INL/RPT-24-76609

2023 Breeding Bird Surveys on the Idaho National Laboratory Site

March 2024

Idaho National Laboratory

INL is a U.S. Department of Energy National Laboratory
operated by Battelle Energy Alliance, LLC

DISCLAIMER

This information was prepared as an account of work sponsored by an agency of the U.S. Government. Neither the U.S. Government nor any agency thereof, nor any of their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness, of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. References herein to any specific commercial product, process, or service by trade name, trade mark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the U.S. Government or any agency thereof.

INL/RPT-24-76609

2023 Breeding Bird Surveys on the Idaho National Laboratory Site

March 2024

Idaho National Laboratory
Idaho Falls, Idaho 83415

http://www.inl.gov

Prepared for the
U.S. Department of Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517

Page intentionally left blank.

SUMMARY

Breeding Bird Surveys have been conducted annually since 1985 (no surveys were conducted in 1992 and 1993) to monitor bird populations on the Idaho National Laboratory Site. In June 2023, a total of 13 survey routes were completed with five routes being a part of a nationwide survey administered by the United States Geological Survey and eight of which border Idaho National Laboratory Site facilities. A total of 5,269 birds from 66 species were documented during the 2023 surveys, which is 14.1% higher than the 37-year mean of 4,617 birds, the number of species (i.e., species richness) was higher than the 37-year average of 56.

The surveys observed similar bird abundance patterns for those species that are typically the most numerous, including horned lark (*Eremophila alpestris*, *n*=2,320), western meadowlark (*Sturnella neglecta*, *n*=680), Brewer's sparrow (*Spizella breweri*, *n*=356), sage thrasher (*Oreoscoptes montanus*, *n*=341), and sagebrush sparrow (*Artemisiospiza nevadensis*, *n*=136). These five species have been the five most abundant 24 times during the past 37 years of surveys. Nine species observed during the 2023 Breeding Bird Surveys are considered by the Idaho Department of Fish and Game as Species of Greatest Conservation Need, which includes the sage thrasher, sagebrush sparrow, Franklin's gull (*Leucophaeus pipixcan, n*=138), common nighthawk (*Chordeiles minor, n*=89), ferruginous hawk (*Buteo regalis, n*=45), grasshopper sparrow (*Ammodramus savannarum*, *n*=22), short-eared owl (*Asio flammeus, n*=11), long-billed curlew (*Numenius americanus, n*=7), and burrowing owl (*Athene cunicularia*, *n*=4).

Sagebrush obligates, such as the Brewer's and sagebrush sparrow, continue to be observed at near-historical lows. For example, observations of sagebrush obligate species were 42% lower than the average count in the 37 years of surveys. This decrease in observations of sagebrush obligate species is likely an indirect result of wildfires and the resulting loss of available habitat (Holmes 2007).

The most abundant species assemblage in 2023 was the shrub-steppe/grassland, representing 64.8% of all Breeding Bird Surveys observations. This assemblage normally has the highest abundance because the majority of the Idaho National Laboratory Site consists of shrub-steppe and grassland habitats. The second most abundant species assemblage was the sagebrush obligate category representing 15.8% of all observations. The third most abundant species assemblage was the raptor, corvids, and shrike category representing 8.4% of all observations.

Page intentionally left blank.

CONTENTS

FIGURES

TABLES

ACRONYMS

BBS	Breeding Bird Survey
CFA	Central Facilities Area
DOE-ID	U.S. Department of Energy–Idaho Operations Office
IDFG	Idaho Department of Fish and Game
INL	Idaho National Laboratory
NRF	Naval Reactors Facility
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Page intentionally left blank.

2023 Breeding Bird Surveys on the Idaho National Laboratory Site

1. INTRODUCTION

The North American Breeding Bird Survey (BBS) was developed by the U.S. Fish and Wildlife Service (USFWS) and the Canadian Wildlife Service to document trends in bird populations. Pilot surveys began in 1965 and immediately expanded to cover the U.S. east of the Mississippi and Canada, and by 1968 included all North America (Sauer and Link 2011). The BBS program in North America is managed by the U.S. Geological Survey (USGS) and currently consists of over 5,100 routes, with approximately 2,500 of these being sampled each year (Sauer and Link 2011).

BBS data provide long-term species abundance and distribution trends for > 420 species of birds across a broad geographic scale (Sauer and Link 2011). These data have been used to estimate population changes for hundreds of bird species and are the primary source for regional conservation programs and modeling efforts for birds (Sauer and Link 2011). The BBS provides a wealth of information about population trends of birds in North America and is the foundation for broad conservation assessments extending beyond local jurisdictional boundaries (Sauer and Link 2011).

Five official USGS BBS routes (i.e., remote routes) are on the Idaho National Laboratory (INL) Site and have been surveyed nearly each year since 1985 (except 1992 and 1993). In 1985, the U.S. Department of Energy–Idaho Operations Office (DOE-ID) also established eight additional routes around INL Site facilities to monitor birds near the highest human activity centers (i.e., facility routes). These routes are also surveyed annually using the same techniques and methods as those indicated by the USGS. BBS data can benefit INL Site managers directly by providing information on local breeding bird populations, which may be useful as they consider new activities and comply with the National Environmental Protection Act. This report summarizes results from the 2023 BBS and examines long-term averages.

1.1. Study Area

The INL Site encompasses almost 890 mi^2 (2,305 km^2) on the Upper Snake River Plain in southeast Idaho (Figure 1) and is administered by the U.S. Department of Energy. The INL Site was designated a National Environmental Research Park in 1975 to facilitate research assessing environmental impacts from the development of nuclear energy technologies. This area is located within portions of Bingham, Bonneville, Butte, Clark, and Jefferson counties. The INL Site has been designated as an Important Bird Area by the Idaho Department of Fish and Game's (IDFG's) Comprehensive Wildlife Conservation Strategy (IDFG 2005). This designation recognizes wildlife species that are listed by either state or federal agencies and provides a comprehensive listing of the Idaho Species of Greatest Conservation Need (IDFG 2023). The INL Site has also been recognized as a Global Important Bird Area by the National Audubon Society (2013).

Topography across the INL Site is mostly flat with an average elevation of 4,985 ft (1,519 m). Other than minor topographic variation created by basalt outcrops, the only significant geographical relief occurs around the East and Middle buttes and the southern portion of the Lemhi Mountains located near the northwest corner of the INL Site.

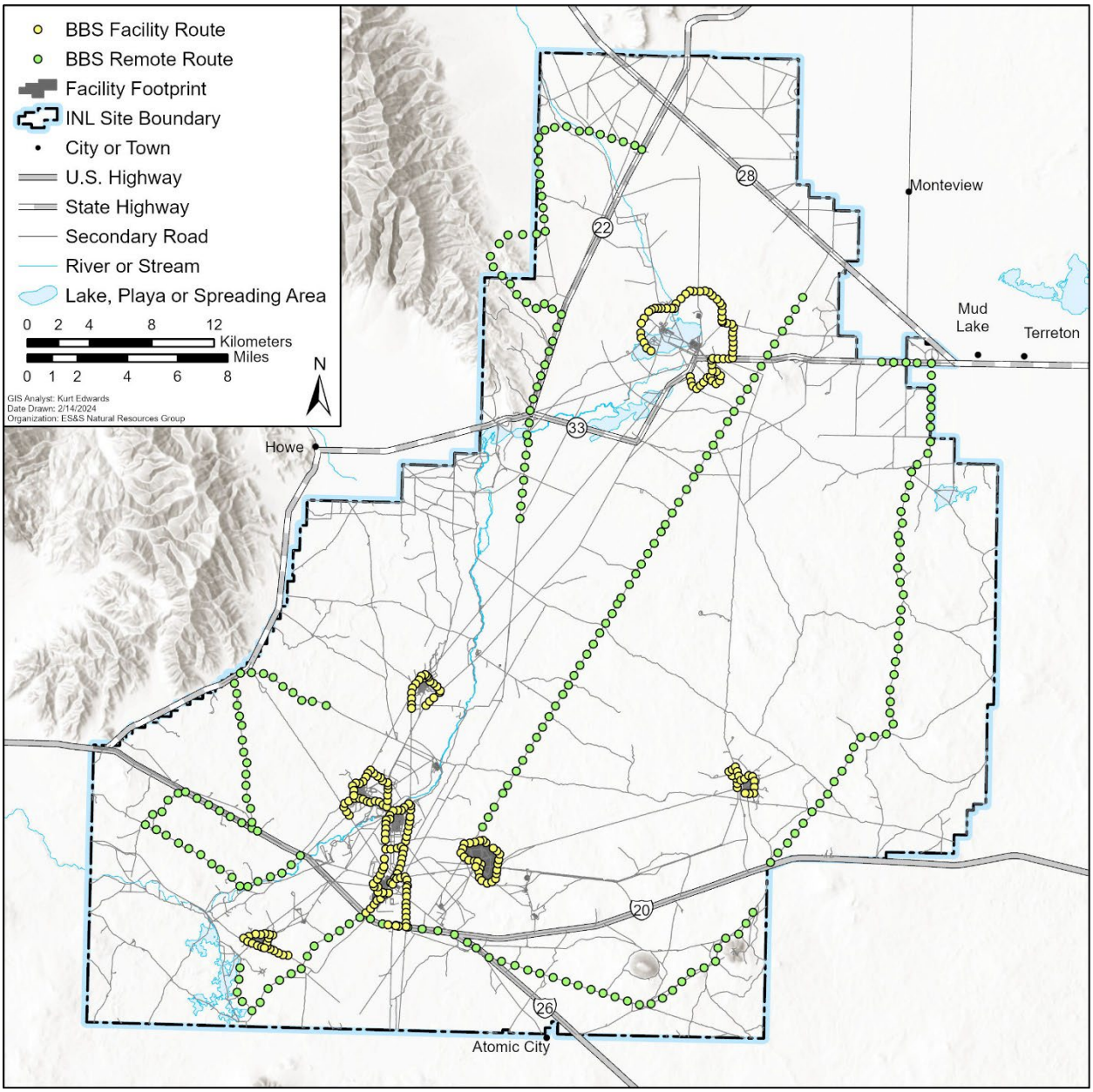

Figure 1. Breeding Bird Survey routes on the Idaho National Laboratory Site. Yellow dots represent survey points along facility routes and green dots represent the same for remote routes.

The INL Site has a semi-arid climate, characterized by hot, dry summers and cold winters. Annual precipitation on the INL Site averages 8 in. (20 cm), with peak precipitation commonly occurring in the spring. The geology is dominated by Quaternary basalt lava flows, including many outcrops and lava tubes. Aeolian soils consisting primarily of silt loam and sandy loam are the most common soil type on the INL Site, while alluvial soils more commonly occur along the floodplain of the Big Lost River. The INL Site is composed primarily of a shrub-steppe ecosystem dominated by a woody shrub over-story and perennial bunchgrass and forb understory. Big sagebrush (*Artemisia tridentata* ssp.) is the most dominant shrub community on the INL Site, while other common species include green rabbitbrush (*Chrysothamnus viscidiflorus*), spiny hopsage (*Grayia spinosa*), shadscale (*Atriplex confertifolia*), winterfat (*Krascheninnikovia lanata*), and other sagebrush species (*A.* spp.). The most common native grasses are thickspike wheatgrass (*Elymus lanceolatus*), bottlebrush squirreltail (*Elymus elymoides*), Indian ricegrass (*Achnatherum hymenoides*), and needle-and-thread grass (*Hesperostipa comata*).

Surface water on the INL Site is limited, especially during the summer months. The Big Lost River and Birch Creek are both diverted upstream for agricultural purposes and consequently little, if any, water from these streams reaches the INL Site. During years of high flow, however, water from the Big Lost River can reach the INL Site where it is diverted into the spreading areas on the south portion of the INL Site or drains into an ephemeral playa known as the Big Lost River Sinks on the north portion of the INL Site. The Sinks and the spreading areas provide the only substantial water source for waterfowl and shorebirds on the INL Site, although several man-made waste treatment ponds near facilities also provide habitat for aquatic birds, as well as a water source for migratory birds.

1.2. Methods

1.2.1. Data Collection

The BBS is a roadside count of all birds seen or heard along predefined routes. Thirteen BBS routes were surveyed in 2023 from June 2–28, consisting of five official USGS BBS routes and eight facility routes developed specifically for the INL Site (Figure 1). Each remote survey route is 24.5 mi (39.2 km) long, consisting of 50 sampling points systematically spaced every 0.5 mi (0.8 km). Facility routes vary in length between 3.6 mi (5.8 km) and 11.9 mi (19.2 km), depending on the size of the facility. Sampling points along facility routes are separated by approximately 0.2 mi (0.32 km).

During the surveys, observers followed the North American BBS protocols provided by the USGS Patuxent Wildlife Research Center (Sauer and Link 2011). At each sampling location (i.e., stop), a trained observer recorded every bird species observed within a quarter-mile radius or heard at any distance during a three-minute interval. Any bird that was suspected of being counted on the previous stop was not recorded again (Sauer and Link 2011). Additional data such as temperature, wind speed, and sky condition were recorded after every five stops along the remote routes, and at the beginning and end of each facility route. Surveys were only conducted when weather conditions were appropriate (e.g., no heavy rain or strong wind). Surveys began one-half hour before sunrise and continued until the route was completed. The number of vehicles that passed observers during the three-minute sampling period was recorded on all remote routes; observers noted whether background noise interfered with audible detection of birds.

Correlation of Bird Abundance and Environmental Factors

In previous reports of BBSs on the INL Site, environmental factors have been investigated to explain variation in observed bird abundance. Between 1985 and 1991, significantly more birds were detected along facility routes in June when the weather was cool and wet than when it was hot and dry (Belthoff et al. 1998). In another report spanning a greater number of years, Belthoff and Ellsworth (1999) reported that high bird abundance in June was significantly correlated with low temperatures and that a non-significant trend existed between high bird abundance and high June precipitation. Interestingly, the removal of one outlier from the 1995 data would have resulted in a statistically significant relationship

between abundance and precipitation (Belthoff and Ellsworth 1999). Those authors used Spearman rank correlation coefficients to identify whether there was a relationship between bird abundance and June temperature and precipitation (Belthoff and Ellsworth 1999).

The Spearman rank correlation coefficient is a non-parametric test used to investigate the relationship between variables (Zar 1984). Instead of using the raw abundance data, both variables are ranked in increasing order and the assigned ranks are used in the statistical analysis.

Spearman rank correlation coefficient was used to investigate relationships between bird abundance and both mean temperature and total precipitation in June since 1985. Weather data were recorded at the Central Facilities Area (CFA) and are available at http://niwc.noaa.inl.gov/climate.htm. Statistical significance was calculated using a two-tailed test with $\alpha = 0.05$.

Community Diversity Indices

An ecological community is comprised of all interacting species within a given environment. A community with low species diversity may indicate that an ecosystem is unhealthy or improperly functioning, whereas high species diversity is often used as an indicator of a healthy and stable ecosystem. Consequently, increasing diversity is the goal of many management activities.

Species diversity indices are mathematical methods used to quantify community composition. Many diversity indices are commonly used in ecology, and each has particular strengths depending on the data to be analyzed and the questions asked. The simplest estimate of community diversity is species richness, which represents the total number of unique species present. Although species richness is a useful measure of diversity, it does not account for differences in abundance between communities. For example, if there are many species for which one individual is observed, richness will be high but may not be comparable to another community with the same number of species and high abundances of those species. Diversity indices that consider both species richness and species abundance may provide a more useful measure of community diversity.

Shannon's diversity index (H) is a method for quantifying diversity of species in an area. This index accounts for both species richness (S) and relative abundance of each species in a community. Shannon's diversity index is derived by first calculating the proportion of species (i) relative to the total number of species (p_i), and then multiplying this proportion by the natural logarithm ($\ln p_i$). Shannon's H can range from 0 to about 4.6, where higher values represent increasing diversity.

$$H = -\sum_{j=1}^{S} p_i \ln p_i$$

Another useful measure is Shannon's equitability (E_H). Shannon's equitability represents a measure of evenness, which is how similar species abundance is within a community. E_H ranges from 0 to 1, with 1 representing a completely even community where all species abundances are equal.

$$E_H = H / \ln S$$

Shannon's H and E_H were calculated for all BBS routes and compared to standard species richness information documented in past reports. It was assumed that data obtained from each survey route is an accurate representation of the local bird community.

1.2.2. Results and Discussion

Summary Statistics

The 2023 surveys documented 5,269 birds and 66 species (Table 1). Total observations were 14.1% higher than the 37-year mean of 4,617 birds (1985–1991 and 1994–2023; Figure 2). Species richness was (i.e., the total number of species recorded) also higher than the 37-year mean of 56 species.

Nine species observed during the 2023 BBS are considered by the IDFG as Species of Greatest Conservation Need, which includes the sage thrasher (*Oreoscoptes montanus*, *n*=341), sagebrush sparrow (*Artemisiospiza nevadensis*, *n*=136), Franklin's gull (*Leucophaeus pipixcan, n*=138), common nighthawk (*Chordeiles minor, n*=89), ferruginous hawk (*Buteo regalis, n*=45), grasshopper sparrow (*Ammodramus savannarum*, *n*=22), short-eared owl (*Asio flammeus, n*=11), long-billed curlew (*Numenius americanus, n*=7 and burrowing owl (*Athene cunicularia*, *n*=4). When Franklin's gulls are observed, they are often in large flocks foraging on the INL Site and it is unlikely they are nesting onsite.

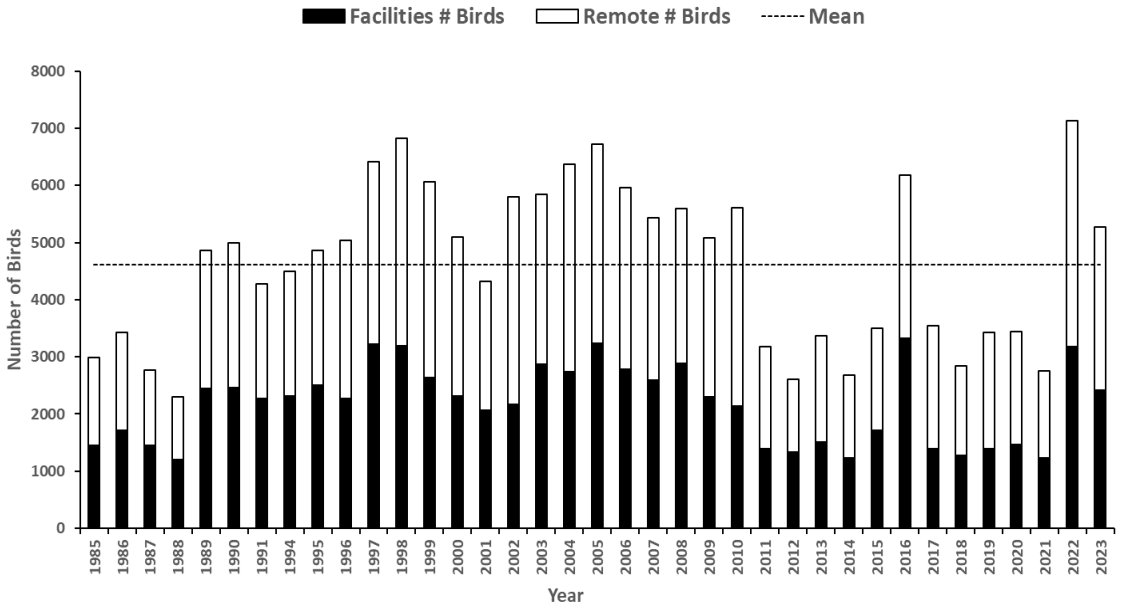

Figure 2. The number of birds observed during Breeding Bird Survey routes on the Idaho National Site. The dashed black line indicates the mean number of birds observed from 1985 to 2023. No surveys were conducted on the Idaho National Laboratory Site in 1992 or 1993.

The five most abundant birds across all routes were horned lark (*Eremophila alpestris*, *n*=2,320), western meadowlark (*Sturnella neglecta*, *n*=680), Brewer's sparrow (*Spizella breweri*, *n*=356), sage thrasher (*Oreoscoptes montanus*, *n*=341), and the Common Raven (*Corvus corax*, *n*=270). All of these species were observed on every remote route (Table 1, Appendix A). Horned lark, western meadowlark, sage thrasher, sagebrush sparrow, and Brewer's sparrow have been the five most abundant species in 24 of the 37 years of INL Site BBS. These five species comprised > 80% of all observations in 2023. Sagebrush sparrow have been pushed out of the top five for the last five years in a row.

The horned lark was the most evenly distributed species, observed at 89.6% (440) of the total stops made during the survey (Table 1). The horned lark is traditionally the most abundant species recorded during BBSs on the INL Site and, apart from 2013, 2016, 2019, and 2020, has been the most abundant species annually since 1998. In those four years, they were the second most abundant species. Horned lark abundance peaked in 2005.

Table 1. A summary of species from 13 routes, sorted by abundance, which were observed during the 2023 Breeding Bird Survey routes on the Idaho National Laboratory Site.

Common Name	Scientific Name	Assemblage[1]	n	%	Routes[2]	Stops[3]	%[4]
Horned Lark	*Eremophila alpestris*	SSG	2320	44.03%	5, 8	440	89.61%
Western Meadowlark	*Sturnella neglecta*	SSG	680	12.91%	5, 8	295	60.08%
Brewer's Sparrow	*Spizella breweri*	SO	356	6.76%	5, 8	216	43.99%
Sage Thrasher[5]	*Oreoscoptes montanus*	SO	341	6.47%	5, 8	200	40.73%
Common Raven	*Corvus corax*	RCS	270	5.12%	5, 8	101	20.57%
Barn Swallow	*Hirundo rustica*	UE	156	2.96%	1, 8	49	9.98%
Franklin's Gull[5]	*Leucophaeus pipixcan*	S	138	2.62%	3, 1	10	2.04%
Sagebrush Sparrow[5]	*Artemisiospiza nevadensis*	SO	136	2.58%	3, 5	83	16.90%
Mourning Dove	*Zenaida macroura*	SSG	112	2.13%	5, 7	73	14.87%
Common Nighthawk[5]	*Chordeiles minor*	SSG	89	1.69%	5, 5	45	9.16%
European Starling	*Sturnus vulgaris*	UE	76	1.44%	3, 6	32	6.52%
Vesper Sparrow	*Pooecetes gramineus*	SSG	67	1.27%	3, 4	40	8.15%
Ferruginous Hawk[5]	*Buteo regalis*	RCS	45	0.85%	4, 2	14	2.85%
Brewer's Blackbird	*Euphagus cyanocelphalus*	SSG	42	0.80%	3, 5	19	3.87%
Red-tailed Hawk	*Buteo jamaicensis*	RCS	26	0.49%	5, 6	25	5.09%
Say's Phoebe	*Sayornis saya*	UE	23	0.44%	2, 6	19	3.87%
Cliff Swallow	*Petrochelidon pyrrhonota*	UE	22	0.42%	0, 1	3	0.61%
Grasshopper Sparrow[5]	*Ammodramus savannarum*	SSG	22	0.42%	5, 3	18	3.67%
Loggerhead Shrike	*Lanius ludovicianus*	RCS	21	0.40%	3, 3	16	3.26%
Mallard	*Anas platyrhynchos*	W	21	0.40%	0, 3	6	1.22%
Northern Harrier	*Circus hudsonius*	RCS	20	0.38%	3, 5	18	3.67%
Swainson's Hawk	*Buteo swainsoni*	RCS	19	0.36%	2, 3	16	3.26%
Rock Wren	*Salpinctes obsoletus*	SSG	18	0.34%	2, 5	16	3.26%
Northern Shoveler	*Spatula clypeata*	W	17	0.32%	0, 3	6	1.22%
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	O	16	0.30%	0, 1	6	1.22%
Chipping Sparrow	*Spizella passerina*	SSG	15	0.28%	3, 4	14	2.85%
Brown-headed Cowbird	*Molothrus ater*	SSG	14	0.27%	3, 3	10	2.04%
Killdeer	*Charadrius vociferus*	S	14	0.27%	0, 5	11	2.24%
Black-billed Magpie	*Pica hudsonia*	RCS	13	0.25%	2, 0	4	0.81%
Red-winged Blackbird	*Agelaius phoeniceus*	O	12	0.23%	1, 4	8	1.63%
Short-eared Owl[5]	*Asio flammeus*	RCS	11	0.21%	2, 2	9	1.83%
Western Tanager	*Piranga ludoviciana*	O	11	0.21%	2, 3	8	1.63%
House Sparrow	*Passer domesticus*	UE	10	0.19%	0, 1	2	0.41%
Western Kingbird	*Tyrannus verticalis*	SSG	9	0.17%	3, 1	6	1.22%
Canada Goose	*Branta canadensis*	W	8	0.15%	0, 3	3	0.61%
Gray Flycatcher	*Empidonax wrightii*	SSG	8	0.15%	1, 0	3	0.61%
American Robin	*Turdus migratorius*	UE	7	0.13%	0, 3	4	0.81%

Table 1. Continued.

Common Name	Scientific Name	Assemblage[1]	n	%	Routes[2]	Stops[3]	%[4]
American Wigeon	*Mareca americana*	W	7	0.13%	0, 2	3	0.61%
Long-billed Curlew[5]	*Numenius americanus*	S	7	0.13%	2, 0	4	0.81%
American Kestrel	*Falco sparverius*	RCS	6	0.11%	2, 2	5	1.02%
Bank Swallow	*Riparia riparia*	O	6	0.11%	0, 2	2	0.41%
Eastern Kingbird	*Tyrannus tyrannus*	SSG	5	0.09%	1, 1	4	0.81%
House Finch	*Haemorhous mexicanus*	UE	5	0.09%	1, 2	5	1.02%
Mountain Bluebird	*Sialia currucoides*	SSG	5	0.09%	2, 2	4	0.81%
Burrowing Owl[5]	*Athene cunicularia*	RCS	4	0.08%	1, 2	3	0.61%
Blue-winged Teal	*Spatula discors*	W	3	0.06%	0, 1	1	0.20%
Dark-eyed Junco	*Junco hyemalis*	O	3	0.06%	0, 2	2	0.41%
Green-winged Teal	*Anas crecca*	W	3	0.06%	0, 1	1	0.20%
Lark Sparrow	*Chondestes grammacus*	SSG	3	0.06%	1, 1	3	0.61%
Merlin	*Falco columbarius*	RCS	3	0.06%	1, 0	3	0.61%
Ring-necked Duck	*Aythya collaris*	W	3	0.06%	0, 1	2	0.41%
Blue-gray Gnatcatcher	*Polioptila caerulea*	SSG	2	0.04%	1, 0	1	0.20%
Great Blue Heron	*Ardea herodias*	S	2	0.04%	0, 1	1	0.20%
Hermit Thrush	*Catharus guttatus*	O	2	0.04%	0, 2	2	0.41%
Prairie Falcon	*Falco mexicanus*	RCS	2	0.04%	1, 1	2	0.41%
Willet	*Tringa semipalmata*	S	2	0.04%	1, 0	1	0.20%
Yellow Warbler	*Setophaga petechia*	O	2	0.04%	0, 2	2	0.41%
American Avocet	*Recurvirostra americana*	S	1	0.02%	0, 1	1	0.20%
American Coot	*Fulica americana*	W	1	0.02%	0, 1	1	0.20%
Black-crowned Night Heron	*Nycticorax nycticorax*	S	1	0.02%	1, 0	1	0.20%
Cinnamon Teal	*Spatula cyanoptera*	W	1	0.02%	0, 1	1	0.20%
Golden Eagle[5]	*Aquila chrysaetos*	RCS	1	0.02%	1, 0	1	0.20%
Great Horned Owl	*Bubo virginianus*	RCS	1	0.02%	0, 1	1	0.20%
Lesser Goldfinch	*Spinus psaltria*	O	1	0.02%	1, 0	1	0.20%
Song Sparrow	*Melospiza melodia*	SSG	1	0.02%	1, 0	1	0.20%
Tree Swallow	*Tachycineta bicolor*	O	1	0.02%	0, 1	1	0.20%

Note that O = other; RCS = raptor, corvid, and shrike; S = shorebird; SO = sagebrush obligate; SSG = shrub-steppe/grassland; UE = urban and exotic; and W = waterfowl.

1. What species assemblage the bird species is assigned. See species assemblage section.
2. The first value represents the number of remote routes at which a species was recorded, and the second value represents the number of facility routes at which a species was recorded.
3. Number of stops at which a species was documented.
4. Percent of stops (from a total of 491) at which a species was recorded.
5. Identified as Species of Greatest Conservation Need.

Circular Butte (786 birds) and Tractor Flats (761 birds) had the highest bird abundance of remote routes observed in 2023 (Table 2). All the routes, except for Kyle Canyon and Twin Buttes, had an annual abundance that was greater than the 37-year mean. Of the facility routes, Advanced Test Reactor Complex, Critical Infrastructure Test Range Complex, CFA, Idaho Nuclear Technology and Engineering

Center, and Test Area North had an increase in the abundance of birds observed in 2023 compared to the 37-year mean (Table 2). Test Area North had the greatest bird abundance of these routes.

Species richness is the number of species observed during the survey whether it be a single individual of a species or a multitude of individuals of the same species. On remote routes, the most species observed in 2023 was on the Kyle Canyon route, followed closely by Twin Buttes. CFA had the most species observed on the facility routes followed by Materials and Fuels Complex (Table 2). The number of species observed would be expected to change between years; however, for all routes, the number of species observed does not appear to have changed dramatically and the species present on the INL Site remain relatively the same.

In 2019, construction started at Naval Reactors Facility (NRF) affected six stops (5, 6, 7, 8, 9, and 10) on the corresponding route (Figure 3). These stops were not accessible to be surveyed as a consequence of being in the construction zone. In 2022, stops 5 and 6 were visited (Figure 3) while stops 7, 8, 9, and 10 (located behind the NRF concrete perimeter wall) remain inaccessible. Stop 11 was not surveyed at the correct stop location in 2022 but was surveyed in 2023 and will be in the future. Because the number of stops varied on the NRF route, it would be inaccurate to compare the data to previous NRF route data.

Table 2. Summary numbers for each breeding bird route that was surveyed in 2023 on the Idaho National Laboratory Site.

Route	Stops	Species Richness	Mean Species Richness[1]	Abundance	Mean Abundance[2]
Remote Routes					
Lost River	50	18	17	508	416 (22.1%)
Circular Butte	50	13	15	786	461 (70.5%)
Kyle Canyon	50	31	23	378	398 (-5%)
Tractor Flats	50	23	23	761	747 (1.9%)
Twin Buttes	50	27	21	424	428 (-1.2%)
Subtotal	250	44[3]		2,857	
Facility Routes					
Central Facilities Area	42	32	21	427	326 (31%)
Idaho Nuclear Technology and Engineering Center	25	20	16	287	209 (37.3%)
Materials and Fuels Complex	18	26	21	178	261 (-31.8%)
Naval Reactors Facility	16	19	20	177	*
Critical Infrastructure Test Range Complex	28	20	15	350	256 (36.7%)
Advanced Test Reactor Complex	32	22	18	298	284 (49.3%)
Radioactive Waste Management Complex	20	22	19	151	176 (-14.2%)
Test Area North	60	19	17	544	436 (24.8%)
Subtotal	241	56[3]		2,412	
Total	491	66[3]		5,269	

1. Mean species richness 1985–2022.
2. Mean abundance 1985–2022 and percent different from mean.
3. Total combined number of unique species.

* The Naval Reactors Facility Route was altered in 2019 due to construction. The number of stops has varied on the route, and it would be inaccurate to compare the data to previous data.

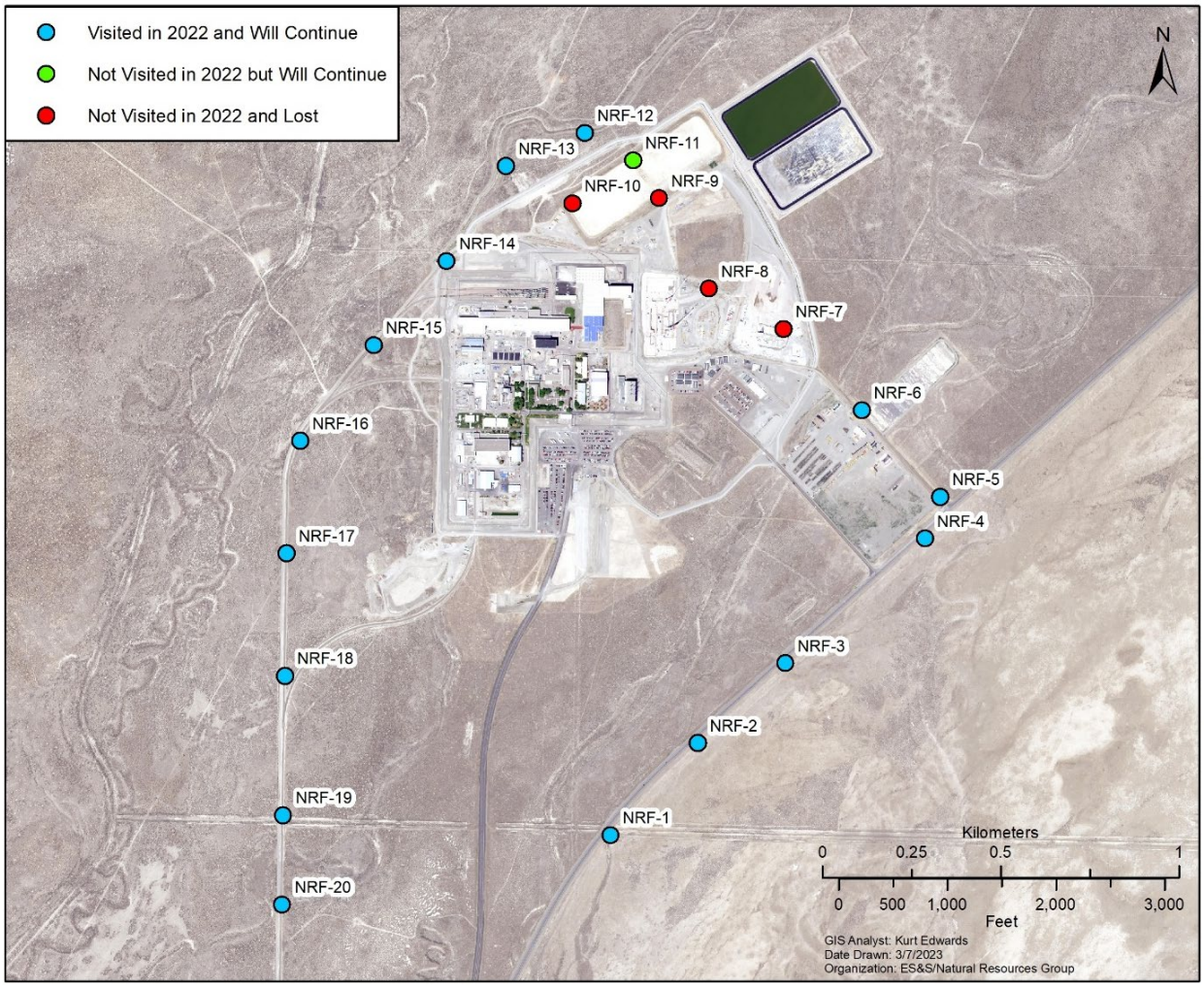

Figure 3. Naval Reactor Facility route stops.

Species Assemblage

Assemblages of bird species that are commonly observed in particular habitats can provide useful insights regarding the general ecological health of such habitats. For example, if a study area contains large shrubland and grassland habitat patches, and the corresponding observations of associated bird assemblage for that habitat is low it may indicate that the condition of the habitat is declining resulting in a decrease in bird numbers. Each species of bird detected on the INL Site has been assigned to one of seven species assemblages: shrub-steppe/grassland; sagebrush obligate; raptor, corvid, and shrike; shorebird; urban and exotic; waterfowl; and other species (Table 3).

The most abundant species assemblage in 2023 was shrub-steppe/grassland, which consists of 17 species and represents 64.8% of all BBS observations (Figure 4). This assemblage normally has the highest abundance because the majority of the INL Site consists of shrub-steppe and grassland habitats. The second most abundant species assemblage, consisting of three species, was sagebrush obligate representing 15.8% of all observations. The third most abundant species assemblage was raptor, corvid, and shrike, consisting of 14 species representing 8.4% of all observations.

Table 3. 2023 species assemblage abundance on the Idaho National Laboratory Site.

Species Assemblage	Number of Species	Abundance	Mean Abundance[1]
Shrub-Steppe/Grassland	17	3,412	2,476
Sagebrush Obligate	3	833	1,429
Shorebird	7	165	293
Raptor, Corvid and Shrike	14	442	189
Urban and Exotic	7	299	164
Waterfowl	9	64	45
Other species	9	54	21

1. Mean abundance 1985–1991, 1994–2023.

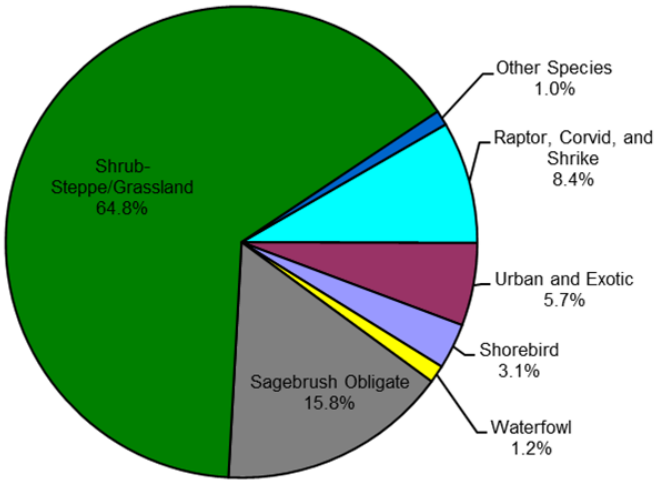

Figure 4. Summary of Breeding Bird Survey species assemblage for remote and facility routes on the Idaho National Laboratory Site in 2023.

Shrub-Steppe/Grassland

Shrub-steppe/grassland refers to the dominant plant types in the habitat: shrubs and grasses. Species representing the shrub-steppe/grassland assemblage have always been observed in the greatest numbers in past BBSs, and they again dominated observations in 2023 (n=3,412; Figure 4; Table 3). Common shrub-steppe/grassland species include horned lark, western meadowlark, mourning dove, and common nighthawk.

Horned lark (n=2,320) and western meadowlark (n=680) were the most abundant species in this assemblage and were in the top three most abundant species for the entire survey (Table 1). The total number of birds observed within the shrub-steppe/grassland assemblage was higher than the 37-year mean of 2,476 (Table 3).

Sagebrush Obligate

The sagebrush obligate assemblage had the second highest species abundance with 833 individuals; however, it is below the mean abundance of 1,429 (Figure 4; Table 3). This assemblage included only

three species in 2023: sage thrasher, Brewer's sparrow, and sagebrush sparrow. Brewer's sparrow was the most abundant sagebrush obligate (*n*=356), followed by the sage thrasher (*n*=341) and the sagebrush sparrow (*n*=136). Since 1985, sage thrasher counts have fluctuated, but appear to be stable (Figure 5). In 2023, sagebrush and Brewer's sparrows observations declined after an increase in 2022, but sage thrasher observations continued to increase (Figure 5).

In many western states, sagebrush obligates are facing significant habitat loss; consequently, many populations are in decline (Knick 1999, Knick and Rotenberry 2002, Knick et al. 2003, Rockwell et al. 2021). On the INL Site, three large fires in 2010 and 2011 burned 29,944 ha (73,993 ac) of sagebrush-dominated communities, representing over 20% of big sagebrush communities (DOE-ID and USFWS 2014). In 2019, there was one large fire that burned a total of 40,403 ha (99,839 ac)—9,171 ha (22,662 ac) of which was in sagebrush-dominated communities (Forman et al. 2020). In 2020, four wildland fires removed 1,088.4 ha (2,689.5 ac) of sagebrush habitat (Shurtliff et al. 2021).

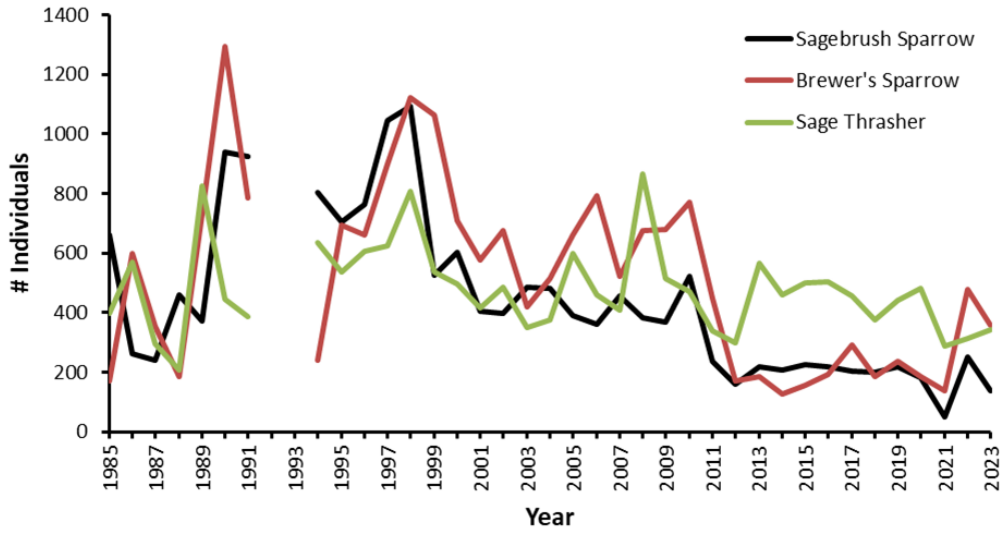

Figure 5. Trends of sagebrush obligates recorded during Idaho National Laboratory surveys since 1985. Surveys were not conducted in 1992 and 1993.

Raptor, Corvid, and Shrike

The raptor, corvid, and shrike assemblage consisted of 14 species with a total of 442 observations, representing 8.4% of the total count (Figure 4; Table 3). Among these were 11 species of raptors (i.e., eagles, hawks, falcons, and owls). Ferruginous hawk (*n*=45), red-tailed hawk (*Buteo jamaicensis, n*=26), northern harrier (*Circus hudsonius, n*=20), and Swainson's hawk (*Buteo swainsoni, n*=19) were the most abundant raptors observed.

The corvids that were observed included the common raven and black-billed magpie (*Pica hudsonia, n*=13). The common raven was the most abundant species within this assemblage in 2023 (*n*=270). Common raven observations have increased over the years (Figure 6).

Twenty-one loggerhead shrikes were observed in 2023, which was lower than the mean of 27 loggerhead shrikes per year (1985–2023). Although this species is not considered a sagebrush obligate, it does rely on stout woody shrubs, such as sagebrush, for nesting and perching. The reduction of sagebrush areas may also be influencing this species as well.

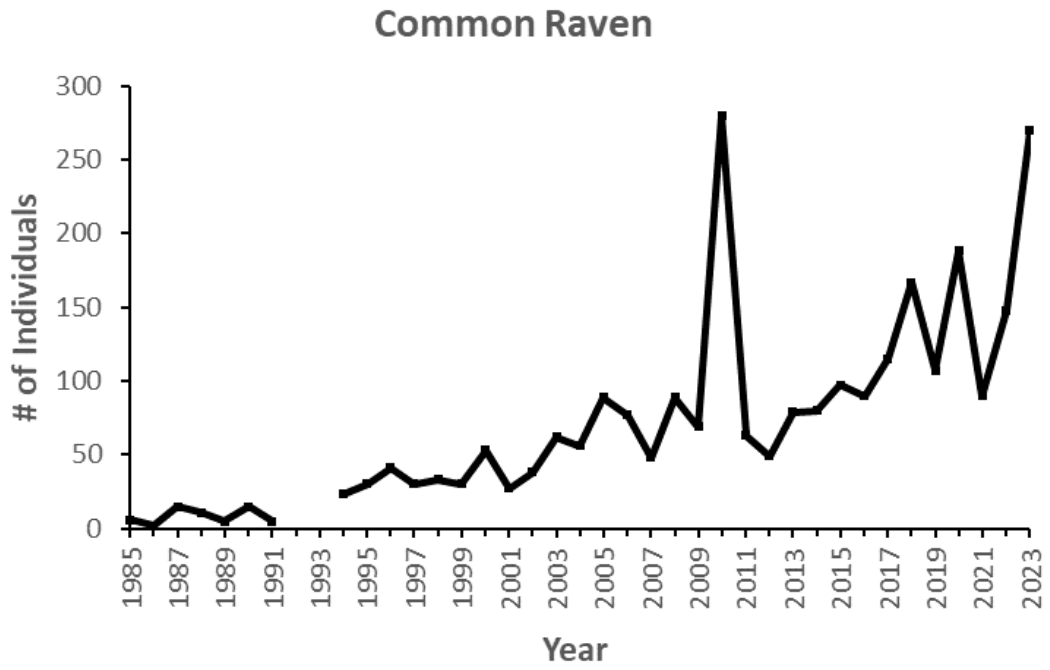

Figure 6. Common raven observations on the Idaho National Laboratory Site 1985–2023. No surveys were conducted in 1992 and 1993.

Urban and Exotic

The urban and exotic assemblage represents seven bird species that are known to be closely associated with urban or human-altered environments, which are most commonly found around INL Site facilities. Examples of these species include barn swallow (*Hirundo rustica, n*=156), European starling (*Sturnus vulgaris, n*=76), Say's phoebe (*Sayornis saya, n*=23), and cliff swallow (*Petrochelidon pyrrhonota, n*=22). This assemblage constituted 5.7% (*n*=299) of the total observations in 2023 (Figure 4; Table 3).

Shorebird

One hundred sixty-five individuals representing seven species from the shorebird assemblage were observed, which accounted for 3.1% of the total BBS observations (Figure 4; Table 3). Because standing water is rare on the INL Site (typically most observations of shorebirds occur in proximity to waste ponds along facility routes); shorebirds were observed near the Mud Lake Landfill and in agricultural fields adjacent to the INL Site boundary. In 2023, Franklin's gull observations (*n*=138) comprised 83.6% of all shorebird observations. Most of the Franklin's gulls were observed on the Tractor Flats route, near the Mud Lake Landfill. Franklin's gulls were not displaying breeding behaviors nor was it a nesting colony, but a flock foraging at the landfill. Some of the other shorebirds seen included the killdeer (*Charadrius vociferus, n*=14), long-billed curlew (*n*=7), great blue heron (*Ardea Herodias, n*=2), and willet (*Tringa semipalmata, n*=2). The mean shorebird abundance since 1985 is 293 (Table 3).

Waterfowl

Waterfowl are commonly observed during the BBS even though little standing water exists on the INL Site. Apart from the ephemeral Big Lost River, the Big Lost River spreading area, and the Big Lost River Sinks playa, the only standing water bodies on the INL Site during these surveys are wastewater treatment ponds near facilities. These man-made ponds serve as stopover locations for migrating birds and occasionally provides nesting opportunity for some waterfowl species.

Sixty four individuals were documented from nine waterfowl species including: mallard (*Anas platyrhynchos, n*=21), northern shoveler (*Spatula clypeata, n*=17), Canada goose (*Branta canadensis, n*=8), American wigeon (*Mareca americana, n*=7), blue-winged teal (*Spatula discors, n*=3), green-winged teal (*Anas crecca, n*=3), ring-necked duck (*Aythya collaris, n*=3), American coot (*Fulica americana, n*=1), and cinnamon teal (*Spatula cyanoptera, n*=1), representing 1.2% of total observations (Figure 4). The mean waterfowl abundance since 1985 is 45 (Table 3).

Other Species

The other species assemblage included nine species: yellow-headed blackbird (*Xanthocephalus xanthocephalus, n*=16), red-winged blackbird (*Agelaius phoeniceus, n*=12), western tanager (*Piranga ludoviciana, n*=11), bank swallow (*Riparia riparia, n*=6), dark-eyed junco (*Junco hyemalis, n*=3), hermit thrush (*Catharus guttatus, n*=2), yellow warbler (*Setophaga petechia, n*=2), lesser goldfinch (*Spinus psaltria, n*=1), and tree swallow (*Tachycineta bicolor, n*=1), for a total of 64 observations. Mean bird abundance for other bird species since 1985 is 21 (Table 3).

Bird Abundance Correlation

Bird abundance correlation analysis was last conducted in the 2015 BBS report. In 2022 this analysis was revisited. In 2023, bird abundance was not significantly correlated (r_s= -0.30, n= 37, P= 0.07) with mean June temperature (Figure 7). This result differs from previous findings from BBS on the INL Site (Belthoff et al. 1998, Belthoff and Ellsworth 1999) that indicated that June temperature should be a consideration when interpreting BBS results. They found in years where June temperatures are above average, the number of bird observations during the BBS tends to be lower compared with cooler years. The correlation between June temperature and bird abundance would allow for interpretation of changes in bird abundance across the INL Site and may help explain annual variability in BBS results. Although this year didn't show a relationship with temperature and abundance, future data analyses using multivariate techniques to test the strength of each independent variable (i.e., temperature, date of survey, or observer) that could influence bird abundance are recommended.

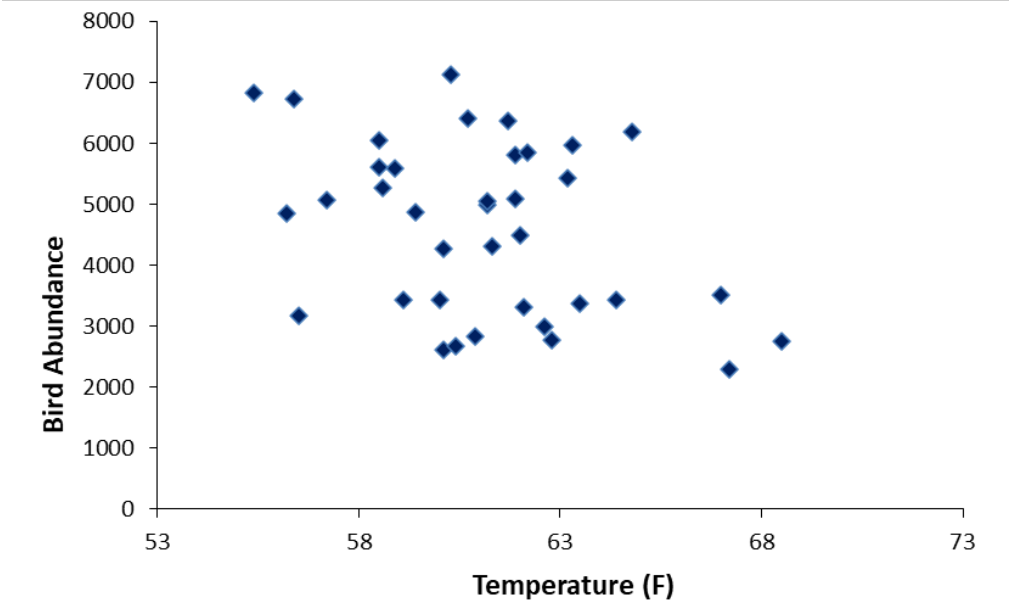

Figure 7. Relationship between bird abundance at the Idaho National Laboratory Site and the average June temperature recorded at the Central Facilities Area from 1985 to 2023.

Total precipitation in June was also not significantly correlated with bird abundance (r_{sc}= 0.32, n= 37, P= 0.06; Figure 8). These results also support previous analyses (Belthoff and Ellsworth 1999). It is interesting that the relationship with June precipitation is not stronger since temperature and precipitation are environmental variables that are inversely related (i.e., in years where there is a lot of rainfall, temperatures are typically lower due to evaporative cooling). Although not statistically significant, there is a clear trend towards increased bird abundance as total June precipitation increases. Therefore, precipitation is an important variable to be considered when interpreting changes in annual BBS abundance.

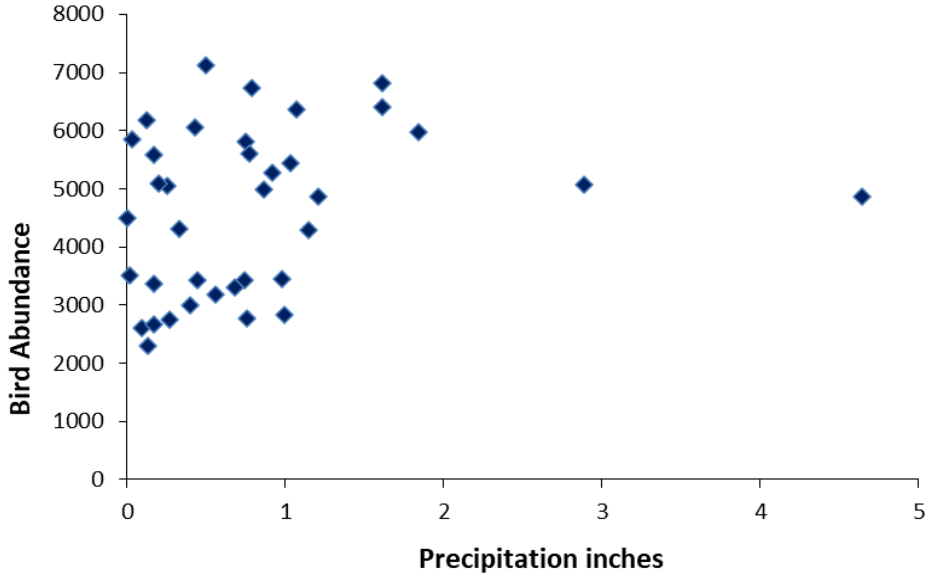

Figure 8. Relationship between bird abundance at the Idaho National Laboratory Site and total June precipitation recorded at the Central Facilities Area from 1985 to 2023.

Community Diversity Index

Based on both of Shannon's measures of diversity, the Materials and Fuels Complex Route had the most diverse bird community of all 13 routes (H=2.74, E_H=0.84), followed by the CFA Route (H=2.58, E_H=0.75; Table 4). CFA had the highest species richness (n=32) among the facility routes. Kyle Canyon had the highest species richness (n=31) among remote routes. The Circular Butte Route was the least diverse based on richness (n=13) and H (H=0.80) of all routes.

The CFA route has been among the top three regarding diversity in fourteen of the past fifteen years. Radioactive Waste Management Complex has been among the four most diverse routes during fourteen of the past seventeen years. This information indicates that the area surrounding CFA and Radioactive Waste Management Complex (e.g., buildings, trees, and waste-water ponds) may provide a more diverse habitat for several species of birds. Additionally, the northern stops on the Tractor Flats route occur in the agricultural areas near State Highway 33, which likely influences the species richness for that route.

Table 4. Values for species richness, Shannon Diversity (H), and Equitability (E_H) indices during the 2023 Breeding Bird Surveys on the Idaho National Laboratory Site.

Route	Species Richness	Shannon's H	Shannon's E_H
Remote Routes			
Kyle Canyon	31	2.39	0.69
Tractor Flats	23	2.24	0.71
Twin Buttes	27	2.03	0.61
Lost River	18	1.50	0.52
Circular Butte	13	0.80	0.31
Facility Routes			
Materials and Fuels Complex	26	2.74	0.84
Central Facilities Area	32	2.58	0.75
Radioactive Waste Management Complex	22	2.48	0.80
Idaho Nuclear Technology and Engineering Center	20	2.19	0.73
Advanced Test Reactor Complex	22	2.12	0.69
Naval Reactors Facility*	19	1.94	0.66
Test Area North	19	1.77	0.60
Critical Infrastructure Test Range Complex	20	1.56	0.52

* The Naval Reactors Facility Route was altered in 2022. These stops cannot be accurately compared to previous years.

2. CONCLUSIONS

Results were similar to previous years, shrub-steppe and grassland community assemblage dominated observations during the 2023 BBS on the INL Site. The total number of birds observed (n= 5,269) and species richness (n= 66) from all routes was higher than the INL Site averages since 1985. Following patterns of abundance from previous BBSs on the INL Site, horned larks, western meadowlark, sage thrasher, Brewer's sparrow, and sage sparrow were some of the most abundant species. These species have been consistently among the most abundant species each year of the BBS. This is good news, considering these species have been declining over much of their range. In 2023, no concerning patterns were observed, but it would be wise to continue to monitor how the sagebrush obligates are doing.

2.1. Landscape Change and Habitat Variation

The habitat and vegetation communities across the INL Site are a mosaic of sagebrush-steppe habitat. The INL Site has experienced some large, natural disturbances (e.g., wildfire), which have caused

changes in vegetation community composition and distribution across the INL Site. Little is known concerning responses of bird populations to alterations of habitat composition and distribution across the landscape (Rockwell et al. 2021; Knick et al. 2003) and how habitat fragmentation can influence local populations. Local bird populations and community assemblages can respond to these habitat changes, and the long-term BBS data should reflect these changes. The patterns of habitat modification in conjunction with changes in observed bird abundance and richness along routes could be investigated.

2.2. Future Data Analyses

With over three decades of BBS data collected, the program is well positioned to conduct a long-term analysis of bird population trends for species occupying the INL Site. Past reports have provided details regarding particular species, but more consideration could be made to do a comprehensive analysis of all BBS data from the INL Site. In the future, all data from past BBSs could be analyzed and long-term trends in bird abundance and species richness could be investigated (Sauer and Link 2011).

The annual BBS provides DOE-ID with historical information regarding population trends of breeding birds relative to activities conducted in remote areas and near facilities on the INL Site. This data can be useful when addressing issues regarding the National Environmental Policy Act, as well as the Migratory Bird Treaty Act. Additionally, the BBS complies with the direction to promote monitoring of migratory birds as described in the Memorandum of Understanding between the Department of Energy and the USFWS for responsibilities of federal agencies to protect migratory birds (U.S. Department of Energy and the USFWS 2006).

3. ACKNOWLEDGEMENTS

This report was authored by Battelle Energy Alliance, LLC (BEA) Natural Resources Group. Bryan F. Bybee and Samuel R. Williams conducted the fieldwork. Sarah A. Baccus, Samuel R. Williams, George J. Krauszer, and Brande M. Hendricks assisted with editing and document formatting.

4. REFERENCES

Belthoff, J. R., L. R. Powers, and T. D. Reynolds, 1998, "Breeding birds at the Idaho National Engineering and Environmental Laboratory, 1985 – 1991," *Great Basin Naturalist*. 58: 167-183.

Belthoff, J. R., and E. A. Ellsworth, 1999, *Breeding bird surveys at the Idaho National Engineering Laboratory,* Unpublished Technical Report, Environmental Science and Research Foundation, Idaho Falls, Idaho.

IDFG, 2005, *Idaho Comprehensive Wildlife Conservation Strategy,* Idaho Conservation Data Center, Idaho Department of Fish and Game, Boise, ID. http://fishandgame.idaho.gov/cms/tech/CDC/cwcs.cfm

IDFG. 2023. Idaho state wildlife action plan. 2023 rev. ed. Boise (ID): Idaho Department of Fish and Game. https://idfg.idaho.gov/.

Forman, A. D., J. R. Hafla, S. J. Vilord, J. P. Shive, K. N. Kaser, Q. R. Shurtliff, K. T. Edwards, and B. F. Bybee, 2020, *Sheep Fire Ecological Resources Post-Fire Recovery Plan,* Environmental Surveillance, Education, and Research Program, Idaho Falls, ID, VSF-ID-ESER-LAND-076.

Holmes, A. L., 2007, Short-term effects of a prescribed burn on songbirds and vegetation in mountain big sagebrush, *Western North American Naturalist* 67(2): 12.

Knick, S. T., 1999, Requiem for a sagebrush ecosystem, *Northwest Science* 73: 53–57.

Knick, S. T. and J. T. Rotenberry, 2002, Effects of habitat fragmentation on passerine birds breeding in intermountain shrubsteppe, *Studies in Avian Biology* 25: 131–141.

Knick, S. T., D. S. Dobkin, J. T. Rotenberry, M. A. Schroeder, W. Matthew, V. Haegen, and C. Van Riper III, 2003, Teetering on the edge of too late? Conservation and research issues for avifauna of sagebrush habitats, *Condor* 105: 611–634.

National Audubon Society, 2013, *Important Bird Areas in the U.S.*, retrieved from https://www.audubon.org/important-bird-areas/idaho-national-laboratory-inl.

Rockwell, S. M., B. Wehausen, P. R. Johnson, A. Kristof, J. L. Stephens, J. D. Alexander, and J. K. Barnett, 2021. Sagebrush bird communities differ with varying levels of crested wheatgrass invasion. Journal of Fish and Wildlife Management 12(1):27-39; e1944-687X. https://doi.org/10.3996/JFWM-20-035

Sauer, J. R. and W. A. Link, 2011, Analysis of the North American Breeding Bird Survey using hierarchical models, *Auk* 128: 87–98.

Shurtliff, Q. R., K. N. Kaser, J. P. Shive, J. R. Hafla, S. J. Vilord, K. T. Edwards, B. F. Bybee, and A. D. Forman, 2021, *Implementing the Candidate Conservation Agreement for greater sage-grouse on the Idaho National Laboratory Site: 2020 Full Report*, Environmental Surveillance, Education, and Research Program; Veolia Nuclear Solutions – Federal Services, Idaho Falls, ID. Report VFS-ID-ESER-CCA074.

Zar, J. H., 1984, "Biostatistical Analysis," 2nd edition. *Prentice Hall.* Englewoods Cliffs, New Jersey.

U.S. Department of Energy and the USFWS, 2006, Memorandum of Understanding between the United States Department of Energy and the United States Fish and Wildlife Service Regarding Implementation of Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds", 20 pp.

Page intentionally left blank.

APPENDIX A

SUMMARY OF SPECIES BY ROUTE 2023

Survey Route: Advanced Test Reactor Complex

Survey Date: June 20, 2023

Species	Abundance	Percentage
Horned Lark	104	34.90
Western Meadowlark	68	22.82
Barn Swallow	26	8.72
Common Raven	20	6.71
European Starling	13	4.36
Sage Thrasher	11	3.69
Sagebrush Sparrow	11	3.69
Brewer's Sparrow	10	3.36
Mourning Dove	8	2.68
Brewer's Blackbird	5	1.68
Canada Goose	5	1.68
Brown-headed Cowbird	3	1.01
Green-winged Teal	3	1.01
Chipping Sparrow	2	0.67
Western Tanager	2	0.67
American Kestrel	1	0.34
American Robin	1	0.34
Killdeer	1	0.34
Red-winged Blackbird	1	0.34
Swainson's Hawk	1	0.34
Tree Swallow	1	0.34
Vesper Sparrow	1	0.34
Total Individuals	*298*	
Total Species	*22*	

Survey Route: Central Facilities Area

Survey Date: June 26, 2023

Species	Abundance	Percentage
Horned Lark	131	30.68
Western Meadowlark	57	13.35
Sage Thrasher	26	6.09
Barn Swallow	24	5.62
Brewer's Sparrow	22	5.15
Cliff Swallow	22	5.15
European Starling	19	4.45
Sagebrush Sparrow	18	4.22
Brewer's Blackbird	17	3.98
Common Nighthawk	17	3.98
House Sparrow	10	2.34
Mourning Dove	10	2.34
Common Raven	9	2.11
American Robin	5	1.17
Loggerhead Shrike	5	1.17
Chipping Sparrow	4	0.94
Eastern Kingbird	4	0.94
Killdeer	4	0.94
American Kestrel	3	0.70
House Finch	3	0.70
Say's Phoebe	3	0.70
Brown-headed Cowbird	2	0.47
Rock Wren	2	0.47
Yellow Warbler	2	0.47
Dark-eyed Junco	1	0.23
Grasshopper Sparrow	1	0.23
Great Horned Owl	1	0.23
Hermit Thrush	1	0.23
Northern Harrier	1	0.23
Red-tailed Hawk	1	0.23
Red-winged Blackbird	1	0.23
Western Tanager	1	0.23
Total Individuals	*427*	
Total Species	*32*	

Survey Route: Circular Butte
Survey Date: June 19, 2023

Species	Abundance	Percentage
Horned Lark	646	82.19
Western Meadowlark	40	5.09
Sage Thrasher	33	4.20
Brewer's Sparrow	23	2.93
Common Raven	17	2.16
Common Nighthawk	15	1.91
Mourning Dove	3	0.38
Northern Harrier	3	0.38
Grasshopper Sparrow	2	0.25
Chipping Sparrow	1	0.13
Franklins Gull	1	0.13
Lesser Goldfinch	1	0.13
Red-tailed Hawk	1	0.13
Total Individuals	*786*	
Total Species	*13*	

Survey Route: Critical Infrastructure Test Range Complex (PBF)

Survey Date: June 13, 2023

Species	Abundance	Percentage
Horned Lark	205	58.57
Western Meadowlark	64	18.29
Brewer's Sparrow	20	5.71
Brewer's Blackbird	8	2.29
Sage Thrasher	7	2.00
Common Raven	6	1.71
European Starling	5	1.43
Ferruginous Hawk	5	1.43
Grasshopper Sparrow	4	1.14
Mourning Dove	4	1.14
Brown-headed Cowbird	3	0.86
Common Nighthawk	3	0.86
Say's Phoebe	3	0.86
Short-eared Owl	3	0.86
Barn Swallow	2	0.57
Red-Tailed Hawk	2	0.57
Rock Wren	2	0.57
Vesper Sparrow	2	0.57
Mountain Bluebird	1	0.29
Northern Harrier	1	0.29
Total Individuals	*350*	
Total Species	*20*	

Survey Route: Idaho Nuclear Technology and Engineering Center
Survey Date: June 8, 2023

Species	Abundance	Percentage
Horned Lark	107	37.28
Brewer's Sparrow	35	12.20
Western Meadowlark	27	9.41
Sage Thrasher	24	8.36
Barn Swallow	22	7.67
Common Nighthawk	20	6.97
European Starling	8	2.79
Mourning Dove	8	2.79
Common Raven	6	2.09
Red-tailed Hawk	5	1.74
Brewer's Blackbird	4	1.39
Killdeer	4	1.39
Mallard	4	1.39
Say's Phoebe	3	1.05
Red-winged Blackbird	2	0.70
Sagebrush Sparrow	2	0.70
Short-eared Owl	2	0.70
Western Kingbird	2	0.70
Ferruginous Hawk	1	0.35
Northern Harrier	1	0.35
Total Individuals	*287*	
Total Species	*20*	

Survey Route: Kyle Canyon
Survey Date: June 7, 2023

Species	Abundance	Percentage
Horned Lark	96	25.40
Western Meadowlark	68	17.99
Brewer's Sparrow	52	13.76
Sagebrush Sparrow	44	11.64
Sage Thrasher	24	6.35
Mourning Dove	22	5.82
Common Raven	12	3.17
Gray Flycatcher	8	2.12
Loggerhead Shrike	6	1.59
Swainson's Hawk	5	1.32
Vesper Sparrow	5	1.32
Western Tanager	5	1.32
Red-tailed Hawk	4	1.06
Chipping Sparrow	3	0.79
Merlin	3	0.79
Blue-gray Gnatcatcher	2	0.53
Common Nighthawk	2	0.53
Lark Sparrow	2	0.53
Long-billed Curlew	2	0.53
Western Kingbird	2	0.53
American Kestrel	1	0.26
Black-billed Magpie	1	0.26
Black-crowned Night Heron	1	0.26
Brown-headed Cowbird	1	0.26
Ferruginous Hawk	1	0.26
Franklin's Gull	1	0.26
Grasshopper Sparrow	1	0.26
House Finch	1	0.26
Mountain Bluebird	1	0.26
Rock Wren	1	0.26
Song Sparrow	1	0.26
Total Individuals	*378*	
Total Species	*31*	

Survey Route: Lost River

Survey Date: June 14, 2023

Species	Abundance	Percentage
Horned Lark	306	60.24
Western Meadowlark	64	12.60
Brewer's Sparrow	39	7.68
Sage Thrasher	30	5.91
Common Raven	22	4.33
Vesper Sparrow	13	2.56
Mourning Dove	6	1.18
Brewer's Blackbird	5	0.98
Brown-headed Cowbird	4	0.79
Red-tailed Hawk	4	0.79
Ferruginous Hawk	3	0.59
Grasshopper Sparrow	3	0.59
Burrowing Owl	2	0.39
Chipping Sparrow	2	0.39
Say's Phoebe	2	0.39
Common Nighthawk	1	0.20
European Starling	1	0.20
Red-winged Blackbird	1	0.20
Total Individuals	*508*	
Total Species	*18*	

Survey Route: Materials and Fuels Complex

Survey Date: June 5, 2023

Species	Abundance	Percentage
Horned Lark	27	15.17
Barn Swallow	26	14.61
Western Meadowlark	19	10.67
Yellow-headed Blackbird	16	8.99
Northern Shoveler	14	7.87
European Starling	11	6.18
Brewer's Sparrow	10	5.62
Mallard	10	5.62
Red-winged Blackbird	7	3.93
American Wigeon	5	2.81
Franklins Gull	5	2.81
Common Raven	4	2.25
Northern Harrier	3	1.69
Ring-necked Duck	3	1.69
Say's Phoebe	3	1.69
Grasshopper Sparrow	2	1.12
Great Blue Heron	2	1.12
Killdeer	2	1.12
Mourning Dove	2	1.12
American Avocet	1	0.56
American Coot	1	0.56
Canada Goose	1	0.56
Cinnamon Teal	1	0.56
Prairie Falcon	1	0.56
Red-tailed Hawk	1	0.56
Sage Thrasher	1	0.56
Total Individuals	*178*	
Total Species	*26*	

Survey Route: Naval Reactors Facility

Survey Date: June 15, 2023

Species	Abundance	Percentage
Horned Lark	78	44.07
Western Meadowlark	31	17.51
Sage Thrasher	17	9.60
Brewer's Sparrow	14	7.91
Barn Swallow	6	3.39
Common Raven	6	3.39
Say's Phoebe	5	2.82
Rock Wren	4	2.26
Dark-eyed Junco	2	1.13
Northern Shoveler	2	1.13
Sagebrush Sparrow	2	1.13
Swainson's Hawk	2	1.13
Western Tanager	2	1.13
American Robin	1	0.56
Chipping Sparrow	1	0.56
House Finch	1	0.56
Lark Sparrow	1	0.56
Loggerhead Shrike	1	0.56
Mourning Dove	1	0.56
Total Individuals	*253*	
Total Species	*19*	

Survey Route: Radioactive Waste Management Complex

Survey Date: June 2, 2023

Species	Abundance	Percentage
Brewer's Sparrow	30	19.87
Barn Swallow	23	15.23
Western Meadowlark	23	15.23
Horned Lark	21	13.91
Sage Thrasher	11	7.28
Mallard	7	4.64
European Starling	4	2.65
Vesper Sparrow	4	2.65
Blue-winged Teal	3	1.99
Killdeer	3	1.99
Mourning Dove	3	1.99
Rock Wren	3	1.99
Say's Phoebe	3	1.99
American Wigeon	2	1.32
Canada Goose	2	1.32
Common Raven	2	1.32
Mountain Bluebird	2	1.32
Brewer's Blackbird	1	0.66
Burrowing Owl	1	0.66
Common Nighthawk	1	0.66
Northern Shoveler	1	0.66
Red-tailed Hawk	1	0.66
Total Individuals	*151*	
Total Species	*22*	

Survey Route: Test Area North

Survey Date: June 28, 2023

Species	Abundance	Percentage
Horned Lark	257	47.24
Sage Thrasher	115	21.14
Sagebrush Sparrow	36	6.62
Brewer's Sparrow	31	5.70
Barn Swallow	25	4.60
Vespers Sparrow	23	4.23
Common Nighthawk	17	3.13
Mourning Dove	10	1.84
Bank Swallow	6	1.10
Common Raven	5	0.92
Western Meadowlark	4	0.74
Loggerhead Shrike	3	0.55
Red-tailed Hawk	3	0.55
Chipping Sparrow	2	0.37
Northern Harrier	2	0.37
Rock Wren	2	0.37
Burrowing Owl	1	0.18
Hermit Thrush	1	0.18
Swainson's Hawk	1	0.18
Total Individuals	*544*	
Total Species	*19*	

Survey Route: Tractor Flats

Survey Date: June 12, 2023

Species	Abundance	Percentage
Horned Lark	166	21.81
Common Raven	136	17.87
Franklin's Gull	131	17.21
Western Meadowlark	131	17.21
Brewer's Sparrow	36	4.73
Ferruginous Hawk	34	4.47
Mourning Dove	29	3.81
Sage Thrasher	18	2.37
Black-billed Magpie	12	1.58
Sagebrush Sparrow	12	1.58
European Starling	11	1.45
Common Nighthawk	8	1.05
Northern Harrier	6	0.79
Grasshopper Sparrow	5	0.66
Loggerhead Shrike	5	0.66
Long-billed Curlew	5	0.66
Short-eared Owl	4	0.53
Red-tailed Hawk	3	0.39
Western Kingbird	3	0.39
Barn Swallow	2	0.26
Willet	2	0.26
Brewer's Blackbird	1	0.13
Golden Eagle	1	0.13
Total Individuals	*761*	
Total Species	*23*	

Survey Route: Twin Buttes

Survey Date: June 21, 2023

Species	Abundance	Percentage
Horned Lark	176	41.51
Western Meadowlark	84	19.81
Brewer's Sparrow	34	8.02
Common Raven	25	5.90
Sage Thrasher	24	5.66
Vesper Sparrow	19	4.48
Sagebrush Sparrow	11	2.59
Swainson's Hawk	10	2.36
Mourning Dove	6	1.42
Common Nighthawk	5	1.18
European Starling	4	0.94
Grasshopper Sparrow	4	0.94
Rock Wren	4	0.94
Northern Harrier	3	0.71
Short-eared Owl	2	0.47
Western Kingbird	2	0.47
American Kestrel	1	0.24
Brown-headed Cowbird	1	0.24
Brewer's Blackbird	1	0.24
Eastern Kingbird	1	0.24
Ferruginous Hawk	1	0.24
Loggerhead Shrike	1	0.24
Mountain Bluebird	1	0.24
Prairie Falcon	1	0.24
Red-tailed Hawk	1	0.24
Say's Phoebe	1	0.24
Western Tanager	1	0.24
Total Individuals	*424*	
Total Species	*27*	