

# Idaho National Laboratory 2007 Breeding Bird Surveys



# 2007 Breeding Bird Survey on the Idaho National Laboratory

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## EXECUTIVE SUMMARY

Annual breeding bird surveys have been conducted on the Idaho National Laboratory (INL) since 1985 (no surveys were conducted in 1992 and 1993) to monitor bird populations. In 2007, surveys were conducted in late May and early June along 13 permanently established routes, five of which are part of the U.S. Geological Survey's nationwide program and eight around facilities specific to the INL. A total of 5,412 birds were observed during the 2007 survey which is slightly above the 1985-2007 average of 4,991 birds. A total of 69 different species were documented during the 2007 BBS which is above the average of 59 species recorded since 1985.

Similar patterns of species abundance were found with horned lark (*Eremophila alpestris*; n = 1416) the most abundant species in 2007 and previous years. Western meadowlark (*Sturnella neglecta*; n = 987), Brewer's sparrow (*Spizella breweri*; n = 528), sage sparrow (*Amphispiza belli*; n = 459), and sage thrasher (*Oreoscoptes montanus*; n = 410) constitute the next four most abundant species. In the 21 years of INL breeding bird surveys, these five species have been the most abundant 16 times, and are among the six most abundant species recorded in all years. Considering the declines observed in sagebrush obligate species throughout the intermountain west, this trend of abundance suggests the quality of INL sagebrush steppe habitat remains high.

The 2007 survey yielded four species never recorded during the INL survey. A single observation of a greater scaup (*Aythya marila*), bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), and turkey vulture (*Cathartes aura*) was made this year. This is the first documented field observation of a bald eagle observed on INL during spring.

Species observed during the 2007 BBS that have been assigned an Idaho state ranking of critically imperiled or imperiled include greater sage-grouse (*Centrocercus urophasianus*; n=4), ferruginous hawk (*Buteo regalis*; n=8), long-billed curlew (*Numenius americanus*; n=7), Franklin's gull (*Larus pipixcan*; n=178), Brewer's sparrow (n=528), and the grasshopper sparrow (*Ammodramus savannarum*; n=102).

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## ACRONYMS

BBS	Breeding Bird Survey
CFA	Central Facilities Area
CWCS	Comprehensive Wildlife Conservation Strategy
INL	Idaho National Laboratory
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
SGCN	Species of Greatest Conservation Need
TAN	Test Area North
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

## 1. INTRODUCTION

The North American Breeding Bird Survey (BBS) was developed by the U.S. Fish and Wildlife Service (USFWS) in conjunction with the Canadian Wildlife Service to initiate the collection of data to document bird population trends. Pilot surveys began in 1965 and immediately expanded to cover the U.S and Canada east of the Mississippi and by 1968 included the entire North American Continent (Bystrak 1981, Robbins et al. 1986). The North American BBS program is managed by the U.S. Geological Survey (USGS) and currently consists of over 4100 routes with approximately 3000 sampled each year.

BBS survey data continue to provide some of the only long-term bird population information covering broad geographic scales. These data have been used to estimate population changes for hundreds of bird species, and remain the primary data source 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 amongst researchers (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 undeniably provides a wealth of information about North American bird population trends that form the foundation for broad conservation assessments extending beyond local jurisdictional boundaries.

The Idaho National Laboratory (INL) has five permanent official BBS routes originally established in 1985 (hereafter referred to as *remote routes*) and eight additional survey routes around INL facilities (hereafter referred to as *facility routes*). The facility routes were developed to monitor avifauna populations in proximity to anthropogenic activities and disturbances. The annual BBS survey provides land managers with breeding bird population trend information relative to the activities conducted on the INL. This report summarizes the results from the 2007 BBS survey, and compares observed species abundance across survey routes with long-term averages.

## 2. STUDY AREA

The INL is a Department of Energy facility encompassing almost 900 mi<sup>2</sup> (2315 km<sup>2</sup>) located on the Upper Snake River Plain in southeast Idaho (Figure 1). The INL was designated as a National Environmental Research Park in 1975 to facilitate field research assessing environmental impacts from nuclear energy development technologies. The INL lies within portions of Bingham, Bonneville, Butte, Clark, and Jefferson counties.

Topography across the INL is mostly flat with an average elevation of 4985 ft (1520 m) above sea level. Other than minor topographic variation created by basalt outcrops, the only significant relief occurs around East and Middle Buttes and the southern extent of the Lemhi mountain range located on the northwest corner of the INL.

Anderson et al. (1996) provide a detailed description of the climate, geology, and vegetation communities found on the INL. In general, the INL is located in a semi-arid desert that experiences hot, dry summers and cold winters. Annually the INL receives on average eight inches (20 cm) of precipitation with a peak common in the spring. The geology is dominated by Quaternary basalt lava flows producing the outcrops and lava tubes found across the site today.

Aeolian soils consisting primarily of silt loam and sandy loam are the most common soil type found throughout the INL, while alluvial soils are more commonly found along the Big Lost River flood plain. The INL 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, while other sagebrush species, green rabbitbrush (*Chrysothamnus viscidiflorus*), spiny hopsage (*Grayia spinosa*) shadscale (*Atriplex confertifolia*) and winterfat (*Krascheninnikovia lanata*) can be commonly found. The most common native grasses include thickspiked wheatgrass (*Elymus laceolatus*), bottlebrush squirreltail (*Elymus elymoides*), Indian ricegrass (*Achnatherum hymenoides*), and needle-and-thread grass (*Hesperostipa comata*).

Very little surface water is present on the INL during the spring and summer. The Big Lost River and Birch Creek drainages are both diverted upstream for agricultural purposes and consequently little if any stream water reaches the INL. During years of high flow volume the Big Lost River can reach the INL and drains into an ephemeral wetland known as the Lost River Sinks. The Lost River Sinks wetland provides the only substantial water source for waterfowl and shorebirds on the INL, however a number of man-made waste treatment ponds near facilities also provide aquatic habitat for migrating birds.

The Idaho Comprehensive Wildlife Conservation Strategy (CWCS) 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 (SGCN) (Appendix B: Idaho Department of Fish and Game 2005). The CWCS also identifies Idaho Important Bird Areas (Appendix H: Idaho Department of Fish and Game 2005), and the INL has received such designation.

### 3. METHODS

#### 3.1 Data Collection

The BBS is a roadside count of all birds seen or heard along predefined routes. Thirteen BBS routes (Figure 1) were surveyed between May 22 and June 12, 2007, consisting of five official USGS BBS remote routes in addition to eight facility routes developed specifically for the INL. Each remote survey route is 24.5 miles (39.2 km) long with 50 systematically spaced sampling locations located every 0.25 miles (0.4 km). The facility routes vary in total length depending on the size of the facility, and sampling locations are spaced approximately 0.2 miles (0.4 km) apart.

The North American BBS protocols provided by the USGS Patuxent Wildlife Research Center were followed during these surveys. At each sampling location, a trained observer records every bird species visually observed within a quarter mile radius or heard (song) during a 3-minute time period. Any bird that was suspected of being counted on the previous stop was not recorded a second time at the next sequential stop. A number of additional data such as temperature, wind speed, and sky condition are recorded at the beginning and end of each survey route and each route is only surveyed when weather conditions are appropriate (e.g., no heavy rains or strong wind). BBS surveys begin a half-hour before sunrise and can continue for up to 6 hours until the route is complete. The total number of cars that pass during the 3-min sampling period are recorded on all remote routes, and if background noise becomes loud enough to interfere with audible detection it is also noted.



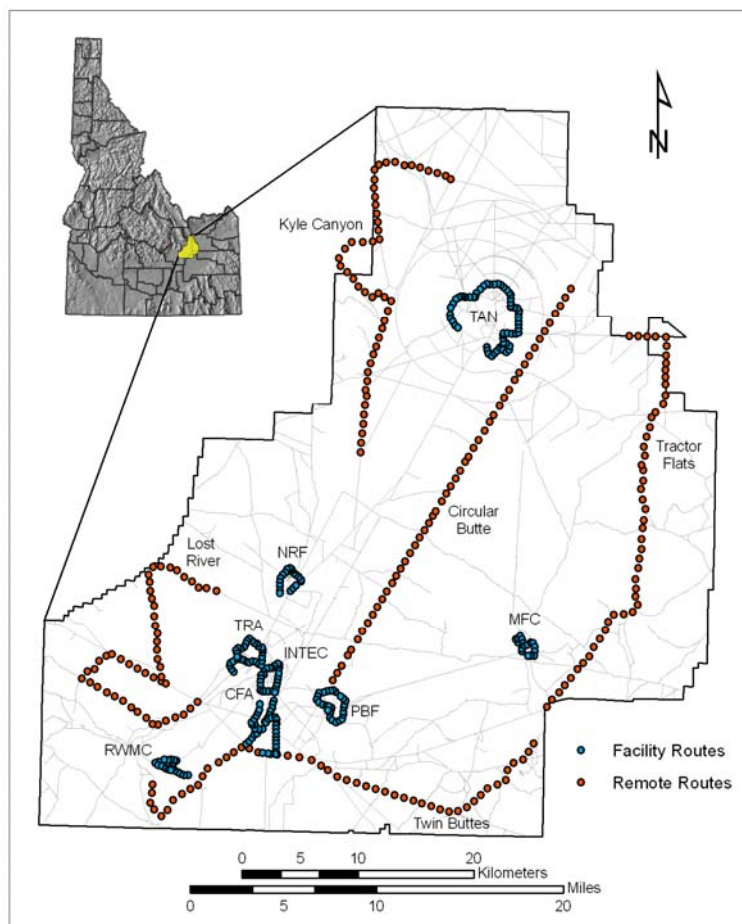


Figure 1. The INL and BBS route locations.

### 3.2 Bird Abundance Correlation

In previous INL BBS reports, environmental abiotic factors were investigated in an attempt to explain the variation in observed bird abundance. Belthoff et al. (1998) found a relationship between cool and wet June weather and bird abundance for 1985-1991. Belthoff and Ellsworth (1999) found that bird abundance was significantly negatively correlated with mean June temperature, where higher bird abundance corresponded to lower temperatures. A relationship between bird abundance and June precipitation was noted, and although not statistically significant, the removal of an outlier from 1995 would have resulted in a significant p-value (Belthoff and Ellsworth 1999). Belthoff and Ellsworth (1999) used the Spearman rank correlation coefficient to identify correlations with June temperature and precipitation, and the same statistic was recalculated this year to compare current relationships in the 2007 abundance data.

The Spearman rank correlation 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. The 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.

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

In cases where two data values have a tied rank, a different equation is used to account for the 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 ( $(r_s)_c$ ).

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

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

Mean June temperature and total June precipitation data collected since 1985 at the Central Facilities Area (CFA) were used to test bird abundance correlations. Statistical significance was calculated using a two-tailed hypothesis with an alpha of 0.05. The June precipitation data contained a tied ranking, and the corrected equation described above was calculated for these data.

### 3.3 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. Higher species diversity is often interpreted as a stable, functioning system and increasing diversity is the goal of many management activities.

Species diversity indices are a mathematical way to quantify community composition. There is a number of diversity indices commonly used in ecology and each has particular strengths depending on the data and the questions. 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 with a single individual observed, richness will be high but may not be comparable to another community with the same number of species and large abundances across all species. Diversity indices that consider both species richness and species abundance may provide a more useful measure of community diversity.

One of the most popular diversity indices used by biologists is the Shannon diversity index ( $H$ ) (Shannon 1948). Shannon's diversity index takes into account both species richness ( $S$ ) and relative abundance of each species present in the 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 multiplied by the natural logarithm of this proportion ( $\ln p_i$ ). 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 that can be derived is Shannon's Equitability ( $E_H$ ). Shannon's Equitability represents a measure of evenness which is how similar species abundance is among the community.  $E_H$  ranges from 0-1 with one representing a completely even community where all species abundances are equal.

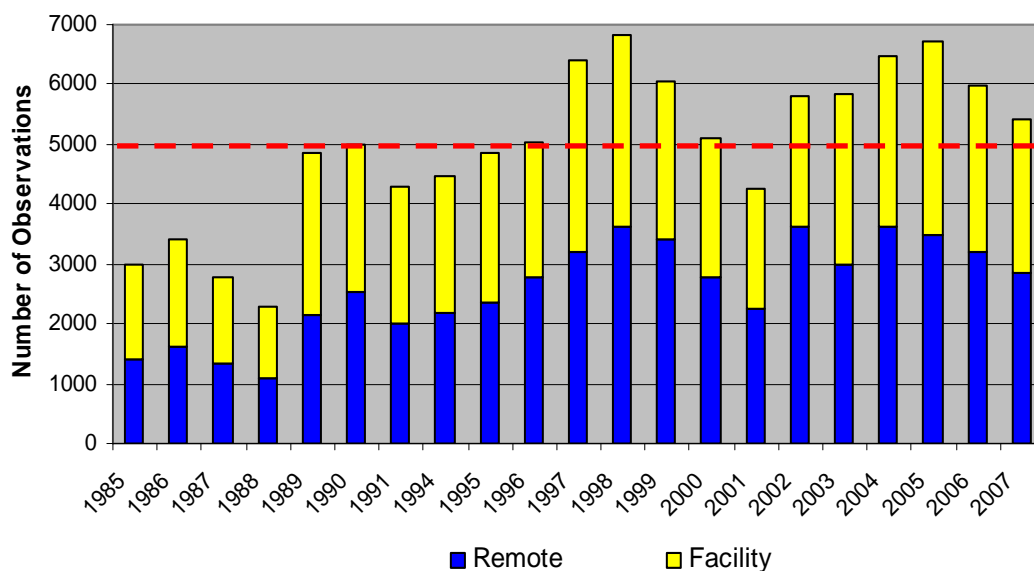
$$E_H = H / \ln S$$

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 community diversity index values reflect BBS route diversity.

## 4. RESULTS AND DISCUSSION

### 4.1 Summary Statistics

A total of 5412 birds were documented during this year's survey. The 2007 total abundance was greater than the 1985-2007 average of 4991 birds (Figure 2). No BBS surveys were conducted on the INL in 1992 or 1993. There were a total of 69 unique species (i.e., species richness) recorded during this year's survey. This year is above the average species richness of 59 for all BBS routes combined. Of the remote routes, only Kyle Canyon is slightly below the average of 25 species with 22 recorded this year, and all other remote routes were above the average richness.



**Figure 2. Total bird observations the 2007 INL BBS. The dashed red line is the mean number of observations from 1985-2007.**

The Tractor Flats remote route had the greatest bird abundance with 853 individuals observed (Table 1). Since 1985 the Tractor Flats route has the greatest average abundance of all BBS

routes with mean bird abundance of 711 individuals. This year the Tractor Flats route also contained the greatest species richness with 30 different species recorded.

Horned lark (*Eremophila alpestris*) was the most abundant species observed during the 2007 survey with 1416 individuals counted representing 26% of all observations (Table 2). Horned Lark is continually the most abundant species recorded during the INL BBS. This species was observed on 83% (408) of the total stops made during the entire survey.

The five most abundant birds are horned lark (n = 1416), western meadowlark (*Sturnella neglecta*; n = 987), Brewer's sparrow (*Spizella breweri*; n = 528), sage sparrow (*Amphispiza belli*; n = 459), and sage thrasher (*Oreoscoptes montanus*; n = 410). These five species comprise over 72% of all observations made in 2007. These five species were also the most abundant in the 2006 BBS survey, and were observed on every remote and facility route surveyed. In the 21 years of INL breeding bird surveys, these five species have been the most abundant 16 times, and are among the six most abundant species recorded in all years. Horned larks, western meadowlarks, Brewer's sparrow, and Sage sparrows have all experienced significant population declines in Breeding Bird Surveys across their range (Peterjohn and Sauer 1999). Given the fact that many additional sagebrush obligates are exhibiting population declines due to suspected habitat loss and disturbance, it is encouraging to see consistently high abundance among these species.

**Table 1. Observed bird abundance and species richness summary data for each survey route from the 2007 INL BBS.**

Route	Stops	Species	Abundance
<i>Remote Routes</i>			
Lost River	50	19	525
Circular Butte	50	20	505
Kyle Canyon	50	22	475
Tractor Flats	50	30	853
Twin Buttes	50	28	474
<b>Subtotal</b>	<b>250</b>	<b>51*</b>	<b>2832</b>
<i>Facility Routes</i>			
CFA	42	24	430
INTEC	25	24	231
MFC	18	20	208
NRF	20	24	231
PBF	28	15	307
RTC	32	26	346
RWMC	19	27	185
TAN	60	23	642
<b>Subtotal</b>	<b>244</b>	<b>51*</b>	<b>2580</b>
<b>Total</b>	<b>494</b>	<b>69*</b>	<b>5412</b>

\* Many species are counted on multiple routes, and these data reflect each unique species observation

**Table 2. The 2007 INL BBS Species observation summary for all thirteen routes. The percentage of total observations and stops are listed.**

Common Name	Scientific Name	n	%	Routes <sup>1</sup>	Stops <sup>2</sup>	%
Horned Lark	<i>Eremophila alpestris</i>	1416	26.16	5, 8	408	82.6
Western Meadowlark	<i>Sturnella neglecta</i>	987	18.24	5, 8	376	76.1
Brewer's Sparrow	<i>Spizella breweri</i>	528	9.76	5, 8	288	58.3
Sage Sparrow	<i>Amphispiza belli</i>	459	8.48	5, 8	256	51.8
Sage Thrasher	<i>Oreoscoptes montanus</i>	410	7.58	5, 8	307	62.1
Brown-headed Cowbird	<i>Molothrus ater</i>	193	3.57	5, 8	116	23.5
Franklin's Gull	<i>Larus pipixcan</i>	178	3.29	1, 0	6	1.2
Mourning Dove	<i>Zenaida macroura</i>	173	3.20	4, 6	91	18.4
Vesper Sparrow	<i>Pooecetes gramineus</i>	150	2.77	5, 6	85	17.2
Canada Goose	<i>Branta canadensis</i>	112	2.07	1, 2	5	1.0
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	102	1.88	5, 7	91	18.4
Common Raven	<i>Corvus corax</i>	89	1.64	5, 7	51	10.3
Barn Swallow	<i>Hirundo rustica</i>	75	1.39	2, 8	30	6.1
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	65	1.20	1, 5	20	4.0
European Starling	<i>Sturnus vulgaris</i>	57	1.05	1, 5	22	4.5
Red-tailed Hawk	<i>Buteo jamaicensis</i>	39	0.72	5, 6	35	7.1
N. Rough-wing Swallow	<i>Stelgidopteryx serripennis</i>	28	0.52	2, 3	11	2.2
Gray Flycatcher	<i>Empidonax wrightii</i>	27	0.50	2, 0	11	2.2
Killdeer	<i>Charadrius vociferus</i>	25	0.46	1, 5	20	4.0
Loggerhead Shrike	<i>Lanius ludovicianus</i>	22	0.41	5, 1	17	3.4
American Robin	<i>Turdus migratorius</i>	22	0.41	2, 6	18	3.6
Chipping Sparrow	<i>Spizella passerina</i>	22	0.41	4, 4	18	3.6
Rock Pigeon	<i>Columba livia</i>	18	0.33	1, 3	6	1.2
Mallard	<i>Anas platyrhynchos</i>	16	0.30	0, 4	8	1.6
Western Kingbird	<i>Tyrannus verticalis</i>	14	0.26	5, 2	9	1.8
Say's Phoebe	<i>Sayornis saya</i>	13	0.24	1, 6	13	2.6
House Finch	<i>Carpodacus mexicanus</i>	13	0.24	0, 5	10	2.0
Northern Harrier	<i>Circus cyaneus</i>	12	0.22	1, 2	10	2.0
House Sparrow	<i>Passer domesticus</i>	12	0.22	0, 3	3	0.6
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	9	0.17	1, 2	3	0.6
Black-necked Stilt	<i>Himantopus mexicanus</i>	8	0.15	0, 1	1	0.2
Ferruginous Hawk	<i>Buteo regalis</i>	8	0.15	2, 0	7	1.4

**Table 2. Continued.**

Common Name	Scientific Name	n	%	Routes <sup>1</sup>	Stops <sup>2</sup>	%
Golden Eagle	<i>Aquila chrysaetos</i>	8	0.15	3, 1	8	1.6
Long-billed Curlew	<i>Numenius americanus</i>	7	0.13	1, 0	4	0.8
Common Nighthawk	<i>Chordeiles minor</i>	7	0.13	1, 4	7	1.4
Cliff Swallow	<i>Hirundo pyrrhonota</i>	7	0.13	0, 3	3	0.6
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>	7	0.13	0, 3	3	0.6
Cinnamon Teal	<i>Anas cyanoptera</i>	6	0.11	0, 2	2	0.4
Rock Wren	<i>Salpinctes obsoletus</i>	6	0.11	2, 1	4	0.8
Gadwall	<i>Anas strepera</i>	5	0.09	0, 3	3	0.6
Willet	<i>Catoptrophorus semipalmatus</i>	5	0.09	1, 1	3	0.6
Northern Shoveler	<i>Anas clypeata</i>	4	0.07	0, 2	2	0.4
Greater Sage-grouse	<i>Centrocercus urophasianus</i>	4	0.07	2, 1	3	0.6
Lark Sparrow	<i>Chondestes grammacus</i>	4	0.07	2, 1	3	0.6
Prairie Falcon	<i>Falco mexicanus</i>	3	0.06	1, 1	3	0.6
Wilson's Phalarope	<i>Phalaropus tricolor</i>	3	0.06	0, 3	3	0.6
Green-tailed Towhee	<i>Pipio chlorurus</i>	3	0.06	2, 0	3	0.6
Ruddy Duck	<i>Oxyura jamaicensis</i>	2	0.04	0, 1	1	0.2
American Coot	<i>Fulica americana</i>	2	0.04	0, 1	1	0.2
Swainson's Hawk	<i>Buteo swainsoni</i>	2	0.04	2, 0	2	0.4
Short-eared Owl	<i>Asio flammeus</i>	2	0.04	2, 0	2	0.4
Northern Flicker	<i>Colaptes auratus</i>	2	0.04	1, 0	1	0.2
Eastern Kingbird	<i>Tyrannus tyrannus</i>	2	0.04	1, 0	2	0.4
Black-billed Magpie	<i>Pica pica</i>	2	0.04	2, 0	2	0.4
Mountain Bluebird	<i>Sialia currucoides</i>	2	0.04	0, 2	2	0.4
Savannah Sparrow	<i>Passerculus sandwichensis</i>	2	0.04	1, 0	1	0.2
Common Goldeneye	<i>Bucephala clangula</i>	1	0.02	0, 1	1	0.2
Greater Scaup	<i>Aythya marila</i>	1	0.02	0, 1	1	0.2
Bald Eagle	<i>Haliaeetus leucocephalus</i>	1	0.02	1, 0	1	0.2
Osprey	<i>Pandion haliaetus</i>	1	0.02	0, 1	1	0.2
American Kestrel	<i>Falco sparverius</i>	1	0.02	1, 0	1	0.2
Common Poorwill	<i>Phalaenoptilus nuttallii</i>	1	0.02	0, 1	1	0.2
Forster's Tern	<i>Sterna forsteri</i>	1	0.02	1, 0	1	0.2

**Table 2. Continued.**

Common Name	Scientific Name	n	%	Routes <sup>1</sup>	Stops <sup>2</sup>	%
Great Horned Owl	<i>Bubo virginianus</i>	1	0.02	0, 1	1	0.2
Dusky Flycatcher	<i>Empidonax oberholseri</i>	1	0.02	1, 0	1	0.2
American Crow	<i>Corvus brachyrhynchos</i>	1	0.02	1, 0	1	0.2
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	1	0.02	1, 0	1	0.2
Black-throated Sparrow	<i>Amphispiza bilineata</i>	1	0.02	1, 0	1	0.2
Turkey Vulture	<i>Cathartes aura</i>	1	0.02	1, 0	1	0.2

<sup>1</sup> The first data value represents the number of remote routes where the species occurred, and the second value represents the number of facility routes where the species occurred

<sup>2</sup> The total number of stops at which this species was observed (n = 494)

#### 4.2 Rare Observations and Species of Special Concern

New species to the INL BBS have been found throughout the duration of these surveys, and additional species were added to the list this year. This survey yielded four new species observations never recorded in prior surveys on the INL. A single greater scaup (*Aythya marila*), bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), and turkey vulture (*Cathartes aura*) were observed during the 2007 BBS.

The sagebrush steppe habitat on the INL is relatively pristine and undisturbed and continually supports a high abundance of species that are showing signs of decline in comparable areas in the western U.S. There were six species observed during the 2007 BBS that have been assigned an Idaho state ranking of critically imperiled or imperiled (Idaho Conservation Data Center 2008) including greater sage-grouse (*Centrocercus urophasianus*; n=4), ferruginous hawk (*Buteo regalis*; n=8), long-billed curlew (*Numenius americanus*; n=7), Franklin's gull (*Larus pipixcan*; n=178), Brewer's sparrow (n=528), and the grasshopper sparrow (*Ammodramus savannarum*; n=102).

## 5. SPECIES ASSEMBLAGE SUMMARY

Observed bird assemblage proportions can be considered in the context of the habitat composition within a region to provide useful insight about general ecological health. For example, if a study area contains large shrubland and grassland habitat patches and the corresponding bird assemblage observations are low, this may be an indication the local population is threatened or experiencing population declines.

The most abundant species assemblage was the shrub-steppe and grassland category representing 59% of all BBS observations (Figure 3). The shrub-steppe and grassland bird assemblage always dominates the observed bird abundance as the majority of the INL is composed of shrub-steppe and grassland habitats. The second most abundant species assemblage is sagebrush obligates representing 26% of all observations. Given the regional concern for sagebrush obligate species, it is encouraging to see that obligates are doing well on the INL.

### 5.1 Shrub-steppe and Grassland

This species assemblage has always yielded the greatest number of observations in past BBS and continues to dominate the observations in 2007 with 3231 individuals representing 59% of the total observations. Common shrub-steppe and grassland species include horned lark, western meadowlark, brown-headed cowbird (*Molothrus ater*), and vesper sparrows (*Pooecetes gramineus*). Horned lark (n = 1416) and western meadowlark (n = 987) were the most abundant species within this assemblage, and were also the top two abundant species for the entire survey. Horned lark abundance has steadily risen across the INL as wildfire continues to impact and alter the plant communities across the site converting shrub dominated communities into more grassland dominated vegetation communities.

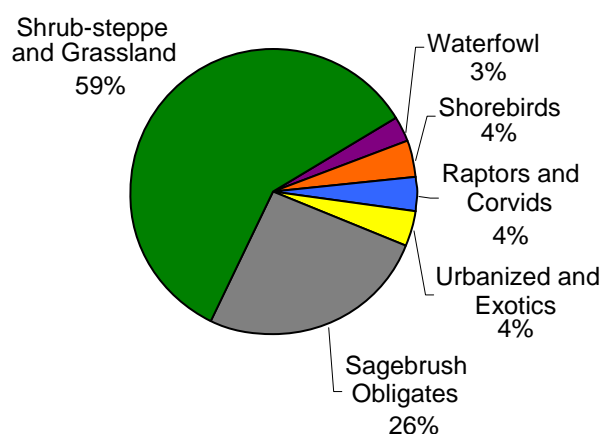


Figure 3. Species assemblage summary for the 2007 INL BBS of remote and facility routes combined.

### 5.2 Sagebrush Obligates

The sagebrush obligate assemblage had the second largest species abundance with 1401 individuals representing 26% of all observations. This assemblage contains four species including Brewer's sparrow, sage sparrow, sage thrasher, and greater sage-grouse. Brewer's sparrow was the most abundant sagebrush obligate with 528 individuals counted. These data suggest that the sagebrush obligates are thriving on the INL which contains fairly undisturbed sagebrush-steppe habitat in the Intermountain west. In many other western states, sagebrush obligates are facing significant habitat loss and conversion, and consequently sagebrush obligate species are showing population declines. The population trend across the INL shows a consistent high abundance of sagebrush obligates (Vilord 2007).

### 5.3 Raptors and Corvids

The raptor and corvid assemblage contained 193 observations representing 4% of the total observations. Twelve species of raptors (eagles, hawks, falcons, and owls) were recorded. Red-tailed hawk (*Buteo jamaicensis*) was the most abundant raptor species detected with 39



individuals, and marks the highest abundance ever recorded for this species during the INL BBS. Other notable observations include the first INL BBS records for bald eagle, osprey, and turkey vulture.

The Corvidae family includes ravens and crows, magpies, and jays. The common raven (*Corvus corax*) was the most abundant species within this assemblage with 89 individuals. The raven population on the INL has shown a steady increase and the 2007 raven abundance ties 2005 for the highest numbers ever recorded. Recent research has shown that ravens negatively impact sage-grouse nest success (Coates 2007), and the continued increase in raven abundance may become a concern as sage-grouse populations exhibit declines across the western U.S.

#### **5.4 Urbanized and Exotics**

This species assemblage represents birds associated with urban or human-altered environments, and are most commonly found around facilities. Example species include European starling (*Sturnus vulgaris*), rock pigeon (*Columba livia*), and American robin (*Turdus migratorius*). This assemblage constitutes 4% of the total observations in 2007 with 210 total individuals. Barn swallows (*Hirundo rustica*) were the most abundant species in this assemblage with 75 individuals followed closely by European starlings with 57 individuals.

#### **5.5 Waterfowl**

Waterfowl are commonly reported on the BBS despite the fact the INL contains very little standing water. With the exception of the ephemeral and sporadic presence of the Big Lost River and Sinks wetland, the only standing water bodies on the INL consist of wastewater treatment ponds found near facilities. These man-made ponds serve as stopover locations for migrating birds and a number of different species have been observed using these sites since 1985.

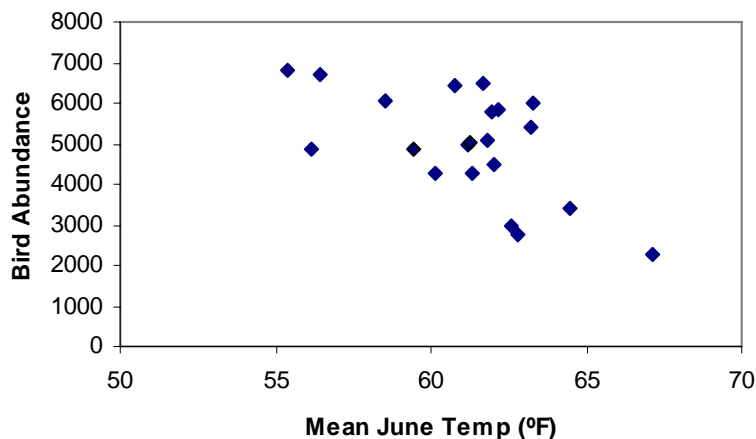
There were nine waterfowl species documented with an abundance of 149 individuals representing about 3% of the total observations. The number of waterfowl observations was primarily driven by a single large flock of Canada geese ( $n = 95$ ) from the Test Area North (TAN) survey route. Many species within this assemblage included only a few individuals and contributed the lowest assemblage proportion of total bird observations.

#### **5.6 Shorebirds**

The shorebird assemblage including grebes, gulls, and waders had low combined abundance with eight species detected this year. There were a total of 228 individuals representing 4% of the total BBS observations. Due to the lack of standing water across the INL, most observations within the shorebird assemblage occurred in proximity to waste ponds at facilities. The total number of observations was influenced by two large flocks of Franklin's gulls (60 and 81 birds) counted along the Tractor Flats route representing 62% of all shorebird observations. The close proximity of the Tractor Flats route to Mud Lake agricultural areas can explain why so many gulls were observed. Without the inclusion of Franklin's gull, this assemblage would only contribute about 1% of all observations.

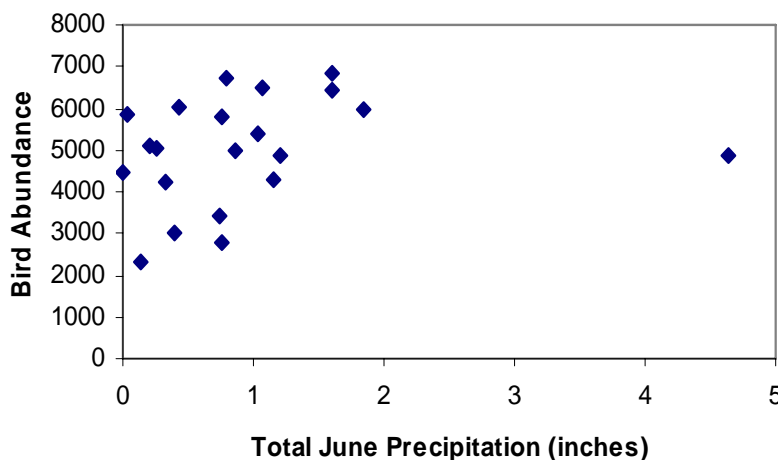
## 6. BIRD ABUNDANCE CORRELATION

Observed bird abundance from 2007 showed a significant negative correlation ( $r_s = -0.469$ ,  $N = 21$ ,  $P < 0.5$ ) to mean June temperature (Figure 4). This result supports previous finding from the INL BBS (Belthoff et al. 1998, Belthoff and Ellsworth 1999), suggesting 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 than comparisons to cooler years. The correlation with June temperature provides a mechanism to assist with the interpretation of changes to bird abundance across the INL, and may help explain observed annual variability in BBS results.



**Figure 4. The plotted relationship between observed INL BBS abundance (all years) and the average June temperature recorded at the CFA.**

Total June precipitation was not significantly correlated with bird abundance ( $r_{sc} = 0.368$ ,  $N = 21$ ,  $P < 0.20$ ). Since there was an obvious outlier in the precipitation data in 1995 with almost five inches of rainfall (Figure 5), this data point was removed from the dataset and the Spearman rank correlation was recalculated. The result with the outlier removed remained not significant, but was approaching significance ( $r_{sc} = 0.395$ ,  $N = 20$ ,  $P < 0.10$ ). These results support what Belthoff and Ellsworth (1999) found from previous analyses.



**Figure 5. The plotted relationship between observed INL BBS abundance (all years) and total June precipitation recorded at the CFA.**

It is surprising that the relationship with June precipitation is not stronger since temperature and precipitation are often identified as inversely related environmental variables. In years where there is a lot of rainfall, temperatures are typically lower due to evaporative cooling. Although only approaching statistical significance, there is an obvious visual relationship 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.

## 7. COMMUNITY DIVERSITY INDEX

The CFA facility route showed the highest values for both Shannon's  $H$  and  $E_H$  and was identified as the most diverse bird community from the 2007 INL BBS (Table 3). Even though the CFA route does not have the highest species richness, there are consistently greater abundances among most species present. However, it is important to note that a number of birds detected along the CFA route are urbanized or exotic species, and high diversity does not always directly correspond to ecological health found with native species diversity. There are not quantitative thresholds to aid in the ranking of diversity index results. The remote route with the greatest diversity appears to be the Twin Buttes route, but both Tractor Flats and Kyle Canyon exhibited similar results.

The Lost River route had the lowest values for both Shannon's  $H$  and  $E_H$  (Table 3). The Lost River route had two species (horned lark and western meadowlark) with abundances 2-4 times greater than the third most abundant, and 42% of the remaining species had only a single individual detected as reflected in the lowest calculated  $E_H$ . So along the Lost River route there were large numbers of two species, and very few observations of almost half of the birds observed. This can be interpreted as low community diversity and shows the utility of considering abundance in diversity measures.

**Table 3. Shannon Diversity ( $H$ ) and Equitability ( $E_H$ ) index results for the 2007 INL BBS.**

Route	Species Richness	Shannon's $H$	Shannon's $E_H$
Circular Butte	20	1.88	0.63
Kyle Canyon	22	2.28	0.74
Lost River	19	1.78	0.60
Tractor Flats	30	2.28	0.67
Twin Buttes	28	2.34	0.70
CFA	24	2.71	0.85
INTEC	24	2.51	0.79
MFC	19	2.08	0.71
NRF	24	2.50	0.79
PBF	15	2.02	0.75
RTC	26	2.18	0.67
RWMC	27	2.65	0.80
TAN	23	2.09	0.67

In previous INL BBS reports, species richness alone has represented route diversity. The Tractor Flats route has the highest species richness observed during the 2007 surveys (Table 1). Considering both Shannon's  $H$  and  $E_H$  indices, the Tractor Flats route is not the most diverse bird community (Table 3). The Tractor Flats  $H$  is on the upper end of the range of values calculated for all BBS routes, but is not the highest value from the survey or even the highest among remote routes. Shannon's  $E_H$  for Tractor flats is on the lower end of the range of values calculated for 2007 which indicates species abundance varies greatly. Referring to the Tractor Flats summary data in Appendix A, three species greatly outnumber all other species (more than double), 50% 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 has/is changing over time. Future BBS reports should rely on diversity indices to compare communities.

## 8. SUMMARY

The results from the 2007 INL BBS were similar to previous years where shrub-steppe and grassland bird species dominated the observations. The total bird observations ( $n = 5412$ ) and species richness ( $n = 69$ ) from all routes is above the INL average since 1985. Following common patterns of abundance from previous INL BBS, horned larks were the most abundant species followed by western meadowlark, Brewer's sparrow, sage sparrow, and sage thrasher. These five species are continually among the most abundant detected during these surveys, and considering that these species are declining in other parts of their range, the habitat quality on the INL appears to remain high. Four species (greater scaup, bald eagle, osprey, and turkey vulture) were recorded for the first time during this year's survey. The INL continues to support species of special concern and this year six species (greater sage-grouse, ferruginous hawk, long-billed curlew, Franklin's gull, Brewer's sparrow, and grasshopper sparrow) listed by the State of Idaho as imperiled or critically imperiled were documented on site.

## 9. FUTURE DATA ANALYSIS

With over two decades of BBS data, long-term INL-specific species trend analysis should be conducted for each species. 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. Before the complete dataset can be analyzed, all of the data have to be organized into a single database. Since the INL BBS surveys have been conducted by different organizations since 1985, database formats and file naming conventions vary. We will be organizing all INL BBS during 2008 to facilitate a more in depth analysis to be included in next year's report.

### 9.1 *Landscape Change and Habitat Variation*

The habitat and vegetation communities across the INL are a diverse mosaic of sagebrush-steppe habitat. The INL has experienced some large natural disturbances (e.g. wildfire) which have caused changes in vegetation community composition and distribution across the site. It is not well understood how bird populations respond to alterations of habitat composition and distribution across the landscape (Knick and Rotenberry 2002), and habitat fragmentation can influence local population dynamics. Local bird populations and community assemblages can show a response 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.

## 9.2 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 from all years to assess which routes have experience significant change in bird community abundance. The initial community diversity results reported above 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 since 1985.

## 10. ACKNOWLEDGEMENTS

We would like to thank Sue Vilord for conducting the surveys this year and providing training and suggestions for future INL BBS. We also thank Neil Hukari (NOAA/ARLFRD) for providing the weather data summaries from the CFA.

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**APPENDIX A**

**SUMMARY OF SPECIES BY ROUTE  
2007**



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**Survey Route:** RWMC

**Survey Date:** May 22, 2007

Species	Abundance	Percentage
Horned Lark	33	17.8
Western Meadowlark	33	17.8
Brewer's Sparrow	25	13.5
Sage Thrasher	18	9.7
Sage Sparrow	12	6.5
Brown-headed Cowbird	9	4.9
Mallard	6	3.2
Killdeer	5	2.7
Barn Swallow	5	2.7
Red-winged Blackbird	5	2.7
Say's Phoebe	4	2.2
Cinnamon Teal	3	1.6
Northern Shoveler	3	1.6
Mourning Dove	3	1.6
Rock Wren	3	1.6
European Starling	3	1.6
Gadwall	2	1.1
Ruddy Duck	2	1.1
Rock Pigeon	2	1.1
Brewer's Blackbird	2	1.1
Common Poorwill	1	0.5
Wilson's Phalarope	1	0.5
Great Horned Owl	1	0.5
Common Nighthawk	1	0.5
Mountain Bluebird	1	0.5
American Robin	1	0.5
House Finch	1	0.5

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**Total Individuals = 185**

**Total Species = 27**

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**Survey Route:** PBF

**Survey Date:** May 23, 2007

Species	Abundance	Percentage
Western Meadowlark	100	32.6
Brewer's Sparrow	61	19.9
Horned Lark	35	11.4
Sage Thrasher	33	10.7
Grasshopper Sparrow	18	5.9
Sage Sparrow	17	5.5
Mourning Dove	13	4.2
Brown-headed Cowbird	13	4.2
Common Raven	6	2.0
Rough-wing Swallow	3	1.0
Chipping Sparrow	3	1.0
Barn Swallow	2	0.7
Red-tailed Hawk	1	0.3
Lark Sparrow	1	0.3
House Finch	1	0.3

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**Total Individuals = 307**

**Total Species = 15**

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**Survey Route:** TAN

**Survey Date:** May 24, 2007

Species	Abundance	Percentage
Horned Lark	224	34.9
Canada Goose	95	14.8
Sage Sparrow	82	12.8
Sage Thrasher	68	10.6
Vesper Sparrow	48	7.5
Brewer's Sparrow	46	7.2
Western Meadowlark	21	3.3
Barn Swallow	11	1.7
Brown-headed Cowbird	9	1.4
Grasshopper Sparrow	6	0.9
Cliff Swallow	5	0.8
Golden Eagle	4	0.6
Mourning Dove	3	0.5
Rough-wing Swallow	3	0.5
Chipping Sparrow	3	0.5
Willet	3	0.5
Rock Pigeon	3	0.5
Northern Harrier	2	0.3
Common Raven	2	0.3
Red-tailed Hawk	1	0.2
Common Nighthawk	1	0.2
Greater Sage Grouse	1	0.2
Prairie Falcon	1	0.2

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**Total Individuals = 642**

**Total Species = 23**

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**Survey Route:** RTC

**Survey Date:** May 25, 2007

Species	Abundance	Percentage
Horned Lark	134	38.7
Brewer's Sparrow	50	14.5
Western Meadowlark	49	14.2
Sage Thrasher	19	5.5
Barn Swallow	17	4.9
Brown-headed Cowbird	11	3.2
Vesper Sparrow	9	2.6
Grasshopper Sparrow	9	2.6
House Finch	6	1.7
Common Raven	5	1.4
Killdeer	4	1.2
Rough-wing Swallow	4	1.2
Sage Sparrow	4	1.2
Brewer's Blackbird	4	1.2
Cinnamon Teal	3	0.9
Red-tailed Hawk	3	0.9
Northern Harrier	2	0.6
European Starling	2	0.6
Chipping Sparrow	2	0.6
Red-winged Blackbird	2	0.6
Yellow-headed Blackbird	2	0.6
Osprey	1	0.3
Say's Phoebe	1	0.3
Cliff Swallow	1	0.3
American Robin	1	0.3
Canada Goose	1	0.3

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**Total Individuals = 346**

**Total Species = 26**

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**Survey Route:** Circular Butte

**Survey Date:** May 29, 2007

Species	Abundance	Percentage
Horned Lark	155	30.7
Western Meadowlark	131	25.9
Brewer's Sparrow	76	15.0
Sage Sparrow	52	10.3
Sage Thrasher	41	8.1
Brown-headed Cowbird	14	2.8
Grasshopper Sparrow	11	2.2
Common Raven	6	1.2
Red-tailed Hawk	4	0.8
Golden Eagle	2	0.4
Eastern Kingbird	2	0.4
Loggerhead Shrike	2	0.4
Rock Wren	2	0.4
Swainson's Hawk	1	0.2
Bald Eagle	1	0.2
Mourning Dove	1	0.2
Short-eared Owl	1	0.2
Western Kingbird	1	0.2
Vesper Sparrow	1	0.2
Brewer's Blackbird	1	0.2

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**Total Individuals = 505**

**Total Species = 20**

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**Survey Route:** Lost River

**Survey Date:** May 30, 2007

Species	Abundance	Percentage
Horned Lark	234	44.6
Western Meadowlark	108	20.6
Brewer's Sparrow	49	9.3
Sage Sparrow	40	7.6
Sage Thrasher	29	5.5
Grasshopper Sparrow	17	3.2
Vesper Sparrow	14	2.7
Red-tailed Hawk	9	1.7
Common Raven	9	1.7
Brown-headed Cowbird	6	1.1
Prairie Falcon	2	0.4
Swainson's Hawk	1	0.2
Ferruginous Hawk	1	0.2
Say's Phoebe	1	0.2
Western Kingbird	1	0.2
Loggerhead Shrike	1	0.2
Black-billed Magpie	1	0.2
American Robin	1	0.2
Chipping Sparrow	1	0.2

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**Total Individuals = 525**

**Total Species = 19**

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**Survey Route:** Tractor Flats

**Survey Date:** May 31, 2007

Species	Abundance	Percentage
Western Meadowlark	195	22.9
Franklin's Gull	178	20.9
Horned Lark	173	20.3
Mourning Dove	64	7.5
Brewer's Sparrow	43	5.0
Sage Sparrow	40	4.7
Sage Thrasher	36	4.2
Brown-headed Cowbird	25	2.9
Canada Goose	16	1.9
Rough-wing Swallow	16	1.9
Northern Harrier	8	0.9
Long-billed Curlew	7	0.8
Rock Pigeon	7	0.8
Vesper Sparrow	7	0.8
Grasshopper Sparrow	7	0.8
Common Raven	5	0.6
European Starling	5	0.6
Red-tailed Hawk	4	0.5
Greater Sage-grouse	2	0.2
Willet	2	0.2
Loggerhead Shrike	2	0.2
Savannah Sparrow	2	0.2
Red-winged Blackbird	2	0.2
Golden Eagle	1	0.1
Forster's Tern	1	0.1
Western Kingbird	1	0.1
Black-billed Magpie	1	0.1
American Crow	1	0.1
Barn Swallow	1	0.1
Chipping Sparrow	1	0.1
<b>Total Individuals =</b>	<b>853</b>	
<b>Total Species =</b>	<b>30</b>	

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**Survey Route:** Twin Buttes

**Survey Date:** June 1, 2007

Species	Abundance	Percentage
Western Meadowlark	123	25.9
Horned Lark	80	16.9
Sage Sparrow	47	9.9
Sage Thrasher	45	9.5
Common Raven	40	8.4
Mourning Dove	36	7.6
Brewer's Sparrow	34	7.2
Brown-headed Cowbird	16	3.4
Gray Flycatcher	11	2.3
Grasshopper Sparrow	9	1.9
Red-tailed Hawk	6	1.3
Loggerhead Shrike	6	1.3
American Robin	3	0.6
Common Nighthawk	2	0.4
Northern Flicker	2	0.4
Barn Swallow	2	0.4
Greater Sage-grouse	1	0.2
American Kestrel	1	0.2
Killdeer	1	0.2
Short-eared Owl	1	0.2
Dusky Flycatcher	1	0.2
Western Kingbird	1	0.2
Blue-gray Gnatcatcher	1	0.2
Green-tailed Towhee	1	0.2
Chipping Sparrow	1	0.2
Vesper Sparrow	1	0.2
Lark Sparrow	1	0.2
Turkey Vulture	1	0.2

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**Total Individuals = 474**

**Total Species = 28**

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**Survey Route:** CFA

**Survey Date:** June 2, 2007

Species	Abundance	Percentage
Horned Lark	55	12.8
Western Meadowlark	50	11.6
Brewer's Blackbird	43	10.0
Brown-headed Cowbird	43	10.0
Brewer's Sparrow	41	9.5
European Starling	40	9.3
Sage Thrasher	29	6.7
Mourning Dove	25	5.8
Sage Sparrow	25	5.8
Barn Swallow	12	2.8
American Robin	9	2.1
Grasshopper Sparrow	9	2.1
House Sparrow	8	1.9
Vesper Sparrow	7	1.6
Rock Pigeon	6	1.4
Common Raven	6	1.4
Killdeer	5	1.2
Red-tailed Hawk	3	0.7
Western Kingbird	3	0.7
Loggerhead Shrike	3	0.7
House Finch	3	0.7
Mallard	2	0.5
Say's Phoebe	2	0.5
Gadwall	1	0.2

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**Total Individuals = 430**

**Total Species = 24**

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**Survey Route:** INTEC

**Survey Date:** June 3, 2007

Species	Abundance	Percentage
Horned Lark	58	25.1
Brewer's Sparrow	32	13.9
Western Meadowlark	23	10.0
Sage Sparrow	21	9.1
Sage Thrasher	19	8.2
Brown-headed Cowbird	12	5.2
Grasshopper Sparrow	11	4.8
Barn Swallow	9	3.9
Vesper Sparrow	9	3.9
Killdeer	6	2.6
European Starling	6	2.6
Brewer's Blackbird	5	2.2
Common Raven	3	1.3
American Robin	3	1.3
House Sparrow	3	1.3
Common Nighthawk	2	0.9
House Finch	2	0.9
Red-tailed Hawk	1	0.4
Wilson's Phalarope	1	0.4
Say's Phoebe	1	0.4
Western Kingbird	1	0.4
Cliff Swallow	1	0.4
Mountain Bluebird	1	0.4
Yellow-headed Blackbird	1	0.4

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**Total Individuals = 231**

**Total Species = 24**

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**Survey Route:** Kyle Canyon

**Survey Date:** June 4, 2007

Species	Abundance	Percentage
Horned Lark	109	22.9
Sage Sparrow	92	19.4
Western Meadowlark	73	15.4
Sage Thrasher	42	8.8
Vesper Sparrow	39	8.2
Brewer's Sparrow	38	8.0
Mourning Dove	16	3.4
Gray Flycatcher	16	3.4
Chipping Sparrow	9	1.9
Loggerhead Shrike	8	1.7
Ferruginous Hawk	7	1.5
Red-tailed Hawk	6	1.3
Western Kingbird	6	1.3
Common Raven	2	0.4
Rough-wing Swallow	2	0.4
Green-tailed Towhee	2	0.4
Lark Sparrow	2	0.4
Grasshopper Sparrow	2	0.4
Golden Eagle	1	0.2
Rock Wren	1	0.2
Black-throated Sparrow	1	0.2
Brown-headed Cowbird	1	0.2

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**Total Individuals = 475**

**Total Species = 22**

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**Survey Route:** NRF

**Survey Date:** June 5, 2007

Species	Abundance	Percentage
Horned Lark	58	25.1
Western Meadowlark	29	12.6
Brewer's Sparrow	23	10.0
Sage Sparrow	22	9.5
Sage Thrasher	19	8.2
Barn Swallow	15	6.5
Vesper Sparrow	14	6.1
Brown-headed Cowbird	11	4.8
Black-necked Stilt	8	3.5
Mallard	5	2.2
Mourning Dove	5	2.2
Yellow-headed Blackbird	4	1.7
Common Raven	3	1.3
Gadwall	2	0.9
American Coot	2	0.9
American Robin	2	0.9
Grasshopper Sparrow	2	0.9
Common Goldeneye	1	0.4
Northern Shoveler	1	0.4
Greater Scaup	1	0.4
Wilson's Phalarope	1	0.4
Say's Phoebe	1	0.4
European Starling	1	0.4
House Sparrow	1	0.4

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**Total Individuals = 231**

**Total Species = 24**

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**Survey Route:** MFC

**Survey Date:** June 12, 2007

Species	Abundance	Percentage
Horned Lark	68	32.7
Western Meadowlark	52	25.0
Brown-headed Cowbird	23	11.1
Sage Thrasher	12	5.8
Brewer's Sparrow	10	4.8
Brewer's Blackbird	10	4.8
Mourning Dove	7	3.4
Sage Sparrow	5	2.4
Killdeer	4	1.9
Mallard	3	1.4
Say's Phoebe	3	1.4
Common Raven	2	1.0
American Robin	2	1.0
Chipping Sparrow	2	1.0
Red-tailed Hawk	1	0.5
Common Nighthawk	1	0.5
Barn Swallow	1	0.5
Vesper Sparrow	1	0.5
Grasshopper Sparrow	1	0.5
<b>Total Individuals =</b>	<b>208</b>	
<b>Total Species =</b>	<b>19</b>	

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