2012 Breeding Bird Surveys on the Idaho National Laboratory Site

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EXECUTIVE SUMMARY

Breeding bird surveys (BBSs) 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 2012, we conducted surveys from June 4 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 2,612 birds from 47 species during those surveys. Bird abundance was less than the 1985-2011 average of 4,971 birds, and the number of species (i.e., species richness) was lower than the 25-year average of 58.

Compared with past surveys, we observed similar patterns of bird abundance among those species that are typically the most numerous. In 2012, the five species that were documented in greatest abundance were horned lark (*Eremophila alpestris*, n = 897), western meadowlark (*Sturnella neglecta*, n = 621), sage thrasher (*Oreoscoptes montanus*, n = 298), Brewer's sparrow (*Spizella breweri*, n = 172), and sage sparrow (*Amphispiza belli*, n = 161). During 26 years of breeding bird surveys on the INL Site these species have been the five most abundant 19 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 2012. One species was observed during the surveys that had been recorded in ≤ 6 of the past 26 years. This species was the Canada goose (*Branta canadensis*).

Species observed during the 2012 BBS that are considered species of conservation concern in Idaho included the Franklin's gull (*Larus pipixcan*, n = 15), burrowing owl (*Athene cunicularia*, n = 1), ferruginous hawk (*Buteo regalis*, n = 7), and greater sage-grouse (*Centrocercus urophasianus*, n = 4).

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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 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).

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 avifauna populations in proximity to anthropogenic activities and disturbances. The annual BBS provides land managers with information regarding the population trends of breeding birds relative to activities conducted on the INL Site. This report summarizes the results from the 2012 BBS and compares species abundance across survey routes with long-term averages.

1.1 STUDY AREA

The INL Site encompasses almost 900 mi^2 (2,315 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 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.

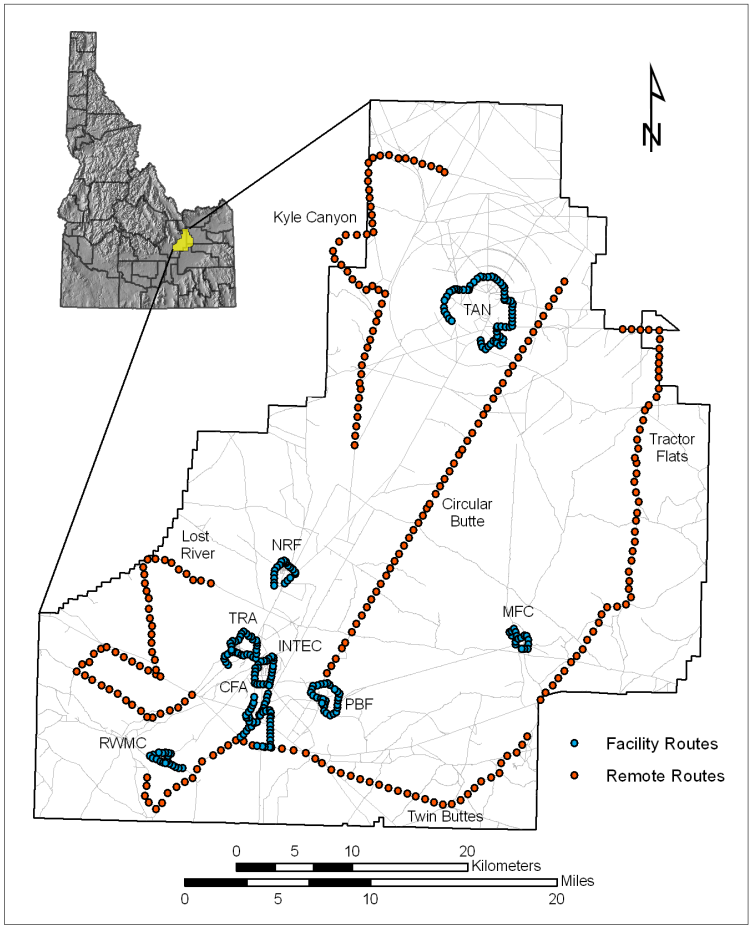

Figure 1. Location of Breeding Bird Survey routes on the Idaho National Laboratory Site. Blue dots represent survey points along facility routes and red dots represent the same for remote routes.

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 June 4 to July 3, 2012, 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 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 (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 $(r_s)_c$.

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

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

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 to standard species richness information documented in past reports. We assumed that data obtained from each survey route is an accurate representation of the local bird community.

1.3 RESULTS AND DISCUSSION

Summary Statistics

We documented 2,612 birds during the 2012 survey (Appendix A), which was lower than the average from 1985 to 2011 of 4,971 birds (Figure 2). Species richness of all BBS routes consisted of 47 species, which was lower than the historic average of 58 species (Table 1).

The Tractor Flats Route had the highest species richness and 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 701 individuals, which is higher than other remote routes. For facility routes, TAN had the highest abundance and MFC had the highest species richness (Table 1). The TAN Route has had the highest mean abundance at a facility since 1985 with 507 birds, and NRF has had the highest mean richness since 1985 with 22 species.

Horned lark (*Eremophila alpestris*) was the most abundant species counted during the 2012 survey with 897 individuals representing 34.3% of all observations (Table 2). This species was observed at 65.25% (323) of the total stops made during the survey (Table 2). The horned lark is the most abundant species recorded during historic BBSs on the INL Site, and has been the most abundant species annually since 1998.

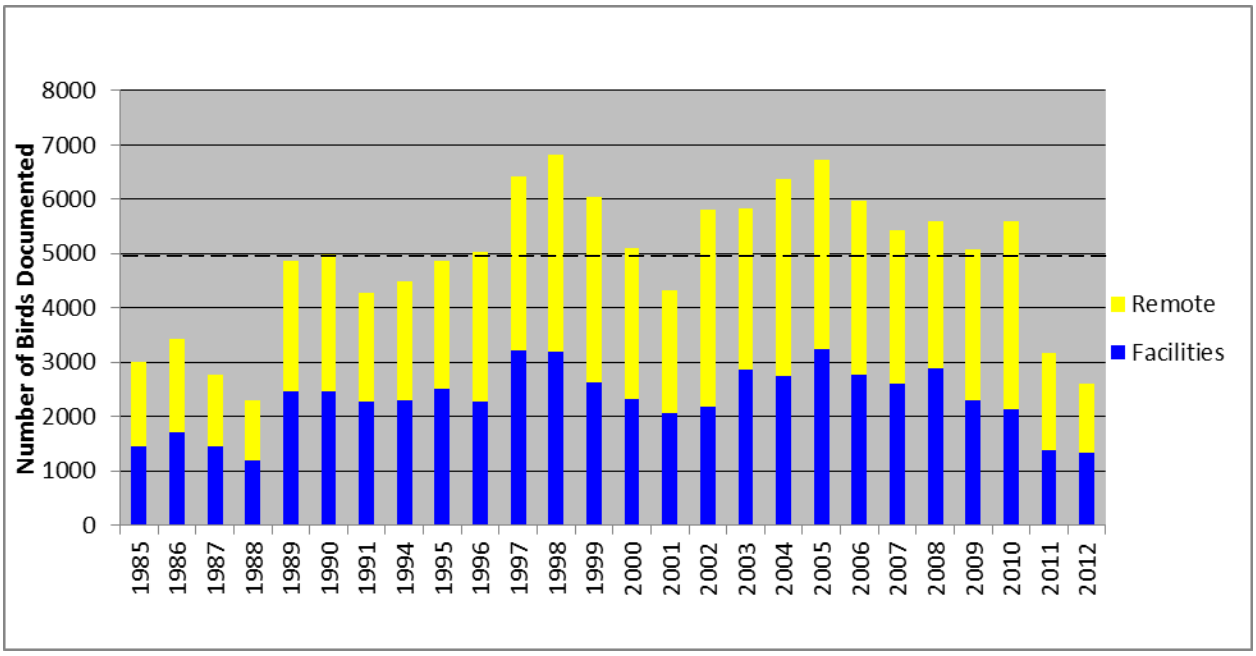

Figure 2. Number of birds observed during the Breeding Bird Survey on the Idaho National Laboratory Site. The dashed black line indicates the mean number of birds observed from 1985 to 2011. No BBSs were conducted on the INL Site in 1992 or 1993.

The five most abundant birds we observed were horned lark (*n* = 897), western meadowlark (*Sturnella neglecta*, *n* = 621), sage thrasher (*Oreoscoptes montanus*, *n* = 298), Brewer's sparrow (*Spizella breweri*, *n* = 172), and sage sparrow (*Amphispiza belli*, *n* = 161). These five species consisted of > 82% of all observations made in 2012 and they, with the exception of Brewer's sparrow and sage sparrow, were observed on every remote and facility route (Table 2, Appendix A). Sage sparrow was observed on every remote route and on seven of the facility routes. In the 26 years of INL Site breeding bird surveys, these five species, have been the most abundant 19 times, in five of the remaining seven years they were among the six most abundant species, during the other two years there were eastern meadowlarks (*S. magna*) observed instead of western meadowlarks. 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 2012 for Breeding Bird Survey routes on the Idaho National Laboratory Site.

Route	Stops	# Species	Abundance
Remote Routes			
Lost River	50	10	269
Circular Butte	50	15	267
Kyle Canyon	50	17	140
Tractor Flats	50	20	447
Twin Buttes	50	17	155
Subtotal	**250**	**36***	**1278**
Facility Routes			
CFA	42	15	192
INTEC	25	15	85
MFC	18	17	169
NRF	20	12	103
PBF	28	10	167
ATRC	32	9	218
RWMC	20	15	168
TAN	60	10	232
Subtotal	**245**	**30***	**1334**
Total	**495**	**47**	**2612**

*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

Four species were observed during the 2012 BBS that are considered species of conservation concern in Idaho by the Idaho Department of Fish and Game (2013). These include the burrowing owl (*Athene cunicularia*, $n = 1$), Franklin's gull (*Larus pipixcan*, $n = 15$), ferruginous hawk (*Buteo regalis*, $n = 7$), and greater sage-grouse (*Centrocercus urophasianus*, $n = 4$).

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 2012 Breeding Bird Survey on the Idaho National Laboratory Site.

Common Name	Scientific Name	*n*	%	Routes[1]	Stops[2]	%
Horned Lark	*Eremophila alpestris*	897	34.34	5,8	323	65.25
Western Meadowlark	*Sturnella neglecta*	621	23.77	5,8	268	54.14
Sage Thrasher	*Oreoscoptes montanus*	298	11.41	5,8	193	38.99
Brewer's Sparrow	*Spizella breweri*	172	6.58	3,8	101	20.40
Sage Sparrow	*Amphispiza belli*	161	6.16	5,7	107	21.62
Mourning Dove	*Zenaida macroura*	134	5.13	4,7	80	16.16
Barn Swallow	*Hirundo rustica*	70	2.68	0,7	24	4.85
Common Raven	*Corvus corax*	49	1.88	5,8	34	6.87
Common Nighthawk	*Chordeiles minor*	26	1.00	3,4	16	3.23
Loggerhead Shrike	*Lanius ludovicianus*	15	0.57	4,3	13	2.63
Vesper Sparrow	*Pooecetes gramineus*	15	0.57	5,1	12	2.42
Brown-headed Cowbird	*Molothrus ater*	15	0.57	1,6	8	1.62
Franklin's Gull	*Larus pipixcan*	15	0.57	1,0	3	0.61
American Robin	*Turdus migratorius*	14	0.54	1,2	10	2.02
Say's Phoebe	*Sayornis saya*	10	0.38	1,4	10	2.02
Rock Wren	*Salpinctes obsoletus*	9	0.34	1,3	7	1.41
Ferruginous Hawk	*Buteo regalis*	7	0.27	2,1	5	1.01
Black-billed Magpie	*Pica pica*	6	0.23	2,0	5	1.01
Northern Shoveler	*Anas clypeata*	6	0.23	0,2	2	0.40
Red-tailed Hawk	*Buteo jamaicensis*	5	0.19	4,1	5	1.01
Swainson's Hawk	*Buteo swainsoni*	5	0.19	3,0	5	1.01
American Kestrel	*Falco sparverius*	5	0.19	1,2	3	0.61
Red-winged Blackbird	*Agelaius phoeniceus*	5	0.19	0,1	2	0.40
Cliff Swallow	*Hirundo pyrrhonota*	5	0.19	0,1	1	0.20
Willet	*Catoptrophorus semipalmatus*	4	0.15	1,0	3	0.61
Greater Sage-grouse	*Centrocercus urophasianus*	4	0.15	2,0	2	0.40
European Starling	*Sturnus vulgaris*	4	0.15	0,1	2	0.40
N. Rough-winged Swallow	*Stelgidopteryx serripennis*	4	0.15	0,1	2	0.40
Brewer's Blackbird	*Euphagus cyanocelphalus*	3	0.11	1,2	3	0.61
Northern Flicker	*Colaptes auratus*	3	0.11	1,0	2	0.40
Bank Swallow	*Riparia riparia*	3	0.11	0,1	1	0.20
Chipping Sparrow	*Spizella passerina*	2	0.08	2,0	2	0.40
Golden Eagle	*Aquila chrysaetos*	2	0.08	1,0	2	0.40
House Finch	*Carpodacus mexicanus*	2	0.08	0,2	2	0.40
Rock Pigeon	*Columba livia*	2	0.08	1,0	1	0.20
Lark Sparrow	*Chondestes grammacus*	2	0.08	1,0	1	0.20
Western Kingbird	*Tyrannus verticalis*	2	0.08	1,0	1	0.20
Northern Harrier	*Circus cyaneus*	1	0.04	1,0	1	0.20
Gray Flycatcher	*Empidonax wrightii*	1	0.04	1,0	1	0.20
Burrowing Owl	*Athene cunicularia*	1	0.04	1,0	1	0.20
Northern Mockingbird	*Mimus polyglottos*	1	0.04	1,0	1	0.20
Violet-green Swallow	*Tachycineta thalassina*	1	0.04	1,0	1	0.20
Canada Goose	*Branta canadensis*	1	0.04	1,0	1	0.20

Common Name	Scientific Name	*n*	%	Routes[1]	Stops[2]	%
American Avocet	*Recurvirostra americana*	1	0.04	0,1	1	0.20
Killdeer	*Charadrius vociferus*	1	0.04	0,1	1	0.20
Mallard	*Anas platyrhynchos*	1	0.04	0,1	1	0.20
Gadwall	*Anas strepera*	1	0.04	0,1	1	0.20

[1]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.
[2]Number of stops at which a species was documented.
[3]Percent 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 66.8% of all BBS observations (Figure 3). The shrub-steppe/grassland bird assemblage consistently has 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 24.3% 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 31% (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 BBSs, and they dominated observations in 2012 with 1,744 individuals (66.8%). Common shrub-steppe/grassland species include horned lark, western meadowlark, brown-headed cowbird (*Molothrus ater*), and vesper sparrow (*Pooecetes gramineus*). Horned lark (*n* = 897) and western meadowlark (*n* = 621) 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 1,514 birds, whereas the average number observed between 1985 and 2001 was 699 per year. 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 635 individuals (24.3% 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 298 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.

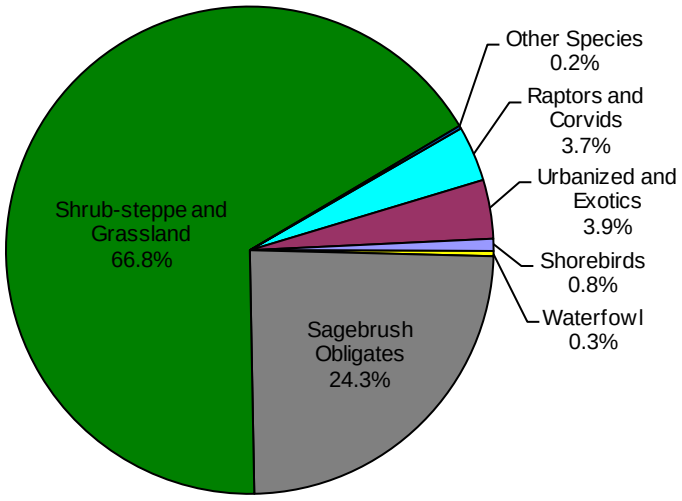

Figure 3. Summary of species assemblage for Breeding Bird Surveys of remote and facility routes on the Idaho National Laboratory Site in 2012.

Raptors and Corvids

The raptor and corvid assemblage consisted of 96 observations representing 3.7% of the total count. Among these were eight species of raptors (eagles, hawks, falcons, and owls). Ferruginous hawk was the most abundant raptor with 7 individuals observed. Observations that were notable in 2012 included the 15 loggerhead shrikes (*Lanius ludovicianus*) that were observed. While still lower than the average of 37 loggerhead shrikes per year between 1985 and 2007, it is comparable to the average of 14 loggerhead shrikes per year between 2008 and 2010.

The corvids include ravens (*Corvus* spp.), crows (*C.* spp.), and magpies (*Pica* spp.). The common raven (*C. corax*) was the most abundant species within this assemblage with 49 individuals observed. The number observed in 2012 was the lowest abundance since 2007. 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 3.9% (n = 102) of the total observations in 2012. The barn swallow (*Hirundo rustica*) was the most abundant species observed in this assemblage (70 individuals), followed by American robin (14 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 9 individuals from four waterfowl species, northern shoveler (*Anas clypeata*, n = 6), mallard (*A. platyrynchos*, n = 1), Canada goose (*Branta canadensis*, n = 1), and gadwall (*A. strepera*, n = 1), representing 0.3% of total observations. As in past years mallards and gadwall were observed along the facility routes.

Shorebirds

We observed 21 individuals representing four species from the shorebird assemblage, which accounted for 0.8% 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 = 15), killdeer (*Charadrius vociferous*, n = 1), American avocet (*Recurvirostra americana*, n = 1), and willet (*Catoptrophorus semipalmatus*, n = 4) 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 = 15) were observed.

Other Birds

Three bird species that were not assigned to any species assemblage were observed in 2012. These include the bank swallow (*Riparia riparia*, n = 3), northern mockingbird (*Mimus polyglottos*, n = 1), and violet-green swallow (*Tachycineta thalassina*, n = 1). Most of these species have been rarely observed during past breeding bird surveys. Bank swallow have been observed during 21 of 26 years of surveys. Northern mockingbird were observed during 8 of the 26 years of surveys. Violet-green swallow have been observed during 12 of the 26 years of surveys.

Bird Abundance Correlation

Bird abundance was marginally negatively correlated (r_s = -0.32, n = 26, P = 0.12) with mean June temperature (Figure 4). This result supports previous findings from BBSs 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.

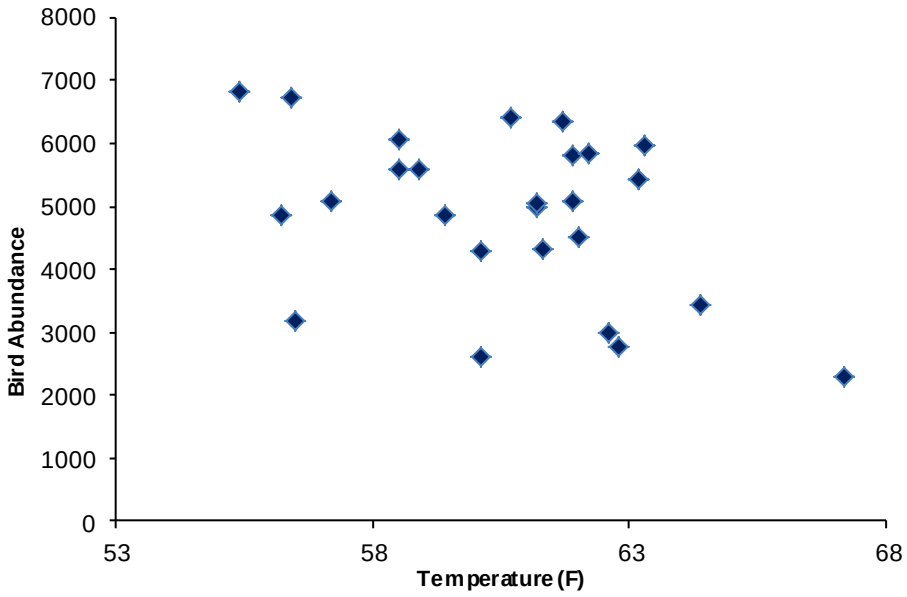

Figure 4. Relationship between bird abundance at the Idaho National Laboratory Site and the average June temperature recorded at the Central Facilities Area from 1985 to 2012.

Total precipitation in June was marginally correlated with bird abundance (r_{sc} = 0.36, n = 26, P = 0.07; Figure 5). These results also support previous analyses (Betlhoff and Ellsworth 1999). A trend exists 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. As indicated above, we recognize that the relationship between bird abundance and precipitation is affected by other variables, and that such needs to be considered in future analyses.

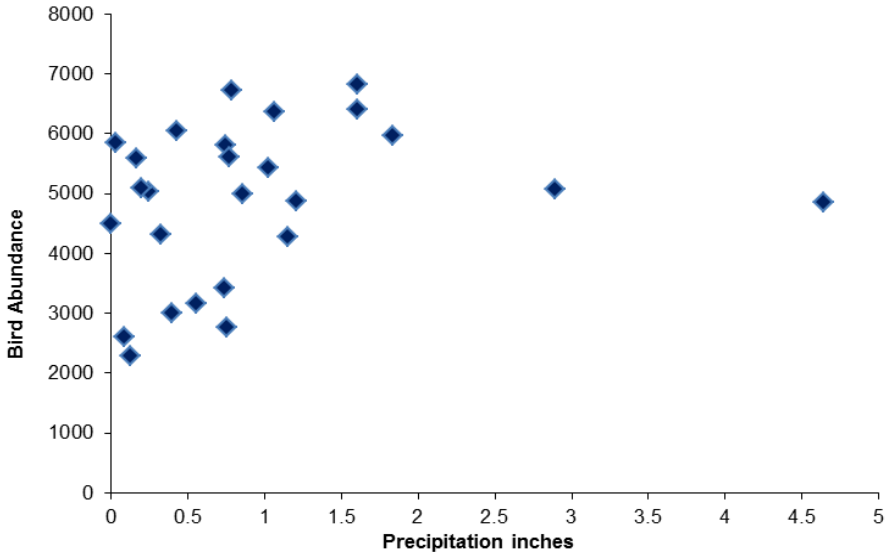

Figure 5. Relationship between bird abundance at the Idaho National Laboratory Site and total June precipitation recorded at the Central Facilities Area from 1985 to 2012.

Community Diversity Index

Based on both of Shannon's measures of diversity, the CFA Route had the most diverse bird community of all 13 routes (H = 2.42, E_H = 0.87; Table 3), followed by INTEC Route (H = 2.26, E_H = 0.84). Tractor Flats had the highest species richness (n = 20), but had the second lowest equitability score (E_H = 0.61), because not only did 65% of species have an abundance <10, the two most abundant species also had close to 67% of the individuals observed on the route (Appendix A). Kyle Canyon had the most diverse bird community among remote routes based on both of Shannon's indicators (H = 2.16, E_H = 0.76). The TAN Route had the lowest diversity among facility routes based on Shannon's measures of diversity (H = 0.81; E_H = 0.35), and Lost River was the least diverse among remote routes based on richness and H (n = 10; H = 1.61). Overall, TAN was the least diverse of all routes.

Over the past five 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 six 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 2012 Idaho National Laboratory Site Breeding Bird Surveys.

Route	Species Richness	Shannon's H	Shannon's E_H
Remote Routes			
Circular Butte	15	1.75	0.64
Kyle Canyon	17	2.16	0.76
Lost River	10	1.61	0.70
Tractor Flats	20	1.82	0.61
Twin Buttes	17	2.00	0.70
Facility Routes			
CFA	15	2.42	0.87
INTEC	15	2.26	0.84
MFC	17	1.92	0.68
NRF	12	1.79	0.72
PBF	10	1.74	0.75
ATRC	9	1.38	0.63
RWMC	15	2.20	0.81
TAN	10	0.81	0.35

2.0 SUMMARY

As in most previous years, birds belonging to shrub-steppe and grassland community assemblages dominated observations during the 2012 BBS on the INL Site. The total number of birds observed (n = 2,612) and species richness (n = 47) from all routes was lower than the INL Site averages ($\bar{x}$ = 4,971; $\bar{x}$ = 58) since 1985. Following patterns of abundance from previous BBSs on the INL Site, horned larks were the most abundant species, followed by western meadowlark, sage thrasher, Brewer's sparrow, and sage sparrow. These species have been consistently among the most abundant species each year of the BBS. This is good news 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 2012 BBS that are considered species of conservation concern in Idaho included the Franklin's gull (n = 15), burrowing owl (n = 1), ferruginous hawk (n = 7), and greater sage-grouse (n = 4).

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 BBSs, 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 eta 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. We will investigate the patterns of habitat modification in conjunction with changes in observed bird abundance and richness along routes.

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 population 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, BBSs 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 2012

Survey Route: **RWMC**
Survey Date: **June 4, 2012**

Species	Abundance	Percentage
Western Meadowlark	49	29.17
Brewer's Sparrow	23	13.69
Sage Sparrow	22	13.10
Barn Swallow	17	10.12
Horned Lark	17	10.12
Sage Thrasher	10	5.95
Cliff Swallow	5	2.98
Northern Shoveler	5	2.98
Red-winged Blackbird	5	2.98
Common Raven	4	2.38
Mourning Dove	4	2.38
Rock Wren	4	2.38
Brewer's Blackbird	1	0.60
Gadwall	1	0.60
Say's Phoebe	1	0.60
Total Individuals	***168***	
Total Species	***15***	

Survey Route: **PBF**
Survey Date: **June 14, 2012**

Species	Abundance	Percentage
Horned Lark	57	34.13
Western Meadowlark	34	20.36
Sage Thrasher	33	19.76
Brewer's Sparrow	20	11.98
Mourning Dove	11	6.59
Sage Sparrow	5	2.99
Common Raven	3	1.80
Say's Phoebe	2	1.20
Brown-headed Cowbird	1	0.60
Rock Wren	1	0.60
Total Individuals	***167***	
Total Species	***10***	

Survey Route: **TAN**
Survey Date: **July 2, 2012**

Species	Abundance	Percentage
Horned Lark	188	81.03
Mourning Dove	14	6.03
Sage Sparrow	14	6.03
Sage Thrasher	7	3.02
Brewer's Sparrow	3	1.29
Common Raven	2	0.86
Barn Swallow	1	0.43
Ferruginous Hawk	1	0.43
Loggerhead Shrike	1	0.43
Western Meadowlark	1	0.43
Total Individuals	***232***	
Total Species	***10***	

Survey Route: **ATRC**
Survey Date: **June 8, 2012**

Species	Abundance	Percentage
Horned Lark	84	38.53
Western Meadowlark	78	35.78
Sage Thrasher	28	12.84
Brewer's Sparrow	21	9.63
Brown-headed Cowbird	3	1.38
Common Raven	1	0.46
House Finch	1	0.46
Mallard	1	0.46
Barn Swallow	1	0.46
Total Individuals	***218***	
Total Species	***9***	

Survey Route: **Circular Butte**
Survey Date: **June 12, 2012**

Species	Abundance	Percentage
Western Meadowlark	90	33.71
Horned Lark	75	28.09
Sage Thrasher	37	13.86
Sage Sparrow	33	12.36
Brewer's Sparrow	13	4.87
Loggerhead Shrike	4	1.50
Common Raven	3	1.12
Common Nighthawk	2	0.75
Greater Sage-Grouse	2	0.75
Rock Wren	2	0.75
Vesper Sparrow	2	0.75
Brown-headed Cowbird	1	0.37
Canada Goose	1	0.37
Mourning Dove	1	0.37
Red-tailed Hawk	1	0.37
Total Individuals	***267***	
Total Species	***15***	

Survey Route: **Lost River**
Survey Date: **June 7, 2012**

Species	Abundance	Percentage
Horned Lark	96	35.69
Western Meadowlark	81	30.11
Sage Thrasher	34	12.64
Sage Sparrow	23	8.55
Brewer's Sparrow	22	8.18
Common Raven	7	2.60
American Robin	3	1.12
Vesper Sparrow	1	0.37
Ferruginous Hawk	1	0.37
Chipping Sparrow	1	0.37
Total Individuals	***269***	
Total Species	***10***	

Survey Route: **Tractor Flats**
Survey Date: **June 11, 2012**

Species	Abundance	Percentage
Horned Lark	156	34.90
Western Meadowlark	142	31.77
Sage Thrasher	41	9.17
Brewer's Sparrow	29	6.49
Sage Sparrow	22	4.92
Franklin's Gull	15	3.36
Mourning Dove	14	3.13
Black-billed Magpie	5	1.12
Common Raven	4	0.89
Willet	4	0.89
Greater Sage-Grouse	2	0.45
Golden Eagle	2	0.45
Loggerhead Shrike	2	0.45
Rock Pigeon	2	0.45
Vesper Sparrow	2	0.45
Brewer's Blackbird	1	0.22
Common Nighthawk	1	0.22
Northern Harrier	1	0.22
Red-tailed Hawk	1	0.22
Swainson's Hawk	1	0.22
Total Individuals	***447***	
Total Species	***20***	

Survey Route: **Twin Buttes**
Survey Date: **June 27, 2012**

Species	Abundance	Percentage
Western Meadowlark	46	29.68
Horned Lark	44	28.39
Mourning Dove	22	14.19
Sage Thrasher	11	7.10
Common Raven	7	4.52
Loggerhead Shrike	4	2.58
Vesper Sparrow	4	2.58
Barn Swallow	3	1.94
Northern Flicker	3	1.94
American Kestrel	2	1.29
Sage Sparrow	2	1.29
Swainson's Hawk	2	1.29
Burrowing Owl	1	0.65
Common Nighthawk	1	0.65
Red-tailed Hawk	1	0.65
Violet-green Swallow	1	0.65
Say's Phoebe	1	0.65
Total Individuals	***155***	
Total Species	***17***	

Survey Route: **CFA**
Survey Date: **June 29, 2012**

Species	Abundance	Percentage
Mourning Dove	38	19.79
Horned Lark	29	15.10
Barn Swallow	22	11.46
Sage Thrasher	22	11.46
Western Meadowlark	16	8.33
Brewer's Sparrow	15	7.81
Common Nighthawk	12	6.25
Sage Sparrow	11	5.73
American Robin	10	5.21
Common Raven	6	3.13
European Starling	4	2.08
Say's Phoebe	3	1.56
American Kestrel	2	1.04
Brown-headed Cowbird	1	0.52
Loggerhead Shrike	1	0.52
Total Individuals	***192***	
Total Species	***15***	

Survey Route: **INTEC**
Survey Date: **June 21, 2012**

Species	Abundance	Percentage
Sage Thrasher	19	22.35
Horned Lark	17	20.00
Brewer's Sparrow	11	12.94
Western Meadowlark	9	10.59
Brown-headed Cowbird	7	8.24
Barn Swallow	4	4.71
Common Raven	4	4.71
Sage Sparrow	4	4.71
Mourning Dove	3	3.53
Loggerhead Shrike	2	2.35
American Kestrel	1	1.18
American Robin	1	1.18
Brewer's Blackbird	1	1.18
Common Nighthawk	1	1.18
House Finch	1	1.18
Total Individuals	***85***	
Total Species	***15***	

Survey Route: **Kyle Canyon**
Survey Date: **June 25, 2012**

Species	Abundance	Percentage
Sage Thrasher	31	22.14
Horned Lark	27	19.29
Western Meadowlark	20	14.29
Sage Sparrow	19	13.57
Mourning Dove	19	13.57
Ferruginous Hawk	5	3.57
Ring-billed Gull	5	3.57
Common Raven	2	1.43
Lark Sparrow	2	1.43
Swainson's Hawk	2	1.43
Western Kingbird	2	1.43
Black-billed Magpie	1	0.71
Chipping Sparrow	1	0.71
Gray Flycatcher	1	0.71
Loggerhead Shrike	1	0.71
Northern Mockingbird	1	0.71
Red-tailed Hawk	1	0.71
Total Individuals	***140***	
Total Species	***17***	

Survey Route: **NRF**
Survey Date: **July 3, 2012**

Species	Abundance	Percentage
Horned Lark	51	49.51
Barn Swallow	12	11.65
Common Nighthawk	8	7.77
Sage Thrasher	8	7.77
Brewer's Sparrow	5	4.85
Mourning Dove	4	3.88
Northern Rough-winged Swallow	4	3.88
Western Meadowlark	4	3.88
Sage Sparrow	3	2.91
Common Raven	2	1.94
Brown-headed Cowbird	1	0.97
Vesper Sparrow	1	0.97
Total Individuals	***103***	
Total Species	***12***	

Survey Route: **MFC**
Survey Date: **June 13, 2012**

Species	Abundance	Percentage
Western Meadowlark	51	30.18
Horned Lark	56	33.14
Sage Thrasher	17	10.06
Brewer's Sparrow	10	5.92
Barn Swallow	10	5.92
Common Raven	4	2.37
Mourning Dove	4	2.37
Bank Swallow	3	1.78
Say's Phoebe	3	1.78
Sage Sparrow	3	1.78
Rock Wren	2	1.18
American Avocet	1	0.59
Brown-headed Cowbird	1	0.59
Common Nighthawk	1	0.59
Killdeer	1	0.59
Northern Shoveler	1	0.59
Red-tailed Hawk	1	0.59
Total Individuals	***169***	
Total Species	***17***	