# 2008 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 Site (INL Site). In 2008, investigators conducted surveys from June 2 to 23 along 13 established routes, five of which are part of the nationwide program of the U.S. Geological Survey (USGS) and eight of which are around INL Site facilities. Observers located 5,592 birds during this survey, which was above the 1985-2007 average of 5,018 birds. We observed 58 species during the 2008 BBS, which was near the average of 59 species recorded since 1985.

We observed similar patterns of species abundance compared with historic surveys for horned lark (*Eremophila alpestris*, *n* = 1,749), which was the most abundant species in 2008. Western meadowlark (*Sturnella neglecta*, *n* = 943), Brewer's sparrow (*Spizella breweri*, *n* = 675), sage sparrow (*Amphispiza belli*, *n* = 382), and sage thrasher (*Oreoscoptes montanus*, *n* = 864) were the next most abundant species. In the 22 years of breeding bird surveys on the INL Site, these five species have been the most abundant birds 17 times, and in the remaining five years these species were five of the six most abundant species. Considering declines reported in populations of sagebrush-obligate species throughout the intermountain west, this trend of abundance indicates the quality of INL Site sagebrush-steppe habitat remains stable.

Investigators observed two species that were previously not recorded during the INL Site surveys: one dark-eyed junco (*Junco hyemalis*) and one red-breasted nuthatch (*Sitta canadensis*). Similar to the 2007 survey, two bald eagles (*Haliaeetus leucocephalus*) were observed; these birds were first documented during spring on the INL Site in 2007.

Species observed during the 2008 BBS that are considered imperiled or critically imperiled in Idaho included greater sage-grouse (*Centrocercus urophasianus*, *n* = 1), ferruginous hawk (*Buteo regalis*, *n* = 12), long-billed curlew (*Numenius americanus*, *n* = 4), Franklin's gull (*Larus pipixcan*, *n* = 52), Brewer's sparrow (*n* = 675), and the grasshopper sparrow (*Ammodramus savannarum*, *n* = 63).

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# ACRONYMS

| | |
|---|---|
| BBS | Breeding Bird Survey |
| CFA | Central Facilities Area |
| INL | Idaho National Laboratory Site |
| INTEC | Idaho Nuclear Technology and Engineering Center |
| MFC | Materials and Fuels Complex |
| NRF | Naval Reactor Facility |
| PBF | Power Burst Facility |
| RTC | Reactor Technology Complex |
| RWMC | Radioactive Waste Management Complex |
| TAN | Test Area North |
| USFWS | United States Fish and Wildlife Service |
| 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. and Canada east of the Mississippi and by 1968 included all of North America (Bystrak 1981, Robbins et al. 1986). The BBS program in North America is managed by the U.S. Geological Survey (USGS) and currently consists of over 4,100 routes with approximately 3,000 of these routes sampled each year.

BBS data provide some of the only long-term information regarding trends in bird populations that covers a broad-geographic scale. These data have been used to estimate population changes for hundreds of bird species, and remain the primary source of information for regional conservation programs and modeling efforts (Sauer et al. 2003). Numerous statistical pathways for exploring and analyzing BBS data have been proposed and discussed (James et al. 1996, Link and Sauer 1997, McCulloch et al. 1997, Bart et al. 2004, Sauer et al. 2005). Regardless of differences in opinion concerning the most appropriate analysis techniques, the BBS provides a wealth of information about population trends of birds in North America, and form the foundation for broad conservation assessments extending beyond local jurisdictional boundaries.

The Idaho National Laboratory Site (INL Site) has five permanent, official BBS routes originally established in 1985 (hereafter referred to as remote routes) and eight additional survey routes around INL Site facilities (hereafter referred to as facility routes). 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 2008 BBS and compares species abundance across survey routes with long-term averages.

## 1.1 Study Area

The INL Site is a Department of Energy facility encompassing almost 900 $mi^2$ (2,315 $km^2$) located on the Upper Snake River Plain in southeast Idaho (Figure 1). 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).

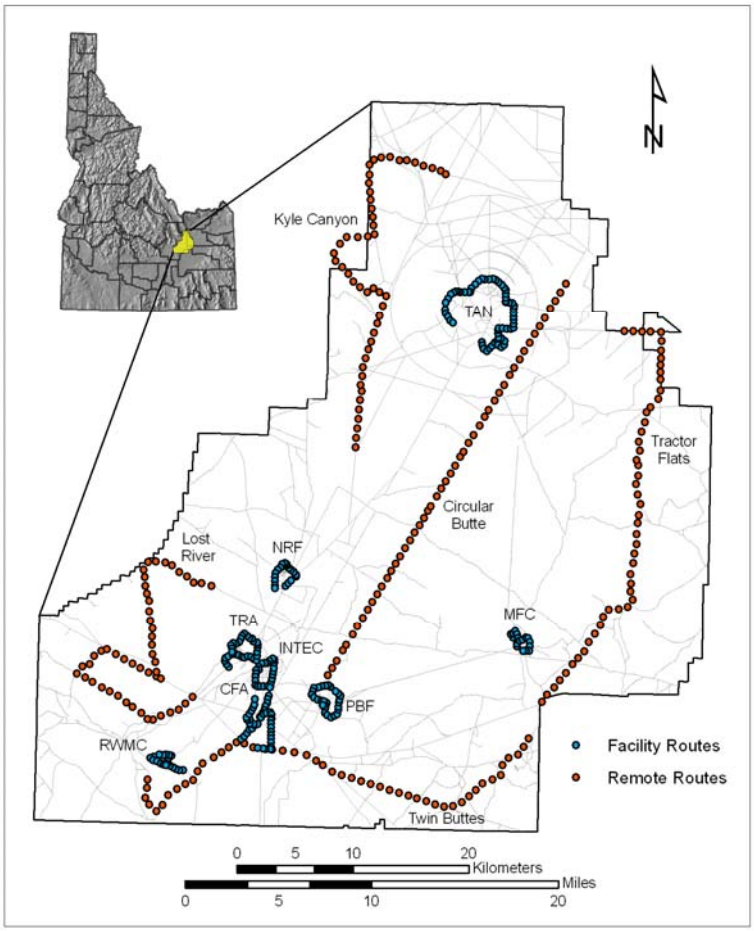



Figure 1. Location of Breeding Bird Survey routes on the Idaho National Laboratory Site.

Topography across the INL Site is mostly flat with an average elevation of 4,985 ft (1,520 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.

A description of the climate, geology, and vegetation communities on the INL Site is provided in Anderson et al. (1996). 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. Wyoming big sagebrush (*Artemisia tridentata wyomingensis*) is the most dominant shrub on the INL Site, while other common species include sagebrush species (*A*. spp.), green rabbitbrush (*Chrysothamnus viscidiflorous*), spiny hopsage (*Grayia spinosa*) shadscale (*Atriplex confertifolia*), and winterfat (*Krascheninnikovia lanata*). The most common native grasses are thickspike wheatgrass (*Elymus laceolatus*), bottlebrush squirreltail (*Elymus*

*elymoides*), Indian ricegrass (*Achnatherum hymenoides*), and needle-and-thread grass (*Hesperostipa comata*).

Very little surface water exists during spring and summer on the INL Site. The Big Lost River and Birch Creek drainages 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, water from the Big Lost River can reach the INL Site and 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; however, 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 2 to 23, 2008, consisting of five official USGS BBS routes in addition to eight facility routes developed specifically for the INL Site (Figure 1). Each remote survey route was 24.5 miles (39.2 km) long with 50 sampling points that were systematically spaced every 0.5 mile (0.8 km). The facility routes varied in length—3.6 miles (5.8 km) to 11.9 miles (19.2 km)—depending on the size of the facility. Sampling points were separated by approximately 0.2 mile (0.4 km).

Observers followed the North American BBS protocols during surveys provided by the USGS Patuxent Wildlife Research Center. At each sampling location, 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. 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 hour before sunrise and continued for up to 6 hours until the route was complete. The number of automobiles that passed observers during the 3-min sampling period was recorded on all remote routes. Also, observers noted if background noise interfered with audible detection of birds.

### Bird Abundance Correlation

In previous INL Site BBS reports, environmental factors were investigated to explain variation in observed bird abundance. More birds were recorded on surveys during June from 1985 to 1991 when weather was cool and wet (Belthoff et al. 1998). Additionally, Belthoff and Ellsworth (1999) indicated that higher bird abundance corresponded with lower temperatures on the INL Site. A relationship between bird abundance and June precipitation existed, although not statistically significant. The removal of an outlier from the data during 1995, however, would have resulted in a statistically significant relationship (Belthoff and Ellsworth 1999). Those authors used Spearman rank correlation coefficient to identify correlations with June temperature and precipitation (Belthoff and Ellsworth 1999). We used the same statistic for the 2008 data to compare relationships between bird abundance and temperature and precipitation.

Spearman rank correlation coefficient is a non-parametric test used to investigate the relationship between variables (Spearman 1904). 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.

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

A different equation is used to account for tied ranks (Thomas 1989). The first equation 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 $(r_s)_c$.

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

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

We used Spearman rank correlation coefficient to investigate relationships between bird abundance on all survey routes and mean temperature and total precipitation in June since 1985 at the Central Facilities Area (CFA). Statistical significance was calculated using a two-tailed test with $\alpha = 0.05$. Data for June precipitation contained a tied ranking, and the equation described above was used for those data.

### Community Diversity Indices

Diversity describes the number of interacting organisms in an ecological system and is commonly defined by species abundance and richness. A community with low species diversity may be indicative of an unhealthy or improperly functioning community. High species diversity is often interpreted as a stable, functioning system and increasing diversity is the goal of many management activities.

Species diversity indices are mathematical methods 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 popular method for quantifying diversity of species in an area (Shannon 1948). 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 ($\ln p_i$). The resulting product is then summed across species and multiplied by -1. Shannon's $H$ can range from zero to about 4.6 with higher values representing 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 among 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 reported in past reports. Each survey route was considered as a representation of the local bird community, and values for community diversity indices reflected BBS route diversity.

## 1.3 Results and Discussion

### Summary Statistics

Observers documented 5,592 birds during the 2008 survey (Appendix A). Total abundance was greater than the average from 1985 to 2008 of 5,018 birds (Figure 2). We documented 58 species (i.e., species richness) during the survey on all BBS routes, which was near the historic average of 59 species. Observers recorded 17 species on the Lost River route and 13 on the Circular Butte route; these values were slightly below the average of 18 species for the Lost River route and 16 species for the Circular Butte route since 1985. Species richness for all other remote routes was above the historic average (Table 1).

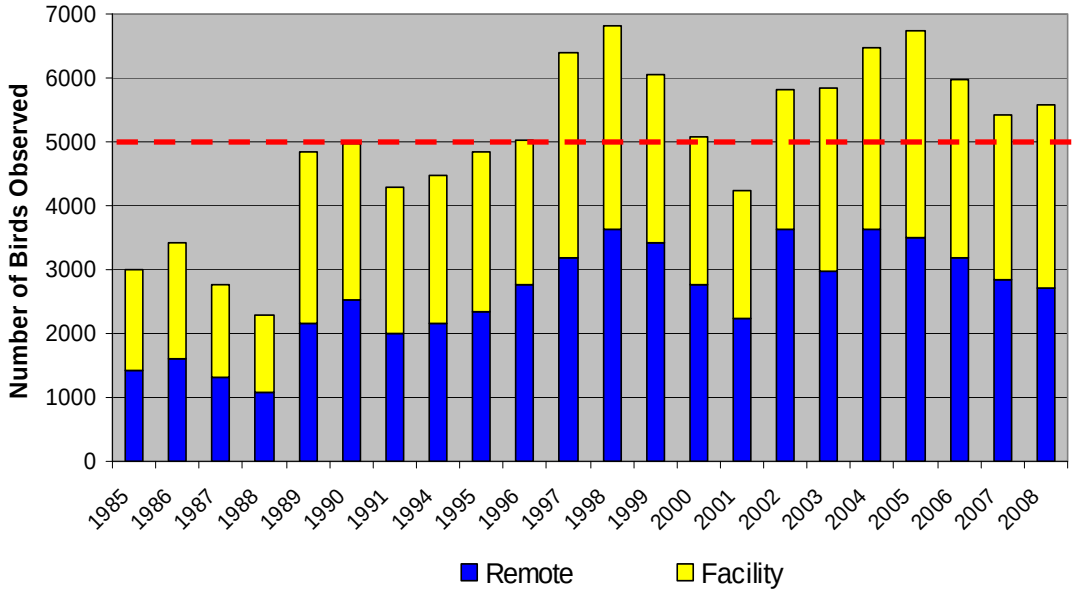



Figure 2. Number of birds observed during the Breeding Bird Survey on the Idaho National Laboratory Site. The dashed red line indicates the mean number of birds observed from 1985 to 2008. No BBS were conducted on the INL Site in 1992 or 1993.

The Tractor Flats route had the greatest bird abundance for remote routes with 688 individuals (Table 1). Since 1985, the Tractor Flats route has had the highest average abundance of all BBS routes with mean bird abundance of 709 individuals. During 2008 surveys, we counted the highest number of species on the Kyle Canyon route (Table 1).

Horned lark (*Eremophila alpestris*) was the most abundant species counted during the 2008 survey with 1,794 individuals representing 32% of all observations (Table 2). This species was observed on 82% (407) of the total stops made during the survey (Table 2). The horned lark is the most abundant species recorded during historic INL Site BBS.

The five most abundant birds we observed were horned lark ($n$ = 1,794), western meadowlark (*Sturnella neglecta*, $n$ = 943), sage thrasher (*Oreoscoptes montanus*, $n$ = 864), Brewer's sparrow (*Spizella breweri*, $n$ = 675), and sage sparrow (*Amphispiza belli*, $n$ = 382). These five species consisted of > 83% of all observations made in 2008 (Table 2). These five birds were also the most abundant in the 2007 BBS, and were observed on every remote and facility route surveyed in 2008 (Table 2). In the 22 years of INL Site breeding bird surveys, these five species have been the five most abundant birds 17 times, and in the remaining five years these species were five of the six most abundant species. Breeding Bird Surveys in the western U.S. indicate that populations of horned larks, western meadowlarks, Brewer's sparrow, and sage sparrows have all declined across their range (Peterjohn and Sauer 1999). As sagebrush obligates are experiencing population declines from habitat loss and disturbance (Knick et al. 2003), it is encouraging to see a consistently high abundance of these species on the INL Site.

Table 1. Number of stops surveyed, species richness, and bird abundance for each survey route from the Breeding Bird Survey on the Idaho National Laboratory Site, 2008.

| Route | Stops | Species | Abundance |
|---|---|---|---|
| *Remote Routes* | | | |
| Lost River | 50 | 17 | 580 |
| Circular Butte | 50 | 13 | 466 |
| Kyle Canyon | 50 | 26 | 478 |
| Tractor Flats | 50 | 24 | 688 |
| Twin Buttes | 50 | 22 | 493 |
| Subtotal | 250 | 43* | 2705 |
| *Facility Routes* | | | |
| CFA | 42 | 24 | 413 |
| INTEC | 25 | 14 | 293 |
| MFC | 18 | 14 | 231 |
| NRF | 20 | 18 | 299 |
| PBF | 28 | 17 | 395 |
| RTC | 32 | 22 | 326 |
| RWMC | 19 | 22 | 174 |
| TAN | 60 | 13 | 756 |
| Subtotal | 244 | 40* | 2887 |
| Total | 494 | 58 | 5592 |

*Similar species are counted on multiple routes; this value reflects unique species documented across all facility and remote routes combined.

Table 2. Summary of species observed during 2008 Breeding Bird Survey on the Idaho National Laboratory Site for 13 routes.

| Common Name | Scientific Name | n | % | Routes[1] | Stops[2] | % |
|---|---|---|---|---|---|---|
| Horned Lark | *Eremophila alpestris* | 1,794 | 32.08 | 5, 8 | 407 | 82.4 |
| Western Meadowlark | *Sturnella neglecta* | 943 | 16.86 | 5, 8 | 335 | 67.8 |
| Sage Thrasher | *Oreoscoptes montanus* | 864 | 15.45 | 5, 8 | 348 | 70.4 |
| Brewer's Sparrow | *Spizella breweri* | 675 | 12.07 | 5, 8 | 329 | 66.6 |
| Sage Sparrow | *Amphispiza belli* | 382 | 6.83 | 5, 8 | 194 | 39.3 |
| Mourning Dove | *Zenaida macroura* | 111 | 1.98 | 5, 6 | 64 | 13 |
| Barn Swallow | *Hirundo rustica* | 90 | 1.61 | 0, 7 | 30 | 6.1 |
| Brown-headed Cowbird | *Molothrus ater* | 89 | 1.59 | 4, 7 | 64 | 13 |
| Common Raven | *Corvus corax* | 89 | 1.59 | 5, 7 | 68 | 13.8 |
| European Starling | *Sturnus vulgaris* | 84 | 1.5 | 1, 7 | 29 | 5.9 |
| Vesper Sparrow | *Pooecetes gramineus* | 67 | 1.2 | 4, 4 | 31 | 6.3 |
| Grasshopper Sparrow | *Ammodramus savannarum* | 63 | 1.13 | 5, 6 | 46 | 9.3 |
| Franklin's Gull | *Larus pipixcan* | 52 | 0.93 | 1, 0 | 2 | 0.4 |
| Common Nighthawk | *Chordeiles minor* | 33 | 0.59 | 4, 4 | 23 | 4.7 |
| Red-tailed Hawk | *Buteo jamaicensis* | 29 | 0.52 | 5, 2 | 25 | 5.1 |
| Brewer's Blackbird | *Euphagus cyanocelphalus* | 24 | 0.43 | 1, 5 | 15 | 3 |
| Mallard | *Anas platyrhynchos* | 22 | 0.39 | 0, 5 | 7 | 1.4 |
| Killdeer | *Charadrius vociferus* | 20 | 0.36 | 0, 7 | 16 | 3.2 |
| Chipping Sparrow | *Spizella passerina* | 15 | 0.27 | 3, 4 | 14 | 2.8 |
| Ferruginous Hawk | *Buteo regalis* | 12 | 0.21 | 3, 1 | 10 | 2 |
| Rock Wren | *Salpinctes obsoletus* | 12 | 0.21 | 2, 4 | 10 | 2 |
| Swainson's Hawk | *Buteo swainsoni* | 12 | 0.21 | 3, 3 | 11 | 2.2 |
| Northern Harrier | *Circus cyaneus* | 10 | 0.18 | 3, 1 | 8 | 1.6 |
| American Robin | *Turdus migratorius* | 7 | 0.13 | 1, 2 | 6 | 1.2 |
| N. Rough-winged Swallow | *Stelgidopteryx serripennis* | 7 | 0.13 | 1, 2 | 4 | 0.8 |
| Loggerhead Shrike | *Lanius ludovicianus* | 6 | 0.11 | 2, 0 | 5 | 1 |
| Say's Phoebe | *Sayornis saya* | 6 | 0.11 | 0, 3 | 6 | 1.2 |
| Yellow-headed Blackbird | *Xanthocephalus xanthocephalus* | 6 | 0.11 | 0, 1 | 2 | 0.4 |
| American Kestral | *Falco sparverius* | 5 | 0.09 | 2, 1 | 5 | 1 |
| Lark Sparrow | *Chondestes grammacus* | 5 | 0.09 | 2, 1 | 4 | 0.8 |
| Blue-gray Gnatcatcher | *Polioptila caerulea* | 4 | 0.07 | 1, 0 | 2 | 0.4 |
| Gadwall | *Anas strepera* | 4 | 0.07 | 0, 2 | 3 | 0.6 |
| Long-billed Curlew | *Numenius americanus* | 4 | 0.07 | 1, 1 | 3 | 0.6 |
| Black-throated Sparrow | *Amphispiza bilineata* | 3 | 0.05 | 1, 0 | 2 | 0.4 |
| Eastern Kingbird | *Tyrannus tyrannus* | 3 | 0.05 | 1, 1 | 3 | 0.6 |
| Western Tanager | *Piranga ludoviciana* | 3 | 0.05 | 1, 2 | 3 | 0.6 |
| House Finch | *Carpodacus mexicanus* | 3 | 0.05 | 0, 3 | 3 | 0.6 |
| Bald Eagle | *Haliaeetus leucocephalus* | 2 | 0.04 | 1, 0 | 1 | 0.2 |
| Burrowing Owl | *Athene cunicularia* | 2 | 0.04 | 2, 0 | 2 | 0.4 |

**Table 2. Continued.**

| Common Name | Scientific Name | n | % | Routes[1] | Stops[2] | %[3] |
|---|---|---|---|---|---|---|
| Black-billed Magpie | *Pica pica* | 2 | 0.04 | 1, 0 | 2 | 0.4 |
| Gray Flycatcher | *Empidonax wrightii* | 2 | 0.04 | 2, 0 | 2 | 0.4 |
| Red-winged Blackbird | *Agelaius phoeniceus* | 2 | 0.04 | 0, 1 | 1 | 0.6 |
| Western Kingbird | *Tyrannus verticalis* | 2 | 0.04 | 1, 0 | 1 | 0.2 |
| Golden Eagle | *Aquila chrysaetos* | 1 | 0.02 | 1, 0 | 1 | 0.2 |
| Greater Sage-grouse | *Centrocercus urophasianus* | 1 | 0.02 | 0, 1 | 1 | 0.2 |
| Mountain Bluebird | *Sialia currucoides* | 1 | 0.02 | 0, 1 | 1 | 0.2 |
| Prairie Falcon | *Falco mexicanus* | 1 | 0.02 | 1, 0 | 1 | 0.2 |
| Ruddy Duck | *Oxyura jamaicensis* | 1 | 0.02 | 0, 1 | 1 | 0.2 |
| Savannah Sparrow | *Passerculus sandwichensis* | 1 | 0.02 | 1, 0 | 1 | 0.2 |
| Short-eared Owl | *Asio flammeus* | 1 | 0.02 | 1, 0 | 1 | 0.2 |
| Sage Grouse | *Centrocercus urophasianus* | 1 | 0.02 | 1, 0 | 1 | 0.2 |
| Red-breasted Nuthatch | *Sitta canadensis* | 1 | 0.02 | 1, 0 | 1 | 0.2 |
| Northern Mockingbird | *Mimus polyglottos* | 1 | 0.02 | 1, 0 | 1 | 0.2 |
| Lazuli Bunting | *Passerina amoena* | 1 | 0.02 | 1, 0 | 1 | 0.2 |
| Dark-eyed Junco | *Junco hyemalis* | 1 | 0.02 | 0, 1 | 1 | 0.2 |
| Bullock's Oriole | *Icterus bullockii* | 1 | 0.02 | 1, 0 | 1 | 0.2 |
| Wilson's Phalarope | *Phalaropus tricolor* | 1 | 0.02 | 0, 1 | 1 | 0.2 |

[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 494) at which a species was recorded.

### Rare Observations and Species of Special Concern

Previously undocumented species have been observed during the 22 years of surveys on the INL Site. In 2008, investigators observed two species never recorded in prior surveys: a dark-eyed junco (*Junco hyemalis*) and a red-breasted nuthatch (*Sitta canadensis*). Similar to the 2007 survey, two bald eagles (*Haliaeetus leucocephalus*) were observed; these birds were first documented during spring on the INL Site in 2007.

Sagebrush steppe habitat on the INL Site is relatively undisturbed and continually supports a high abundance of species that are experiencing declines in comparable areas in the western U.S. (Knick et al. 2003). Species observed during the 2008 BBS that are considered imperiled or critically imperiled in Idaho included greater sage-grouse ($n$ = 1), ferruginous hawk (*Buteo regalis*, $n$ = 12), long-billed curlew (*Numenius americanus*, $n$ = 4), Franklin's gull (*Larus pipixcan*, $n$ = 52), Brewer's sparrow ($n$ = 675), and the grasshopper sparrow (*Ammodramus savannarum*, $n$ = 63).

### 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.

The most dominant species assemblage on the INL Site was the shrub-steppe and grassland categories representing 57.2% of all BBS observations (Figure 3). The shrub-steppe and grassland bird assemblage has historically dominated the bird abundance, as the majority of the INL Site consists of shrub-steppe and grassland habitats. The second most abundant species assemblage was sagebrush obligates representing 34.5% of all observations (Figure 3). Given the regional concern for sagebrush-obligate species (Knick et al. 2003); it is encouraging that sagebrush-obligate species are doing well on the INL Site.

### Shrub-steppe and Grassland

The species representing this assemblage have always been observed in the greatest number in past BBS and dominated observations in 2008 with 3,187 individuals representing 57.2% of the total observations. Common shrub-steppe and grassland species included horned lark, western meadowlark, brown-headed cowbird (*Molothrus ater*), and vesper sparrows (*Pooecetes gramineus*). Horned lark ($n$ = 1,794) and western meadowlark ($n$ = 943) were the most abundant species in this assemblage, and were also the top two abundant species for the entire survey (Table 2). Horned lark abundance has steadily increased across the INL Site, possibly because wildfires have altered plant communities on the site converting shrub-dominated communities into more grassland-dominated communities.

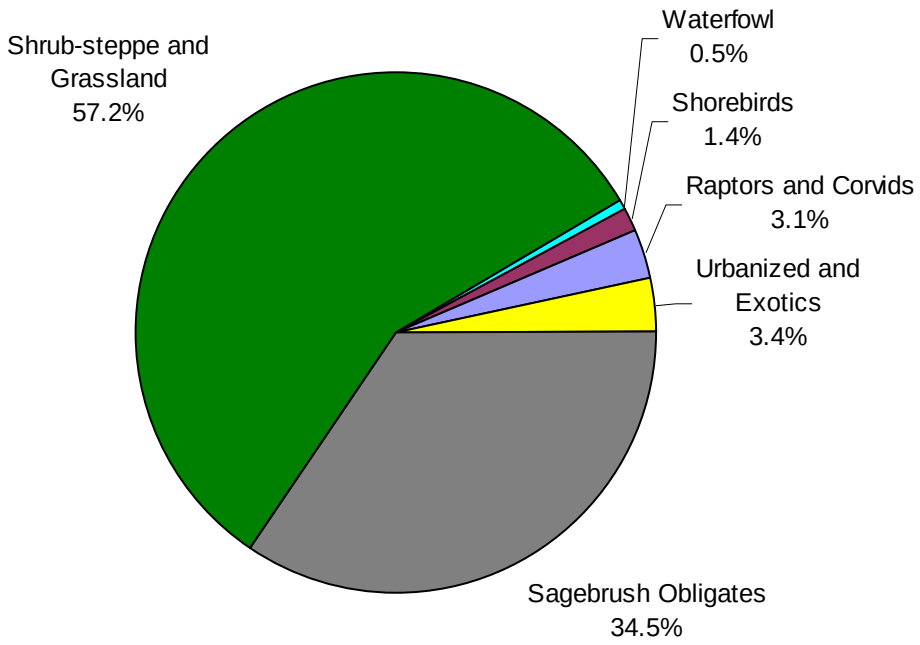



Figure 3. Summary of species assemblage for Breeding Bird Surveys of remote and facility routes on the Idaho National Laboratory Site in 2008.

### Sagebrush Obligates

The assemblage representing sagebrush obligates had the second highest species abundance with 1,922 individuals comprising 34.5% of all observations. This assemblage includes Brewer's sparrow, sage sparrow, sage thrasher, and greater sage-grouse. Sage thrasher was the most

abundant sagebrush obligate with 864 individuals counted. These data indicate that populations of sagebrush obligates are thriving 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 et al. 2003). The population trends across the INL Site shows a consistently high abundance of sagebrush obligates (Vilord 2007), which may be because the INL Site is comprised of a large area of relatively undisturbed sagebrush-steppe habitat compared with other areas in the Intermountain West.

### Raptors and Corvids

The raptor and corvid assemblage consisted of 170 observations representing 3.1% of all observations. We recorded twelve species of raptors (eagles, hawks, falcons, and owls). Red-tailed hawk (*Buteo jamaicensis*) was the most abundant raptor with 29 individuals observed. Other notable observations included two bald eagles.

The corvids include ravens (*Corvus* spp.), crows (*Corvus* spp.), and magpies (*Pica* spp.). The common raven (*C. corax*) was the most abundant species within this assemblage with 89 individuals observed. The number of ravens on the INL Site has increased steadily, and the 2008 raven abundance ties 2005 and 2007 for the highest numbers recorded. Ravens preying on eggs can negatively impact sage-grouse nest success (Coates 2007), and the continued increase in raven abundance may become a concern as sage-grouse populations experience declines across the western U.S.

### Urbanized and Exotics

This species assemblage represents birds associated with urban or human-altered environments, and are most commonly found around INL Site facilities. Examples of these species include European starling (*Sturnus vulgaris*), rock pigeon (*Columba livia*), and American robin (*Turdus migratorius*). This assemblage constituted 3.4% of the total observations in 2008 with 190 total individuals recorded. Barn swallows (*Hirundo rustica*) were the most abundant species observed in this assemblage with 90 individuals recorded, followed closely by European starlings with 84 individuals recorded.

### Waterfowl

Waterfowl are commonly reported on the BBS, although very little standing water exists on the INL Site. With the exception of the ephemeral Big Lost River and 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 three species of waterfowl with an abundance of 27 individuals representing about 0.5% of our observations. The number of waterfowl recorded was primarily driven by observations of mallard (*Anas platyrynchos*, $n = 22$) flocks from five facility routes. We counted only a few individuals for many species within this assemblage; therefore, this assemblage contributed the lowest proportion of total number of bird observed.

### Shorebirds

We observed only four species that were included in the shorebird assemblage. In this assemblage, 77 individuals represented only 1.4% of the total BBS observations. Because standing water was rare on the INL Site most observations of species in the shorebird assemblage occurred in proximity to waste ponds at facilities, and the number of observations was influenced by one flock of Franklin's gulls (*Larus pipixcan*, $n = 52$) recorded on the Tractor Flats route. This group of gulls represented 68% of all shorebird observations. The close proximity of the Tractor Flats route to agricultural areas near Mud Lake was probably why so many gulls were observed. Without the inclusion of Franklin's gull, this assemblage would only contribute < 1% of all observations.

### Bird Abundance Correlation

Bird abundance was negatively correlated ($r_s = -0.47$, $n = 22$, $P < 0.05$) with mean June temperature (Figure 4). This result supports previous finding from the INL Site BBS (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, bird populations would expectedly be lower compared with when years are cooler. The correlation with June temperature and bird abundance allows for interpretation of changes in bird abundance across the INL Site, and may help explain annual variability in BBS results.

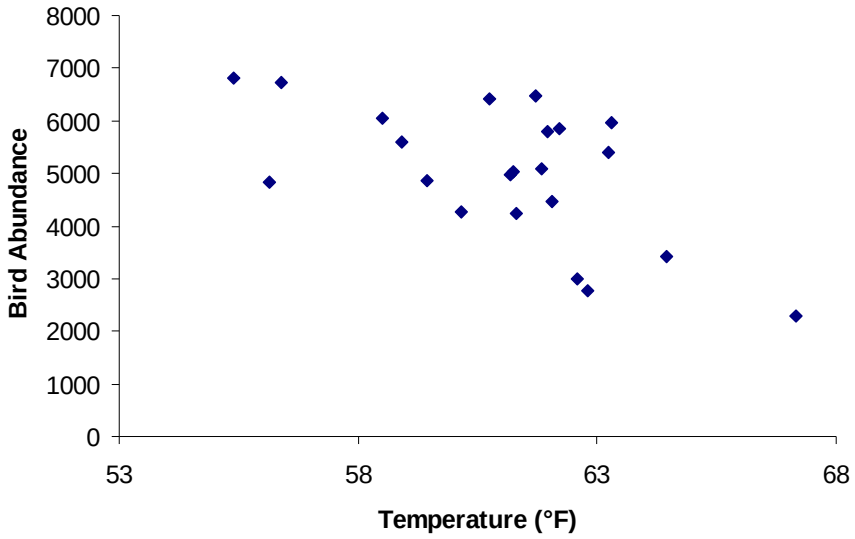
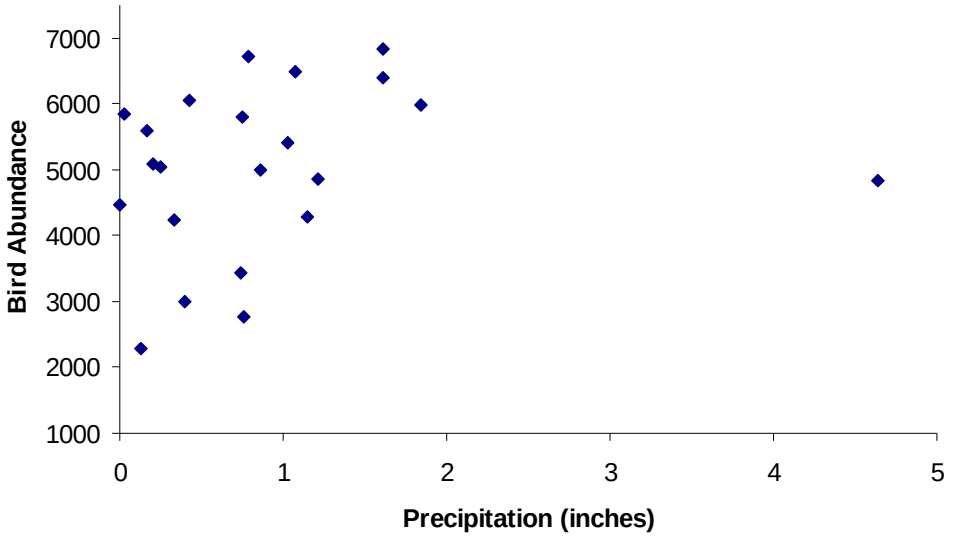



Figure 4. Relationship between bird abundance at the Idaho National Laboratory Site and the average June temperature recorded at the Central Facilities Area from 1985 to 2008.

Total precipitation in June was not significantly correlated with bird abundance ($r_{sc} = 0.33$, $n = 22$, $P > 0.10$; Figure 5). These results support previous analyses (Betlhoff and Ellsworth 1999). It is interesting that the relationship with June precipitation is not stronger since temperature and precipitation are environmental variables that are inversely related (i.e., in years with high rainfall, temperatures are typically lower due to evaporative cooling). Although only approaching statistical significance, there is an obvious trend between bird abundance and total

June precipitation. Precipitation data should be an additional variable that should be considered when interpreting changes in annual BBS abundance.

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 2008.




### Community Diversity Index

The NRF facility route had the highest values for Shannon's *H* and was identified as the most diverse bird community from the 2008 INL Site BBS (Table 3). Even though the NRF route did not have the highest species richness, there were consistently greater abundances among most species present. The remote route with the greatest diversity was Kyle Canyon, and both Tractor Flats and Circular Butte routes exhibited similar results (Table 3).

The Circular Butte route had the lowest values for Shannon's *H* among remote routes (Table 3). This route had two species (horned lark and western meadowlark) with abundances 1-2 times greater than the third most abundant. Along this route there were large numbers of these two species recorded, and very few observations of almost one half of the birds observed. This can be interpreted as low community diversity and shows the utility of considering abundance in diversity measures.

In previous INL Site BBS reports, species richness alone has represented route diversity. The Kyle Canyon route has the highest species richness observed during the 2008 surveys (Table 3). Considering both Shannon's *H* and $E_H$ indices, the Kyle Canyon route is not the most diverse bird community (Table 3). The Kyle Canyon *H* is on the upper end of the range of values calculated for all BBS routes. Shannon's $E_H$ for Kyle Canyon is on the lower end of the range of values calculated for 2008, which indicates species abundance varies greatly. Five species greatly outnumber all other species on the Kyle Canyon route, 65% of all species observed had five individuals or less which does not represent high community diversity. Considering species richness alone may misrepresent the diversity observed on BBS routes and confound the

interpretation of how diversity changes through time. Future BBS reports should rely on diversity indices for comparisons.

Table 3. Values for species richness and Shannon Diversity (*H*) and Equitability ($E_H$) indices for the 2008 Idaho National Laboratory Site Breeding Bird Surveys.

| Route | Species Richness | Shannon's *H* | Shannon's $E_H$ |
|---|---|---|---|
| Circular Butte | 13 | 1.73 | 0.67 |
| Kyle Canyon | 26 | 2.26 | 0.69 |
| Lost River | 17 | 1.80 | 0.63 |
| Tractor Flats | 24 | 1.75 | 0.55 |
| Twin Buttes | 23 | 2.07 | 0.66 |
| | | | |
| CFA | 24 | 2.34 | 0.74 |
| INTEC | 14 | 2.35 | 0.89 |
| MFC | 14 | 1.91 | 0.73 |
| NRF | 19 | 2.54 | 0.86 |
| PBF | 17 | 2.17 | 0.76 |
| RTC | 22 | 1.79 | 0.58 |
| RWMC | 22 | 2.14 | 0.69 |
| TAN | 14 | 1.66 | 0.63 |

## 2.0 SUMMARY

Results from the 2008 INL Site BBS were similar to previous years in which shrub-steppe and grassland bird species dominated observations. The total number of birds observed ($n$ = 5,592) and species richness ($n$ = 58) from all routes was near the INL Site average since 1985. Following patterns of abundance from previous INL Site BBS, horned larks were the most abundant species followed by western meadowlark, sage thrasher, Brewer's sparrow, and sage sparrow. These five species are continually among the most abundant recorded during these surveys, and considering that these species are declining in other parts of their range, the habitat quality on the INL Site appears to remain high. Investigators observed two new species in 2008: a dark-eyed junco and a red-breasted nuthatch, and similar to the 2007 survey, two bald eagles were observed in 2008. Species of special concern continue to inhabit the INL Site; during 2008, we observed six species considered imperiled or critically imperiled in Idaho: greater sage-grouse, ferruginous hawk, long-billed curlew, Franklin's gull, Brewer's sparrow, and the grasshopper sparrow.

### 2.1 Future Data Analysis

With over two decades of BBS data, long-term trend analysis for species occupying the INL Site should be conducted. Past reports have provided details regarding particular species, but no effort has been made to consider a comprehensive analysis of all BBS observation data from the INL Site. We will be organizing all INL Site BBS during 2009 to facilitate a more in-depth analysis to be included in next year's report.

### 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 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. We will investigate the patterns of habitat change 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, such as Morisita's index (Morisita 1959) or percent similarity, 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.

## 3.0 ACKNOWLEDGEMENTS

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# APPENDIX A

# SUMMARY OF SPECIES BY ROUTE 2008

Survey Route: RWMC
Survey Date: June 10, 2008

| Species | Abundance | Percentage |
|---|---|---|
| Horned Lark | 66 | 37.9 |
| Western Meadowlark | 23 | 13.2 |
| Barn Swallow | 15 | 8.6 |
| Sage Thrasher | 15 | 8.6 |
| Brewer's Sparrow | 12 | 6.9 |
| Mallard | 7 | 4.0 |
| Brown-headed Cowbird | 6 | 3.4 |
| Common Raven | 6 | 3.4 |
| Killdeer | 4 | 2.3 |
| Sage Sparrow | 4 | 2.3 |
| Mourning Dove | 2 | 1.1 |
| Red-tailed Hawk | 2 | 1.1 |
| Red-winged Blackbird | 2 | 1.1 |
| Say's Phoebe | 2 | 1.1 |
| Common Nighthawk | 1 | 0.6 |
| Dark-eyed Junco | 1 | 0.6 |
| European Starling | 1 | 0.6 |
| Grasshopper Sparrow | 1 | 0.6 |
| Long -billed Curlew | 1 | 0.6 |
| Rough-winged Swallow | 1 | 0.6 |
| Sage Grouse | 1 | 0.6 |
| Swainson's Hawk | 1 | 0.6 |

| | |
|---|---|
| *Total Individuals* | *174* |
| *Total Species* | *22* |

Survey Route: PBF
Survey Date: June 5, 2008

| Species | Abundance | Percentage |
|---|---|---|
| Western Meadowlark | 112 | 28.4 |
| Sage Thrasher | 92 | 23.3 |
| Brewer's Sparrow | 80 | 20.3 |
| Horned Lark | 31 | 7.8 |
| Sage Sparrow | 23 | 5.8 |
| Grasshopper Sparrow | 21 | 5.3 |
| Brown-headed Cowbird | 12 | 3.0 |
| Common Raven | 7 | 1.8 |
| Mourning Dove | 6 | 1.5 |
| Barn Swallow | 3 | 0.8 |
| Chipping Sparrow | 2 | 0.5 |
| Common Nighthawk | 1 | 0.3 |
| European Starling | 1 | 0.3 |
| Killdeer | 1 | 0.3 |
| Rock Wren | 1 | 0.3 |
| Swainson's Hawk | 1 | 0.3 |
| Vesper Sparrow | 1 | 0.3 |
| *Total Individuals* | *395* | |
| *Total Species* | *17* | |

Survey Route: TAN
Survey Date: June 23, 2008

| Species | Abundance | Percentage |
|---|---|---|
| Horned Lark | 339 | 44.8 |
| Sage Thrasher | 186 | 24.6 |
| Sage Sparrow | 93 | 12.3 |
| Brewer's Sparrow | 60 | 7.9 |
| Vesper Sparrow | 31 | 4.1 |
| Western Meadowlark | 20 | 2.6 |
| Common Raven | 8 | 1.1 |
| Mourning Dove | 6 | 0.8 |
| Common Nighthawk | 4 | 0.5 |
| Red-tailed Hawk | 4 | 0.5 |
| Brewer's Blackbird | 2 | 0.3 |
| Chipping Sparrow | 1 | 0.1 |
| Grasshopper Sparrow | 1 | 0.1 |
| Rock Wren | 1 | 0.1 |

| | |
|---|---|
| *Total Individuals* | *756* |
| *Total Species* | *14* |

Survey Route: RTC
Survey Date: June 12, 2008

| Species | Abundance | Percentage |
|---|---|---|
| Horned Lark | 149 | 45.7 |
| Western Meadowlark | 52 | 16.0 |
| Brewer's Sparrow | 47 | 14.4 |
| Sage Thrasher | 22 | 6.7 |
| Grasshopper Sparrow | 10 | 3.1 |
| Common Raven | 8 | 2.5 |
| Barn Swallow | 7 | 2.1 |
| Brown-headed Cowbird | 6 | 1.8 |
| Mallard | 5 | 1.5 |
| European Starling | 4 | 1.2 |
| Brewer's Blackbird | 3 | 0.9 |
| Killdeer | 3 | 0.9 |
| American Robin | 1 | 0.3 |
| Chipping Sparrow | 1 | 0.3 |
| Ferruginous Hawk | 1 | 0.3 |
| Gadwall | 1 | 0.3 |
| House Finch | 1 | 0.3 |
| Mountain Bluebird | 1 | 0.3 |
| Northern Harrier | 1 | 0.3 |
| Sage Sparrow | 1 | 0.3 |
| Swainson's Hawk | 1 | 0.3 |
| Western Tanager | 1 | 0.3 |

| | |
|---|---|
| *Total Individuals =* | *326* |
| *Total Species =* | *22* |

Survey Route: Circular Butte
Survey Date: June 3, 2008

| Species | Abundance | Percentage |
|---|---|---|
| Horned Lark | 144 | 30.9 |
| Western Meadowlark | 126 | 27.0 |
| Brewer's Sparrow | 73 | 15.7 |
| Sage Thrasher | 57 | 12.2 |
| Sage Sparrow | 26 | 5.6 |
| Mourning Dove | 14 | 3.0 |
| Brown-headed Cowbird | 7 | 1.5 |
| Common Raven | 6 | 1.3 |
| Grasshopper Sparrow | 4 | 0.9 |
| Rock Wren | 4 | 0.9 |
| Northern Harrier | 3 | 0.6 |
| Common Nighthawk | 1 | 0.2 |
| Red-tailed Hawk | 1 | 0.2 |
| *Total Individuals* | *466* | |
| *Total Species* | *13* | |

Survey Route: Lost River
Survey Date: June 16, 2008

| Species | Abundance | Percentage |
|---|---|---|
| Horned Lark | 274 | 47.2 |
| Brewer's Sparrow | 106 | 18.3 |
| Sage Thrasher | 52 | 9.0 |
| Sage Sparrow | 47 | 8.1 |
| Western Meadowlark | 47 | 8.1 |
| Common Nighthawk | 9 | 1.6 |
| Red-tailed Hawk | 9 | 1.6 |
| Common Raven | 7 | 1.2 |
| Grasshopper Sparrow | 6 | 1.0 |
| Ferruginous Hawk | 5 | 0.9 |
| Brown-headed Cowbird | 3 | 0.5 |
| Mourning Dove | 3 | 0.5 |
| Northern Harrier | 3 | 0.5 |
| Vesper Sparrow | 3 | 0.5 |
| Bald Eagle | 2 | 0.3 |
| Brewer's Blackbird | 2 | 0.3 |
| Chipping Sparrow | 2 | 0.3 |
| *Total Individuals* | *580* | |
| *Total Species* | *17* | |

Survey Route: Tractor Flats
Survey Date: June 2, 2008

| Species | Abundance | Percentage |
|---|---|---|
| Horned Lark | 222 | 22.9 |
| Western Meadowlark | 165 | 20.9 |
| Sage Thrasher | 87 | 20.3 |
| Brewer's Sparrow | 83 | 7.5 |
| Franklin's Gull | 52 | 5.0 |
| Mourning Dove | 18 | 4.7 |
| Sage Sparrow | 14 | 4.2 |
| Brown-headed Cowbird | 10 | 2.9 |
| European Starling | 6 | 1.9 |
| Rough-winged Swallow | 5 | 1.9 |
| Red-tailed Hawk | 5 | 0.9 |
| Northern Harrier | 3 | 0.8 |
| Long -billed Curlew | 3 | 0.8 |
| Common Raven | 3 | 0.8 |
| Grasshopper Sparrow | 2 | 0.8 |
| Black-billed Magpie | 2 | 0.6 |
| Western Tanager | 1 | 0.6 |
| Vesper Sparrow | 1 | 0.5 |
| Swainson's Hawk | 1 | 0.2 |
| Short-eared Owl | 1 | 0.2 |
| Savannah Sparrow | 1 | 0.2 |
| Golden Eagle | 1 | 0.2 |
| Common Nighthawk | 1 | 0.2 |
| Burrowing Owl | 1 | 0.1 |

| | |
|---|---|
| *Total Individuals* | *688* |
| *Total Species* | *24* |

Survey Route: Twin Buttes
Survey Date: June 9, 2008

| Species | Abundance | Percentage |
|---|---|---|
| Horned Lark | 139 | 28.2 |
| Western Meadowlark | 121 | 24.5 |
| Sage Thrasher | 81 | 16.4 |
| Sage Sparrow | 41 | 8.3 |
| Brewer's Sparrow | 39 | 7.9 |
| Mourning Dove | 18 | 3.7 |
| Brown-headed Cowbird | 12 | 2.4 |
| Common Raven | 12 | 2.4 |
| American Robin | 4 | 0.8 |
| Blue-gray Gnatcactcher | 4 | 0.8 |
| Grasshopper Sparrow | 4 | 0.8 |
| Swainson's Hawk | 4 | 0.8 |
| Ferruginous Hawk | 3 | 0.6 |
| Chipping Sparrow | 2 | 0.4 |
| Red-tailed Hawk | 2 | 0.4 |
| American Kestrel | 1 | 0.2 |
| Burrowing Owl | 1 | 0.2 |
| Gray Flycatcher | 1 | 0.2 |
| Lark Sparrow | 1 | 0.2 |
| Lazuli Bunting | 1 | 0.2 |
| Loggerhead Shrike | 1 | 0.2 |
| Vesper Sparrow | 1 | 0.2 |
| Sage Grouse | 0 | 0.0 |
| *Total Individuals* | *493* | |
| *Total Species* | *23* | |

Survey Route: CFA
Survey Date: June 17, 2008

| Species | Abundance | Percentage |
|---|---|---|
| Sage Thrasher | 75 | 18.2 |
| Horned Lark | 72 | 17.4 |
| Western Meadowlark | 64 | 15.5 |
| Brewer's Sparrow | 51 | 12.3 |
| European Starling | 33 | 8.0 |
| Sage Sparrow | 26 | 6.3 |
| Brown-headed Cowbird | 16 | 3.9 |
| Mourning Dove | 15 | 3.6 |
| Barn Swallow | 13 | 3.1 |
| Brewer's Blackbird | 10 | 2.4 |
| Common Raven | 9 | 2.2 |
| Common Nighthawk | 8 | 1.9 |
| Grasshopper Sparrow | 3 | 0.7 |
| Killdeer | 3 | 0.7 |
| American Kestrel | 2 | 0.5 |
| American Robin | 2 | 0.5 |
| Chipping Sparrow | 2 | 0.5 |
| Mallard | 2 | 0.5 |
| Say's Phoebe | 2 | 0.5 |
| House Finch | 1 | 0.2 |
| Lark Sparrow | 1 | 0.2 |
| Rock Wren | 1 | 0.2 |
| Vesper Sparrow | 1 | 0.2 |
| Western Tanager | 1 | 0.2 |

| | |
|---|---|
| *Total Individuals* | *413* |
| *Total Species* | *24* |

Survey Route: INTEC
Survey Date: June 19, 2008

| Species | Abundance | Percentage |
|---|---|---|
| Horned Lark | 85 | 29.0 |
| Sage Thrasher | 47 | 16.0 |
| Brewer's Sparrow | 38 | 13.0 |
| Barn Swallow | 35 | 11.9 |
| Western Meadowlark | 32 | 10.9 |
| Sage Sparrow | 18 | 6.1 |
| Common Raven | 9 | 3.1 |
| European Starling | 9 | 3.1 |
| Grasshopper Sparrow | 8 | 2.7 |
| Brewer's Blackbird | 4 | 1.4 |
| Mallard | 4 | 1.4 |
| Brown-headed Cowbird | 2 | 0.7 |
| Killdeer | 1 | 0.3 |
| Rough-winged Swallow | 1 | 0.3 |
| *Total Individuals* | *293* | |
| *Total Species* | *14* | |

Survey Route: Kyle Canyon
Survey Date: June 18, 2008

| Species | Abundance | Percentage |
|---|---|---|
| Sage Thrasher | 106 | 22.2 |
| Horned Lark | 101 | 21.1 |
| Sage Sparrow | 64 | 13.4 |
| Western Meadowlark | 63 | 13.2 |
| Brewer's Sparrow | 57 | 11.9 |
| Mourning Dove | 15 | 3.1 |
| Vesper Sparrow | 13 | 2.7 |
| Common Nighthawk | 8 | 1.7 |
| Red-tailed Hawk | 6 | 1.3 |
| Chipping Sparrow | 5 | 1.0 |
| Common Raven | 5 | 1.0 |
| Loggerhead Shrike | 5 | 1.0 |
| Rock Wren | 4 | 0.8 |
| Swainson's Hawk | 4 | 0.8 |
| Black-throated Sparrow | 3 | 0.6 |
| Ferruginous Hawk | 3 | 0.6 |
| Grasshopper Sparrow | 3 | 0.6 |
| Lark Sparrow | 3 | 0.6 |
| American Kestrel | 2 | 0.4 |
| Western Kingbird | 2 | 0.4 |
| Bullock's Oriole | 1 | 0.2 |
| Eastern Kingbird | 1 | 0.2 |
| Gray Flycatcher | 1 | 0.2 |
| Northern Mockingbird | 1 | 0.2 |
| Prairie Falcon | 1 | 0.2 |
| Red-breasted nuthatch | 1 | 0.2 |

| | |
|---|---|
| *Total Individuals* | *478* |
| *Total Species* | *26* |

Survey Route: NRF
Survey Date: June 20, 2008

| Species | Abundance | Percentage |
|---|---|---|
| Horned Lark | 91 | 30.4 |
| Western Meadowlark | 48 | 16.1 |
| Sage Thrasher | 39 | 13.0 |
| Brewer's Sparrow | 25 | 8.4 |
| Sage Sparrow | 22 | 7.4 |
| Vesper Sparrow | 16 | 5.4 |
| Barn Swallow | 15 | 5.0 |
| Mourning Dove | 10 | 3.3 |
| Common Raven | 9 | 3.0 |
| Yellow-head Blackbird | 6 | 2.0 |
| Brown-headed Cowbird | 4 | 1.3 |
| Brewer's Blackbird | 3 | 1.0 |
| Killdeer | 3 | 1.0 |
| Eastern Kingbird | 2 | 0.7 |
| European Starling | 2 | 0.7 |
| House Finch | 1 | 0.3 |
| Rock Wren | 1 | 0.3 |
| Ruddy Duck | 1 | 0.3 |
| Wilson's Phalarope | 1 | 0.3 |
| *Total Individuals* | *299* | |
| *Total Species* | *19* | |

Survey Route: MFC
Survey Date: June 4, 2008

| Species | Abundance | Percentage |
|---|---|---|
| Horned Lark | 81 | 35.1 |
| Western Meadowlark | 70 | 30.3 |
| European Starling | 28 | 12.1 |
| Brown-headed Cowbird | 11 | 4.8 |
| American Wigeon | 9 | 3.9 |
| Killdeer | 5 | 2.2 |
| Sage Thrasher | 5 | 2.2 |
| Brewer's Sparrow | 4 | 1.7 |
| Mallard | 4 | 1.7 |
| Mourning Dove | 4 | 1.7 |
| Gadwall | 3 | 1.3 |
| Sage Sparrow | 3 | 1.3 |
| Barn Swallow | 2 | 0.9 |
| Say's Phoebe | 2 | 0.9 |

| | |
|---|---|
| *Total Individuals =* | *231* |
| *Total Species =* | *14* |