

2020 Breeding Bird Surveys on the Idaho National Laboratory Site

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Executive Summary

To monitor bird populations on the Idaho National Laboratory (INL) Site, protocol Breeding Bird Surveys (BBSs) have been conducted annually almost every year since 1985. In 2020, we conducted surveys in June and early July along five routes that are part of a nationwide survey administered by the U.S. Geological Survey (USGS) and eight additional routes near INL Site facilities. We documented 3,439 birds from 56 species during those surveys, which is 25.4% lower than the 33-year mean of 4,612 from the same number of species.

We observed similar bird abundance patterns for those species that are typically the most numerous including western meadowlark (*Sturnella neglecta*, $n=710$), horned lark (*Eremophila alpestris*, $n=657$), sage thrasher (*Oreoscoptes montanus*, $n=483$), Brewer's sparrow (*Spizella breweri*, $n=186$), and sagebrush sparrow (*Artemisiospiza nevadensis*, $n=181$). These five species have been the five most abundant 24 times during the past 34 years of surveys, and in the other years they were among the seven most abundant species. However, these five species have only been the top five species once in the past five years and only 50% of the time for the past 10 years. Typically, they are pushed out of the top five by Franklin's gulls. In 2020, large numbers of Franklin's gulls (*Leucophaeus pipixcan*, $n=270$) and common ravens ($n=188$) were observed, knocking both Brewer's sparrow and sagebrush sparrow from the top five. Nine species were observed during the 2020 BBS that are considered by the Idaho Department of Fish and Game as Species of Greatest Conservation Need.

The Tractor Flats Route had the highest bird abundance of any route. Twin Buttes Route had the highest species richness of the remote routes. The Test Area North (TAN) Route has had the highest abundance of the facility routes and MFC had the highest species richness at a facility route.

Sagebrush obligates such as the Brewer's and sagebrush sparrow continue to be observed at near-historical lows, likely as an indirect result of wildfires (Holmes 2007). Not that fires directly kill birds, but fires result in loss of habitat. Research has shown an increase in fire frequency due to changes in vegetation and climate. Observations of sagebrush obligates were 43% lower than the average count in the 34 years of surveys. In addition, raven (*Corvus corax*) observations were the second highest count since the beginning of the breeding bird surveys on the INL Site.

The most abundant species assemblage in 2020 was the shrub-steppe/grassland, representing 53.4% of all BBS observations. 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 was the sagebrush obligate category representing 32.5% of all observations.

The MFC Route had the most diverse bird community of the facility routes. Among remote routes, Kyle Canyon had the most diverse bird community, while Circular Butte was the least diverse based on richness and Shannon's H .

Table of Contents

Executive Summary	ii
List of Figures	iii
List of Tables	iv
Acronyms	v
1.0 Introduction.....	1
1.1 Study Area	1
1.2 Methods.....	3
1.3 Results and Discussion	4
2.0 Conclusions.....	14
3.0 Acknowledgements.....	14
4.0 Literature Cited	15
Appendix A Summary of Species by Route 2020	16

List of Figures

Figure 1. Breeding Bird Survey routes on the Idaho National Laboratory Site. Blue dots represent survey points along facility routes and red dots represent the same for remote routes.....	2
Figure 2. Number of birds observed during Breeding Bird Surveys on the Idaho National Laboratory Site. The dashed black line indicates the mean number of birds observed from 1985 to 2020. No BBSs were conducted on the INL Site in 1992 or 1993.	4
Figure 3. Horned lark abundance recorded during Breeding Bird Surveys since 1985. Surveys were not conducted in 1992 and 1993.....	7
Figure 4. Summary of species assemblage for Breeding Bird Surveys of remote and facility routes on the Idaho National Laboratory Site in 2020.	9
Figure 6. Trends of a sagebrush obligate (sage thrasher) recorded during Breeding Bird Surveys since 1985. Surveys were not conducted in 1992 and 1993.	11
Figure 7. Common raven observations during breeding bird surveys on the INL Site 1985-2019. No surveys were conducted in 1992 and 1993.	12

List of Tables

Table 1. Summary of species from 13 routes, sorted by abundance, that were observed during the 2020 Breeding Bird Survey on the Idaho National Laboratory Site.5

Table 2. Summary numbers for each breeding bird route that was surveyed in 2020 on the Idaho National Laboratory Site.8

Table 3. 2020 Species assemblage abundance on the Idaho National Laboratory Site.9

Table 4. Values for species richness, Shannon Diversity (H), and Equitability (E_H) indices for the 2020 Idaho National Laboratory Site Breeding Bird Surveys.14

Acronyms

ATR-X	Advanced Test Reactor Complex
BBS	Breeding Bird Survey
CFA	Central Facilities Area
CITRC	Critical Infrastructure Test Range Complex (use to be known as PBF)
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
MFC	Materials and Fuels Complex
NRF	Naval Reactors Facility
RWMC	Radioactive Waste Management Complex
TAN	Test Area North
USGS	United States Geological Survey

1.0 Introduction

The North American Breeding Bird Survey (BBS) was developed by the U.S. Fish and Wildlife Service 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 of 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).

Breeding bird survey 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 they 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) (Figure 1). These routes are also surveyed annually using the same techniques and methods as those indicated by 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 2020 BBS and examines long-term trends.

1.1 Study Area

The INL Site encompasses almost 900 mi² (2,330 km²) 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 Comprehensive Wildlife Conservation Strategy (Idaho Department of Fish and Game 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 (Idaho Department of Fish and Game 2017). 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 East and Middle buttes and the southern portion of the Lemhi Mountains located near the northwest corner of the INL Site.

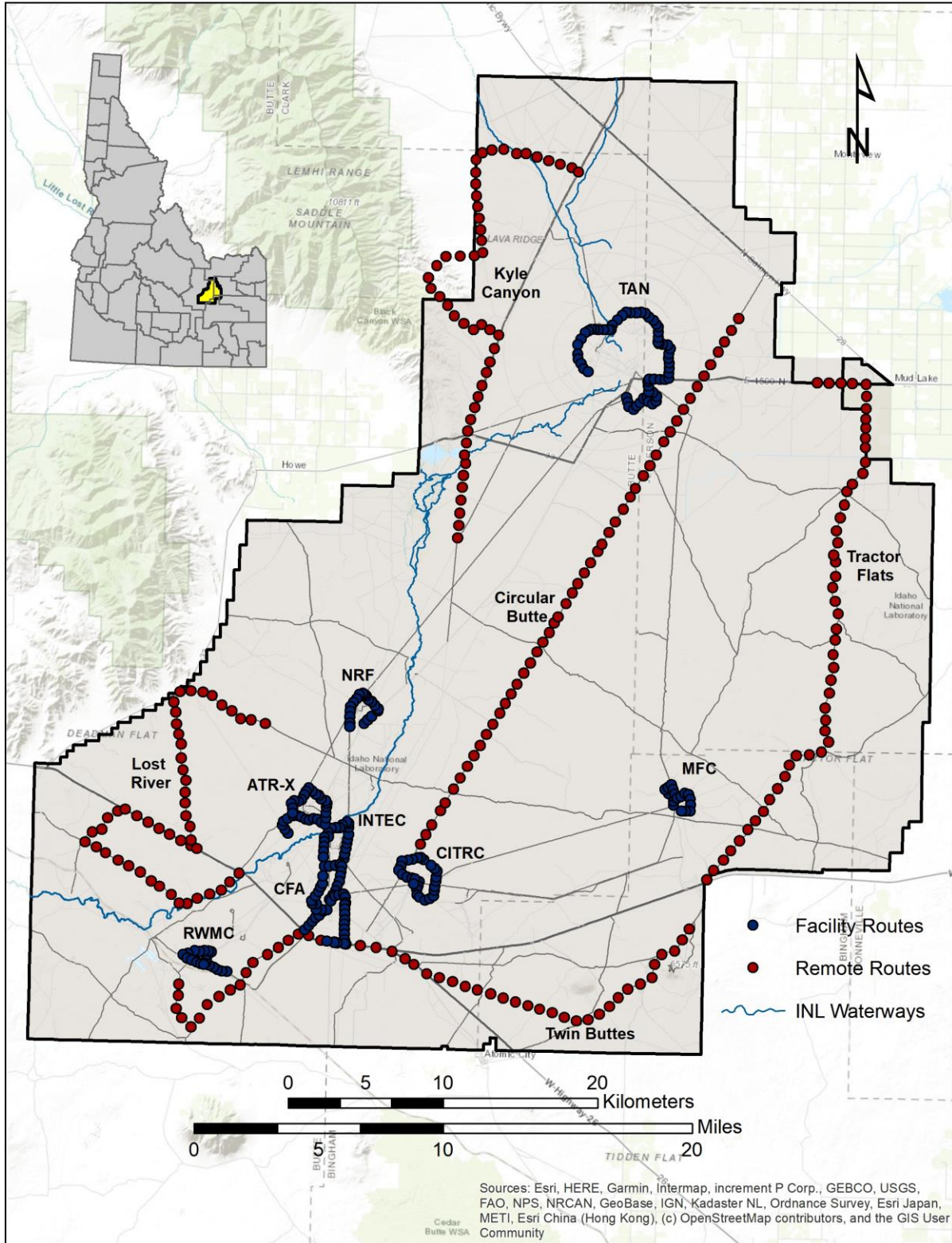


Figure 1. Breeding Bird Survey routes on the Idaho National Laboratory Site. Blue dots represent survey points along facility routes and red dots represent the same for remote routes.

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 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 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 streambank wheatgrass (*Elymus lanceolatus*), bottlebrush squirreltail (*E. elymoides*), Indian ricegrass (*Achnatherum hymenoides*), and needle-and-thread grass (*Hesperostipa comata*). More information regarding the climate, geology, and vegetation communities on the INL Site is described in Shive et al. (2019).

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 a number of 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

Data Collection

The BBS is a roadside count of all birds seen or heard along predefined routes. Thirteen BBS routes were surveyed from May 27 to June 29, 2020, 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), 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 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 3-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 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 for up to 6 hours or until the route was completed. The number of vehicles that passed observers during the 3-minute sampling period was recorded on

all remote routes, and observers noted whether background noise interfered with audible detection of birds.

Shannon's H and E_H were calculated for all BBS routes to show the species diversity, and measure of evenness (the relative frequency of each species or how evenly they are distributed across the landscape) and compared with standard species richness (number of species) information documented in past reports. We assumed that data obtained from each survey route was an accurate representation of the local bird community.

1.3 Results and Discussion

Summary Statistics

We documented 3,439 birds and 56 species during the 2020 surveys (Appendix A). Total observations were 25.4% lower than the 33-year mean of 4,612 birds (1985-1991 and 1994-2019; Figure 2), and the number of species recorded equaled the 33-year mean of 56 species.

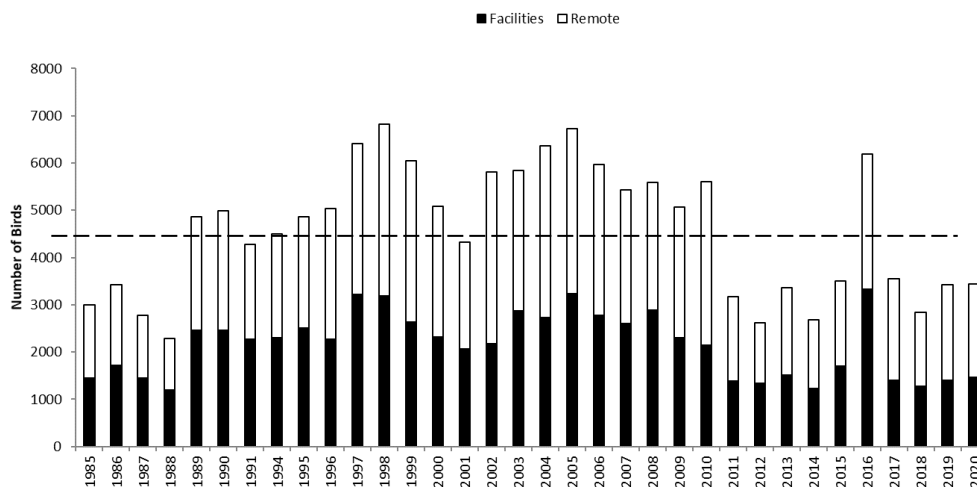


Figure 2. Number of birds observed during Breeding Bird Surveys on the Idaho National Laboratory Site. The dashed black line indicates the mean number of birds observed from 1985 to 2020. No BBSs were conducted on the INL Site in 1992 or 1993.

Species observed during the 2020 BBS that are considered by the Idaho Department of Fish and Game as Species of Greatest Conservation Need included the sage thrasher, sagebrush sparrow, Franklin's gull, common nighthawk (*Chordeiles minor*, $n=26$), ferruginous hawk (*Buteo regalis*, $n=11$), greater sage-grouse (*Centrocercus urophasianus*, $n=2$), grasshopper sparrow (*Ammodramus savannarum*, $n=2$), long-billed curlew (*Numenius americanus*, $n=169$), and burrowing owl (*Athene cunicularia*, $n=1$). When Franklin's gulls are observed they are often in large flocks foraging on the INL Site and it is unlikely that they are nesting.

The seven most abundant birds across all routes were western meadowlark (*Sturnella neglecta*, $n=710$), horned lark (*Eremophila alpestris*, $n=657$), sage thrasher (*Oreoscoptes montanus*, $n=483$), Franklin's gull (*Leucophaeus pipixcan*, $n=270$), common raven (*Corvus corax*, $n=188$), Brewer's sparrow (*Spizella breweri*, $n=186$), and sagebrush sparrow (*Artemisiospiza nevadensis*,

Table 1. Summary of species from 13 routes, sorted by abundance, that were observed during the 2020 Breeding Bird Survey on the Idaho National Laboratory Site.

Common Name	Scientific Name	Assemblage ¹	n	%	Routes ²	Stops ³	% ⁴
Western Meadowlark	<i>Sturnella neglecta</i>	SSG	710	20.65	5,8	269	54.34
Horned Lark	<i>Eremophila alpestris</i>	SSG	657	19.10	5,8	281	56.77
Sage Thrasher ⁵	<i>Oreoscoptes montanus</i>	SO	483	14.04	5,8	268	54.14
Franklin's Gull ⁵	<i>Leucophaeus pipixcan</i>	S	270	7.85	1,1	7	1.41
Common Raven	<i>Corvus corax</i>	RCS	188	5.47	5,8	74	14.95
Brewer's Sparrow	<i>Spizella breweri</i>	SO	186	5.41	5,8	121	24.44
Sagebrush Sparrow ⁵	<i>Artemisiospiza nevadensis</i>	SO	181	5.26	5,7	119	24.04
Long-billed Curlew ⁵	<i>Numenius americanus</i>	S	169	4.91	1,0	5	1.01
Barn Swallow	<i>Hirundo rustica</i>	UE	108	3.14	2,6	26	5.25
Mourning Dove	<i>Zenaida macroura</i>	SSG	66	1.92	4,4	36	7.27
European Starling	<i>Sturnus vulgaris</i>	UE	44	1.28	1,5	16	3.23
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	UE	33	0.96	0,3	6	1.21
Vesper Sparrow	<i>Pooecetes gramineus</i>	SSG	32	0.93	3,4	20	4.04
Mallard	<i>Anas platyrhynchos</i>	W	28	0.81	0,3	7	1.41
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	SSG	26	0.76	2,5	13	2.63
Common Nighthawk ⁵	<i>Chordeiles minor</i>	SSG	26	0.76	3,4	19	3.84
Black-billed Magpie	<i>Pica hudsonia</i>	RCS	21	0.61	3,0	12	2.42
Red-tailed Hawk	<i>Buteo jamaicensis</i>	RCS	19	0.55	3,2	15	3.03
Killdeer	<i>Charadrius vociferus</i>	S	16	0.47	0,4	11	2.22
Rock Wren	<i>Salpinctes obsoletus</i>	SSG	16	0.47	1,5	10	2.02
Western Kingbird	<i>Tyrannus verticalis</i>	SSG	13	0.38	3,3	10	2.02
Bank Swallow	<i>Riparia riparia</i>	O	11	0.32	0,2	3	0.61
Ferruginous Hawk ⁵	<i>Buteo regalis</i>	RCS	11	0.32	3,0	8	1.62
Loggerhead Shrike	<i>Lanius ludovicianus</i>	RCS	11	0.32	4,2	11	2.22
Swainson's Hawk	<i>Buteo swainsoni</i>	RCS	11	0.32	4,1	9	1.82
Northern Shoveler	<i>Spatula clypeata</i>	W	10	0.29	0,1	1	0.20
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>	O	10	0.29	0,2	5	1.01
House Sparrow	<i>Passer domesticus</i>	UE	9	0.26	0,1	2	0.40
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	O	8	0.23	0,2	6	1.21
American Kestrel	<i>Falco sparverius</i>	RCS	7	0.20	1,3	6	1.21
American Robin	<i>Turdus migratorius</i>	UE	7	0.20	0,3	7	1.41
Brown-headed Cowbird	<i>Molothrus ater</i>	SSG	6	0.17	1,1	4	0.81
House Finch	<i>Haemorhous mexicanus</i>	UE	5	0.15	0,2	2	0.40
Say's Phoebe	<i>Sayornis saya</i>	UE	5	0.15	0,3	5	1.01
N. Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	SSG	4	0.12	0,2	4	0.81
Prairie Falcon	<i>Falco mexicanus</i>	RCS	3	0.09	1,0	2	0.40
American Wigeon	<i>Mareca americana</i>	W	2	0.06	0,1	1	0.20
Gadwall	<i>Mareca strepera</i>	W	2	0.06	0,1	1	0.20
Grasshopper Sparrow ⁵	<i>Ammodramus savannarum</i>	SSG	2	0.06	1,0	1	0.20
Greater Sage-grouse ⁵	<i>Centrocercus urophasianus</i>	SO	2	0.06	0,1	1	0.20
Lark Bunting	<i>Calamospiza melanocorys</i>	SSG	2	0.06	1,0	1	0.20
Northern Flicker	<i>Colaptes auratus</i>	SSG	2	0.06	1,0	2	0.40
Northern Harrier	<i>Circus hudsonius</i>	RCS	2	0.06	2,0	2	0.40
Violet-green Swallow	<i>Tachycineta thalassina</i>	O	2	0.06	0,1	2	0.40
Willet	<i>Tringa semipalmata</i>	S	2	0.06	1,0	2	0.40

Common Name	Scientific Name	Assemblage ¹	n	%	Routes ²	Stops ³	% ⁴
Blue-winged Teal	<i>Spatula discors</i>	W	1	0.03	0,1	1	0.20
Burrowing Owl ⁵	<i>Athene cunicularia</i>	RCS	1	0.03	1,0	1	0.20
California Gull	<i>Larus californicus</i>	S	1	0.03	0,1	1	0.20
Chipping Sparrow	<i>Spizella passerina</i>	SSG	1	0.03	0,1	1	0.20
Eastern Kingbird	<i>Tyrannus tyrannus</i>	SSG	1	0.03	1,0	1	0.20
Gray Flycatcher	<i>Empidonax wrightii</i>	SSG	1	0.03	1,0	1	0.20
Lazuli Bunting	<i>Passerina amoena</i>	SSG	1	0.03	1,0	1	0.20
Mountain Bluebird	<i>Sialia currucoides</i>	SSG	1	0.03	0,1	1	0.20
Red-breasted Nuthatch	<i>Sitta canadensis</i>	O	1	0.03	1,0	1	0.20
Rock Dove	<i>Columba livia</i>	UE	1	0.03	0,1	1	0.20
Western Tanager	<i>Piranga ludoviciana</i>	O	1	0.03	1,0	1	0.20

¹What species assemblage the bird species is assigned. See species assemblage section.

²The 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.

³Number of stops at which a species was documented.

⁴Percent of stops (from a total of 495) at which a species was recorded.

⁵Species of Greatest Conservation Need. When Franklin's Gulls are observed they are often observed in large flocks foraging on the INL Site and it is unlikely that they are nesting.

$n = 181$) (Table 1). Each of these species, with the exception of Franklin's gull, was observed on every remote route (Appendix A). Horned lark, western meadowlark, sage thrasher, sagebrush sparrow, and Brewer's sparrow have been the five most abundant species in 26 of the 34 years of INL Site BBS (in the other years they were among the seven most abundant species). These five species comprised >85% of all observations. In 2020, Franklin's gull and common raven numbers were higher than Brewer's sparrow and sagebrush sparrow pushing them out of the top five and for sagebrush sparrow, two years in a row. Franklin gulls were only observed at 1.4% (7) of the total stops and common ravens were observed at 15.0% (74) of the total stops.

The horned lark was the most evenly distributed species, observed at 56.8% (281) 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 has increased since 1996 and peaked in 2005. Since 2005 abundance has been decreasing. Except for 2019, in 2020 horned lark abundance was the lowest since 1995.

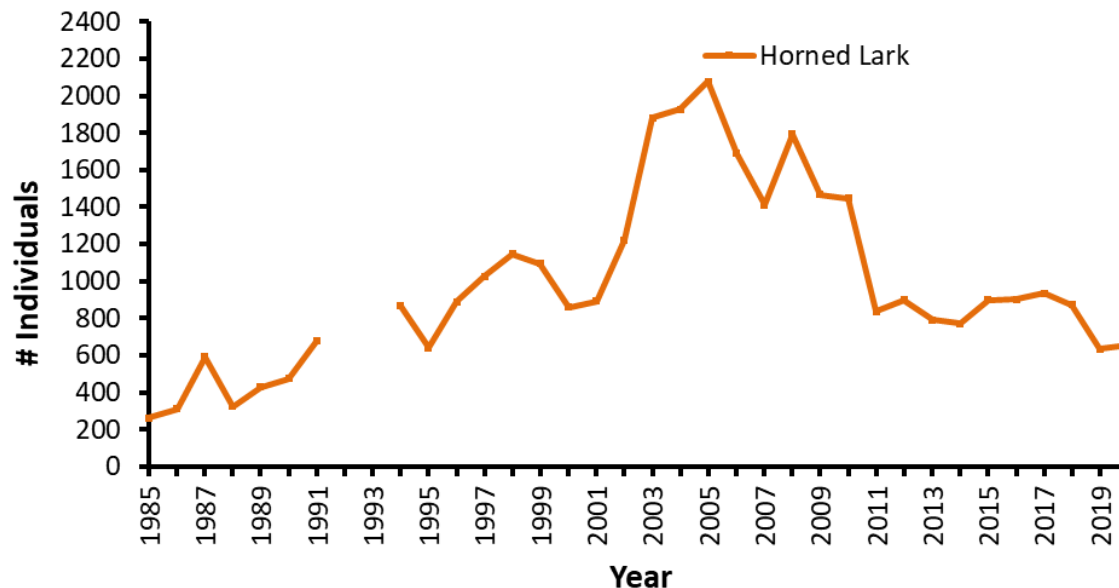


Figure 3. Horned lark abundance recorded during Breeding Bird Surveys since 1985. Surveys were not conducted in 1992 and 1993.

Species richness is basically 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 2020 was on the Twin Buttes route. Additionally, this is the only route where more species were observed than the 33-year mean. MFC had the most species observed on facility routes, and along with Central Facilities Area (CFA) and Radioactive Waste Management Complex (RWMC) had more species observed in 2020 than in the 33-year average. 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. Of note, the only species that would be considered a new arrival to the INL Site would be the introduced Eurasian collared-dove (*Streptopelia decaocto*). Eurasian collared-doves were first observed in 2016 and then observed in 2017.

The Tractor Flats Route had the highest bird abundance of remote route with 816 birds observed in 2020 (Table 2) and the only remote route that has an annual abundance greater than the 33 year mean. This may be due to the observation of large flocks of foraging Franklin's gulls at the Mud Lake Landfill. The abundance of birds is dramatically lower on all other remote routes compared with the 33-year mean with Kyle Canyon showing the reduction in bird abundance of 56 percent fewer birds than the 33-year mean.

Of facility routes, CFA had the greatest bird abundance, however 20% fewer birds were seen in 2020 than the 33-year mean (Table 2). RWMC was the only facility route where 2020 bird abundance was greater than the 33-year mean. All facility routes show a decrease in the abundance of birds with Naval Reactors Facility (NRF) and TAN having almost 60% fewer birds observed in 2020 than the 33-year mean.

Table 2. Summary numbers for each breeding bird route that was surveyed in 2020 on the Idaho National Laboratory Site.

Route	Stops	Species Richness	Mean Species Richness ¹	Abundance	Mean Abundance ²
Remote Routes					
Lost River	50	14	17	241	422 (-43%)
Circular Butte	50	8	15	372	444 (-16%)
Kyle Canyon	50	19	23	179	403 (-56%)
Tractor Flats	50	19	23	816	715 (14%)
Twin Buttes	50	23	21	365	437 (-16%)
Subtotal	250	35		1973	
Facility Routes					
CFA	42	22	21	257	321 (-20%)
INTEC	25	14	16	173	202 (-14%)
MFC	18	24	20	232	262 (-11%)
NRF	14	14	20	87	214 (-59%)
CITRC	28	9	14	143	248 (-44%)
ATR-X	32	14	17	138	283 (-44%)
RWMC	20	23	19	250	176 (42%)
TAN	60	10	17	186	441 (-58%)
Subtotal	245	41		1466	
Total	495	56³		3439	

¹Mean species richness 1985 - 2020²Mean abundance 1985 - 2020³Total number of unique species

Species Assemblage

Assemblages of bird species in particular habitats, within a region, provide useful insight about 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 local population is experiencing a decline.

Each species of bird detected on the INL Site has been assigned to one of seven species assemblages:

- Shrub-Steppe/Grassland (SSG)
- Sagebrush Obligate (SO)
- Raptor, Corvid and Shrike (RCS)
- Shorebird (S)
- Urban and Exotic (UE)
- Waterfowl (W)
- Other (O)

The most abundant species assemblage in 2020 was the shrub-steppe/grassland, which consists of 18 species and represents 45.6% of all BBS observations (Figure 3). This assemblage normally has the highest abundance because the majority of the INL Site consists of shrub-steppe

and grassland habitats. Only four species are part of the second most abundant species assemblage which was the sagebrush obligate category representing 24.8% of all observations (Figure 3). The third most abundant species assemblage, consisting of 5 species, was the Shorebird representing 13.3% of all observations.

Table 3. 2020 Species assemblage abundance on the Idaho National Laboratory Site.

Species Assemblage	Abundance	Mean Abundance ¹
Shrub-Steppe / Grassland	1567	2444
Sagebrush Obligate	852	1486
Shorebird	458	258
Raptor, Corvid and Shrike	274	180
Urban and Exotic	212	147
Waterfowl	43	45
Other species	33	17

¹Mean abundance 1985 – 2019

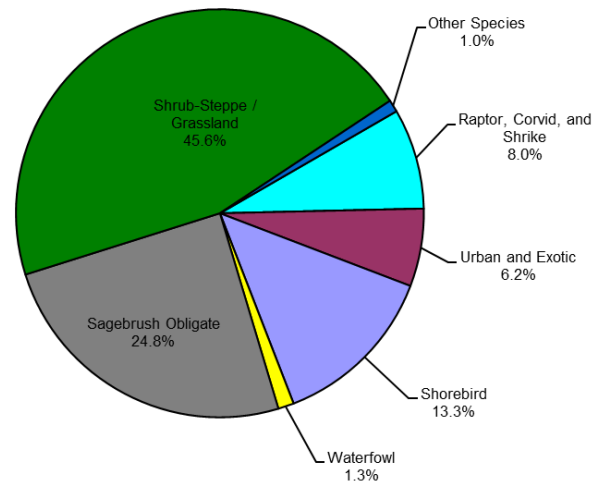


Figure 4. Summary of species assemblage for Breeding Bird Surveys of remote and facility routes on the Idaho National Laboratory Site in 2020.

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 greatest numbers in past BBSs, and they again dominated observations in 2020 ($n= 1,567$, Figure 3). Common shrub-steppe/grassland species include horned lark, western meadowlark, brown-headed cowbird (*Molothrus ater*), vesper sparrow (*Pooecetes gramineus*).

Horned lark ($n= 657$) and western meadowlark ($n= 710$) were the most abundant species in this assemblage and were the top two most abundant species for the entire survey (Table 1). Mean bird abundance the Shrub-steppe/Grassland assemblage since 1985 is 2444 (Table 3).

Sagebrush Obligate

The sagebrush obligate assemblage had the second highest species abundance with 852 individuals (Figure 3); however, it is well below the mean abundance calculated since 1985 as 1,486. This assemblage includes Brewer's sparrow, sagebrush sparrow, sage thrasher, and greater sage-grouse. Sage thrasher was the most abundant sagebrush obligate ($n= 483$), followed by Brewer's sparrow ($n= 186$) and sagebrush sparrow ($n= 181$). For the past nine years (since 2011), sagebrush sparrow observations ranged from 161–237, all of which were lower than the previous low count of 241 individuals recorded in 1987 (Figure 4). Brewer's sparrow observations in 2020 were 21.5% lower than in 2019 (Figure 4). Since 1985, sage thrasher counts have fluctuated, but appear to be stable (Figure 5). Sagebrush and Brewer's sparrows, however, are at historically low levels (Figure 4).

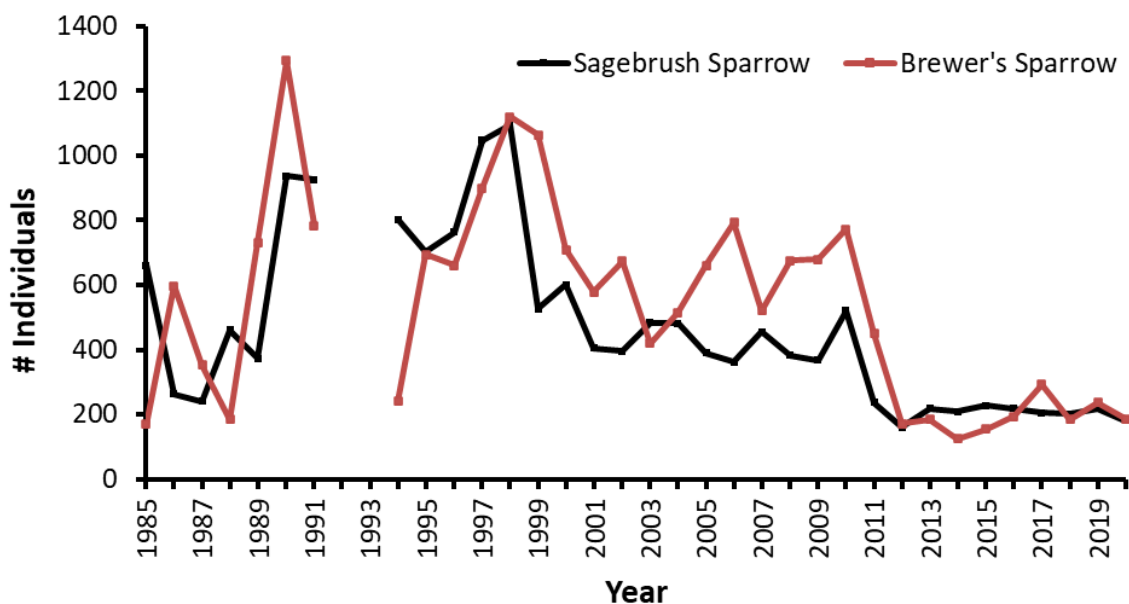


Figure 5. Trends of two sagebrush obligates (sage sparrow and Brewer's sparrow) recorded during Breeding Bird Surveys since 1985. Surveys were not conducted in 1992 and 1993.

In many western states, sagebrush obligates are facing significant habitat loss; consequently, many populations are in decline (Knick 1999; Knick et al. 2003). On the INL Site, three large fires in 2010 and 2011 burned 29,944 ha (73,993 acres) of sagebrush-dominated communities, representing over 20% of big sagebrush communities (DOE-ID and USFWS 2014). In 2019 there was one large fire in 2019 burned a total of 40,403 ha (99,839 acres), 9,171 ha (22,662 acres) of which is in sagebrush-dominated communities (Forman et al. 2020). Sharp declines in the number of observations of Brewer's and sagebrush sparrows correspond with these fires. It is unclear, however, why sage thrasher abundance has apparently not been affected. Across its range in Idaho, sage thrasher populations have declined by 1.6% per year (95% C.I. is 3.25-0.51%) between 1966 and 2013 (Sauer et al. 2014). The sharp reduction in sagebrush-dominated

lands on the INL Site most likely has affected the total abundance of birds detected during these surveys. Breeding bird surveys in the western U.S. indicate that populations of Brewer's sparrows, sage thrashers, and sagebrush sparrows have all declined across their range (Knick et al. 2003; Sauer and Link 2011).

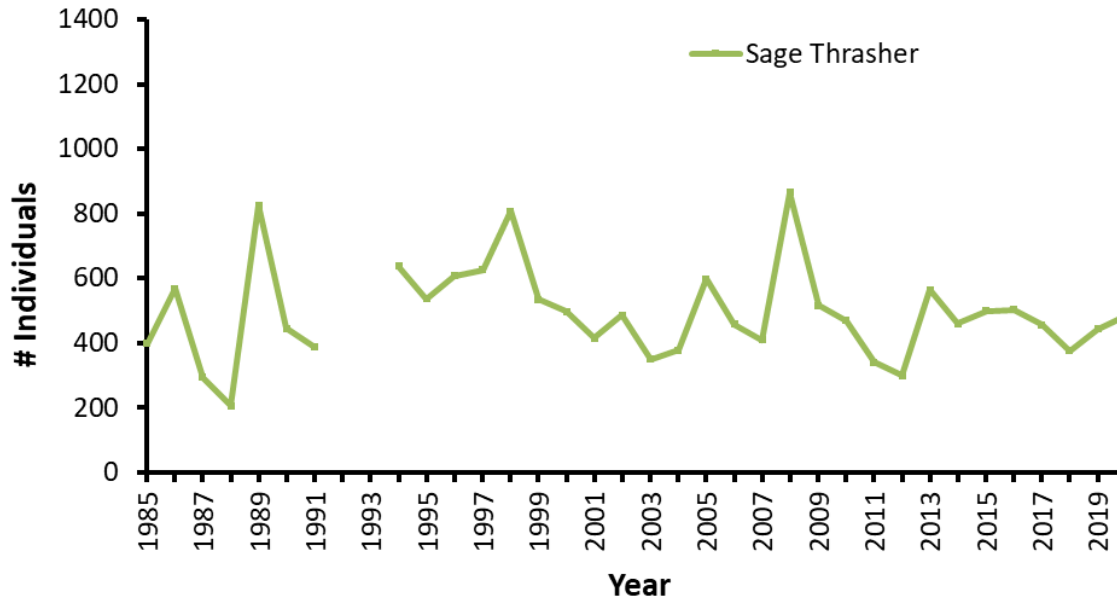


Figure 6. Trends of a sagebrush obligate (sage thrasher) recorded during Breeding Bird Surveys since 1985. Surveys were not conducted in 1992 and 1993.

Raptor, Corvid, and Shrike

The raptor, corvid, and shrike assemblage consisted of 10 species with a total of 274 observations, representing 8% of the total count. Among these were 7 species of raptors (i.e., eagles, hawks, falcons, and owls). Red-tailed hawk (*Buteo jamaicensis*, $n=19$), ferruginous hawk (*Buteo regalis*, $n=11$), and Swainson's hawk (*Buteo swainsoni*, $n=11$) were the most abundant raptors observed.

Corvids observed include the common raven (*Corvus corax*), and black-billed magpie (*Pica hudsonia*, $n=21$). The common raven was the most abundant species within this assemblage in 2020 ($n=188$). Raven observations have increased over the years (Figure 6). The number of birds detected in this assemblage is higher than the mean bird abundance in the Raptor, Corvid, and Shrike assemblage since 1985 which was 180.

Eleven loggerhead shrikes (*Lanius ludovicianus*) were observed in 2020, which was lower than the mean of 28 loggerhead shrikes per year (1985–2019). 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.

The number of birds detected in this assemblage is higher than the mean bird abundance in the Raptor, Corvid, and Shrike assemblage since 1985 which is 180. This is primarily due to the abundance of common ravens recorded during the 2020 survey.

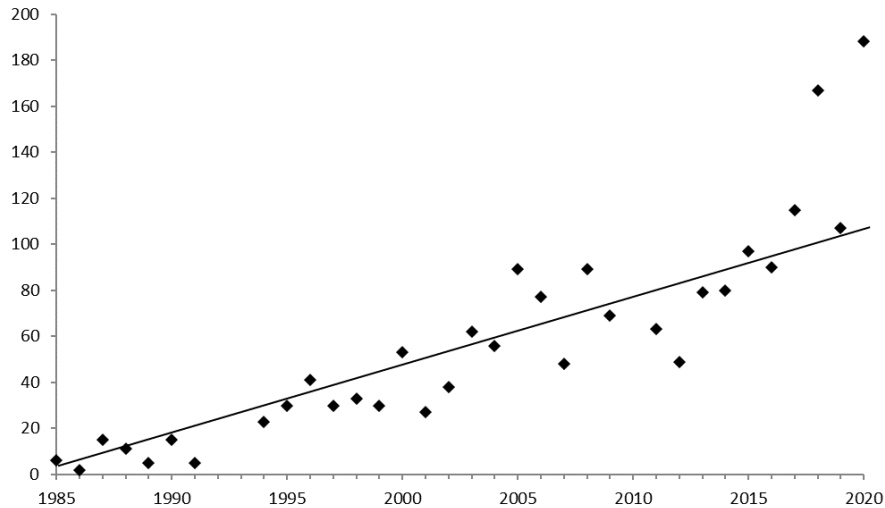


Figure 7. Common raven observations during breeding bird surveys on the INL Site 1985-2019. No surveys were conducted in 1992 and 1993.

Shorebird

We observed 458 individuals representing five species from the shorebird assemblage, which accounted for 13.3% of the total BBS observations (Figure 3). Because standing water is rare on the INL Site, typically most observations of shorebirds occur in proximity to waste ponds near facility routes; however, they are also observed near the Mud Lake Landfill and in agricultural fields along the INL Site boundary. In 2020, Franklin's gull observations ($n=270$) comprised 59% of all shorebird observations. Most of the Franklin's gulls were observed on the Tractor Flats route, near the Mud Lake Landfill. The Franklin's gulls were not displaying breeding behaviors nor was it a nesting colony, but a flock foraging at the landfill. Other shorebirds seen included long-billed curlew (*Numenius americanus*, $n=169$), killdeer (*Charadrius vociferous*, $n=16$), willet (*Tringa semipalmatus*, $n=2$), and California gull (*Larus californicus*, $n=1$). Mean shorebird abundance since 1985 is 270.

Urban and Exotic

The urban and exotic assemblage represents eight 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*, $n=108$), European starling (*Sturnus vulgaris*, $n=44$), house sparrow (*Passer domesticus*, $n=9$), and

American robin (*Turdus migratorius*, $n=7$). This assemblage constituted 4.3% ($n= 179$) of the total observations in 2020. Mean urban and exotic bird abundance since 1985 is 147.

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, 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 provides nesting opportunity for some waterfowl species.

We documented 43 individuals from 5 waterfowl species: mallard (*Anas platyrhynchos*, $n= 28$), American wigeon (*Mareca americana*, $n= 2$), gadwall (*Mareca strepera*, $n= 2$), northern shoveler (*Spatula clypeata*, $n= 10$), blue-winged teal (*Spatula discors*, $n= 1$), representing 1.3% of total observations.

Other Birds

In 2020, the other species assemblage included 4 species, bank swallow (*Riparia riparia*, $n= 11$), violet-green swallow (*Tachycineta thalassina*, $n= 2$), red-breasted nuthatch (*Sitta canadensis*, $n= 1$), and western tanager (*Piranga ludoviciana*, $n= 1$).

Community Diversity Index

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. However, high diversity may not reflect the condition of sagebrush habitat on the INL Site. A greater diversity would be expected on routes that run through or close to facilities which contain additional resources such as wastewater ponds, trees, landscaping plants, etc. Additionally, habitat differences occur along each remote route, thus making direct comparisons an inaccurate portrayal of ecosystem health. It is unknown how diversity on the same route has changed over the years the breeding bird survey has been conducted on the INL Site. It is something to look into in future reports.

The MFC Route had the most diverse bird community of all 13 routes ($H=2.61$, $E_H=0.82$; Table 4), followed by the CFA Route ($H= 2.44$, $E_H= 0.79$). MFC had the highest species richness ($n= 24$) among facility routes. Among remote routes, Kyle Canyon ($H= 2.09$; $E_H= 0.71$) had the most diverse bird community, while Circular Butte was the least diverse based on richness ($n= 8$) and H ($H= 0.94$).

The CFA route has been among the top three in regard to diversity eleven of the past twelve years. RWMC has been among the four most diverse routes during eleven of the past 14 years. This information indicates that the area surrounding CFA and RWMC (building, 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 for the 2020 Idaho National Laboratory Site Breeding Bird Surveys.

Route	Species Richness	Shannon's H	Shannon's E_H
Remote Routes			
Lost River	14	1.76	0.67
Kyle Canyon	19	2.09	0.71
Circular Butte	8	0.94	0.45
Tractor Flats	19	2.01	0.68
Twin Buttes	23	2.08	0.66
Facility Routes			
MFC	24	2.61	0.82
CFA	22	2.44	0.79
INTEC	14	2.04	0.77
NRF	14	2.03	0.77
ATR-X	14	1.95	0.74
CITRC	9	1.63	0.74
RWMC	23	2.30	0.73
TAN	10	1.65	0.72

2.0 Conclusions

Two sagebrush-obligate species continue to be counted at historically low levels on INL Site routes, which is probably a consequence of losing large amounts of sagebrush-dominated communities to wildfires. Conversely, common raven observations continue to increase. 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 site. Little is known, however, concerning responses of bird populations to alterations of habitat composition and distribution across the landscape (Knick and Rotenberry 2002) 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.

3.0 Acknowledgements

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Appendix A

Summary of Species by Route 2020

Survey Route: RWMC		
Survey Date: May 27, 2020		
Species	Abundance	Percentage
Barn Swallow	73	52.14
Western Meadowlark	44	31.43
Sage Thrasher	35	25.00
Horned Lark	17	12.14
Mourning Dove	17	12.14
Sagebrush Sparrow	13	9.29
Brewer's Sparrow	10	7.14
European Starling	8	5.71
Rock Wren	7	5.00
Mallard	3	2.14
Common Raven	3	2.14
Brewer's Blackbird	3	2.14
American Wigeon	2	1.43
Gadwall	2	1.43
Greater-Sage Grouse	2	1.43
Red-winged Blackbird	2	1.43
Western Kingbird	2	1.43
Yellow-headed Blackbird	2	1.43
California Gull	1	0.71
House Finch	1	0.71
Killdeer	1	0.71
Mountain Bluebird	1	0.71
Rock Dove	1	0.71
Total Individuals 250		
Total Species 23		

Survey Route: MFC		
Survey Date: May 29, 2020		
Species	Abundance	Percentage
Western Meadowlark	48	20.69
Franklin's Gull	35	15.09
Mallard	23	9.91
Barn Swallow	21	9.05
Horned Lark	16	6.90
Sage Thrasher	16	6.90
Killdeer	10	4.31
Northern Shoveler	10	4.31
Yellow-headed Blackbird	8	3.45
Brewer's Blackbird	8	3.45
Common Raven	6	2.59
Red-winged Blackbird	6	2.59
Brewer's Sparrow	4	1.72
Say's Phoebe	3	1.29
Vesper Sparrow	3	1.29
Northern Rough-winged Swallow	3	1.29
American Robin	3	1.29
European Starling	2	0.86
Violet-green Swallow	2	0.86
Blue-winged Teal	1	0.43
Mourning Dove	1	0.43
American Kestrel	1	0.43
Western Kingbird	1	0.43
Rock Wren	1	0.43
Total Individuals		
	232	
Total Species		
	24	

Survey Route: INTEC		
Survey Date: June 4, 2020		
Species	Abundance	Percentage
Horned Lark	36	20.81
Brewer's Sparrow	35	20.23
Western Meadowlark	35	20.23
Sagebrush Sparrow	23	13.29
Sage Thrasher	21	12.14
Barn Swallow	5	2.89
Brewer's Blackbird	4	2.31
Bank Swallow	3	1.73
Brown-headed Cowbird	3	1.73
Mourning Dove	2	1.16
Common Nighthawk	2	1.16
Common Raven	2	1.16
Loggerhead Shrike	1	0.58
Rock Wren	1	0.58
Total Individuals		
	173	
Total Species		
	14	

Survey Route: Lost River		
Survey Date: June 9, 2020		
Species	Abundance	Percentage
Western Meadowlark	77	31.95
Horned Lark	64	26.56
Sage Thrasher	50	20.75
Brewer's Sparrow	17	7.05
Common Raven	10	4.15
Sagebrush Sparrow	9	3.73
Brewer's Blackbird	4	1.66
Red-tailed Hawk	2	0.83
Vesper Sparrow	2	0.83
Loggerhead Shrike	2	0.83
Mourning Dove	1	0.41
Swainson's Hawk	1	0.41
Common Nighthawk	1	0.41
Western Kingbird	1	0.41
Total Individuals	241	
Total Species	14	

Survey Route: NRF		
Survey Date: June 10, 2020		
Species	Abundance	Percentage
Western Meadowlark	26	29.89
Sage Thrasher	22	25.29
Horned Lark	11	12.64
Sagebrush Sparrow	7	8.05
Common Raven	5	5.75
Brewer's Sparrow	4	4.60
Mallard	2	2.30
Barn Swallow	2	2.30
Common Nighthawk	2	2.30
Brewer's Blackbird	2	2.30
American Robin	1	1.15
Chipping Sparrow	1	1.15
European Starling	1	1.15
Red-tailed Sparrow	1	1.15
Total Individuals	87	
Total Species	14	

Survey Route: Tractor Flats Survey Date: June 12, 2020		
Species	Abundance	Percentage
Franklin's Gull	235	28.80
Long-billed Curlew	169	20.71
Horned Lark	122	14.95
Western Meadowlark	106	12.99
Sage Thrasher	74	9.07
Brewer's Sparrow	24	2.94
Sagebrush Sparrow	24	2.94
Black-billed Magpie	13	1.59
Common Raven	13	1.59
Mourning Dove	11	1.35
Common Nighthawk	9	1.10
European Starling	5	0.61
Barn Swallow	3	0.37
Willet	2	0.25
Swainson's Hawk	2	0.25
Northern Harrier	1	0.12
Burrowing Owl	1	0.12
Western Kingbird	1	0.12
Loggerhead Shrike	1	0.12
Total Individuals 816		
Total Species 19		

Survey Route: ATR-X		
Survey Date: June 15, 2020		
Species	Abundance	Percentage
Western Meadowlark	39	28.26
Horned Lark	38	27.54
Sage Thrasher	23	16.67
Bank Swallow	8	5.80
Brewer's Sparrow	8	5.80
Vesper Sparrow	6	4.35
Common Raven	5	3.62
Cliff Swallow	3	2.17
Rock Wren	2	1.45
Sagebrush Sparrow	2	1.45
American Kestrel	1	0.72
Barn Swallow	1	0.72
European Starling	1	0.72
Say's Phoebe	1	0.72
Total Individuals		
	138	
Total Species		
	14	

Survey Route: Kyle Canyon		
Survey Date: June 18, 2020		
Species	Abundance	Percentage
Common Raven	113	30.38
Western Meadowlark	73	19.62
Sage Thrasher	61	16.40
Sagebrush Sparrow	29	7.80
Brewer's Sparrow	24	6.45
Horned Lark	19	5.11
Red-tailed Hawk	13	3.49
Mourning Dove	9	2.42
Ferruginous Hawk	8	2.15
Black-billed Magpie	6	1.61
Western Kingbird	5	1.34
Prairie Falcon	3	0.81
Loggerhead Shrike	3	0.81
Swainson's Hawk	1	0.27
Gray Flycatcher	1	0.27
Lazuli Bunting	1	0.27
Northern Harrier	1	0.27
Western Tanager	1	0.27
Red-breasted Nuthatch	1	0.27
Total Individuals		
	372	
Total Species		
	19	

Survey Route: CFA		
Survey Date: June 19, 2020		
Species	Abundance	Percentage
Western Meadowlark	64	24.90
Sage Thrasher	32	12.45
European Starling	27	10.51
Horned Lark	27	10.51
Cliff Swallow	27	10.51
Sagebrush Sparrow	16	6.23
Brewer's Sparrow	12	4.67
Mourning Dove	9	3.50
House Sparrow	9	3.50
Common Nighthawk	8	3.11
House Finch	4	1.56
American Kestrel	3	1.17
Western Kingbird	3	1.17
Common Raven	3	1.17
Loggerhead Shrike	3	1.17
American Robin	3	1.17
Swainson's Hawk	2	0.78
Barn Swallow	1	0.39
Killdeer	1	0.39
Northern Rough-winged Swallow	1	0.39
Red-tailed Hawk	1	0.39
Say's Phoebe	1	0.39
Total Individuals		
	257	
Total Species		
	22	

Survey Route: CITRC Survey Date: June 22, 2020		
Species	Abundance	Percentage
Horned Lark	51	35.66
Western Meadowlark	40	27.97
Sage Thrasher	28	19.58
Brewer's Sparrow	7	4.90
Sagebrush Sparrow	5	3.50
Killdeer	4	2.80
Common Raven	3	2.10
Vesper Sparrow	3	2.10
Common Nighthawk	2	1.40
Total Individuals	143	
Total Species	9	

Survey Route: TAN		
Survey Date: June 24, 2020		
Species	Abundance	Percentage
Sage Thrasher	64	34.41
Horned Lark	48	25.81
Sagebrush Sparrow	39	20.97
Brewer's Sparrow	16	8.60
Western Meadowlark	8	4.30
Cliff Swallow	3	1.61
Vesper Sparrow	3	1.61
Common Raven	2	1.08
Brewer's Blackbird	2	1.08
Rock Wren	1	0.54
Total Individuals	186	
Total Species	10	

Survey Route: Twin Buttes		
Survey Date: June 26, 2020		
Species	Abundance	Percentage
Western Meadowlark	140	38.36
Horned Lark	74	20.27
Sage Thrasher	37	10.14
Brewer's Sparrow	19	5.21
Common Raven	17	4.66
Mourning Dove	16	4.38
Vesper Sparrow	14	3.84
Sagebrush Sparrow	13	3.56
Swainson's Hawk	5	1.37
Rock Wren	4	1.10
Brown-headed Cowbird	3	0.82
Brewer's Blackbird	3	0.82
Red-tailed Hawk	2	0.55
Ferruginous Hawk	2	0.55
American Kestrel	2	0.55
Northern Flicker	2	0.55
Common Nighthawk	2	0.55
Black-billed Magpie	2	0.55
Grasshopper Sparrow	2	0.55
Lark Bunting	2	0.55
Barn Swallow	2	0.55
Eastern Kingbird	1	0.27
Loggerhead Shrike	1	0.27
Total Individuals		
	365	
Total Species		
	23	

Survey Route: Circular Butte		
Survey Date: June 29, 2020		
Species	Abundance	Percentage
Horned Lark	134	74.86
Sage Thrasher	20	11.17
Western Meadowlark	10	5.59
Common Raven	6	3.35
Brewer's Sparrow	6	3.35
Ferruginous Hawk	1	0.56
Vesper Sparrow	1	0.56
Sagebrush Sparrow	1	0.56
Total Individuals		
	179	
Total Species		
	8	