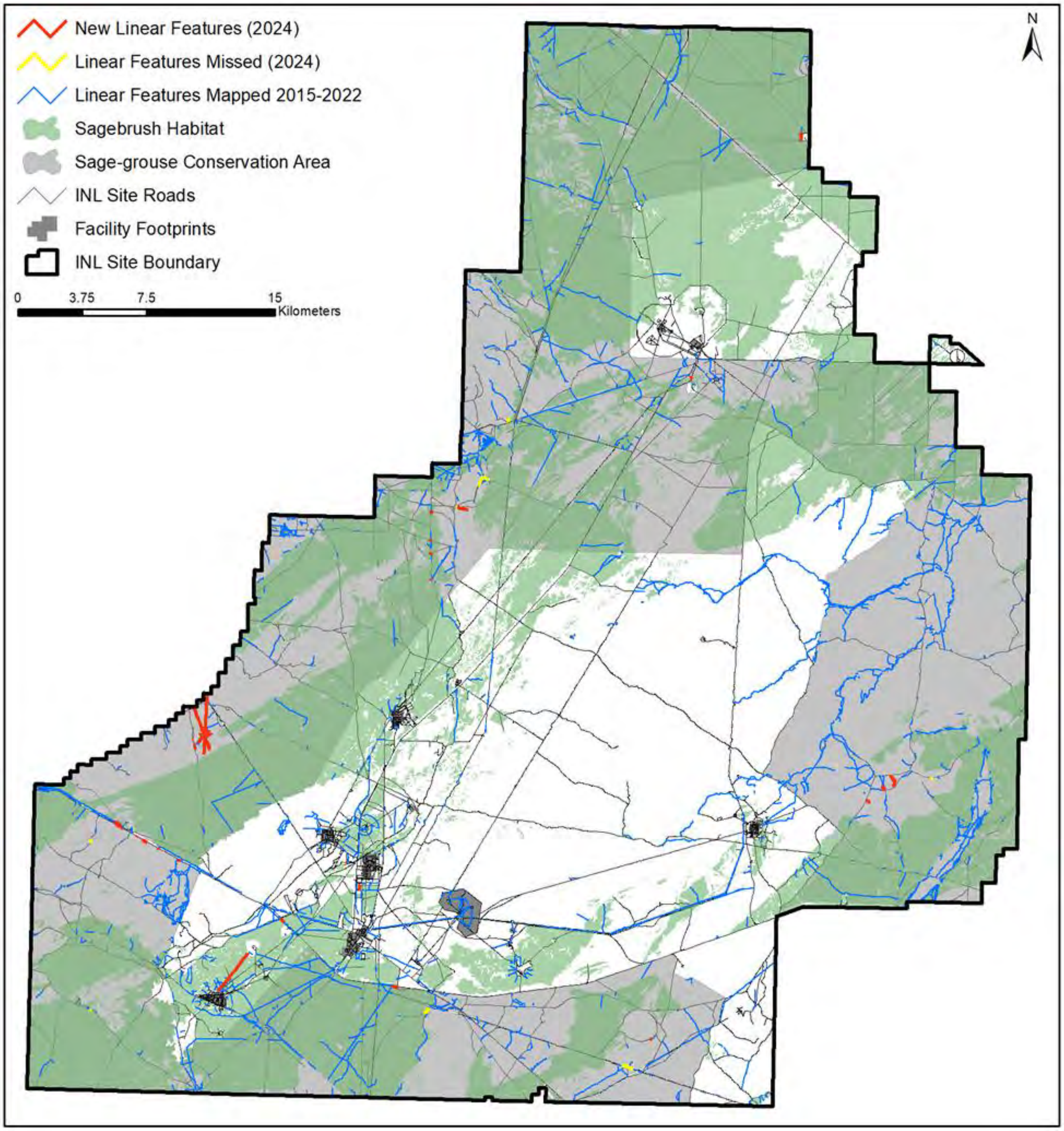

Figure 4-4. Two-track linear expansion mapped within the Sage-grouse Conservation Area or overlap with existing sagebrush habitat at the Idaho National Laboratory Site. The slightly darker green areas are where sagebrush habitat are coincident with the Sage-grouse Conservation Area.

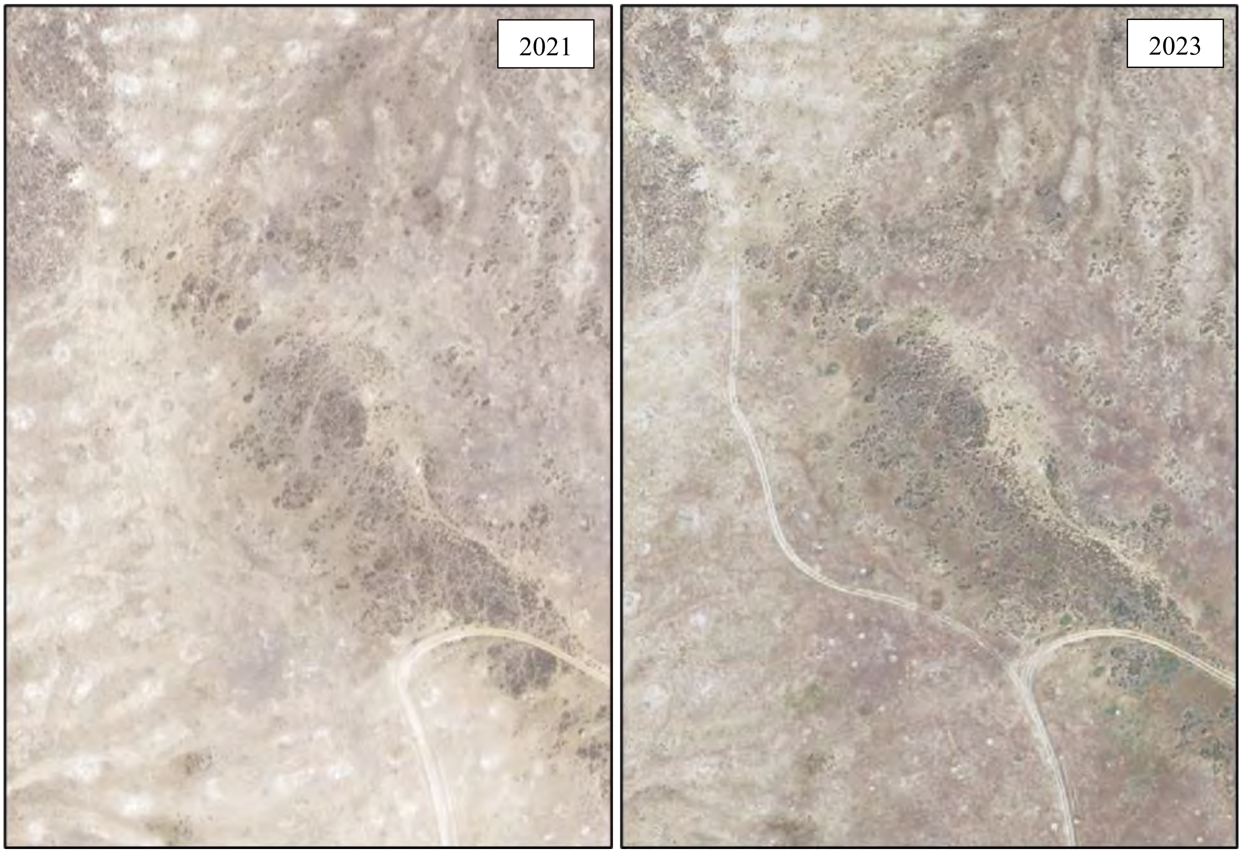

Figure 4-5. An example of a newly mapped two-track linear feature on the Idaho National Laboratory Site.

In addition to the new two-track linear features, 3 km (1.8 mi) of older two-tracks were mapped, because when cross-referenced to previously collected NAIP imagery, these features were found to be present in older imagery but not mapped during the last review. The NAIP imagery is collected across numerous days throughout the summer with the goal of producing cloud free imagery. Subsequently, the sun elevation angle will sometimes differ between image tiles and the shadows cast by lower sun angles sometimes help illuminate linear features, improving our ability to detect them. In some cases, faint two-tracks were previously visible but were assumed to be legacy tracks in the process of natural recovery. However, when the same tracks are still visible in multiple sets of high-resolution imagery, those linear features are added and noted as missed during the previous mapping efforts (Figure 4-4).

Figure 4-6. An example area where numerous vehicle tracks associated with the installation of an underground fiber optic line are visible. In this area only the most heavily traveled new road that junctions with the highway was mapped and indicated with a red arrow.

4.2.4 Discussion

The mapping results from this year showed an increase in losses of sagebrush habitat due to infrastructure expansion compared to the last time this monitoring task was completed in 2022 (INL 2023), but still less than the peak losses reported in 2020 (Shurtliff et al. 2020). Most instances where infrastructure expansion resulted in the loss of sagebrush habitat was due to known and approved projects, rather than from unauthorized sources. And all but three mapped sites removed sagebrush habitat outside the SGCA having no impact on the habitat trigger.

There was a decrease in the distance of new two-track linear features reported this year compared to 2022 (INL 2023), and the majority of new features are from known INL Site projects. There were a few two-track linear features mapped in localized areas within the Sinks and Twin Buttes allotments. But it is unclear whether the source of those new features is from grazing permittees. While new two-track linear features have been mapped every time this monitoring task is conducted, there has not been a consistent increase in new two-tracks observed. Other than greater increases in two-tracks following large wildland fires when they are created during firefighting or mop-up activities, the rate of expansion of two-track features has been relatively small on a routine basis.

High-resolution drone imagery of the 2024 Dry Channel Fire was collected on November 6. Due to the late timing of acquisition, all two-track linear features associated with fire suppression or post-fire mop-up activities were not mapped in time to be included in this report. Those results will be presented in the 2025 annual report.

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

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 habitat on the INL Site (DOE-ID and USFWS 2014). The primary goal of this task is to assess habitat condition with respect to potential threats of wildland fire and livestock operations on habitat at the INL Site. Vegetation abundance is compared among fire footprints, grazing allotments, and areas where both disturbances have occurred. The analysis uses vegetation monitoring plot data from 75 annual and 150 rotational plots and is conducted over a five-year cycle. 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 (Figure 4-7, Figure 4-8). Data are binned into their respective sample period and differentiated by their habitat status for the analyses.

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 a rotational basis. There are 75 annual plots and an additional 150 rotational plots. The rotational 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 rotational plots occurred from 2013–2015 and data collected from the annual plots in 2015 were also included in the first set of analyses. Sample period two for rotational plots occurred from 2018–2020 and analyses from this second period also include data from the annual plots collected in 2020. Further sample periods will follow this pattern. 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 in Appendix B within Shurtliff et al. (2016).

Data from the sample periods are used to address progress toward habitat recovery in specific burned areas and the potential effects of livestock operations on habitat condition in burned and unburned areas. Cover is summarized by 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. Burned areas are compared with unburned habitat over multiple sample periods 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 is used to compare functional groups within allotments and ungrazed areas outside of allotments.

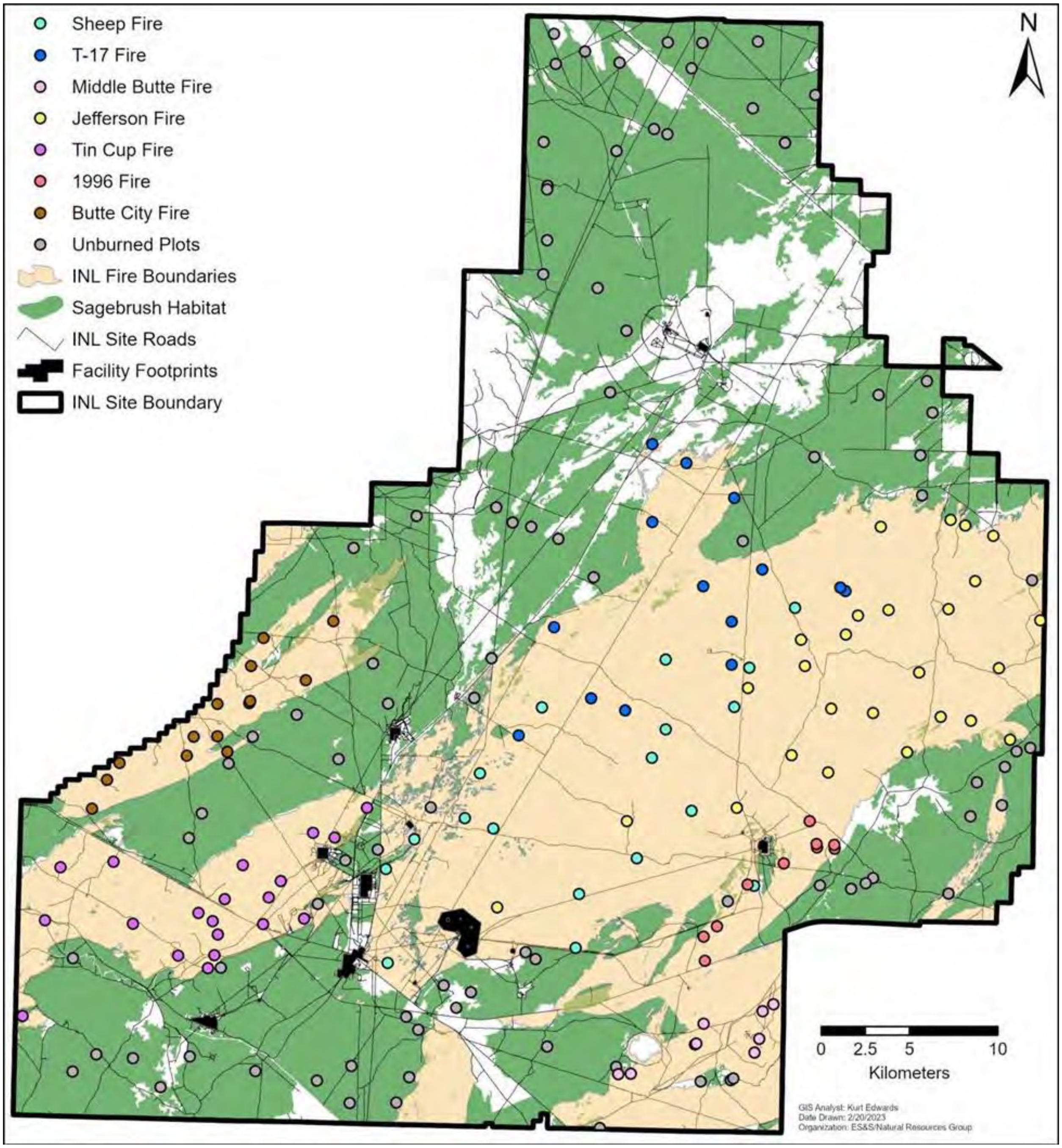

Figure 4-7. Distribution of sage-grouse habitat condition monitoring plots sampled on the Idaho National Laboratory Site with respect to areas burned since 1994.

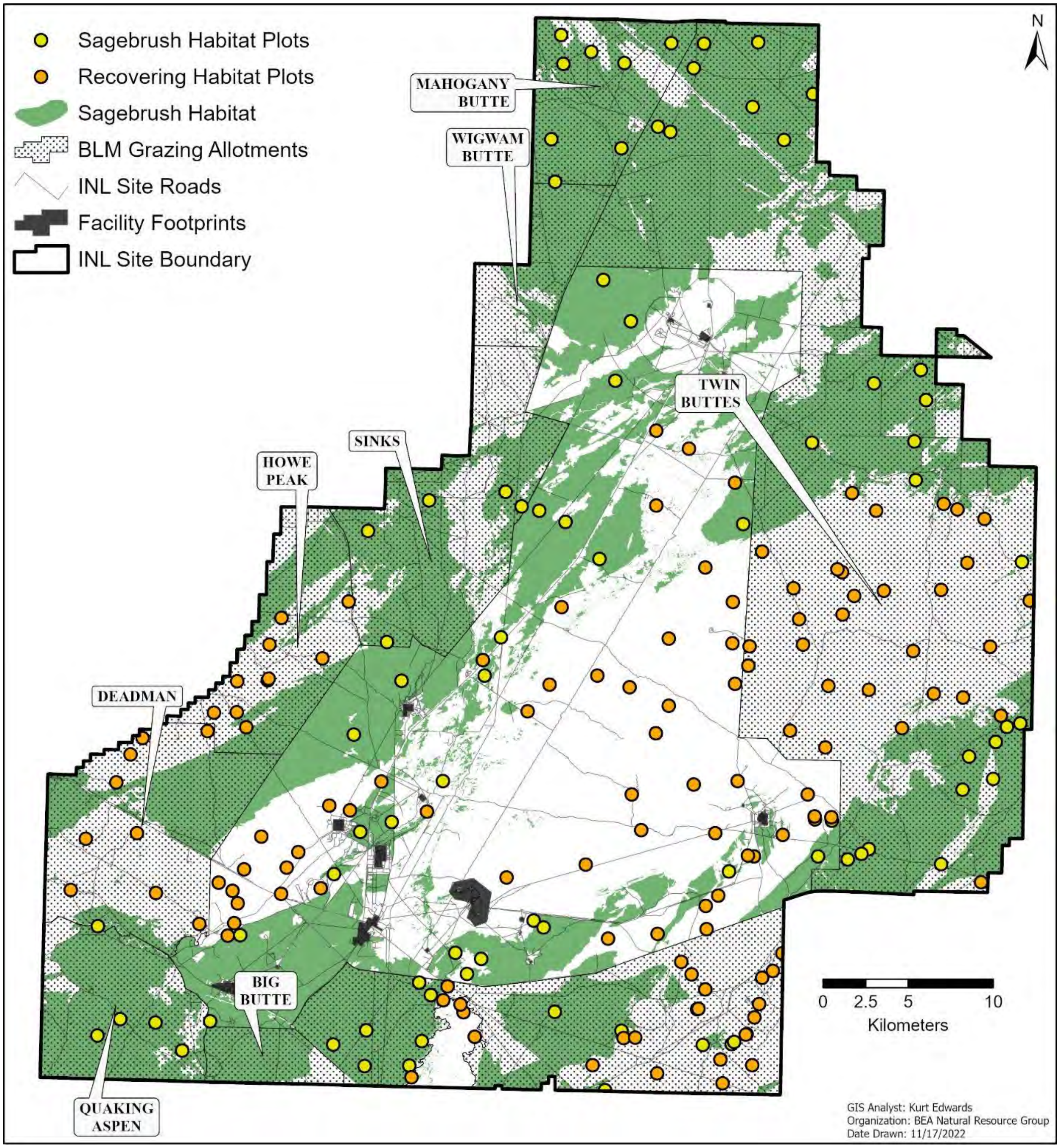

Figure 4-8. Distribution of sage-grouse habitat condition monitoring plots sampled on the Idaho National Laboratory Site with respect to boundaries of grazing allotments administered by the Bureau of Land Management.

4.3.3 Results and Discussion

To support this task, 50 rotational plots were sampled in 2024. Once the vegetation monitoring data is completed for the third sample period from 2023 to 2025, we will conduct the assessment on potential threats to habitat condition and those results will be presented in 2027 (Table 4-1).

Table 4-1. Habitat condition monitoring schedule to conduct vegetation sampling and report results for the third sample period at the Idaho National Laboratory Site.

Assessment of Potential Threats to Sagebrush Habitat Schedule		
Year	**Vegetation Sampling Efforts**	**Reporting Efforts**
2023	Annual + Rotational Set I	Sagebrush Habitat Condition Trends
2024	Annual + Rotational Set II	Sagebrush Habitat Condition Trends
2025	Annual + Rotational Set III	Sagebrush Habitat Condition Trends
2026	Annual	Sagebrush Habitat Condition Trends
2027	Annual	Sagebrush Habitat Condition Trends Assessment of Potential Threats to Habitat

5.0 IMPLEMENTATION OF CONSERVATION MEASURES

5.1 Summary of 2024 Implementation Progress

The CCA identifies eight threats to sage-grouse and its habitat on the INL Site and outlines 13 Conservation Measures designed to mitigate and reduce these threats. The agreement also articulates DOE-ID's desire to achieve no net loss of sagebrush due to infrastructure development. The following table (Table 5-1) summarizes actions and accomplishments associated with each conservation measure that DOE-ID, contractors, and stakeholders achieved during 2024 to reduce threats to sage-grouse and its habitat on the INL Site.

Table 5-1. Accomplishments in 2024 for each conservation measure listed in the Candidate Conservation Agreement for the greater sage-grouse on the Idaho National Laboratory Site.

Threat:	Wildland Fire
Objective:	Minimize the impact of habitat loss due to wildland fire and firefighting activities.
Conservation Measures:	1) Prepare an assessment for the need to restore the burned area. Based on that assessment, DOE-ID would prepare an approach for hastening sagebrush reestablishment in burned areas and reduce the impact of wildland fires >40 ha (99 ac). Primary habitat recovery objectives include: soil stabilization, cheatgrass and noxious weed control, maintaining a healthy herbaceous understory, and sagebrush restoration.
Conservation Measure 1—Accomplishments in 2024: BURN ASSESSMENT—Five fires occurred on the INL Site that burned a total of approximately 57.77 ha (142.75 ac). Only one fire exceeded 40 ha (99 ac). The total mapped burned area of the Dry Channel Fire was 46 ha (113.7 ac) and there was a smaller area outside the fire where 708 m^2 (0.2 ac) was bladed and vegetation was removed. BEA's Natural Resources Group (NRG) will prepare an assessment of the Dry Channel Fire and make recommendations for recovery in the winter of 2024 and 2025. **Associated Actions that Addressed the Wildland Fire Threat:** WILDLAND FIRE PREPAREDNESS—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 the major roadways. In 2024, BEA Facilities and Site Services mowed 6–12 m (20–40 ft) defensible space along 190 km (118 mi) of roadways and around 27 facilities and other infrastructure. UPDATE THE INL APPROACH TO FUELS MANAGEMENT, FIRE SUPRESSION, AND FIRE REOCOVERY—To better address preparedness, response, and recovery from wildland fires, the INL Fire Department is planning to update an existing plan for fuels management and fire suppression and the NRG published a Wildland Fire Recovery Framework for the INL Site. A new Environmental Assessment (EA) will evaluate the proposed actions contained in both the plan and the recovery framework. SAGEBRUSH REESTABLISHMENT—INL carried out mechanical sagebrush seeding across approximately 283.3 ha (700 ac) in the Tractor Flats area using locally collected sagebrush seed. Additionally, INL planted 19,050 seedlings within the 2010 Middle Butte Fire and 2007 Twin Butte Fire footprints to	

<table>
<tr><td colspan="2">support habitat restoration efforts. Weed control efforts continue in recently burned areas. A subset of sagebrush seedlings planted in 2023 and 2019 were revisited in 2024, 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 within 1 km (0.6 mi) of active leks and minimize the impact of infrastructure development on all other seasonal and potential habitat 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>
<tr><td colspan="2">Conservation Measure 2—Implementation of Best Management Practices in 2024:
In 2024 multiple projects outside facility footprints adopted and implemented best management practices to minimize the impacts to both seasonal and potential habitat on the INL Site. The following infrastructure projects were designed so that the total distance of habitat edge caused by construction activities was minimized.
• An upgrade to Critical Infrastructure Test Range Complex Pad D Access (Environmental Compliance Permit [ECP] INL-23-092) was completed within and adjacent to existing access routes at Critical Infrastructure Test Range Complex.
• New CFA Fire Station Gravel Lots (ECP INL-24-012) was sited mostly within the existing disturbance footprint of the CFA waterline project completed in 2023.
• Cell Site #6 Expansion (ECP INL-23-068 R1) was sited immediately adjacent to the existing Cell Site #6 footprint.
• A Relocatable Storage Unit Area (ECP INL-21-039 R1) was sited immediately adjacent to the existing MFC perimeter road.

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.
• CFA Salt and Sand Shelter (ECP INL-23-090) was sited within the previously developed footprint used for salt and sand storage.
• Green Day/Snow Eagle II (ECP INL-23-012 R1) infrastructure was all sited within the disturbed footprint of the Radiological Response Test Range.
• MFC-721 TREAT Office Building & MFC-724 TREAT Control Building (INL-21-084 R1) were sited within the previously disturbed footprints of existing buildings.

Best Management Practices employed in INL Power Management Activities 2022 (ECP INL-21-067 R1) included the installation of avian protection devices where possible.

<u>COMPENSETORY MITIGATION</u>: The sagebrush seedlings discussed in Conservation Measure 1 were planted as compensatory mitigation required by a past infrastructure project at the INL Site. Multiple projects currently taking place on the INL Site are going to be required to carry out compensatory mitigation for existing and potential sagebrush habitat destruction. These projects will be assessed following their activities to determine the amount of area requiring compensatory mitigation per the INL compensatory mitigation strategy.</td></tr>
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Conservation Measure 3—Accomplishments in 2024:

- Three polygons associated with two infrastructure projects were observed within the SGCA while completing Task 8 in 2024.
    - One polygon was mapped at the USGS Geotechnical Drilling for USGS 153 (ECP INL-22-025) project location. This project was initiated and approved in 2022. As required by the CCA, DOE consulted with the USFWS on how to minimize impacts to sage-grouse prior to ground disturbing activities.
    - Two polygons were mapped resulting from disturbance associated with the installation of an underground fiber optic line within the right-of-way managed and maintained by the Idaho Transportation Department along U.S. Highway 20/26.

Threat:	Annual Grasslands
Objective:	Maintain and restore healthy, native sagebrush plant communities.
Conservation Measures:	4) ~~Inventory areas dominated or co-dominated by non-native annual grasses, work cooperatively with other agencies as necessary to identify the actions or stressors that facilitate annual grass domination, and develop options for eliminating or minimizing those actions or stressors.~~ (See Section 6.2.4, Shurtliff et al. 2019).

Conservation Measure 4—Discontinued

Threat:	Livestock
Objective:	Limit direct disturbance of sage-grouse on leks by livestock operations and promote healthy sagebrush and native perennial grass and forb communities within grazing allotments.
Conservation Measures:	5) Encourage the Bureau of Land Management (BLM) to seek voluntary commitments from allotment permittees and to add stipulations during the permit renewal process to keep livestock at least 1 km (0.6 mi) away from active leks until after May 15 of each year. Regularly provide updated information to BLM on lek locations and status to assist in this effort. 6) Communicate and collaborate with BLM to ensure that the herbaceous understory on the INL Site is adequately maintained to promote sage-grouse reproductive success and that rangeland improvements follow guidelines in the BLM Land Use Plan and the CCA.

Conservation Measure 5—Accomplishments and Disturbances in 2024:

LEK DISTURBANCE - During the 2024 sage-grouse lek counts, biologists did not observe any livestock on leks.

Conservation Measure 6—Accomplishments in 2024:

COMMUNICATION & COLLABORATION - DOE-ID and BLM continued to collaborate on updating their Memorandum of Understanding for management of land currently occupied by the INL Site.

Bipartisan Infrastructure Law funding was allocated for a local sagebrush seed collection to take place on the INL Site in 2023 in collaboration between INL, BLM and USFWS. This seed was planted using mechanical means on previously burned areas on the INL Site and adjacent BLM lands to promote the

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<tr><td colspan="2">recovery of sagebrush habitat. This mechanical seeding effort was initiated mid-October 2024 and ran into logistical, management and labor issues preventing it from covering the entire proposed area. Additional mechanical seeding efforts are planned for future years.</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>
<tr><td colspan="2">Conservation Measure 7—Accomplishments in 2024:
The NRG assisted projects by recommending a project-specific native perennial seed mix list for revegetation work. It is mandatory that all seed mixes exclude intentional use of crested wheatgrass seed. Because crested wheatgrass is not native, it is never included as acceptable plant materials in INL Site revegetation plans.</td></tr>
<tr><td>Threat:</td><td>Landfills and Borrow Sources</td></tr>
<tr><td>Objective:</td><td>Minimize the impact of borrow source and landfill activities and development on sage-grouse and sagebrush habitat.</td></tr>
<tr><td>Conservation Measures:</td><td>8) Eliminate human disturbance of sage-grouse that use borrow sources as leks (measure applies only to activities from 6 p.m. to 9 a.m., March 15–May 15, within 1 km [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-ID accomplishes this measure by:
• avoiding new borrow pit and landfill development in undisturbed sagebrush habitat, especially within the SGCA;
• ensuring reclamation plans incorporate appropriate seed mix and seeding technology;
• implementing adequate weed control measures throughout the life of an active borrow source or landfill.</td></tr>
<tr><td colspan="2">Conservation Measure 8—Accomplishments in 2024:
INL complied with seasonal and time-of-day restrictions associated with sage-grouse. Per “Idaho National Laboratory Gravel/Borrow Pits (Overarching) Environmental Checklist [EC]” (EC 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 Blvd, Lincoln Blvd, Monroe Blvd, Ryegrass Flats, T-12, and T-28 South are covered by this Environmental Checklist. Historically, sage-grouse leks have been observed in three borrow pits: T-12, Adams Blvd, and Ryegrass Flats. Source material was removed from the Ryegrass Flats, T-12, and Adams Blvd borrow pits after 9 a.m. and before 6 p.m., complying with seasonal restrictions.
Conservation Measure 9—Accomplishments in 2024:
No new borrow pits or landfills were opened in 2024.</td></tr>
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<tr><td colspan="2">Expansion of existing borrow sources and landfills is limited to footprints approved in Appendix C of the Spent Nuclear Fuel Environmental Impact Statement (DOE/EIS-0203) or the EA for Silt/Clay Development and Use (DOE-EA-1083) with the exception of the T-12 pit, Monroe Blvd pit, and the Adams Blvd pit. The T-12 pit was expanded through appropriate authorizations in 2023. The Monroe Blvd pit and Adams Blvd pit experienced expansion within the previous two years and the expansions will initiate the need for compensatory mitigation.

All landfills and borrow sources are planned to have reclamation activities completed when they are deemed to be no longer of use.

All noxious weeds are treated when encountered and other invasive species are treated or removed when defensible space is required around infrastructure and equipment within landfills and borrow sources in accordance with INL’s Sitewide Noxious Weed Management Plan, PLN-611. In 2024, Noxious weeds were observed and treated at the CFA landfill in five instances. The weeds treated include, rush skeletonweed (Chondrilla juncea), spotted knapweed (Centaurea stoebe), Russian knapweed (Acroptilon repens), and musk thistle (Carduus nutans). Additionally, sterilant was applied to prevent the establishment and spread of noxious and invasive species and provide necessary defensible space at the T-28 gravel pit.</td></tr>
<tr><td>Threat:</td><td>Raven Predation</td></tr>
<tr><td>Objective:</td><td>Reduce food and nesting subsidies for ravens on the INL Site.</td></tr>
<tr><td>Conservation Measures:</td><td>10) DOE-ID will work with INL contractors and the National Oceanic and Atmospheric Administration to opportunistically reduce raven nesting on power lines and towers and at facilities.
11) Instruct the INL to include an informational component in its annual Environment, Safety, and Health training module by January 2015 that teaches the importance of eliminating food subsidies to ravens and other wildlife near facilities.</td></tr>
<tr><td colspan="2">Conservation Measure 10—Accomplishments in 2024:
During 2024, three INL-controlled transmission structures were retrofitted with single crossarms, permanently excluding future raven nesting at these sites (Section 4.1.1). In total, 66 INL-controlled transmission structures have been retrofitted.

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 within 1 km (0.6 mi) Lek Buffers.</td></tr>
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<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 (NSTR) from 9 a.m.–6 p.m.
• No non-emergency disruptive activities allowed within Lek Buffers March 15–May 15.
13) Seasonal guidelines (April 1–June 30) for human-related activities within the SGCA (exemptions apply—see Section 10.9.3):
• Avoid non-emergency disruptive activities within the SGCA.
• Avoid erecting mobile cell towers in the SGCA, especially within sagebrush-dominated plant communities.</td>
</tr>
<tr>
<td colspan="2">Conservation Measures 12 and 13—Accomplishments in 2024:
The Carbon Free Power Project site was located within the SGCA. In 2023 this project was discontinued, and cleanup activities took place in the spring of 2024. These activities were considered exempt from Conservation Measure 13 but adhered to time-of-day restrictions outlined in Conservation Measure 12. Revegetation, weed treatment, and compensatory mitigation for the removal of potential sagebrush habitat will take place in the years following the discontinuation.
All unmanned aerial vehicle flights conducted at the UAS runway or at the 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 (2,700 lb) did not occur at the NSTR between 6 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 nor within the SGCA during 2024.</td>
</tr>
</table>

5.2 Reports on Projects Associated with Conservation Measures

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

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

5.2.1.1 Background

The threat level of wildland fire was ranked as high in the CCA (DOE-ID 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 communities less resistant to invasion and dominance by non-native weeds like cheatgrass (Bradley 2010, Connelly et al. 2011). Annual grasslands were 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 fires on the INL Site were relatively infrequent prior to 1994; only a few large fires were known to have occurred or could be seen in imagery prior to that time (Shive et al. 2011). Over the past 25 years, several large fires (>40 ha [>99 ac]) have burned across the INL Site. Potential effects of wildland fire on natural resources were initially addressed in the Wildland Fire Management Plan and Environmental Assessment (hereafter, INL Wildland Fire EA; DOE-ID 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-ID 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; 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. 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. The Sheep Fire Recovery Plan (Forman et al. 2020) expired at the end of FY 2024, and it resulted in the largest sagebrush restoration effort within the footprint of any wildfire on the INL Site to-date.

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. To standardize and streamline the process of developing natural resource recovery plans moving forward, the NRG recently developed a Wildland Fire Recovery Framework for the INL Site (Forman et al. 2024). This framework identifies INL's fire recovery goals, defines the fire recovery planning process, describes a post-fire ecological resource assessment process for quantifying fire impacts, presents all potential post-fire treatments that may be considered for improving natural resource recovery, establishes the basis for an annual post-fire monitoring program, and provides a template for future fire recovery plans. Post-fire recovery goals and treatment options in each fire recovery plan will continue to be organized by the same four primary recovery objectives that were developed for the Sheep Fire Recovery Plan: (1) To stabilize soils and minimize erosion, (2) To limit cheatgrass dominance and control the spread of noxious weeds, (3) To facilitate the recovery of a resilient native herbaceous layer, and (4) To speed the recovery of functional sagebrush habitat.

This section of the report contains a summary of current fire recovery plans and any ongoing treatment activity for older wildland fires, including results from the associated monitoring of each. Several recovery actions have been completed under the 2020 Fires Recovery Plan, and it will expire at the end of FY 2025. Because the size of the 2024 Dry Channel Fire was initially estimated at 58 ha (142 ac), the WFMC has requested a recovery plan for this fire. The Dry Channel Fire Natural Resources Recovery Plan was drafted by the NRG and will be presented to the WFMC in the spring of 2025. Restoration activities were 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.

5.2.1.2 Dry Channel Fire

The Dry Channel Fire burned on June 26, 2024, and was likely caused by a lightning strike. Although, the recovery plan for this fire will not be finalized until the WFMC has approved it during the spring 2025 meeting, there are several actions that can and should be taken prior to completion of the plan. Some actions, like acquiring imagery of the fire, are necessary for completing the ecological resource assessment that informs the recovery plan. Others are considered emergency stabilization actions and are outlined by the INL Wildland Fire EA (2003).

Fire Summary and Post-Fire Restoration Planning

Imagery was collected for the Dry Channel Fire in November and mapping was completed shortly thereafter (see Section 3.1 for details). The mapped fire footprint and existing biological monitoring data were used to assess impacts on natural resources. A recovery plan was drafted for the Dry Channel Fire using the results of the ecological resources assessment to select appropriate restoration treatment options for addressing INL's wildland fire recovery goals and objectives. The WFMC will review and prioritize treatments to be implemented over the next five years.

Emergency Stabilization

Emergency stabilization is one action that is covered by the INL Wildland Fire EA and can be completed prior to finalization of the fire recovery plan. Recontouring containment lines and returning topsoil to the surface is the first step toward restoring those disturbed soils. The Dry Channel Fire containment lines were recontoured on October 29 and 30, 2024.

Cheatgrass and Noxious Weed Control

Noxious weed treatments are addressed by the INL Wildland Fire EA and should be initiated as soon as possible post-fire. Disturbed soils associated with fire suppression activities are vulnerable to weed invasion and linear features can become vectors for spread. The area impacted by the Dry Channel Fire and fire suppression activities was added to Facilities and Site Services noxious weed treatment list. Inventory and treatment efforts were conducted periodically throughout summer and fall.

5.2.1.3 2020 – Four Fires

In 2020, there were two very small wildland fires (<1000 m^2 or 0.25 ac) and five wildland fires ranging in size from 11.0 ha (27.1 ac) to 677.9 ha (1,675.1 ac) on the INL Site. Only three of the five fires were large enough to meet the wildland fire conservation measure criteria in the CCA; however, the WFMC requested an ecological assessment and fire recovery plan for four of the fires. The 11.0 ha (27.1 ac) fire was included because containment lines were used to control it, and it was mapped as sagebrush habitat prior to the fire. It is also partially in SGCA. The four fires included in the INL Site 2020 Wildfires

Ecological Resources Recovery Plan (Forman et al. 2021) were the Howe Peak, Telegraph, Lost River, and Cinder Butte fires. A total of 1,920 ha (4,744 ac) was affected by these four fires.

Fire Summary and Post-Fire Restoration Planning

A post-fire ecological resource assessment and an ecological resources post-fire recovery plan was completed for four fires that occurred in 2020 (Forman et al. 2021). The WFMC met to review the 2020 Wildland Fires Ecological Resources Recovery Plan and prioritized several of the restoration options provided therein. Most emergency soil stabilization actions, including containment line recontouring, were completed immediately after the 2020 wildland fires, prior to completion of the plan, but continued monitoring was recommended for some areas that were disturbed during fire suppression. 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

A soil stabilization recommendation that was made for the Telegraph Fire included monitoring temporary fire suppression access roads for natural recovery and considering signage and replanting if necessary. This recommendation required evaluation after a few growing seasons to determine whether natural recovery was adequate or further action was necessary, and the final evaluation was completed in 2024. Several locations where temporary access had been mapped immediately post-fire and where containment lines crossed existing two-track roads were evaluated in October 2024. Temporary access roads were generally very difficult to see and there was no indication that they had continued to be used or were more prone to weed establishment than the surrounding areas.

Cheatgrass was more abundant in the Telegraph Fire containment lines than in either the unburned adjacent areas or within the fire footprint where soil had not been disturbed (Figure 5-1). Musk thistle (*Carduus nutans*), a noxious weed, was also found along the containment lines. There was evidence of some sections of containment line being used as a road, presumably associated with livestock operations within the Twin Buttes grazing allotment. Due to other cheatgrass treatment priorities, there was no action recommended for cheatgrass control on the containment lines at the time. To discourage vehicle use of containment lines, NRG recommended to the WFMC that containment lines be signed and replanted everywhere they intersect an established two-track road. Planting approximately 100-200 m (328 -656 ft) of the containment line extending either side of the road intersection should be sufficient to make the containment lines appear more like the surrounding undisturbed vegetation and discourage continued use.

Cheatgrass and Noxious Weed 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 removed 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.

Post-fire noxious weed control continues to be implemented through the INL Site weed control programs. Spraying efforts focused on rush skeletonweed (*Chondrilla juncea*) because it was identified as being of particular concern by neighboring stakeholder agencies. Musk thistle is also widespread throughout post-fire plant communities at the INL Site and other Idaho noxious weeds like Canada thistle (*Cirsium arvense*), black henbane (*Hyoscyamus niger*), Russian knapweed (*Acroptilon repens*), and spotted knapweed (*Centaurea stoebe*) have also been identified and treated within areas affected by wildland fires over the past few years.

Figure 5-1. Containment line around the 2020 Telegraph Fire on the Idaho National Laboratory Site. Photographed in 2024.

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 BLM radio collared sage-grouse pre-fire (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, sagebrush planting is not likely to make a substantial impact toward improving sagebrush habitat condition on the Howe Peak Fire, Lost River Fire, and Cinder Butte Fire because of current herbaceous conditions or the distribution of habitat surrounding the burned area. See Forman et al. (2021) for a 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 were not abundant unburned islands of sagebrush and access was feasible. See the 2023 CCA implementation report (INL 2024) for additional planting details and for initial estimates of sagebrush seedling survivorship.

5.2.1.4 Pre-2020 – 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 resistant to weed invasion and dominance. Occasionally, sagebrush is also planted in areas that burned more than five years ago. The reasons for planting within older burned areas may vary but are often related to 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. Approximately 12,000 seedlings were planted in 2022, 74,875 seedlings were planted in 2023, and 19,500 seedlings were planted in 2024 in an area between East Butte and Middle Butte that burned in 2007 and 2010 and hosted active sage-grouse leks prior to wildland fire. These seedlings were planted to address compensatory mitigation for current and anticipated infrastructure projects.

In 2022, DOE-ID, INL, USFWS, and BLM partnered to pursue Bipartisan Infrastructure Law (BIL) funding to support sagebrush habitat restoration in the Tractor Flats area of the INL Site and adjacent BLM land, some of which burned most recently in the 2010 Jefferson Fire. This area is recognized as a high-priority habitat restoration location because long-term lek count data and more recent movement data from radio collared sage-grouse indicate that despite declines in habitat condition, Tractor Flats continues to be used for breeding, nesting, and overwintering.

Funding was awarded to the multiagency partnership beginning in 2023. Mechanical sagebrush planting began on BLM land adjacent to the eastern INL Site border during fall of 2023 and a commercial seed collection vendor collected sagebrush seed within the unburned areas of the southern and eastern portion of the INL Site (Figure 5-2) and within similar unburned areas managed by BLM. The seed was cleaned and stored and was to be used for mechanical planting of approximately 810 ha (2,000 ac) on the INL Site in 2024 as well as a slightly larger area on adjacent BLM land. By the end of the 2024 planting window, seeding was completed on approximately 280 ha (700 ac) of the INL Site using a broadcast spreader followed by an imprinter. Rice hulls were used as a carrier, and seed was applied at a rate of approximately 0.7 kg (1.5 lb) of pure live seed (PLS) per 0.4 ha (1 ac). Sagebrush seed was applied in 7.3 m (24 ft) wide strips, with a spacing of 14.6 m (48 ft) between planted strips. The remaining area of the 2024 planting will be planted in 2025 along with a scheduled 2025 planting (Figure 5-2). In addition to improving local sagebrush habitat, fostering collaboration among agencies, and continuing to demonstrate INL's commitment to land stewardship, benefits of this partnership include knowledge and skills transfer which will ultimately facilitate developing backcountry land management capabilities at INL.

Along with the sagebrush restoration efforts at Tractor Flats, DOE-ID and INL requested BIL funding for Rejuvra © (liquid) Indaziflam herbicide for cheatgrass-dominated areas in the Sheep Fire. Funding would be sufficient to treat a total of 3,683 ha (9,100 ac); this represents about 40% of the area on the INL Site that has been mapped as cheatgrass-dominated. The treatment area was divided into four polygons, approximately 810 ha (2,000 ac) each, and the polygons were prioritized according to the probability of a successful outcome without additional restoration efforts. The treatment would be phased in over four years and the areas with the greatest potential for a successful outcome would be treated first. In 2024, INL received sufficient herbicide to treat the highest-priority 810 ha (2,000 ac) polygon. Herbicide will be applied in 2025 after NEPA review has been completed.

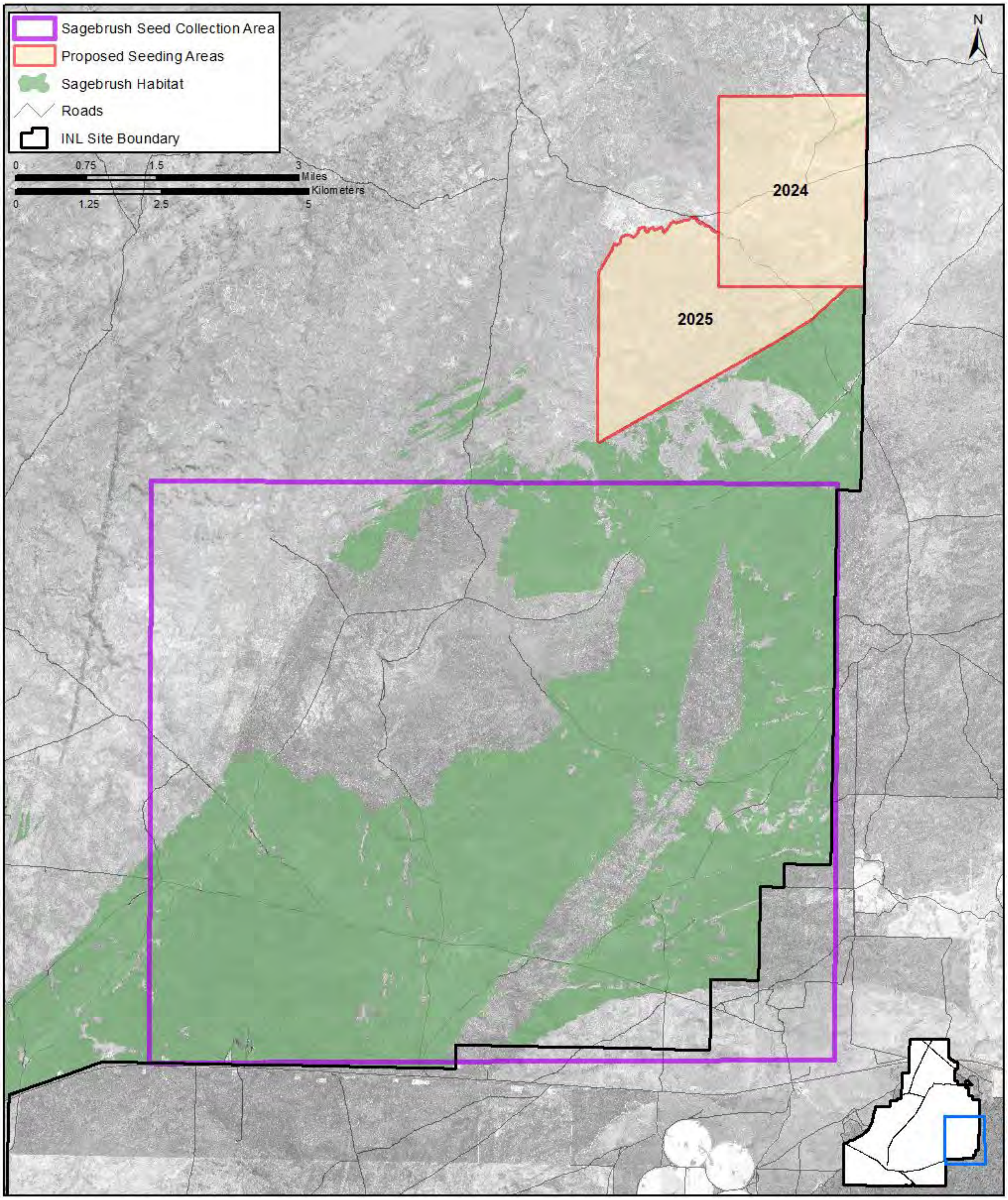

Figure 5-2. Sagebrush seed collection and proposed mechanical seeding locations for sagebrush habitat restoration efforts within the Tractor Flats area of the Idaho National Laboratory Site.

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

5.2.2.1 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 (Table 5-1). The CCA includes three related strategies for addressing sagebrush habitat loss. The first is periodic sagebrush 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 specific to 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-ID has a no net loss sagebrush habitat goal (DOE-ID and USFWS 2014). It states that for every acre of sagebrush habitat or potential sagebrush habitat that is impacted, BEA will contribute funds to replant approximately 1,000 sagebrush seedlings as compensatory mitigation (INL 2022). Seedlings from all funding sources are grown concurrently and planted in priority restoration areas identified in the CCA (DOE-ID and USFWS 2014) and in post-fire ecological recovery plans.

The NRG oversees the planting of sagebrush seedlings and monitors their survivorship to evaluate the effectiveness of this sagebrush restoration strategy. 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 sagebrush restoration 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).

5.2.2.2 Methods

Desert Sage Farms, LLC, located in Oakley, Idaho, was contracted to grow and plant approximately 23,500 sagebrush seedlings from seed collected on the INL Site in 2021. Seedlings were funded by and acquired for compensatory mitigation in response to an INL waterline infrastructure project that was completed in 2023. The planting site location was selected using priority restoration areas; priority restoration areas were identified using sources of information which include wildfire boundaries and pre-fire habitat favorable soil types, and logistical constraints, such as accessibility. During each planting, a subset of approximately 500 seedlings are marked for future monitoring and will be revisited at one and five-year post planting to assess survivorship.

In addition to planting seedlings in 2024, monitoring was completed on seedlings planted in previous years. During the fall 2023 planting, we collected Global Positioning System locations of a subset of seedlings in all planting locations. To inform and to improve future plantings, four different methods or materials (hereafter, treatments) were tested in 2023. Each treatment was approximately 20,000 seedlings. One subset of seedlings planted in 2023 contained the same growth medium and were planted the same way as previous INL Site sagebrush plantings; this subset was intended to act as a control for the other treatments. Of the control seedlings planted, protective mesh cages were installed on an additional subset of approximately 500 seedlings. The other three treatments included the use of various supplemental materials in the growing medium; the supplemental materials are Terra-Sorb hydrogel, Am 120 mycorrhizal inoculant, and vermiculite.

In September 2024, 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. Seedlings planted in the fall of 2019 were revisited in the fall of 2024 to assess survivorship at five years. One-year survivorship of these seedlings was initially assessed in 2020 and all seedlings were revisited in 2024, 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. Revisited seedlings were also evaluated for the presence of reproductive structures during the five-year assessment.

5.2.2.3 Results

On October 9 and 10, 2024, 19,050 sagebrush seedlings were planted on approximately 43.56 ha (107.65 ac; Figure 5-3). The number of seedlings delivered was reduced from the initial contract quantity due to germination issues of the INL provided seed in the greenhouse. The 2024 planting was located within portions of the 2010 Middle Butte Fire and the 2007 Twin Buttes Fire. In 2024, a planting crew from MP Forestry of Medford, OR installed the seedlings over a two-day period using hodads, traveling on foot from existing roads, and utilizing a single pass of a utility terrain vehicle to transport seedlings further from the road (Figure 5-4). For future monitoring, 500 seedling locations were marked following installation.

Figure 5-3. Areas planted with big sagebrush (*Artemisia tridentata*) seedlings in 2024 with reference to previous years plantings on the Idaho National Laboratory Site.

Figure 5-4. Planting crew from MP Forestry planting big sagebrush (*Artemisia tridentata*) seedlings on the Idaho National Laboratory Site during October 2024.

Since 2015, sagebrush seedling planting on the INL Site has been conducted on 1,202.87 ha (2,972.35 ac). Over the past ten years, a total of 349,675 seedlings have been planted from multiple funding sources, including DOE-ID, BEA, the Idaho Governor's Office of Species Conservation, and IDFG.

Survivorship survey results of the subset of seedlings planted in the Middle Butte Fire and Twin Buttes Fire can be seen in Table 5-2. When compared to the control, the caged treatment and vermiculite treatment resulted in noticeably higher survivorship. Although the caged treatment appeared to increase survivorship, this treatment comes with logistical challenges and increased cost, making it less appealing to use in future plantings. The addition of vermiculite as a treatment is much more feasible to implement and will be considered for all future plantings.

Table 5-2. Survivorship results for big sagebrush (*Artemisia tridentata*) seedlings planted in 2023 on the Idaho National Laboratory Site. Results are shown for seedlings in the control subset and for four different treatments.

Treatment (n)		Healthy Seedlings	Stressed Seedlings	Dead Seedlings	Missing Seedlings	% of Seedlings Survived
Control	(500)	42	25	40	393	13.4
Caged	(480)	64	66	165	185	27.1
Vermiculite	(500)	78	19	5	398	19.4
HydroGel	(500)	66	15	17	402	16.2
Mycorrhizal	(500)	43	19	23	415	12.4
Total	**(2480)**	**293**	**144**	**250**	**1793**	**17.6**

Assuming the missing seedlings were dead, approximately 17.6% of all seedlings planted in 2023 survived the first year. This result is higher than the 2019 and 2020 plantings, and around the same as the 2021 and 2022 plantings, but remains much lower than the plantings between 2015 and 2018 (Figure 5-5).

Water year precipitation following the 2023 seedling planting was slightly lower than the previous planting year but remains around the average for the INL Site (Figure 5-5). During the 2024 water year, monthly precipitation was atypical in both timing and seasonal amount compared to the long-term seasonal averages (Figure 3-7). An unseasonably wet fall in 2023 followed by a wet late winter, below average spring and early summer, and unseasonably wet mid to late summer contributed to both deviations in precipitation timing and amount. Overall, low seedling survivorship could be due to many variables, but it appears that sustained deviations in both precipitation timing and amount are likely contributing factors to the past five years of lower than average seedling survivorship.

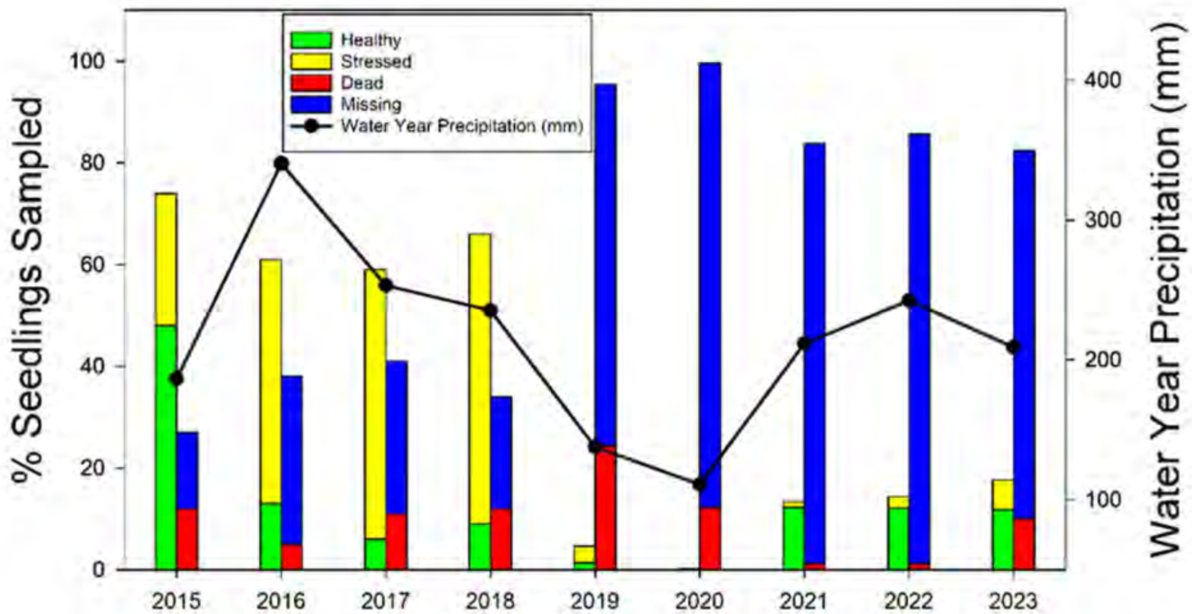

Figure 5-5. Sagebrush seedling survivorship one year after planting on the Idaho National Laboratory Site. The yellow and green bar represents the observed living seedlings. The blue and red bar represents seedlings presumed to be dead. The black dots indicate the total water year precipitation, and the black line denotes precipitation trends. Water year is calculated as precipitation received in October of the planting year to September of the following year.

To evaluate five-year survivorship, 500 seedlings planted in the fall of 2019 were revisited in the fall of 2024. In total, 66 seedlings were located, of which 51 were healthy and 12 were stressed. This means that over the last five years, 63 (12.6%) of the marked seedlings continued to grow. Initial one-year results of the 2019 planting indicated that 4.6% of the seedlings had survived to the fall of 2020 (Shurtliff et al. 2020). The higher survivorship from the five-year survey compared to the one year is likely an artifact of the difficulty of locating the small seedlings one year after planting and comparing survivorship rates between one-year and five-year monitoring efforts suggest that if seedlings survive the first year, they will continue to persist. In addition to revisiting seedlings for condition and survivorship, development of reproductive structures was noted. Of the observed surviving seedlings, 17 (3.4%) 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 are likely the seed source. This evidence supports the chosen method of planting at a density to establish sagebrush seed sources in priority areas to shorten the recovery time interval between a fire and the reestablishment of sagebrush habitat (Shurtliff et al. 2016).

5.2.2.4 Discussion

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 five most recent plantings, sagebrush establishment one and five-years post planting on the INL Site was above average, with an average survivorship of 65% (2015–2018). It is unfortunate that the 2019-2023 plantings have deviated from this trend of successful plantings, but INL continues to explore methods for improving the planting process that allow for the use of new techniques or approaches, such as those tested in 2023, to increase the success of future planting efforts.

One of the reasons that INL and DOE-ID continue 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 to plant containerized seedlings in recovering burned areas 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 there are better options or alternatives to the current annual sagebrush seedling planting efforts (Forman et al. 2020). With assistance from multiple agency partners, INL has begun testing sagebrush seeding through mechanical means. Details about these efforts are described in Section 5.2.1.

6.0 SYNTHESIS AND ADAPTIVE MANAGEMENT RECOMMENDATIONS

6.1 Trends and Threats in a Regional Context

The IDFG annually compiles data and shares results from hundreds of sage-grouse lek counts conducted by its staff and partners. The INL contributes to this dataset by providing lek and route count information on an annual basis (i.e., IDFG lek routes, Figure 2-1). Comparing these two data sets allows the NRG to evaluate if trends observed on the INL Site are like those observed on state-wide and/or regional levels. The peak male count of 829 for 2024 was 38% higher than in 2023 and was the highest recorded on the INL Site since 2011. This upward trend was observed throughout Idaho, with IDFG (2024) reporting a 22% state-wide increase. Oregon and Wyoming also reported state-wide increases of 63.9% (Vold 2024) and 33% (WGFD 2024), respectively, which suggests that populations increased in many areas range wide. Sage-grouse populations vary between high and low abundances on six to ten-year cycles and populations on the INL Site, in the State of Idaho, and in many places across the range, are clearly in the upward portion of this cycle after a low (i.e., nadir) from 2020–2021. Heavy snowpack, like what occurred in the winter of 2022–2023 has a positive, but lagged effect on sage-grouse populations (Blomberg et al. 2014, Coates et al. 2018, Lundblad et al. 2022). Heavy snowpack ensures the availability of mesic resources the following summer which chicks rely on for food and shelter (Blomberg et al. 2014, Gibson et al. 2017, Lundblad et al. 2022). This increase in recruitment may then be reflected in lek counts the following year (i.e., 2024). It is important to note that a single major increase in males on lek does not indicate recovery. Because sage-grouse populations cycle naturally, population trend estimates should not be calculated year to year, but instead should be calculated peak-to-peak or nadir-to-nadir, otherwise estimates may indicate false declines or increases (Coates et al. 2023). Overall, sage-grouse populations are still declining throughout their range (Coates et al. 2023), and accurate trend estimates for the INL Site cannot be evaluated until the population reaches the next peak and then begins naturally cycling downward again.

Although the State has established habitat distribution triggers (Idaho 2021) like the INL Site, and the State recommends managing habitat condition so that it meets the same general guidelines as those used for the INL Site, results of local and/or regional summaries are not annually published for management areas at a fine enough scale to facilitate direct comparisons of habitat distribution and/or condition every year. The most recent summaries were published in 2020 as part of a causal factor analysis (Idaho Adaptive Management Team 2020). Of the fine scale management areas that overlap the INL Site, the adaptive management team reported that a soft habitat trigger (i.e., a decrease in distribution of >10% but < 20%) was tripped in the Mountain Valley Important Habitat Management Area, which extends onto approximately the northern one-quarter of the INL Site. This trigger was tripped due primarily to two wildland fires that did not directly affect the INL Site.

No habitat triggers were tripped within the Desert Conservation Area, which includes the southern three-quarters of the INL Site. Within the Desert Conservation Area, much of the INL Site is included in the Twin Buttes Target Fine Scale Area. The landscape cover of sagebrush across this Fine Scale Area was estimated to be between 60% and 70% across all seasonal habitat types, which is comparable to the distribution of sagebrush habitat across the INL Site. The Idaho Adaptive Management Team has identified the Tractor Flats area within the Twin Buttes Target Fine Scale Area as an important winter habitat. They have recommended considering top management priorities such as minimizing any further loss of sagebrush and restoring sagebrush where it has been lost, particularly from the 2010 Jefferson Fire. They have also recommended identifying priority areas where cheatgrass control can be used to improve nesting habitat. INL habitat condition data and spatial vegetation distribution data (Shive et al. 2019) indicate the most extensive cheatgrass-dominated areas within the Jefferson Fire footprint are also within Sheep Fire footprint, located west of Tractor Flats. Four potential cheatgrass treatment areas have been identified within the overlapping footprints of these two fires. Section 5.2.1 includes a summary of sagebrush restoration and cheatgrass treatment efforts proposed and in progress for in this area.

Although habitat condition data from the INL Site indicates that cheatgrass is more abundant in burned areas than intact sagebrush habitat, post-fire areas on the INL Site are still largely dominated by native, perennial species. Cheatgrass cover can fluctuate considerably from one year to the next and a decrease in cover is as likely as an increase (Forman and Hafla 2018), so it is important to interpret annual changes within the context of longer-term patterns. Because cheatgrass cover generally does not increase at the expense of cover from native perennial species, it does not appear to be affecting overall habitat condition. There are localized areas on the INL Site where cheatgrass has become dominant (Shive et al. 2019), but they are limited in extent and are not yet widespread enough to influence the fire regime. Although the fire regime at the INL Site is not driven by cheatgrass dominance, fires have been more frequent in the past 30 years when compared to the previous 30 years, most likely due to changes in weather patterns and other anthropogenic influences. Therefore, the INL continues to prioritize reducing wildland fire impacts to habitat by minimizing fire size and by implementing post-fire recovery strategies.

The CCA and resulting relationship between its signatories have helped DOE-ID and its contractors take proactive, focused measures (Section 5.1) to conserve sage-grouse while still pursuing DOE-ID’s mission. The agreement and Conservation Measures therein have also been the key to strengthening relationships with natural resource partners to collaborate on projects relevant to sage-grouse. For example, in 2023, BIL funding was awarded to USFWS, BLM, and DOE-ID to facilitate a large-scale sagebrush seed collection effort on the INL Site and adjacent BLM property. The seed will be used to support sagebrush restoration in important winter habitat that spans DOE-ID/BLM boundaries. Additionally, DOE-ID shares habitat data with BLM when allotments are reassessed, and BLM invites DOE-ID to participate in grazing allotment assessments on the INL Site. This increased collaboration and pursuit of common land management goals are among the benefits that has resulted from DOE-ID’s efforts, via the CCA, to join with federal and state partners to conserve sage-grouse and sagebrush lands in eastern Idaho.

6.2 Proposed Changes to the CCA

No changes to the CCA were proposed during 2024.

6.3 Adopted Changes

No changes to the CCA were adopted during 2024.

6.4 Work Plan

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

Table 6-1. Natural Resources Group work plan for 2025 at the Idaho National Laboratory Site.

CCA Monitoring Task	Schedule for 2025
1. Lek Counts and Lek Route Surveys	Continue to monitor all active leks and a rotational subset of inactive leks.
4. Raven Nest Surveys	Monitoring of infrastructure where nest deterrents have been installed to determine if they were effective at excluding ravens.
5. Sagebrush Habitat Condition Trends	Sample all annual and rotational set III 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	New Idaho NAIP imagery will be available again in 2026, 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. Cover from sagebrush habitat plots summarized by native plant functional groups on the Idaho National Laboratory Site from 2013 through 2024. Cover (%) is the absolute mean ($\bar{x}$). Minimum significant difference (MSD) is the smallest distance between two $\bar{x}$ that is significant at $\alpha < 0.05$.

Year	Sagebrush ($\bar{x}$)	Other Shrubs ($\bar{x}$)	Native Perennial Graminoids ($\bar{x}$)	Native Perennial Forbs ($\bar{x}$)	Native Annual and Biennial Forbs ($\bar{x}$)
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
2023	24.6	6.7	11.4	1.6	1.8
2024	25.4	6.9	11.8	1.0	0.3
MSD	**2.7**	**2.1**	**4.5**	**1.0**	**1.3**

Table A-2. Cover from sagebrush habitat plots summarized by introduced plant functional groups on the Idaho National Laboratory Site from 2013 through 2024. Cover is the absolute mean ($\bar{x}$). Minimum significant difference (MSD) is the smallest distance between two $\bar{x}$ that is significant at $\alpha < 0.05$.

Year	Introduced Perennial Grasses ($\bar{x}$)	Introduced Annual Grasses ($\bar{x}$)	Introduced Annual Forbs ($\bar{x}$)
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
2023	1.6	3.4	3.9
2024	1.6	3.5	1.9
MSD	**1.8**	**2.3**	**2**

Table A-3. Cover from recovering habitat plots summarized by native plant functional groups on the Idaho National Laboratory Site from 2013 through 2024. Cover is the absolute mean ($\bar{x}$). Minimum significant difference indicates the value at which the difference between two means becomes significant at $\alpha < 0.05$.

Year	Sagebrush ($\bar{x}$)	Other Shrubs ($\bar{x}$)	Native Perennial Graminoids ($\bar{x}$)	Native Perennial Forbs ($\bar{x}$)	Native Annual and Biennial Forbs ($\bar{x}$)
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
2023	1.2	10.8	17.1	1.1	1.4
2024	1.4	11.5	17.9	1.2	1.3
MSD	**1.4**	**N/A**	**6.2**	**1.6**	**1.9**

Table A-4. Cover from recovering habitat plots summarized by introduced plant functional groups on the Idaho National Laboratory Site from 2013 through 2024. Cover is the absolute mean ($\bar{x}$). Minimum significant difference (MSD) is the smallest distance between two $\bar{x}$ that is significant at $\alpha < 0.05$.

Year	Introduced Perennial Grasses ($\bar{x}$)	Introduced Annual Grasses ($\bar{x}$)	Introduced Annual Forbs ($\bar{x}$)
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
2023	1.1	16.1	12.2
2024	1.1	14.5	3.8
MSD	**N/A**	**11.1**	**6.8**