

2013 Breeding Bird Surveys on the Idaho National Laboratory Site

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EXECUTIVE SUMMARY

Breeding bird surveys (BBS) have been conducted annually since 1985 (no surveys were conducted in 1992 and 1993) to monitor bird populations on the Idaho National Laboratory (INL) Site. In 2013, we conducted surveys from May 29 to July 3 along 13 established routes, five of which are part of a nationwide survey administered by the U.S. Geological Survey (USGS) and eight of which boarder INL Site facilities. We documented 3,363 birds from 48 species during those surveys. Bird abundance was less than the 1985-2012 average of 4,880 birds, and the number of species (i.e., species richness) was lower than the 26-year average of 57.

Compared with past surveys, we observed similar patterns of bird abundance among those species that are typically the most numerous. In 2013, the five species that were documented in greatest abundance were western meadowlark (*Sturnella neglecta*, $n = 827$), horned lark (*Eremophila alpestris*, $n = 792$), sage thrasher (*Oreoscoptes montanus*, $n = 564$), sage sparrow (*Amphispiza belli*, $n = 218$), and Brewer's sparrow (*Spizella breweri*, $n = 184$). During 27 years of breeding bird surveys on the INL Site these species have been the five most abundant 20 times, and in the remaining seven years they were among the six most abundant species. Considering reported declines in populations of sagebrush-obligate species throughout the intermountain west, this trend indicates that the quality of sagebrush-steppe habitat on the INL Site remains stable.

Although three new species were added in the past four years to the list of birds that have been observed at least once during BBS on the INL Site, no observations of new species were made in 2013.

Birds observed during the 2013 BBS that are considered species of conservation concern in Idaho included the Franklin's gull (*Larus pipixcan*, $n = 164$), ferruginous hawk (*Buteo regalis*, $n = 7$), long-billed curlew (*Numenius americanus*, $n = 5$), burrowing owl (*Athene cunicularia*, $n = 1$), grasshopper sparrow (*Ammodramus savannarum*, $n = 1$), and greater sage-grouse (*Centrocercus urophasianus*, $n = 2$).

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ACRONYMS

ATRC	Advanced Test Reactor Complex
BBS	Breeding Bird Survey
CFA	Central Facilities Area
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
MFC	Materials and Fuels Complex
NRF	Naval Reactor Facility
PBF	Power Burst 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 along with 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).

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 they are the primary source for regional conservation programs and modeling efforts (Sauer and Link 2011). The BBS data provide 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).

The Idaho National Laboratory (INL) Site has five permanent, official BBS routes originally established in 1985 (hereafter referred to as remote routes) and eight additional survey routes near INL Site facilities (hereafter referred to as facility routes) (Figure 1). Facility routes were developed to monitor trends of avifauna in proximity to anthropogenic activities and disturbances. The annual BBS provides land managers with information regarding trends of abundance of breeding birds relative to activities conducted on the INL Site. This report summarizes the results from the 2013 BBS and compares species abundance across survey routes with long-term averages.

1.1 STUDY AREA

The INL Site encompasses almost 900 mi² (2,315 km²) on the Upper Snake River Plain in southeast Idaho (Figure 1) and is administered by the U. S. Department of Energy (DOE-ID). 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 2005). The INL Site has also been recognized as a Global Important Bird Area by the National Audubon Society.

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 relief occurs around East and Middle buttes and the southern portion of the Lemhi Mountains located near the northwest corner of the INL Site.

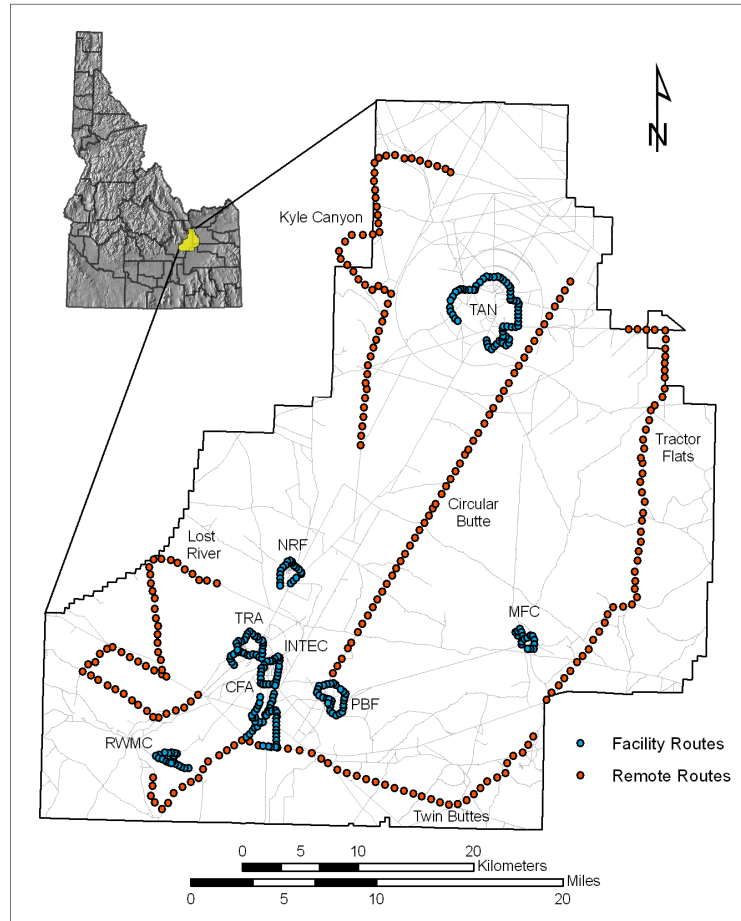


Figure 1. Location of Breeding Bird Survey routes on the Idaho National Laboratory Site. Blue dots represent survey points along facility routes and red dots represent the same for remote routes.

In general, the INL Site is located in a semi-arid desert that experiences hot, dry summers and cold winters. Annual precipitation on the INL Site averages 8 inches (20 cm), with peak precipitation commonly occurring in spring. The geology is dominated by Quaternary basalt lava flows producing outcrops and lava tubes. Aeolian soils, consisting primarily of silt loam and sandy loam, are the most common soil type found throughout the INL Site, while alluvial soils are more commonly found along the flood plain of the Big Lost River. The INL Site is a shrub-steppe ecosystem dominated by a woody shrub overstory 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. (2011).

Very little surface water exists during spring and summer on the INL Site. 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 drains into an ephemeral wetland known as the Big Lost River Sinks. This ephemeral wetland provides 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 aquatic habitat for migrating 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 29 to July 3, 2013, consisting of five official USGS BBS routes and eight facility routes that were developed specifically for the INL Site (Figure 1). Each remote survey route is 24.5 miles (39.2 km) with 50 sampling points systematically spaced every 0.5 mile (0.8 km). Facility routes vary in length between 3.6 miles (5.8 km) and 11.9 miles (19.2 km), depending on the size of the facility. Sampling points along facility routes are separated by approximately 0.2 mile (0.4 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 or heard (song) within a quarter-mile radius 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. Each route was only surveyed when weather conditions were appropriate (e.g., no heavy rain or strong wind). These surveys began one-half of one hour before sunrise and continued for up to 6 hours until the route was completed. The number of vehicles that passed observers during the 3-minute sampling period was recorded on all remote routes. Also, observers noted whether background noise interfered with audible detection of birds.

Correlation of Bird Abundance and Environmental Factors

In previous reports of BBS 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 (r_s) is calculated using the following equation, where (d) is the difference between the ranks and (n) is the sample size.

$$r_s = 1 - \frac{6 \sum d_i^2}{n^3 - n}$$

It is most appropriate to use a different set of equations when there are tied ranks, although there is no appreciable difference in the outcome unless there are numerous tied values (Zar 1984). The first equation (see below) is calculated for both variables (x and y) where (t_i) is the number of tied values, and the second equation calculates the Spearman rank correlation coefficient corrected to rank ties (r_s)_c.

$$\sum t_{(xy)} = \frac{\sum (t_i^3 - t_i)}{12}$$

$$(r_s)_c = \frac{(n^3 - n)/6 - \sum d_i^2 - \sum t_x - \sum t_y}{\left[\left[(n^3 - n)/6 - 2 \sum t_x \right] \left[(n^3 - n)/6 - 2 \sum t_y \right] \right]^{1/2}}$$

We used Spearman rank correlation coefficient 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.inel.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 with species richness documented in past surveys. 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 3,363 birds during the 2013 surveys (Appendix A), which was lower than the average from 1985 to 2012 of 4,880 birds (Figure 2). Species richness of all BBS routes consisted of 48 species, which was lower than the historic average of 57 species (Table 1).

The CFA Route had the highest species richness and the Tractor Flats Route had the highest bird abundance of all routes (Table 1). Among remote routes, Tractor Flats consistently has had the highest abundance since 1999, excluding 2010. The mean bird abundance of this route since 1985 is 697 individuals, which is higher than other remote routes. For facility routes TAN had the highest abundance and CFA had the highest species richness. The TAN Route has had the highest mean abundance at a facility since 1985 with 499 birds, and the NRF Route has had the highest mean richness since 1985 with 22 species.

Western meadowlark (*Sturnella neglecta*) was the most abundant species counted during the 2013 surveys with 827 individuals representing 24.6% of all observations (Table 2). This species was observed at 69.09% (342) of the total stops made during the surveys (Table 2). The horned lark (*Eremophila alpestris*) has been the most abundant species recorded during historic BBS on the INL Site, and has been the most abundant species annually from 1998 until 2013.

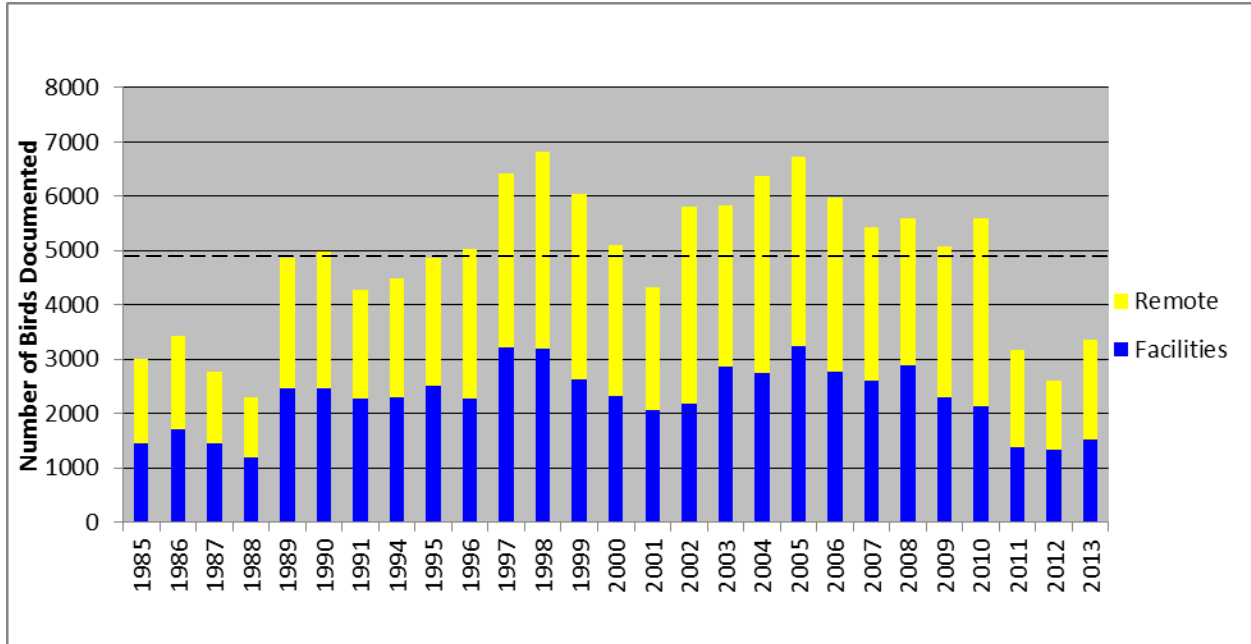


Figure 2. Number of birds documented during the Breeding Bird Survey on the Idaho National Laboratory Site. The dashed black line indicates the mean number of birds observed from 1985 to 2012. No BBS were conducted on the INL Site in 1992 or 1993.

The five most abundant birds we observed were western meadowlark ($n = 827$), horned lark ($n = 792$), sage thrasher (*Oreoscoptes montanus*, $n = 564$), sage sparrow (*Amphispiza belli*, $n = 218$), and Brewer’s sparrow (*Spizella breweri*, $n = 184$). These five species consisted of > 76% of all observations made in 2013, and they were documented on every remote and facility route (Table 2, Appendix A). In the 27 years of INL Site breeding bird surveys, these five species, have been the most abundant 20 times, in five of the remaining seven years they were among the six most abundant species. Surveys in the western U.S. indicate that populations of horned larks, western meadowlarks, Brewer’s sparrows, and sage sparrows have all declined across their range (Knick et al. 2003; Sauer and Link 2011). As sagebrush obligates are experiencing population declines from habitat loss and disturbance (Knick et al. 2003), it is encouraging to see the relatively high abundance of these species each year on the INL Site. Recent fires on the INL Site, however, have reduced the amount of sagebrush habitat. Such reduction in habitat most likely has affected the total abundance of birds, including sagebrush obligates in this area.

Table 1. Number of stops surveyed, species richness, and bird abundance in 2013 for Breeding Bird Survey routes on the Idaho National Laboratory Site.

Route	Stops	# Species	Abundance
Remote Routes			
Lost River	50	14	325
Circular Butte	50	12	356
Kyle Canyon	50	17	289
Tractor Flats	50	22	604
Twin Buttes	50	18	276
Subtotal	250	35*	1,850
Facility Routes			
CFA	42	23	215
INTEC	25	13	151
MFC	18	18	133
NRF	20	16	147
PBF	28	12	269
ATRC	32	16	204
RWMC	20	12	104
TAN	60	14	290
Subtotal	245	38*	1,513
Total	495	48	3,363

*This value represents the combined number of unique species documented within each route subgroup (i.e., remote vs. facility).

Rare Observations and Species of Special Concern

Six species were observed during the 2013 BBS that are considered species of conservation concern in Idaho by the Idaho Department of Fish and Game (2010). These include the burrowing owl (*Athene cunicularia*, $n = 1$), Franklin's gull (*Larus pipixcan*, $n = 164$), long-billed curlew (*Numenius americanus*, $n = 5$), grasshopper sparrow (*Ammodramus savannarum*, $n = 1$), ferruginous hawk (*Buteo regalis*, $n = 7$), and greater sage-grouse (*Centrocercus urophasianus*, $n = 2$).

Species Assemblage Summary

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 bird assemblages are low in those areas, this may indicate that the local population is experiencing declines.

Table 2. Summary of species from 13 routes, sorted by abundance, that were observed during the 2013 Breeding Bird Survey on the Idaho National Laboratory Site.

Common Name	Scientific Name	<i>n</i>	%	Routes ¹	Stops ²	% ³
Western Meadowlark	<i>Sturnella neglecta</i>	827	24.59	5,8	342	69.09
Horned Lark	<i>Eremophila alpestris</i>	792	23.55	5,8	329	66.46
Sage Thrasher	<i>Oreoscoptes montanus</i>	564	16.77	5,8	326	65.86
Sage Sparrow	<i>Amphispiza belli</i>	218	6.48	5,8	138	27.88
Brewer's Sparrow	<i>Spizella breweri</i>	184	5.47	5,8	125	25.25
Franklin's Gull	<i>Larus pipixcan</i>	164	4.88	1,0	3	0.61
Mourning Dove	<i>Zenaida macroura</i>	105	3.12	5,6	66	13.33
Common Raven	<i>Corvus corax</i>	79	2.35	5,7	45	9.09
European Starling	<i>Sturnus vulgaris</i>	66	1.96	1,5	11	2.22
Vesper Sparrow	<i>Pooecetes gramineus</i>	59	1.75	5,6	45	9.09
Common Nighthawk	<i>Chordeiles minor</i>	56	1.67	3,6	30	6.06
Barn Swallow	<i>Hirundo rustica</i>	35	1.04	2,7	20	4.04
Black-billed Magpie	<i>Pica pica</i>	19	0.56	2,1	13	2.63
Rock Wren	<i>Salpinctes obsoletus</i>	19	0.56	4,5	15	3.03
Brown-headed Cowbird	<i>Molothrus ater</i>	15	0.45	1,2	4	0.81
Swainson's Hawk	<i>Buteo swainsoni</i>	14	0.42	4,1	12	2.42
Cliff Swallow	<i>Hirundo pyrrhonota</i>	12	0.36	0,1	1	0.20
American Avocet	<i>Recurvirostra americana</i>	11	0.33	0,1	1	0.20
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	10	0.30	1,2	5	1.01
Western Kingbird	<i>Tyrannus verticalis</i>	10	0.30	3,4	9	1.82
American Robin	<i>Turdus migratorius</i>	8	0.24	1,2	4	0.81
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	8	0.24	1,4	6	1.21
Ferruginous Hawk	<i>Buteo regalis</i>	7	0.21	1,0	4	0.81
Red-tailed Hawk	<i>Buteo jamaicensis</i>	7	0.21	2,2	7	1.41
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>	7	0.21	0,1	3	0.61
Killdeer	<i>Charadrius vociferus</i>	6	0.18	0,2	5	1.01
Chipping Sparrow	<i>Spizella passerina</i>	6	0.18	3,1	6	1.21
Say's Phoebe	<i>Sayornis saya</i>	6	0.18	0,4	6	1.21
Long-billed Curlew	<i>Numenius americanus</i>	5	0.15	1,0	2	0.40
Northern Harrier	<i>Circus cyaneus</i>	5	0.15	2,1	5	1.01
American Kestrel	<i>Falco sparverius</i>	4	0.12	0,2	4	0.81
House Finch	<i>Carpodacus mexicanus</i>	4	0.12	0,1	2	0.40
Loggerhead Shrike	<i>Lanius ludovicianus</i>	4	0.12	1,2	3	0.61
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	3	0.09	1,0	1	0.20
Mallard	<i>Anas platyrhynchos</i>	3	0.09	0,2	2	0.40
Short-eared Owl	<i>Asio flammeus</i>	3	0.09	1,1	2	0.40
Willet	<i>Catoptrophorus semipalmatus</i>	3	0.09	1,1	2	0.40
Eastern Kingbird	<i>Tyrannus tyrannus</i>	2	0.06	0,1	1	0.20
Greater Sage-Grouse	<i>Centrocercus urophasianus</i>	2	0.06	1,0	1	0.20
Lark Sparrow	<i>Chondestes grammacus</i>	2	0.06	1,0	2	0.40
Rock Pigeon	<i>Columba livia</i>	2	0.06	1,0	1	0.20
American Coot	<i>Fulica americana</i>	1	0.03	0,1	1	0.20
American Crow	<i>Corvus brachyrhynchos</i>	1	0.03	1,0	1	0.20
Northern Flicker	<i>Colaptes auratus</i>	1	0.03	0,1	1	0.20
Burrowing Owl	<i>Athene cunicularia</i>	1	0.03	1,0	1	0.20
Gadwall	<i>Anas strepera</i>	1	0.03	0,1	1	0.20

Common Name	Scientific Name	<i>n</i>	%	Routes ¹	Stops ²	% ³
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	1	0.03	1,0	1	0.20
Northern Mockingbird	<i>Mimus polyglottos</i>	1	0.03	0,1	1	0.20

¹The 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.

²Number of stops at which a species was documented.

³Percent of stops (from a total of 495) at which a species was recorded.

The most dominant species assemblage on the INL Site was the shrub-steppe/grassland category, representing nearly 57.5% of all BBS observations (Figure 3). The shrub-steppe/grassland assemblage consistently has had the highest bird abundance, because the majority of the INL Site consists of shrub-steppe and grassland habitats. The second most abundant species assemblage was sagebrush obligates representing 28.8% of all observations (Figure 3). Given the regional concern for sagebrush-obligate species (Knick et al. 2003), it is encouraging that these species are doing well on the INL Site. In the past six years the abundance of species in this category has averaged 30% (range = 26% to 35%). As indicated earlier, recent fires on the INL Site have reduced the amount of sagebrush habitat. Such reduction in sagebrush most likely has affected the abundance of sagebrush-obligate species. Further analyses needs to be conducted to verify this relationship.

Shrub-steppe/Grassland

Species representing the shrub-steppe/grassland assemblage have always been observed in the greatest number in past BBS, and they dominated observations in 2013 with 1,935 individuals (57.5%). Common shrub-steppe/grassland species included horned lark, western meadowlark, brown-headed cowbird (*Molothrus ater*), and vesper sparrow (*Pooecetes gramineus*). Western meadowlark (*n* = 827) and horned lark (*n* = 792) were the most abundant species in this assemblage, and were ranked as the top two most abundant species for the entire survey (Table 2). Annual horned lark observations between 2002 and 2012 have averaged 1,454 birds, whereas the average number observed between 1985 and 2001 was 699 birds. We suspect that the high abundance of horned lark in recent years is a response to wildfires that have converted shrub-dominated habitat into grassland communities. Further investigation of this hypothesis may provide useful insight into the effects of wildfire on bird communities.

Sagebrush Obligates

The sagebrush obligate assemblage had the second highest species abundance with 968 individuals (28.8% of total). This assemblage includes Brewer's sparrow, sage sparrow, sage thrasher, and greater sage-grouse. Sage thrasher was the most abundant sagebrush obligate with 564 individuals. These data indicate that populations of sagebrush obligates are stable on the INL Site. In many other western states, sagebrush obligates are facing significant habitat loss, and consequently sagebrush-obligate species are experiencing population declines (Knick 1999; Knick et al. 2003). The population trends across the INL Site show a high abundance of sagebrush obligates, which is likely because the INL Site is comprised of a large area of relatively undisturbed sagebrush-steppe habitat compared with other areas in the Intermountain West.

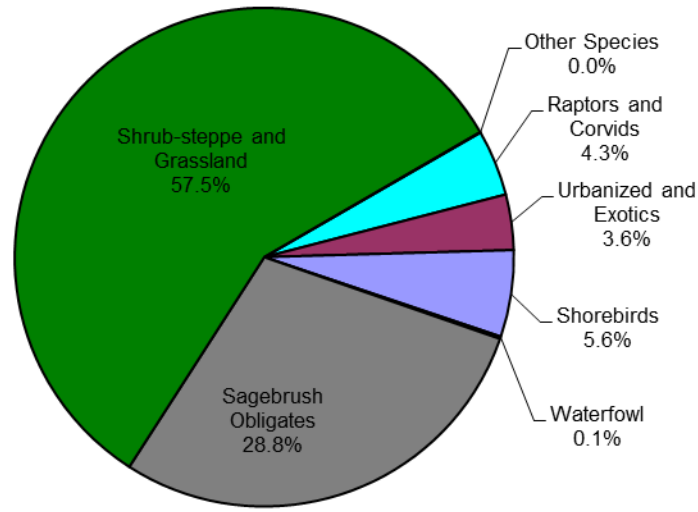


Figure 3. Summary of species assemblages for Breeding Bird Surveys of remote and facility routes on the Idaho National Laboratory Site in 2013.

Raptors and Corvids

The raptor and corvid assemblage consisted of 144 observations representing 4.3% of the total count. Among these were eight species of raptors (eagles, hawks, falcons, and owls), Swainson's hawk (*B. swainsoni*) was the most abundant raptor with 14 individuals observed. Observations that were notable in 2013 included the 4 loggerhead shrikes (*Lanius ludovicianus*) that were observed. This value was significantly lower than the average of 33 loggerhead shrikes per year between 1985 and 2012.

The corvids include common ravens (*Corvus corax*), American crows (*C. brachyrhynchos*), and black-billed magpies (*Pica hudsonia*). The common raven was the most abundant species within this assemblage with 79 individuals observed. The number observed in 2013 was the highest abundance since 2010. Since egg predation by ravens can negatively impact sage-grouse nest success, it will be important to continue to closely monitor raven abundance, especially if sage-grouse populations continue to decline across the western U.S.

Urbanized and Exotics

The urbanized and exotics assemblage represents birds associated with urban or human-altered environments, which are most commonly found around INL Site facilities. Examples of these species include European starling (*Sturnus vulgaris*), rock dove (*Columba livia*), and American robin (*Turdus migratorius*). This assemblage constituted 3.6% ($n = 121$) of the total observations in 2013. The European starling was the most abundant species observed in this assemblage (66 individuals), followed by the barn swallow (*Hirundo rustica*) (35 individuals).

Waterfowl

Waterfowl are commonly observed during the BBS even though little standing water exists on the INL Site. With the exception of the ephemeral Big Lost River and the Big Lost River Sinks Wetland, the only standing water bodies on the INL Site are wastewater treatment ponds near facilities. These man-made ponds serve as stopover locations for migrating birds, and a number of different species have been observed using these areas since 1985.

We documented 5 individuals from three waterfowl species, mallard (*Anas platyrhynchos*, $n = 3$), American coot (*Fulica americana*, $n = 1$), and gadwall (*A. strepera*, $n = 1$), representing 0.1% of total observations. As in past years the mallards and gadwall were observed along the facility routes.

Shorebirds

We observed 189 individuals representing five species from the shorebird assemblage, which accounted for 5.6% of the total BBS observations. Because standing water is rare on the INL Site, most observations of shorebirds occurred in proximity to waste ponds near facility routes. Franklin's gull ($n = 164$), American avocet (*Recurvirostra americana*, $n = 11$), killdeer (*Charadrius vociferous*, $n = 6$), long-billed curlew ($n = 5$) and willet (*Catoptrophorus semipalmatus*, $n = 3$) comprised nearly all observations. The Franklin's gulls were recorded along the Tractor Flats Route. The close proximity of the Tractor Flats Route to agricultural areas near Mud Lake is probably why so many gulls ($n = 164$) were observed.

Other Birds

One bird species that was not assigned to any species assemblage was observed in 2013. This species was the northern mockingbird (*Mimus polyglottos*, $n = 1$). This species has been rarely observed during past breeding bird surveys. The northern mockingbird was observed during 9 of the 27 years of BBS surveys.

Bird Abundance Correlation

Bird abundance was marginally negatively correlated ($r_s = -0.36$, $n = 27$, $P = 0.07$) with mean June temperature (Figure 4). This result supports previous findings from BBS on the INL Site (Belthoff et al. 1998, Belthoff and Ellsworth 1999), indicating that June temperature should be a consideration when interpreting BBS results. 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 with June temperature and bird abundance thus allows for interpretation of changes in bird abundance across the INL Site, and may help explain annual variability in BBS results. Although, a relationship exists with temperature and abundance, we recognize that other factors (i.e., observer) could influence bird abundance. Therefore, we recommend that future data analyses use multivariate techniques to test for strength of each independent variable (i.e., temperature, date of survey, or observer) that could influence bird abundance.

Total precipitation in June was correlated with bird abundance ($r_{sc} = 0.40$, $n = 27$, $P = 0.04$; Figure 5). These results also support previous analyses (Belthoff and Ellsworth 1999). There is a 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.

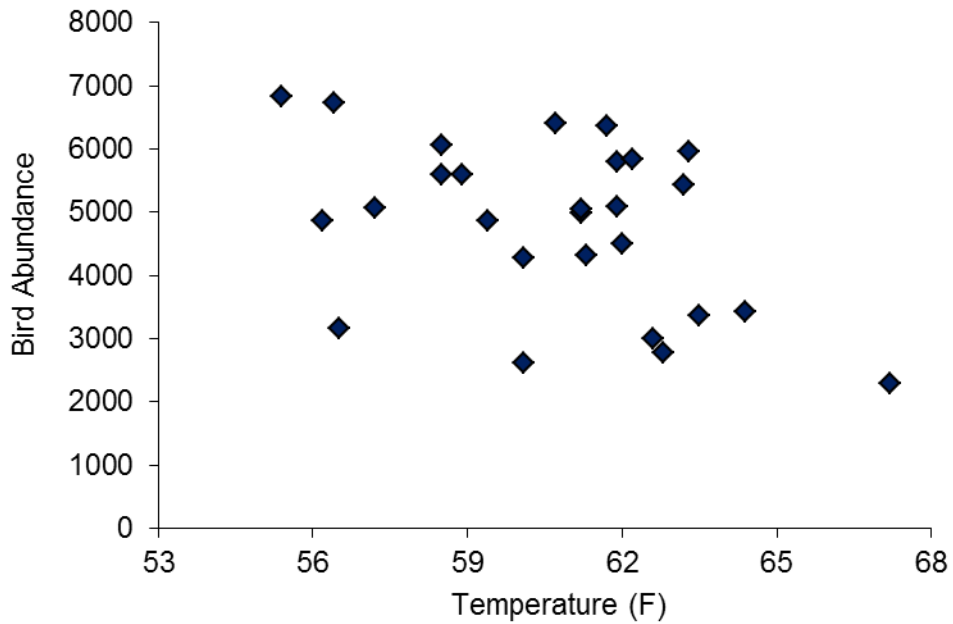


Figure 4. Relationship between bird abundance at the Idaho National Laboratory Site and the average June temperature recorded at the Central Facilities Area from 1985 to 2013.

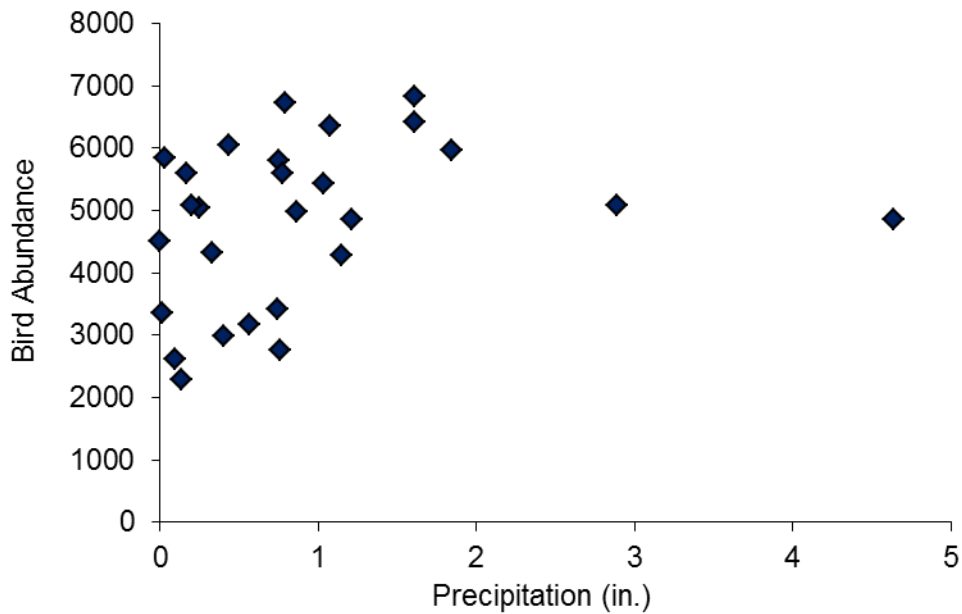


Figure 5. Relationship between bird abundance at the Idaho National Laboratory Site and total June precipitation recorded at the Central Facilities Area from 1985 to 2013.

Community Diversity Indices

Based on the Shannon's measures of diversity, the CFA Route had the most diverse bird community of all 13 routes ($H = 2.27$; Table 3), followed by NRF facility route ($H = 2.22$). CFA had the highest species richness ($n = 23$). The NRF Route had the most diverse bird community among remote routes based on both of Shannon's indicators ($H = 2.22$, $E_H = 0.80$). The TAN Route had the lowest diversity among facility routes based on Shannon's measures of diversity ($H = 1.62$; $E_H = 0.61$), and Circular Butte was the least diverse among remote routes based on richness ($n = 12$; $H = 1.74$). Overall, TAN was the least diverse of all routes.

Over the past six years, CFA is the only route that has been among the top three in regards to diversity each year. RWMC has been among the three most diverse during four of the past seven years. During the same time, Tractor Flats has had the highest or second highest species richness. This information indicates that the area surrounding CFA and RWMC (building, trees, and waste-water ponds) provide unique 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 total number of unique birds that are observed in that area.

Table 3. Values for species richness, Shannon Diversity (H), and Equitability (E_H) indices for the 2013 Idaho National Laboratory Site Breeding Bird Surveys.

Route	Species Richness	Shannon's H	Shannon's E_H
Remote Routes			
Circular Butte	12	1.74	0.70
Kyle Canyon	17	2.19	0.77
Lost River	14	1.76	0.67
Tractor Flats	22	2.01	0.65
Twin Buttes	18	1.97	0.68
Facility Routes			
CFA	23	2.27	0.72
INTEC	13	1.86	0.72
MFC	18	2.19	0.76
NRF	16	2.22	0.80
PBF	12	1.86	0.75
ATRC	16	1.84	0.66
RWMC	12	2.05	0.80
TAN	14	1.62	0.61

2.0 SUMMARY

As in most previous years, birds belonging to shrub-steppe/grassland community assemblage dominated observations during the 2013 BBS on the INL Site. The total number of birds observed ($n = 3,363$) and species richness ($n = 48$) from all routes was lower than the INL Site averages ($\bar{x} = 4,880$; $\bar{x} = 57$) since 1985. Following patterns of abundance from previous BBS on the INL Site, western meadowlark were the most abundant species, followed by horned larks,

sage thrasher, sage sparrow, and Brewer's sparrow. These birds have been consistently among the most abundant species each year of the BBS. This is encouraging for those concerned about the conservation of sage-steppe ecosystems, because these species are in decline over much of their range. Thus, the habitat quality on the INL Site appears to remain stable.

Species observed during the 2013 BBS that are considered species of conservation concern in Idaho included the burrowing owl ($n = 1$), Franklin's gull ($n = 164$), long-billed curlew ($n = 5$), grasshopper sparrow ($n = 1$), ferruginous hawk ($n = 7$), and greater sage-grouse ($n = 2$).

2.1 FUTURE DATA ANALYSES

With over two decades of BBS data collected, we are 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 no effort has been made to consider a comprehensive analysis of all BBS data from the INL Site. In the near future, we plan to analyze all data from past BBS, and to investigate long-term trends in bird abundance and species richness using new methods to do such (Sauer and Link 2011).

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, however, concerning responses of bird populations to alterations of habitat composition and distribution across the landscape (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.

Long-term Community Diversity Trend

Diversity indices have not been calculated each year, and a useful comparison would be to calculate Shannon's H and E_H for all BBS routes for all years to assess which routes have experienced significant change in bird community abundance. The initial community diversity results reported here consider community differences between different routes in the same year. It is unknown how diversity on the same route has changed over time. A number of community similarity indices; can be calculated to address this question. We anticipate coupling the results from the spatial analysis described above with the results from community diversity change over time to present a comprehensive description of how bird communities have changed on the INL Site since 1985.

The INL Site has five permanent, official BBS routes originally established in 1985 and eight additional survey routes near INL Site facilities. The annual BBS provides DOE-ID with historical information regarding trends of breeding birds relative to activities conducted in remote areas and near facilities on the INL Site. These data can be useful when addressing issues regarding the National Environmental Policy Act, as well as the Migratory Bird Treaty Act. Additionally, BBS comply with the direction to promote monitoring of migratory birds as

described in the Memorandum of Understanding between the Department of Energy and the FWS for responsibilities of federal agencies to protect migratory birds (2006).

3.0 ACKNOWLEDGEMENTS

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Appendix A

SUMMARY OF SPECIES BY ROUTE 2013

Survey Route: RWMC		
Survey Date: May 29, 2013		
Species	Abundance	Percentage
Western Meadowlark	31	29.81
Sage Thrasher	25	24.04
Brewer's Sparrow	12	11.54
Horned Lark	8	7.69
Sage Sparrow	7	6.73
Common Raven	5	4.81
Vesper Sparrow	4	3.85
European Starling	3	2.88
Mourning Dove	3	2.88
Red-winged Blackbird	2	1.92
Rock Wren	2	1.92
Barn Swallow	1	0.96
Say's Phoebe	1	0.96
Total Individuals		
	104	
Total Species		
	12	

Survey Route: PBF		
Survey Date: July 3, 2013		
Species	Abundance	Percentage
Horned Lark	86	31.97
Western Meadowlark	59	21.93
Sage Thrasher	33	12.27
Brewer's Sparrow	30	11.15
Sage Sparrow	29	10.78
Mourning Dove	17	6.32
Vesper Sparrow	6	2.23
Common Nighthawk	3	1.12
Common Raven	2	0.74
Say's Phoebe	2	0.74
Brown-headed Cowbird	1	0.37
Loggerhead Shrike	1	0.37
Total Individuals		
	269	
Total Species		
	12	

Survey Route: TAN		
Survey Date: June 26, 2013		
Species	Abundance	Percentage
Horned Lark	119	41.03
Sage Thrasher	70	24.14
Sage Sparrow	57	19.66
Vesper Sparrow	11	3.79
Mourning Dove	9	3.10
Brewer's Sparrow	7	2.41
Rock Wren	6	2.07
Common Nighthawk	4	1.38
Northern Harrier	2	0.69
Barn Swallow	1	0.34
Chipping Sparrow	1	0.34
Red-tailed Hawk	1	0.34
Western Kingbird	1	0.34
Western Meadowlark	1	0.34
Total Individuals		
	290	
Total Species		
	14	

Survey Route: RTC		
Survey Date: June 3, 2013		
Species	Abundance	Percentage
Western Meadowlark	70	34.31
Horned Lark	60	29.41
Sage Thrasher	22	10.78
Brewer's Sparrow	14	6.86
Cliff Swallow	12	5.88
Vesper Sparrow	10	4.90
American Kestrel	2	0.98
Barn Swallow	2	0.98
European Starling	2	0.98
Red-winged Blackbird	2	0.98
Swainson's Hawk	2	0.98
Willet	2	0.98
Common Raven	1	0.49
Mallard	1	0.49
Sage Sparrow	1	0.49
Western Kingbird	1	0.49
Total Individuals		
	204	
Total Species		
	16	

Survey Route: Circular Butte		
Survey Date: June 7, 2013		
Species	Abundance	Percentage
Western Meadowlark	121	33.99
Horned Lark	92	25.84
Sage Thrasher	59	16.57
Brewer's Sparrow	33	9.27
Sage Sparrow	24	6.74
Common Raven	10	2.81
Mourning Dove	6	1.69
Vesper Sparrow	5	1.40
Common Nighthawk	2	0.56
Greater Sage-Grouse	2	0.56
Rock Wren	1	0.28
Swainson's Hawk	1	0.28
Total Individuals 356		
Total Species 12		

Survey Route: Lost River		
Survey Date: May 30, 2013		
Species	Abundance	Percentage
Western Meadowlark	106	32.62
Horned Lark	92	28.31
Sage Thrasher	53	16.31
Brewer's Sparrow	30	9.23
Common Raven	14	4.31
Sage Sparrow	12	3.69
Vesper Sparrow	6	1.85
Red-tailed Hawk	3	0.92
Barn Swallow	3	0.92
Lark Sparrow	2	0.62
Brewer's Blackbird	1	0.31
Chipping Sparrow	1	0.31
Mourning Dove	1	0.31
Rock Wren	1	0.31
Total Individuals		
	325	
Total Species		
	14	

Survey Route: Tractor Flats		
Survey Date: June 5, 2013		
Species	Abundance	Percentage
Franklin's Gull	164	27.15
Western Meadowlark	140	23.18
Horned Lark	117	19.37
Sage Thrasher	65	10.76
Brewer's Sparrow	29	4.80
Mourning Dove	24	3.97
Sage Sparrow	20	3.31
Black-billed Magpie	11	1.82
European Starling	7	1.16
Common Raven	6	0.99
Long-billed Curlew	5	0.83
Barn Swallow	2	0.33
Northern Harrier	2	0.33
Rock Pigeon	2	0.33
Vesper Sparrow	2	0.33
Western Kingbird	2	0.33
American Crow	1	0.17
American Robin	1	0.17
Burrowing Owl	1	0.17
Red-winged Blackbird	1	0.17
Swainson's Hawk	1	0.17
Willet	1	0.17
Total Individuals 604		
Total Species 22		

Survey Route: Twin Buttes		
Survey Date: June 21, 2013		
Species	Abundance	Percentage
Western Meadowlark	85	30.80
Horned Lark	59	21.38
Sage Thrasher	52	18.84
Common Raven	29	10.51
Mourning Dove	12	4.35
Sage Sparrow	9	3.26
Swainson's Hawk	9	3.26
Vesper Sparrow	5	1.81
Common Nighthawk	3	1.09
Loggerhead Shrike	2	0.72
Red-tailed Hawk	2	0.72
Rock Wren	2	0.72
Brewer's Sparrow	2	0.72
Northern Harrier	1	0.36
Short-eared Owl	1	0.36
Western Kingbird	1	0.36
Chipping Sparrow	1	0.36
Grasshopper Sparrow	1	0.36
Total Individuals		
	276	
Total Species		
	18	

Survey Route: CFA		
Survey Date: June 24, 2013		
Species	Abundance	Percentage
Sage Thrasher	48	22.33
European Starling	47	21.86
Western Meadowlark	40	18.60
Horned Lark	22	10.23
Barn Swallow	10	4.65
American Robin	6	2.79
Mourning Dove	6	2.79
Brewer's Blackbird	5	2.33
Common Nighthawk	5	2.33
Sage Sparrow	5	2.33
House Finch	4	1.86
American Kestrel	2	0.93
Brewer's Sparrow	2	0.93
Common Raven	2	0.93
Eastern Kingbird	2	0.93
Say's Phoebe	2	0.93
Killdeer	1	0.47
Loggerhead Shrike	1	0.47
Northern Flicker	1	0.47
Northern Mockingbird	1	0.47
Red-tailed Hawk	1	0.47
Red-winged Blackbird	1	0.47
Western Kingbird	1	0.47
Total Individuals		
	215	
Total Species		
	23	

Survey Route: INTEC		
Survey Date: June 18, 2013		
Species	Abundance	Percentage
Western Meadowlark	55	36.42
Sage Thrasher	34	22.52
Horned Lark	21	13.91
Brown-headed Cowbird	13	8.61
Brewer's Sparrow	9	5.96
Sage Sparrow	6	3.97
Common Raven	3	1.99
Mourning Dove	3	1.99
Barn Swallow	2	1.32
Common Nighthawk	2	1.32
European Starling	1	0.66
Rock Wren	1	0.66
Vesper Sparrow	1	0.66
Total Individuals		
	151	
Total Species		
	13	

Survey Route: Kyle Canyon		
Survey Date: June 19, 2013		
Species	Abundance	Percentage
Sage Thrasher	63	21.80
Western Meadowlark	56	19.38
Horned Lark	49	16.96
Sage Sparrow	41	14.19
Common Nighthawk	19	6.57
Mourning Dove	19	6.57
Vesper Sparrow	8	2.77
Black-billed Magpie	7	2.42
Ferruginous Hawk	7	2.42
Brewer's Sparrow	5	1.73
Blue-gray Gnatcatcher	3	1.04
Chipping Sparrow	3	1.04
Western Kingbird	3	1.04
Common Raven	2	0.69
Rock Wren	2	0.69
Brown-headed Cowbird	1	0.35
Swainson's Hawk	1	0.35
Total Individuals		
	289	
Total Species		
	17	

Survey Route: NRF		
Survey Date: June 28, 2013		
Species	Abundance	Percentage
Horned Lark	40	27.21
Western Meadowlark	23	15.65
Sage Thrasher	22	14.97
Common Nighthawk	15	10.20
Barn Swallow	12	8.16
Brewer's Sparrow	6	4.08
European Starling	6	4.08
Sage Sparrow	6	4.08
Mourning Dove	5	3.40
Brewer's Blackbird	4	2.72
Common Raven	2	1.36
Short-eared Owl	2	1.36
American Robin	1	0.68
Black-billed Magpie	1	0.68
Rock Wren	1	0.68
Western Kingbird	1	0.68
Total Individuals		
	147	
Total Species		
	16	

Survey Route: MFC		
Survey Date: June 10, 2013		
Species	Abundance	Percentage
Western Meadowlark	40	30.08
Horned Lark	27	20.30
Sage Thrasher	18	13.53
American Avocet	11	8.27
Yellow-headed Blackbird	7	5.26
Brewer's Sparrow	5	3.76
Killdeer	5	3.76
Common Nighthawk	3	2.26
Common Raven	3	2.26
Rock Wren	3	2.26
Barn Swallow	2	1.50
Mallard	2	1.50
Red-winged Blackbird	2	1.50
Gadwall	1	0.75
American Coot	1	0.75
Say's Phoebe	1	0.75
Sage Sparrow	1	0.75
Vesper Sparrow	1	0.75
Total Individuals		
	133	
Total Species		
	18	