



2001-02 Avian Inventory Final Report for Northern Colorado Plateau National Parks:

Cedar Breaks National Monument

Fossil Butte National Monument

Golden Spike National Historic Monument

Timpanogos Cave National Monument

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ABSTRACT

This avian inventory project is one component of a suite of biological inventories being conducted within the Northern Colorado Plateau Network as part of a new national emphasis of inventory and monitoring within the National Park Service. During the 2001 and 2002 breeding season, avian inventories were completed in the following parks: Cedar Breaks NM (CEBR), Fossil Butte NM (FOBU), Golden Spike NHS (GOSP), and Timpanogos Cave NM (TICA). The primary objective of the project is to provide a baseline inventory of avifauna in each park with the goal of documenting at least 90% of species present. The study is also designed to determine general abundance and distribution of species present and to identify park-specific species of special concern. Information gained from this study will be used to develop park-specific management guidelines for avifauna.

Each park unit was visited on at least three occasions, with a maximum of four visits, during the breeding season from mid-May to mid-July, 2001 and 2002. Point counts and incidental surveys were conducted at each of the four parks; surveys for nocturnal species (specifically owls) were also completed. Each park unit was also visited at least two occasions during the non-breeding (winter) from December through February 2001, 2002 and 2003. Area searches were completed at each of the four parks and the bird species using the parks' habitats in winter were documented.

We detected additional species (i.e., species not currently included in the Parks' checklists) in all four park units: Cedar Breaks NM, Fossil Butte NM, Golden Spike NHS, and Timpanogos Cave NM. First-order Jackknife estimates show that we have detected an average of 89.1% of the species present at Cedar Breaks NM, 92.0% at Fossil Butte NM, and 82.3% at Golden Spike NHS. (We were unable to calculate Jackknife estimates for Timpanogos Cave NM. due to the it's small survey are) These percentages suggest that we have detected most of the common species.

The results of this inventory show that each park has its own unique habitats, habitat features, and associated bird communities. During 2001 and 2002 we identified both bird species of special concern and critical habitats within each park.

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INTRODUCTION

This avian inventory project is one component of a suite of biological inventories being conducted within the Northern Colorado Plateau Network as part of a new national emphasis of inventory and monitoring resources within the National Park Service. During the 2001 and 2002 breeding season, avian inventories were completed in the following parks: Timpanogos Cave NM, Golden Spike NHS, Fossil Butte NM and Cedar Breaks NM. The level of existing information on avifauna for these parks varied from little or no information. For example species presence/absence had not been adequately determined for most of these parks. With such a lack of baseline information, these four parks have limited ability to develop management guidelines for avifauna. Additionally, information on the occurrence of species of special concern in these parks was also limited.

Information gained from this work can be used to identify an optimal design for an efficient and effective monitoring program for each park throughout the Colorado Plateau. It will also directly contribute to developing monitoring and research programs that provide information on what is there, how things are changing, and what can be managed for.

A well-designed monitoring program must be built upon a comprehensive understanding of the work that has already been done (Noon et al. 1999). Also, a well-designed program should provide monitoring data that enables detection of environmental change, provides insights to the ecological consequences of these changes, and helps decision-makers determine if the observed changes mandate changes in management practices (Noon et al. 1999).

Bird communities and species are often studied and monitored in hopes of gaining insight into physical and biological phenomena, such as changes in climate, habitat, human disturbance, or environmental contaminants. When justifying the use of birds as models for such monitoring, researchers typically argue that birds are good indicators of change because they respond quickly to habitat changes, are influenced by a suite of often subtle factors, and exhibit strong habitat selection (Cody 1985). In general, birds are considered a valuable monitoring tool because they tend to have dynamics that parallel those of the ecosystem or component of interest, provide continuous assessment over a wide range of stress, have dynamics that can be attributed to either natural cycles or anthropogenic stressors, are distributed over wide geographical area/or are very numerous, can be accurately estimated, have costs of measurement that are not cost prohibitive, are low impact to measure, and can have measurable results that are repeatable with different personnel.

Also, many of the endangered, threatened or sensitive species that we are mandated by federal and/or state regulations to manage and conserve, are birds. Significant changes in bird species or populations may alert us to look more closely for changes in the quality or quantity of habitats. It is only through adequate, well-designed and executed monitoring programs that we can track species or population changes, begin the search for causative factors, and/or initiate conservation and management actions.

This report provides a summary of background information on the parks surveyed, a description of the study areas, an explanation of methodologies, and a discussion of results.

Recommendations for monitoring avian communities for National Parks throughout the Colorado Plateau are also proposed.

Northern Colorado Plateau Park Descriptions:

Each of the parks has some documentation of bird species presence/absence, but little information on abundance or distribution. Some parks may not have sampled or have under sampled birds in some habitats. Additional information on bird distribution, nativity, and habitat in Utah is compiled in a Latilong Report, but this information is too general to interrelate to individual parks. Thus the following parks needed a baseline inventory of breeding birds in major habitats within each park, with the goal of documenting at least 90% of the species present.

Cedar Breaks National Monument

Cedar Breaks NM (CEBR) is located in southwest Utah 29 km (18 miles) east of Cedar City, UT. Plant communities include: pinyon-juniper woodlands; mixed forests of ponderosa pine (*Pinus ponderosa*), blue spruce (*Picea pungens*), and Douglas fir; Engleman spruce (*Picea Englemannii*) - subalpine fir (*Abies lasiocarpa*) forests with bristlecone pine (*Pinus longaeva*); and subalpine meadows. We stratified the park into two major habitat types for bird sampling: Mixed conifer and meadow habitat mosaic, and mixed conifer with riparian elements. The Monument had a bird checklist with no information on abundance or distribution, and had no formal bird surveys completed (Grater 1947). Possible species of management concern include Peregrine Falcon (*Falco peregrinus*) and Three-toed Woodpecker (*Picoides tridactylus*).

Fossil Butte National Monument

Fossil Butte NM (FOBU) is located in southwest Wyoming 21 km (13 miles) west of Kemmerer, WY. Plant communities present in the Monument include: sagebrush-dominated areas; areas of sagebrush with a considerable grassland component; aspen (*Populus* spp.); mixed conifer of limber pine (*Pinus flexilis*) and Douglas fir (*Pseudotsuga menziesii*); meadows of Baltic rush (*Juncus balticus*) and sedge species (*Carex* spp.); small stands of cottonwood (*Populus* spp.) and willow (*Salix* spp.); and small areas of shrubs, dominated by serviceberry (*Amelanchier alnifolia*). Limited presence/absence data on birds were collected within the Monument by Rado (1977) and, during a grazing study, by Dorn et al. (1984). Possible species of management concern are Golden Eagle (*Aquila chrysaetos*) and Greater Sage Grouse (*Centrocercus urophasianus*).

Golden Spike National Historic Site

Golden Spike NHS (GOSP) is located 52 km (32 miles) west of Brigham City and 89 km (55 miles) north of Ogden, UT. Plant communities include disturbed grasslands dominated by Cheatgrass (*Bromus tectorum*), Great Basin sagebrush (*Artemisia* spp.), a few scattered junipers (*Juniperus* spp.). We identified grassland/sagebrush habitats as belonging to one of two habitats: Grassland/Mosaic sage, defined as areas with equal or greater than 50% grassland cover and, Mixed Sage/Grassland where equal or greater than 50% cover is contributed by sagebrush. There is a small ravine in the southwest corner of the main block of the monument that contains a relatively high proportion of native bunchgrasses, wildflowers, chokecherry, and a small patch of junipers. Another small ravine at the far eastern end of the railroad grade contains a small stream that apparently issues from an outflow on adjacent Thiokol property. The only documented bird checklist was compiled from sightings from 1975 - 1981 (Boyce 1981). Possible species of management concern likely

include Golden Eagle (*Aquila chrysaetos*), Ferruginous Hawk (*Buteo regalis*), and Sage Grouse (*Centrocercus urophasianus*).

Timpanogos Cave National Monument

Timpanogos Cave NM (TICA) is located 40 km (25 miles) south of Salt Lake City and 19 km (12 miles) east of Lehi, UT. Vegetation communities include riparian, juniper woodland, mountain mahogany-oak shrublands, and mixed-conifer forests. A bird checklist “designed for amateur interest” for American Fork Canyon, but not specific to the monument was revised in 1974. This list has neither an author nor details on how data were collected. Timpanogos Cave and the surrounding area lack reliable baseline information on population status and distribution of birds, and will require parkwide systematic surveys. No possible species of concern have been noted in the monument.

OBJECTIVES

The overall goals of these inventories for each park were to:

- 1) Document through existing, verifiable data and field investigations the occurrence of at least 90 percent of the bird species currently estimated to occur in the parks;
- 2) Using systematic surveys, document presence/absence of bird species, and their distribution and abundance in habitats that were historically under-sampled or not sampled;
- 3) Identify critical habitats (i.e., document locations of key breeding and non-breeding habitats where current records are lacking);
- 4) Identify species of concern (i.e., document presence/absence of birds of special management concern that are known or expected to occur in the park units based on habitat or historic records);
- 5) Identify park-specific species of special concern, which could become part of future “vital signs” monitoring;
- 6) Recommend an effective monitoring program so that Resource Management staff at each park can assess the condition of bird populations over time, and detect significant changes in those populations; and
- 7) Summarize bird information in appropriate formats to contribute to the population of National Park Service, service-wide databases including NPSpecies, Dataset Catalog, NRBib, and ANCS+.

METHODS

Variable circular plot (VCP) point count surveys, incidental surveys, and tape playback surveys for nocturnal species were conducted. Field methods were designed to provide the necessary data for a baseline avifauna inventory and to estimate species richness, relative abundance and density of breeding birds.

Estimating Richness, Relative Abundance and Density of Breeding Birds

Species richness (number of species detected), total number of detections per species, and relative abundance (average number of detections/point count) of species were summarized for the entire park and each major habitat type; these data are included in this report. Estimates of population density (number per unit area) were determined for those species most commonly detected (>40 detections), these data are also included in this report.

It is rarely possible to count all birds actually present in an area. Therefore, distance sampling methods were used to estimate abundance or density. This method has been used for more than 30 years and has been found to be a reliable method for estimating relative abundance and population trends for many bird species (Fancy 1997, Nelson and Fancy 1999). It is based on the assumption that the distance between an observer and an object will affect the probability of detection; the further away an object, the less likely it is to be detected. Distance sampling allows for avoidance of some serious biases associated with traditional analysis of point-count data (i.e. detectability among habitats or years), but comes with three assumptions; all birds at distance 0 are detected, distances of birds close to the point are measured accurately, and birds do not move in response to the observer's presence. In our surveys, we estimated the horizontal distance from an observer to a bird. Using these distances, we calculated a detection function, which is the probability of detecting an object given its distance from the observer. This detection function was used to estimate bird density and accounts the fact that some birds may go undetected (Buckland et al. 1993).

Distance sampling can be conducted using two different sampling methodologies: line transects and variable circular plot point counts. For three of the four parks surveyed in 2001 and 2002, variable circular plot point counts were used. Due to the small area size of Timpanogos Cave NM we did not use variable circular plot point counts. We decided that parks that were <500 acres did not fit the criteria to complete point count surveys, mainly due to the limited number of sample points that could be completed in an area this small. Therefore we only completed area search and incidental surveys at Timpanogos NM.

Variable Circular Plot Point Count Sampling

With variable circular plot (VCP) point count sampling, the observer stands at a sampling station and records the horizontal distance between the observer and the bird. For many surveys, the majority of birds are heard but not seen, so the observer estimates the distance to a tree, bush or other object where they think the bird is located. VCP counts are the preferred approach in (1) patchy habitats, where the objective is to correlate bird data to vegetation or other habitat information; and (2) dense, rugged or hazardous terrain, where you need to watch your footing as you walk.

Three to four visits were conducted per breeding season (2001 and 2002) to cover the period in which the greatest number of passerine bird species would be exhibiting breeding behavior, such as territorial calling and singing. Surveys started at one-half hour after sunrise and were completed by 1000. At each point count station, one observer recorded all individual birds seen or heard for 7 minutes; counting was subdivided into 3 periods: 0-3 minutes, 3-5 minutes and 5-7 minutes. Counting began 1 minute after arriving at a station. Bird detections were measured to the nearest meter using laser rangefinders; the rangefinders that we used are accurate to within 1m. During the final visit, habitat and vegetation data were collected at each point count station. Data was entered onto standardized forms and GPS coordinates were recorded.

Flyover species were also recorded, but with no estimates of distance. Additional notes were taken including: (1) whether the detection was aural, visual or both; (2) whether detections were songs, calls, or other (i.e., drumming wings), and (3) whether the bird was detected at a previous point count station (to avoid double-counting individuals). Birds flushed while walking between point count stations were counted and noted on our incidental bird observations form. Forms for point counts and incidental bird observations were modeled after those recommended by Ralph et al. (1995).

Additional Breeding and Non-breeding Surveys

Most bird survey methods provide good information for common species, but relatively sparse information for rare or secretive species. This does not mean the survey method is invalid; rather, it is a reflection of the difficulty of sampling rare and secretive species using general methods. Therefore, in addition to the point counts, incidental surveys of all habitats during breeding and non-breeding periods were completed to increase the chance of detecting rare and secretive species that occur in the park. Personnel went to the different habitats (i.e., where point counts have been established) in the park and recorded all species they saw and/or heard. These surveys were conducted in conjunction with the standard survey protocol (i.e., VCPs) during the breeding season.

During the non-breeding season (December – January) we conducted two additional visits each year in 2001, 2002 and 2003. These surveys were conducted between 0900 and 1200, with an extra visit made in the late afternoon to detect the presence of vultures, buteos, or any other birds not found in early morning (Robbins 1981). Survey data collected included species encountered, habitat, location, dates, and general behavior.

Breeding/non-breeding Confirmation

During all surveys, surveyors made careful observations of breeding behavior, and the following designations were made:

- **Confirmed Breeder:** direct evidence of breeding was observed, including nest building/presence, courtship behavior, food carry, and/or presence of juveniles;
- **Probable Breeder:** birds were detected during all three visits, and/or general references suggest the habitat and geographic location are suitable for breeding; and
- **Migrant:** birds detected during only one visit (typically the first (Spring) visit).

Nocturnal Species

Nocturnal birds (specifically owls) were surveyed using taped broadcasts. Caprimulgids (i.e., Common Poor-wills, *Phalaenoptilus nuttallii*, and Lesser Nighthawks, *Chordeiles minor*) are vocal enough that playback recordings are rarely needed during these surveys. Owls, however, have been effectively surveyed using tape broadcasts and human vocalizations of the owl species songs and calls (Springer 1978, Forsman 1983). These surveys were conducted in all possible suitable habitats, or where historical sightings had been noted. Tape broadcasts or vocalizations were played for 15 minutes at each designated point. Survey times occurred between 1 hour after sunset and 1 hour before sunrise. We conducted two surveys during the breeding season and two surveys during the non-breeding season. Survey data included species encountered, habitat, location, dates, and evidence of breeding status (i.e., courtship behavior, nests). All other nocturnal and crepuscular species were also noted.

Timing of Surveys (2001 and 2002)

Three visits per park were scheduled so that surveys coincide with seasonal shifts in activity patterns of avifauna and to accommodate differences in overall activity periods of different species. Both daytime and nocturnal surveys were conducted on each visit in each park. Due to the short spring and summer seasons of the higher altitude parks (CEBR, TICA and FOBU), visits to these parks did not start until late May or early June.

Surveys were conducted at each of the four park units as follows:

- Mid May to late May: First trip, 1 VCP and incidental search survey per habitat per day plus 1 nocturnal survey.
- Early June to mid June: Second trip, 1 VCP and incidental survey per habitat per day plus 1 nocturnal survey.
- Mid June to early July: Third trip, 1 VCP and incidental survey per habitat per day plus 1 nocturnal survey.
- Mid July: Fourth trip, Sampling locale description and location documentation.

Sampling Locale Description and Location Documentation

Field crews recorded descriptive site information following a standardized format developed for use by all taxonomic groups in the Northern Colorado Plateau Network.

Global Positioning System (GPS) navigation units were utilized to record UTM coordinates for all inventory sampling points, transects, and other relevant locations. In some situations both UTM and latitude/longitude coordinate systems were recorded. All GPS coordinates used NAD83 as the datum. UTM coordinates, error values, datum reference (NAD83), and zone were recorded.

Data managers from the Northern Colorado Plateau Networks worked together with GIS staff at the Colorado Plateau Field Station to define and describe the GPS protocol for use by field crews. The protocol included the use of GPS units for recording sampling site descriptive attributes.

Data Mining

As opportunities arose, the field crew assisted with acquisition of existing information for each park, including bibliographic citations of pertinent material for inclusion in the NPBib Database. The Northern Colorado Plateau Network (NCPN) provided the principal investigator with a summary of existing avian information for each park. Field crews helped add knowledge to the existing set of information through visits with park personnel and by examining park files. Any new information that was recovered at the parks were noted and added to the bibliography for each park.

Voucher Specimens

In general, bird specimens for NCPN parks are poorly represented within internal (NPS) and external museum collections. Bird voucher specimens were not collected as part of this inventory effort, because no animals were found dead and in identifiable condition.

Data Analysis

Species Richness

The primary objective of this study was to provide a baseline inventory of avifauna in each park, with the goal of documenting 90% of species present. Species richness for each habitat type within the parks was calculated as the number of species detected during field surveys. To evaluate progress toward this objective we generated jackknife estimates using the program PC-ORD 3.0 (McCune and Mefford 1995). Jackknife estimators are non-parametric resampling procedures. The first-order jackknife estimator (Palmer 1990) is: $Jack1 = S + rl(n-l)/n$, where S = the observed number of species, rl = the number of species occurring in a sample unit and n = the number of sample units (number of survey points of a habitat type). The number of observed species in a subsample will typically be smaller than the true number of species. The distribution of species among samples is sampled repeatedly to generate a frequency distribution used to estimate the true number of species in the area represented by the samples.

Therefore, Jackknife estimates provide estimates of the true number of species by generating a frequency distribution by repeatedly sampling the distribution of species among samples (Palmer 1995). These Jackknife estimators produce more accurate and less biased estimates, at least when sub-sampling a restricted area, such as the parks we surveyed in the Northern Colorado Plateau. These estimates are also highly sensitive to the number of rare species observed (i.e., one detection), therefore most the species detected once during the two-year period were eliminated from this analysis. The only species left in the analysis with one detection were those that are confirmed breeders within the park.

By comparing the Jackknife estimate with the number of species detected (observed) per habitat, we can determine the percent of species detected versus the estimated total number of species likely to be present (see calculations for each park below):

$$\text{Number of species observed} \div \text{Jackknife estimate} = \text{Percent of species present detected.}$$

In addition to providing data that can be modeled to give jackknife estimates of species richness, an advantage to conducting VCP point counts is that the amount of detections and effort (i.e., time) can be standardized, allowing for comparison of results for habitats with

unequal sample sizes. Because the number of species detected is partly influenced by the amount of survey effort (e.g., time, area covered) for each habitat, and because habitats differ in size and the number of points counts conducted differed between habitats, we also calculated the average species richness per point count in each habitat. Thus, in addition to reporting the total number of species detected in a habitat, we also report the average number of species detected per point count for each habitat.

Relative Abundance of Species

To measure the relative abundance of particular species within parks and across habitats we estimated the density of each species with >40 detections using the computer program DISTANCE (Thomas et al. 1999). The distance data was used to model detection functions, from which we obtained unbiased abundance estimates and their confidence intervals for each species (Buckland et al. 1993). The advantages in using distance sampling data include: 1) multiple surveys can be combined to increase sample sizes and estimate densities of rare species; 2) the method allows for adjustment of different covariates such as observer effect, effects of dense vegetation and detection distances; and 3) it is possible to analyze historical, unadjusted point count data.

We considered well-sampled species (>40 detections) for which DISTANCE provided a model that met three criteria: coefficient of variation (CV) of <40%, <3 parameters included in the detection curve function, and total variance balance between the variance that is influenced by sample size and the detection probability (ratio from 2:1 to 1:2; D. Anderson pers. Comm.). For those species with unlimited distance that did not meet all three criteria, data were truncated for each individual species at various distances (5% – 10% cut points) developed by DISTANCE and the DISTANCE program was rerun.

In addition, because the number of detections is largely dependent on the amount of survey effort (e.g., time, area covered) for each habitat, and because habitats differ in size and the number of points counts conducted differed between habitats, we calculated each species' relative abundance (the average number of detections per point count) for each habitat, based on the point count data only. This measure of relative abundance indicates a species habitat distribution and is referred to as Frequency in the tables below.

Coordination with the Southern Colorado Plateau Network

The Northern and Southern Colorado Plateau Networks agreed to utilize comparable field methods and data management for biological inventories. To this end we utilized standardized field forms and data entry protocols across the two networks. The Northern Colorado Plateau Network Data Manager worked with us in designing standardized field forms and data entry screens. In cooperation with the Utah Division of Wildlife Resources field crews for both networks received joint training prior to each field season.

Master Species List

Master Species lists were developed for each park in coordination with NPSpecies guidelines. Updated bird species lists and master lists for each park are set up to be entered directly into the web-based version of NPSpecies or an associated Access database. We worked with Network

representatives on development of the specific data entry protocol. Below are the possible values, followed by the standard NPSpecies definitions.

PARK STATUS: The species occurrence status in the park.

Present in Park - Species' occurrence in the park is documented and assumed to be extant. High quality evidence is required for a species to be designated as "present."

Probably Present – The park is within the species' range and contains appropriate habitat. Documented occurrences of the species in the adjoining region of the park give reason to suspect that it probably occurs within the park. The degree of probability may vary within this category, including species that range from common to rare. This category is also for those species that have been reported for a park, but for which evidence has not yet been located or obtained. If the species is non-native and invasive, we used 'Encroaching' (below) instead of "Probably Present."

Encroaching – The species is not documented in the park, but is documented as being adjacent to the park and has potential to occur in the park. This category can be used for non-native and invasive species (e.g., House Sparrow, bullfrog, tamarisk).

Unconfirmed – Included for the park based on weak (unconfirmed record) or no evidence, giving minimal indication of the species' occurrence in the park. This category is a means of maintaining a "watch list," that is, species that could possibly occur in the park, and that should not, at this point, be totally removed or absent from the park's species list.

Historic – Species' historical occurrence in the park is documented, but recent investigations indicate that the species is now probably absent.

False Report – species previously reported to occur within the park, but current evidence indicates that the report was based on a misidentification, a taxonomic concept no longer accepted, or some other similar problem of interpretation.

ABUNDANCE: The current abundance of a species within the park. NOTE: for this field to be entered, the Park Status must be either Present or Probably Present.

Abundant – Animals: may be seen daily, in suitable habitat and season, and counted in relatively large numbers. Plants: large number of individuals; wide ecological amplitude or occurring in habitats covering a large portion of the park.

Common – Animals: may be seen daily, in suitable habitat and season, but not in large numbers. Plants: large numbers of individuals predictably occurring in commonly encountered habitats but not those covering a large portion of the park.

Uncommon – Animals: Likely to be seen monthly in appropriate season/ habitat. May be locally common. Plants: few to moderate numbers of individuals; occurring either sporadically in commonly encountered habitats or in uncommon habitats.

Rare – Animals: present, but usually seen only a few times each year. Plants: few individuals, usually restricted to small areas of rare habitat.

Occasional – Occurs in the park at least once every few years, but not necessarily every year. This is applicable to animals only.

Unknown – abundance unknown.

RESIDENCY - This category is used only for vertebrates. NOTE: for this field to be entered, the Park Status must be either Present or Probably Present.

Confirmed Breeder - This designation requires evidence of breeding in the park and is not assigned based on species presence or behavior alone. For birds, this means an

occupied nest, recently-fledged or downy young, adults attending young, nest with eggs or eggshells (with convincing identification), or similar “hard” evidence.

Probable Breeder - Singing males or territorial birds observed in suitable nesting habitat during the breeding season; courtship behavior or copulation; adults visiting a probable nest site; agitation behavior, distraction display, feigning injury, or anxiety call from an adult; nest building; physiological evidence of breeding (brood patch or eggs in oviduct) based on bird in hand.

Possible Breeder - Species has been observed during the entire breeding season, and the park is within the species breeding range but no evidence of breeding observed (i.e. nest).

Resident - A significant population is maintained in the park for more than two months each year, but it is not known to breed there.

Winter Resident - Species is a winter resident for more than two months each year.

Migratory - Migratory species that occurs in the park approximately two months or less each year, and does not breed there.

Vagrant - Park is outside of the species’ usual range.

Unknown - Residency status in park is unknown.

NATIVITY: Note: For this field to be entered, the Park Status must be either Present or Probably Present.

Native - The species is native to the park (either endemic or indigenous), or if the Park Status is Probably Present, the species would be native to the park if it were eventually confirmed in the park. Nativity should be assessed in the context of the northern Colorado Plateau as opposed to a park-specific geographic extent.

Non-native – The species is not native to the park (neither endemic nor indigenous), or if the Park Status is Probably Present, the species would not be native to the park if it were eventually confirmed in the park. Persistent plant populations that reproduce are also considered non-native. Use this category in the context of the Colorado Plateau as the basis for determining non-nativity.

Unknown – Nativity classification in park is unknown.

STUDY AREAS AND SURVEY POINT PLACEMENT

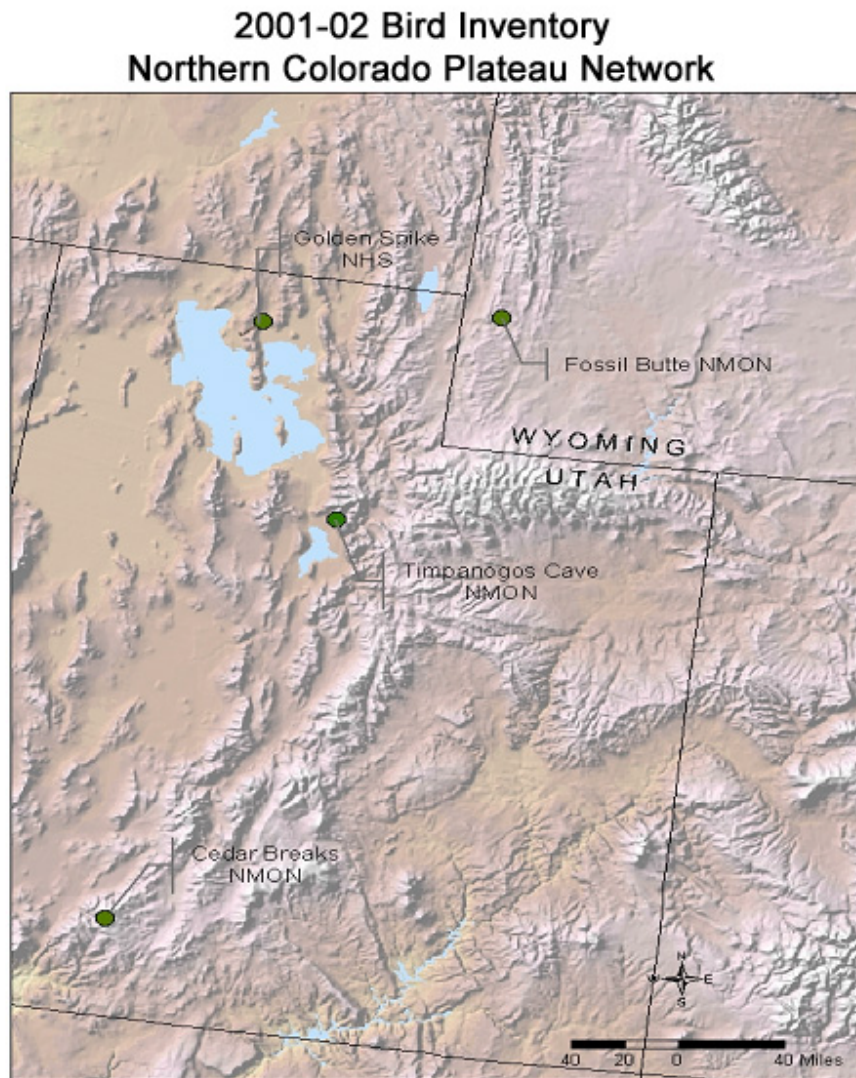
Depending on stand size and shape, VCP point count stations were located 250 meters apart in each habitat type. Between each habitat type a 200-meter buffer was implemented. At Cedar Breaks, Fossil Butte and Golden Spike, habitat within the park was stratified according to slope, elevation and aspect. Random points were generated within each habitat type. For planning purposes, we estimated the number of sample points required to achieve 90% completeness in each inventory based on the number of species estimated to be in an inventoried unit (S) and the number of species we expected to detect, on average, in a single plot (MS). We estimated S from species-area curves specific to birds. We estimated MS from the results of field studies and our personal experience. Number of plots was estimated from the ratio of MS to S , assuming a natural-log (for vertebrates) or square root (for plants) decay in the rate of species detection with the additional sample points. Species-area models relate S to the natural-log transformed area of an inventoried unit (A), reckoned here in hectares (ha). We used the following models for birds: $S = 28.7 + 6.43 \cdot \ln(A + 1)$ $n = 35$, $R^2 = 0.70$. Where inventories were conducted, we determined the number of points ultimately sampled from on-going appraisals of completeness derived from iterative estimates of species richness.

Stratification

Stratification here generally refers to the framework for planning sampling or organizing biological information. Stratification can be attentive to heterogeneity in logistics, such as cost of sampling, or to heterogeneity in the biological response of interest – in this case species richness (Cochran 1977). With respect to sample design, we applied stratification in the following way. Upon detailed examination of the sampling environment, we decided whether stratification for logistical or biological reasons is appropriate to each inventoried NPS unit, and whether stratification was by landform, hydrologic features, and/or some level of vegetation or geological classification. We used consistent descriptions of vegetation types and landforms, either to identify and map strata, classify sample points, or otherwise organize inventory information. All points were classified in the field to vegetation type and landform. Where relevant, we used the finest-resolution classes of the standard U.S. Geological Survey system on geological maps to describe geologic formations.

A subset of the random points generated, were selected for accessibility and survey-ability. Those points which fell on steep, inaccessible slopes were moved whenever possible to the nearest, contiguous terrain. Habitat and vegetation data were collected for each plot on a standardized form and GPS coordinates were recorded at each point.

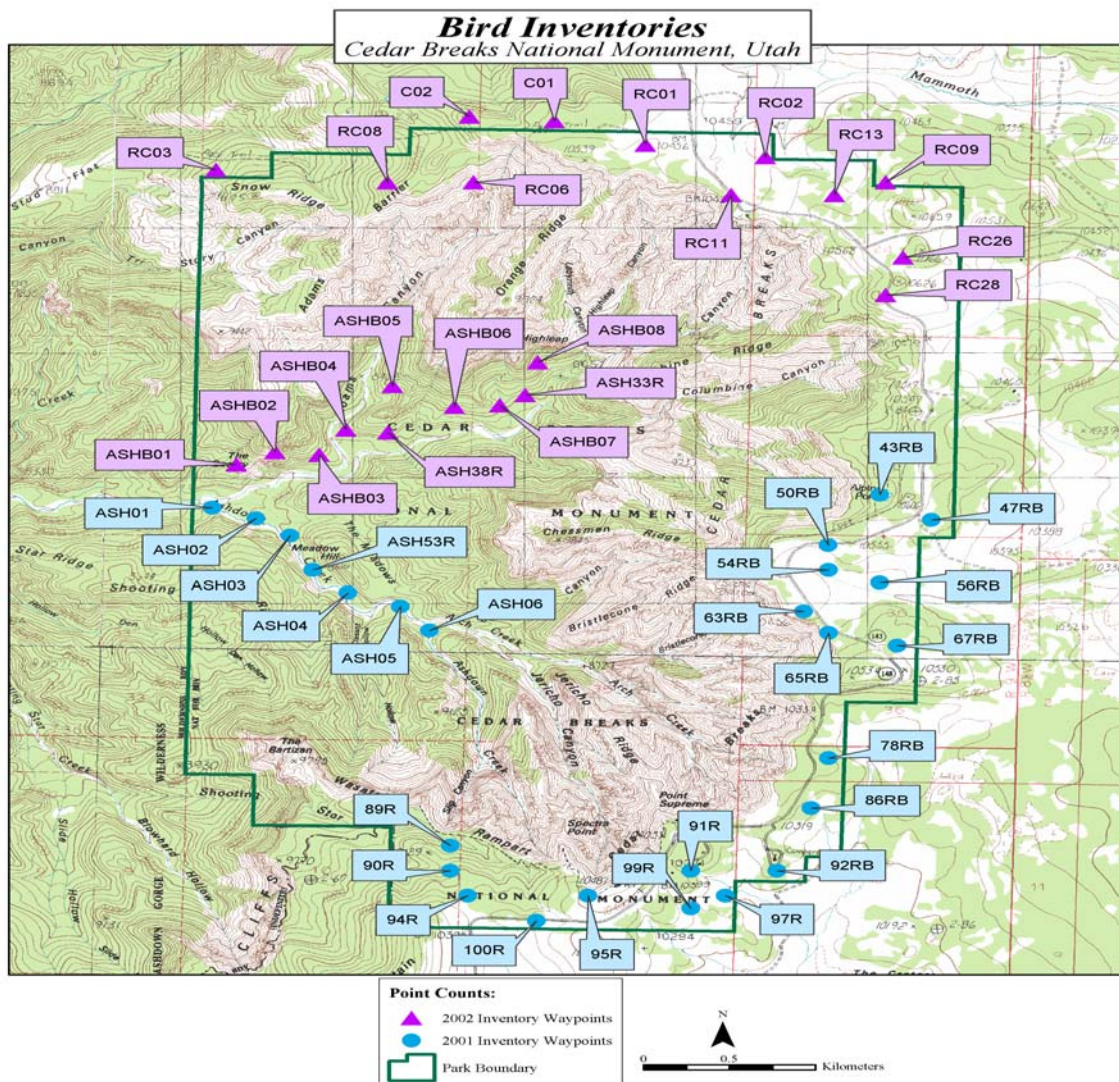
Figure 1. Map showing location of park units surveyed in the Northern Colorado Plateau Network (2001-02). CEBR, FOBU, GOSP, and TICA are part of the Northern Colorado Plateau Network described in this report.



Cedar Breaks National Monument

During the 2001 field season, we established a total of 26-point count stations, 20 of the 100 random points were selected for accessibility and survey-ability, and 6 non-random points were placed in Ashdown Creek in the Ashdown Wilderness area. In 2002, we established 22 point count stations, 12 of the original 100 random points were established, while 2 non-random points were placed in the NE section of the park and 8 on Rattle Creek in the Ashdown Wilderness area (Figure 2).

Figure 2. USGS topographical map of Cedar Breaks National Monument, 2001-02. Blue circles represent 2001 completed random and non-random sample points. Pink triangles represent 2002 completed random sample points. Random points stratified according to habitat, slope, elevation and aspect.

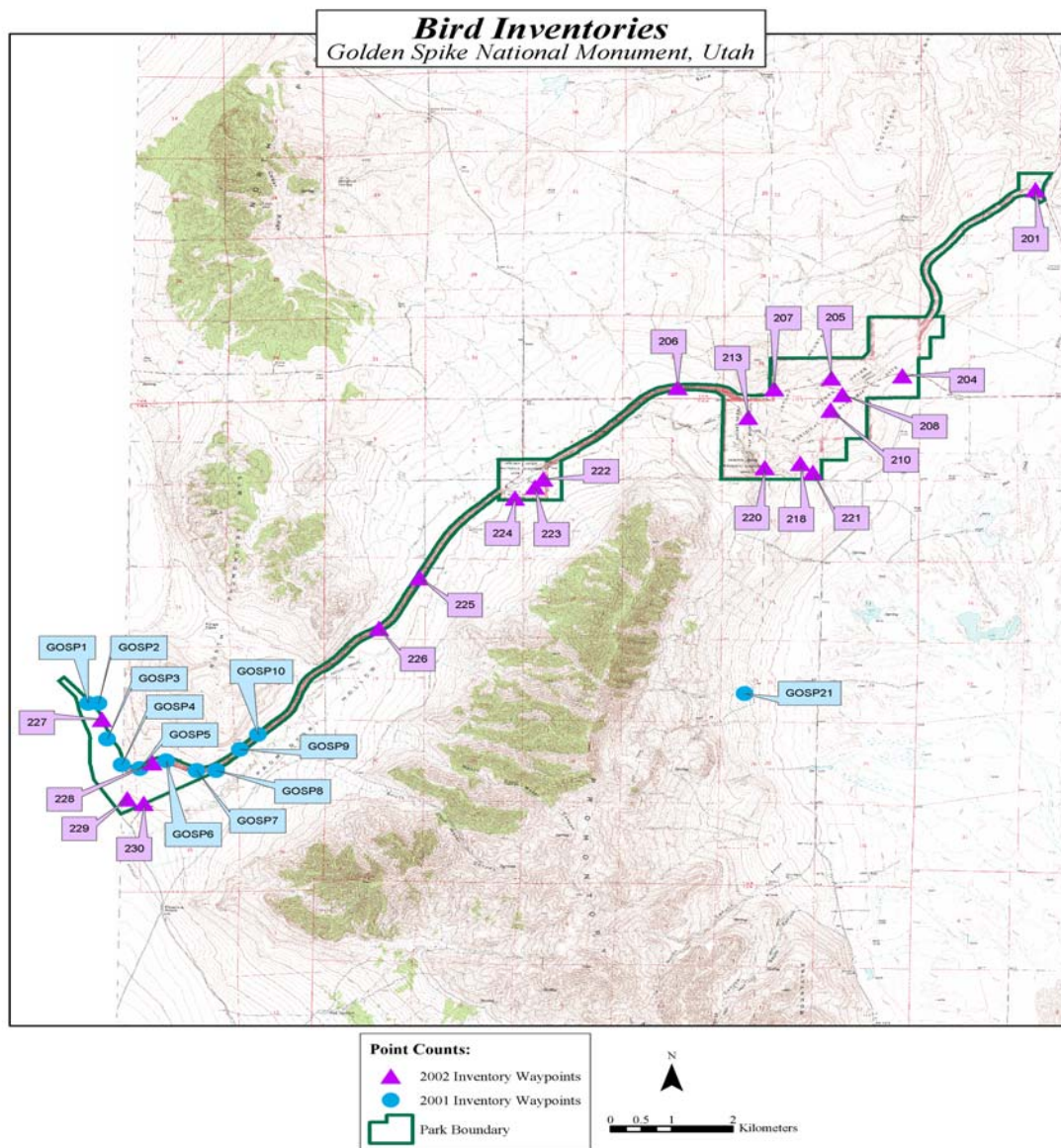


During the 2001, we established 39-point count stations, 13 of the 100 random points were selected for accessibility and survey-ability, and 27 non-random points were established in habitats not represented by the random points. In 2002, 20 additional random point count stations were selected from the original 100 random points (Figure 3).

Golden Spike National Historic Monument

During the 2001 field season 16 non-random point count stations were established along the established railroad tracks. In 2002, 20 random point count stations were selected from 100 random points (Figure 4).

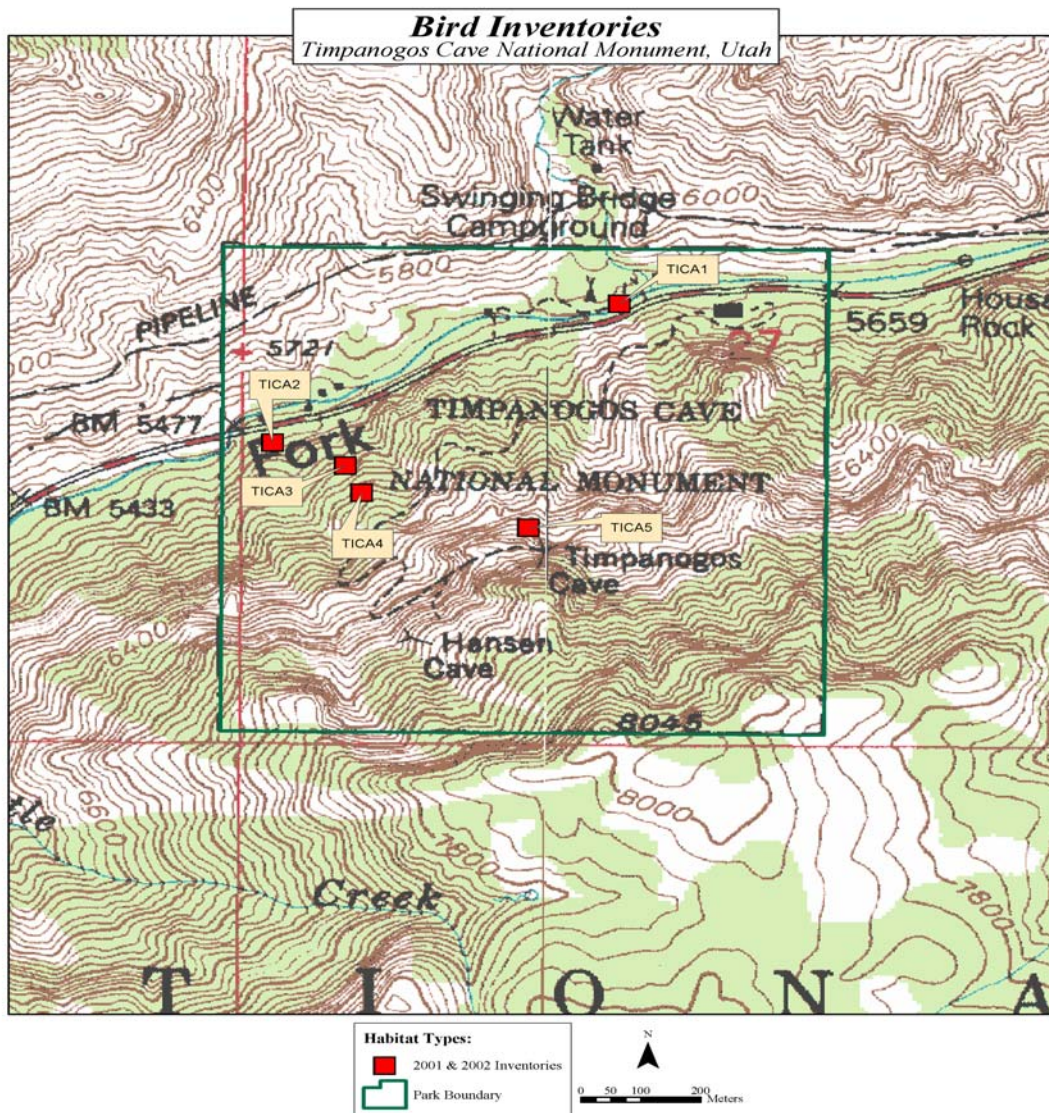
Figure 4. USGS topographical map of Golden Spike National Historic Monument, 2001-02. Blue circles represent 2001 completed non-random sample points. Pink triangles represent 2002 completed random sample points. Random points stratified according to habitat, slope, elevation and aspect.



Timpanogos Cave National Monument

At Timpanogos Cave no random points or non-random point counts were generated due to the limited size of the monument, only area search and incidental searches were conducted in each of the 5 habitat types during the 2001 and 2002 breeding field seasons (Figure 5).

Figure 5. USGS topographical map of Timpanogos National Monument, 2001-02. Red squares represent the 5 habitat types surveyed.



RESULTS

Sampling Effort

The four Northern Colorado Plateau Network National Parks were visited from late-May to mid-August and December - February. Each park was visited between three and seven occasions during each of the 2001 and 2002 field seasons (see Appendix 6a-d).

NCP Avian Inventory Summary, 2001-2002 (CEBR, FOBU, GOSP, TICA)

Overall (2001, 2002) there were 59 species detected at Cedar Breaks, 91 species at Fossil Butte, 56 species at Golden Spike and 50 species detected at Timpanogos Cave (Table 2b; Appendix 1). Table 2 and 2a summarize avian inventory at each park for each year (2001 and 2002). Additional species detected in each park that had not been detected before were documented. Bird species of concern were also documented.

Table 1. Northern Colorado Plateau National Park Service 2001 avian inventory summary. . Includes all breeding point count, incidental and nighttime surveys.

National Park	Spp. Richness (20 May-10 July)	Additional Species Detected	Species of Concern	Habitats Surveyed	Bird Habitat of Concern
Cedar Breaks N.M., UT	45	5	*Three-toed Woodpecker	Meadow Mixed-conifer Riparian	Engelmann Spruce
Fossil Butte N.M., WY	85	3	*Greater Sage Grouse *Brewer's Sparrow	Sagebrush Mixed-conifer Aspen	Sagebrush
Golden Spike N.H.M., UT	46	6	Peregrine Falcon *Burrowing Owl *Short-eared Owl *Sage Grouse	Human-development Grassland Riparian	Grassland
Timpanogos Cave NM, UT	49	1	No Species of Concern	Mixed-conifer Oak/mahogany scrub Riparian	Riparian

- State of Utah or Wyoming Sensitive Bird Species

Table 1a. Northern Colorado Plateau National Park Service 2002 avian inventory summary of CEBR, FOBU, GOSP and TICA. Includes all breeding point count, incidental and nighttime surveys.

National Park	Species Richness (20 May-10 July)	Additional Species Detected	Species of Concern	Habitats Surveyed	Bird Habitat of Concern
Cedar Breaks N.M., UT	43	4	*Three-toed Woodpecker	Meadow Mixed-conifer Riparian	Engelmann Spruce, Riparian
Fossil Butte N.M., WY	48	7	* Greater Sage Grouse	Sagebrush Mixed-conifer Aspen	Sagebrush
Golden Spike N.H.M., UT	37	10	Long-billed Curlew *Burrowing Owl *Short-eared Owl *Sage Grouse	Human-development, Grassland Riparian	Grassland
Timpanogos Cave N.M., UT	23	1	No Species of Concern	Mixed-conifer Oak/mahogany scrub Riparian	Riparian

- State of Utah or Wyoming Sensitive Bird Species

Table 1b. Northern Colorado Plateau National Park Service 2001-02 avian inventory summary of CEBR, FOBU, GOSP and TICA. Includes all breeding point count, incidental and nighttime surveys.

National Park	Species Richness (20 May-10 July)	Additional Species Detected	Species of Concern	Habitats Surveyed	Bird Habitat of Concern
Cedar Breaks N.M., UT	59	10	*Three-toed Woodpecker	Meadow Mixed-conifer Riparian	Engelmann Spruce,
Fossil Butte N.M., WY	91	10	*Greater Sage Grouse Brewer's Sparrow	Sagebrush Mixed-conifer Aspen	Sagebrush
Golden Spike N.H.M., UT	56	16	Long-billed Curlew Peregrine Falcon *Burrowing Owl *Short-eared Owl *Sage Grouse	Human-development, Grassland Riparian	Grassland
Timpanogos Cave N.M., UT	50	2	No Species of Concern	Mixed-conifer Oak/mahogany scrub Riparian	Oak scrub Riparian

- State of Utah or Wyoming Sensitive Bird Species

New Bird Species Added to NPS IMP Lists 2001 – 2002 (May – July) for CEBR, FOBU, GOSP and TICA

Cedar Breaks National Monument, Utah

Northern Pygmy Owl (*Glaucidium gnoma*) 2001
Black-chinned Hummingbird (*Archilochus alexandri*) 2001
Cordilleran Flycatcher (*Empidonax occidentalis*) 2001
Plumbeous Vireo (*Vireo plumbeus*) 2001
Spotted Towhee (*Pipilo maculatus*) 2001
Spotted Sandpiper (*Actitis macularia*) 2002
Northern Rough-winged Swallow (*Stelgidopteryx serripennis*) 2002
Hammond's Flycatcher (*Empidonax hammondi*) 2002
Warbling Vireo (*Vireo gilvus*) 2002

Fossil Butte National Monument, Wyoming

Killdeer (*Charadrius vociferous*) 2001
California Gull (*Larus californicus*) 2001
Pygmy Nuthatch (*Sitta pygmaea*) 2001
Western-wood Pewee (*Contopus sordidulus*) 2002
Red-naped Sapsucker (*Sphyrapicus nuchalis*) 2002
Dusky Flycatcher (*Empidonax oberholseri*) 2002
Hammond's Flycatcher (*Empidonax hammondi*) 2002
Black-throated Gray Warbler (*Dendroica nigrescens*) 2002
Orange-crowned Warbler (*Vermivora celata*) 2002
Spotted Towhee (*Pipilo maculatus*) 2002

Golden Spike National Monument, Utah

Snowy Egret (*Egretta thula*) 2001
Great Blue Heron (*Ardea herodias*) 2001
California Quail (*Callipepla californica*) 2001
Canyon Wren (*Catherpes mexicanus*) 2001
Yellow Warbler (*Dendroica petechia*) 2001
Western Tanager (*Piranga ludoviciana*) 2001
Sandhill Crane (*Grus Canadensis*) 2002
Snowy Egret (*Egretta thula*) 2002
Willet (*Catoptrophorus semipalmatus*) 2002
Loggerhead Shrike (*Lanius ludovicianus*) 2002
Cliff Swallow (*Hirundo pyrrhonota*) 2002
Northern Rough-winged Swallow (*Stelgidopteryx serripennis*) 2002
Violet-green Swallow (*Tachycineta thalassina*) 2002
Northern Mockingbird (*Mimus polyglottos*) 2002
Orange-crowned Warbler (*Vermivora celata*) 2002
House Finch (*Carpodacus mexicanus*) 2002

Timpanogos Cave National Monument, Utah

Brewer's Sparrow (*Spizella breweri*) 2001

AVIAN INVENTORY SUMMARY BY NATIONAL PARK

Cedar Breaks National Monument (CEBR)

During the 2001 breeding season, 84 point count surveys were carried out in 2 main habitat types: mixed-conifer/meadow and mixed conifer/riparian. Fifteen incidental surveys were also completed with an emphasis on habitat that was not adequately covered during point count surveys. Six crepuscular and nighttime surveys were also completed.

During the 2002 breeding season, 47 point count surveys were carried out in 2 main habitat types: mixed-conifer/meadow and mixed conifer/riparian. Four incidental surveys were also completed with an emphasis on habitat that was not adequately covered during point count surveys. Four crepuscular and nighttime surveys were also completed.

Species Richness

At CEBR, combining both breeding seasons 2001 and 2002, we detected 896 birds of 49 species during point count surveys (Table 2). Nine additional species were detected during incidental surveys (Table 2a). During 2001, no birds were detected while completing our crepuscular and nighttime surveys. During 2002 one species, Great-horned Owl, was detected during our crepuscular nighttime surveys. Therefore, a total of 59 species was detected when combining 2001 and 2002 surveys. No U.S. Fish and Wildlife Service (USFWS) species of concern were detected; however, one State of Utah species of concern was detected: the Three-toed Woodpecker (*Picoides tridactylus*).

Habitat types at Cedar Breaks consist of mixed conifer/meadow habitat and mixed conifer/riparian. Of the 59 species detected during point count and incidental search surveys at CEBR, 50 species were detected in the mixed conifer/meadow habitat, of which 23 species (46%) were only detected in this habitat (Table 2). In mixed conifer/riparian habitat 35 species were detected in this habitat type, of which only 8 were only detected in this habitat type.

Relative Abundance across Habitats

During point count surveys, 78% of all birds detected were in the mixed conifer/meadow habitat, the most prevalent habitat in the park, 22% were detected in mix-conifer/riparian in the Ashdown area. Species distributional differences at Cedar Breaks exist according elevation (i.e., mix-conifer/meadow habitats where the visitor center is located (3109 m) and the Ashdown area (2499 m) where mixed conifer/riparian habitat exists) (Table 2). This distributional difference was due to habitat differences (riparian vs. non-riparian) and pinyon/juniper, which does not exist in the park but is adjacent to the park in the Ashdown area. In the Ashdown area, where riparian habitat exists, we detected Spotted Sandpiper, Black-chinned Hummingbirds (*Archilochus alexandri*) and American Dippers (*Cinclus mexicanus*), Warbling Vireo (*Vireo gilvus*), Nashville Warbler (*Vermivora ruficapilla*) and Spotted Towhee (*Pipilo maculatus*). In addition, pinyon associated species detected in this area were Pinyon Jay (*Gymnorhinus cyanocephalus*), Black-throated Gray Warbler (*Dendroica nigrescens*).

The habitat between the upper elevation areas, where the visitor center is located (upper elevation mixed conifer and meadow habitat), and the Ashdown area (lower elevation mixed

conifer/riparian habitat) has very little to no vegetation due to soil composition, and therefore the only birds observed in this area were Violet-green and Cliff Swallows, flying overhead foraging on insects at dusk and dawn.

Table 2. Bird species distribution across habitats based on VCP point count surveys at Cedar Breaks National Monument, May – July 2001, 2002. Average abundance = (total # individuals detected) / (total # of point count surveys conducted in that habitat).

	Common Name	Mix Conifer/ Meadow No. Detections	Mix Conifer/ Meadow Ave. Abund.	Riparian/ Mix Conifer No. Detections	Riparian/ Mix Conifer Ave. Abund.	Total No.	Total Ave. Abund.
CB	American Robin	71	(0.85)	10	(0.27)	81	(0.67)
CB	Dark-eyed Junco	66	(0.79)	15	(0.41)	81	(0.67)
CB	Hermit Thrush	49	(0.58)	26	(0.70)	75	(0.62)
CB	White-crowned Sparrow	61	(0.73)	3	(0.08)	64	(0.53)
CB	Mountain Chickadee	40	(0.48)	20	(0.54)	60	(0.50)
CB	Yellow-rumped Warbler	43	(0.51)	9	(0.24)	52	(0.43)
CB	Chipping Sparrow	46	(0.55)	2	(0.05)	48	(0.40)
CB	Ruby-crowned Kinglet	37	(0.44)	6	(0.16)	43	(0.36)
CB	Cordilleran Flycatcher	8	(0.10)	27	(0.73)	35	(0.29)
CB	Western Tanager	25	(0.30)	8	(0.22)	33	(0.27)
CB	Broad-tailed Hummingbird	13	(0.15)	13	(0.35)	26	(0.21)
CB	Clark's Nutcracker	23	(0.27)	2	(0.05)	25	(0.21)
CB	Pine Siskin	22	(0.26)			22	(0.18)
CB	Townsend's Solitaire	12	(0.14)	7	(0.19)	19	(0.16)
CB	Three-toed Woodpecker	19	(0.23)			19	(0.16)
PB	Hammond's flycatcher	10	(0.12)	7	(0.19)	17	(0.14)
CB	Hairy Woodpecker	13	(0.15)	3	(0.08)	16	(0.13)
PB	Western Wood-Pewee	7	(0.08)	9	(0.24)	16	(0.13)
PB	Cassin's Finch	9	(0.11)	4	(0.11)	13	(0.11)
PB	House Wren	7	(0.08)	5	(0.14)	12	(0.10)
CB	Mountain Bluebird	12	(0.14)			12	(0.10)
PB	Violet-green Swallow	9	(0.11)	2	(0.05)	11	(0.09)
CB	Northern Flicker	10	(0.12)			10	(0.08)
CB	Red-breasted Nuthatch	6	(0.07)	4	(0.11)	10	(0.08)
CB	Western Bluebird	8	(0.10)	2	(0.05)	10	(0.08)
Unk	Northern Rough-winged Swallow	9	(0.11)			9	(0.07)
PB	White-throated Swift	8	(0.10)			8	(0.07)
Unk	Red Crossbill	7	(0.08)			7	(0.06)
PB	Steller's Jay	6	(0.07)	1	(0.03)	7	(0.06)
CB	Brown Creeper	5	(0.06)	1	(0.03)	6	(0.05)
CB	Lincoln Sparrow	6	(0.07)			6	(0.05)
	Unkn. Woodpecker	6	(0.07)			6	(0.05)
PB	Olive-sided Flycatcher	4	(0.05)	1	(0.03)	5	(0.04)
PB	White-breasted Nuthatch	5	(0.06)			5	(0.04)

Table 2. cont.

	Common Name	Mix Conifer/ Meadow No. Detections	Mix Conifer/ Meadow Ave. Abund.	Riparian/ Mix Conifer No. Detections	Riparian/ Mix Conifer Ave. Abund.	Total No.	Total Ave. Abund.
	Unkn. Hummingbird	1	(0.01)	2	(0.05)	3	(0.02)
PB	Warbling Vireo			3	(0.08)	3	(0.02)
Unk	Black-chinned Hummingbird			2	(0.05)	2	(0.02)
Unk	Plumbeous Vireo	1	(0.01)	1	(0.03)	2	(0.02)
PB	Rock Wren	2	(0.02)			2	(0.02)
	Unkn. Sparrow	2	(0.02)			2	(0.02)
CB	American Dipper			1	(0.03)	1	(0.01)
Unk	Black-capped Chickadee	1	(0.01)			1	(0.01)
PB	Common Raven	1	(0.01)			1	(0.01)
M	Dusky Flycatcher	1	(0.01)			1	(0.01)
M	MacGillivray's Warbler	1	(0.01)			1	(0.01)
M	Nashville Warbler			1	(0.03)	1	(0.01)
Unk	Prairie Falcon	1					
Unk	Peregrine Falcon	1	(0.01)			1	(0.01)
Unk	Pygmy Nuthatch	1	(0.01)			1	(0.01)
Unk	Rufous Hummingbird	1	(0.01)			1	(0.01)
	Unkn. Falcon	1	(0.01)			1	(0.01)
M	Vesper Sparrow	1	(0.01)			1	(0.01)
M	Virginia's Warbler	1	(0.01)			1	(0.01)
M	Yellow Warbler		(0.01)	1		1	(0.01)
	Total and Average No. Detections	699 Total	8.4 Ave.	197 Total	5.3 Ave.	896	
	Total and Average No. Species	45 Total	0.54 Ave.	29 Total	0.78 Ave.		

Table 2a. Species and number of birds observed only during area search surveys at CEBR, May – July 2001 and 2002; species all detected in mixed-conifer habitat.

	Common Name	Mixed Conifer/Meadow	Riparian/mixed Conifer	Total No. Detections
M	Black-throated Gray Warbler		1	1
?	Cliff Swallow	2	4	6
PB	Evening Grosbeak	1		1
PB?	Golden Eagle	1		1
PB	Northern Pygmy-Owl	1	1	2
PB	Pinyon Jay		1	1
Unk	Red-tailed Hawk	1		1
CB	Spotted Sandpiper		3	3
Unk	Spotted Towhee		2	1
	Total (9 species)	5 species	6 species	17

Species Abundance (density estimates)

To determine density for species with >40 detections, we used the program DISTANCE, and by using unlimited-radius detections, we obtained CVs of under 40% for 8 species at Cedar Breaks. We were unable to obtain enough detections (>40) for each species within each habitat type and thus were unable to stratify between habitat types (mixed conifer/meadow and mixed conifer/riparian). Yet, for the 8 species, we obtained robust results (well balanced variance sources and <3 parameters) in the detection-curve model that incorporated the complete data sets (when data from all habitats were combined). By truncating outliers at various distances for individual species, we attempted to optimize coefficient of variation's (CV), by decreasing the number of parameters included in the models, and to balance the two sources of variance: sample size and probability of detection. We truncated the data at various distances for all 8 species (Table 2b). These density estimates represent baseline data for comparison with results from future monitoring programs within CEBR or other managed lands (i.e. other National Parks, BLM and State lands) with habitats similar to Cedar Breaks.

Table 2b. Numbers of individual birds detected per habitat and the estimated densities of bird species at Cedar Breaks National Monument. N = number of individuals detected; D = estimated density / hectare, CI = 95% confidence interval; and, CV(%) = percent coefficient of variation.

Species	Truncation % Distance (m)	N	Density	CI		D CV%
American Robin (all habitats)	5% (60)	67	1.73	1.35	2.22	12.5
Chipping Sparrow (all habitats)	10% (50)	42	0.97	0.82	1.16	8.5
Dark-eyed Junco (all habitats)	5% (65)	74	1.86	1.45	2.38	12.5
Hermit Thrush (all habitats)	10% (50)	73	0.55	0.40	0.75	15.7
Mountain Chickadee (all habitats)	10% (28)	50	3.25	2.22	4.76	19.3
Ruby-crowned Kinglet (all habitats)	5% (30)	41	1.11	0.83	1.49	14.5
White-crowned Sparrow (all habitats)	10% (74)	51	2.77	1.80	4.24	21.7
Yellow-rumped Warbler (all habitats)	10% (32)	45	2.11	1.49	2.97	17.4

Jackknife Estimators of Species Richness

In 2001, the lower elevation Ashdown habitat (mixed conifer/riparian) showed the greatest differences between the actual number of species observed and the Jackknife estimate, while the upper elevation habitats (mixed conifer/meadow) showed intermediate differences (Table 2c). When combining 2001 and 2002 data the lower Ashdown elevation habitats showed intermediate differences, while the upper elevation mixed conifer/meadow habitats showed greater differences. However, differences in the actual number of species and Jackknife estimates decreased in both areas. The decrease in difference in both habitats (the improved

detection of species) is probably due to the increase in sampling in both habitat types, particularly in the Ashdown area where sampling was doubled in 2002.

The results of this calculation are presented in the last column of Table 2c. In the upper elevation habitat, 79.6% of the estimated number of species were detected in 2001, however when combining 2001 and 2002 this increased to 83.9%. For the lower elevation Ashdown habitat, we detected 71.4% in 2001 and 85.2% when combining 2001 and 2002 data. Overall, 89.1% of the estimated total species for the park were detected during this inventory. This percentage falls below the goal of documenting at least 90% of the species present. Yet, reaching the goal of 90% of the estimated total may not be possible without considerably more effort/time, as the species we are missing are inconspicuous and “hard-to-detect” species, and always occur in small number.

Table 2c. Comparison of observed number of species and first-order jackknife estimates for all habitats and the two habitat types at Cedar Breaks National Monument during breeding season 2001 and 2002.

Habitat	# of Observed Species	Jackknife Estimate	% Increase of Estimate from Observed	% Species Observed vs. Estimate
Cedar Breaks All habitats 2001-02	40	44.9	10.9	89.1
Upper elevations (Mix conifer/ meadow) 2001	34	42.7	20.4	79.6
Upper elevations (Mix conifer/meadow) 2001, 2002	40	47.7	16.1	83.9
Lower Ashdown (Mix conifer/rip) 2001	18	25.2	28.6	71.4
Lower Ashdown (Mix conifer/rip) 2001, 2002	27	31.7	14.8	85.2

Non-Breeding Winter Surveys

We conducted 16 hours of non-breeding winter bird surveys for 2000, 2001 and 2002 at Cedar Breaks NM. All winter surveys were conducted on the dates between November and February using the area-search methodology. During these surveys, we documented habitat use and time of survey. We detected 78 individuals of 5 species (Table 2d).

Table 2d. Summary data of winter incidental search data, Cedar Breaks National Monument, 2001-2003. Shaded lines indicate species that are considered year-round inhabitants. An “X” indicates whether a species was detected during a particular year.

Rank	Species	2001	2002	2003	No. Detections
1	Dark-eyed Junco	X	X	X	54
2	Mountain Chickadee	X	X	X	12
3	Clark’s Nutcracker	X		X	5
4	Common Raven	X	X	X	5
5	Red Crossbill			X	2

Fossil Butte NM (FOBU)

During the 2001 breeding season 44-VCP point count surveys were conducted. Five incidental surveys were also completed with an emphasis in habitat that was not adequately covered in point count surveys. Eight crepuscular and nighttime surveys were also completed.

During the 2002 breeding season, 60 VCP point count surveys were carried out. Six incidental surveys were also completed with an emphasis on habitat that was not adequately covered during point count surveys. Four crepuscular and nighttime surveys were also completed.

Species Richness

Seven habitat types were sampled during point counts including mixed conifer, fir, aspen, grassland, sage/grassland (greater than 50% sage cover), grassland/sage (greater than 50% grassland cover), and serviceberry. Combining both breeding seasons 2001 and 2002, we detected 1473 birds of 64 species during point count surveys (Table 3). Incidental surveys detected 25 species that were not detected in point count surveys (Table 3a). Nighttime and crepuscular surveys detected 4 species (Table 3b). Therefore, we detected a total of 93 species for both 2001 and 2002. No U.S. Fish and Wildlife Service (USFWS) or state species of concern were detected.

VCP point count and incidental surveys detected 54 species in aspen, of which 13 species were found only in this habitat. Seventeen species were detected in fir habitat, of which one species was only found there. Thirty-six species were detected in grassland habitat of which 8 were only detected in that habitat. Nineteen species were detected in mixed conifer of which 7 species were detected only here. In sagebrush/grass mix, 9 species were detected of which 1 was detected only there. In sagebrush habitat, 42 species were detected, of which 8 species were detected only in sagebrush (Tables 3, 3a) and 9 species were detected in serviceberry; none were detected only in this habitat.

Relative Abundance across Habitats

Of the 63 species detected during VCP point count surveys at Fossil Butte, only 2 species were detected in all seven habitat types, 1 was detected in 6 habitats, 4 species were detected in five habitat types, 7 species in four habitat types, 7 species in three habitat types, 20 in two habitat types and 19 species in 1 habitat type (Table 3). Point count surveys detected 45.6 % of the total number of detections in sagebrush habitat, 30.0% in aspen habitat and 14.4 % in grass 4.3%, 3.4% in fir habitat, 2.0% in serviceberry, 1.8% in sage/grass mix and 1.4% in mixed conifer.

Table 3. Species distribution across habitats, Fossil Butte National Monument, 2001-2002. Numbers in parentheses are average abundances. Average abundance = Frequency = (total # individuals detected) / (total # of point count surveys conducted in that habitat).

ST.	Common Name	Aspen No.	Aspen Freq.	Aspen No.	Aspen Freq.	Grass No.	Grass Freq.	Mixed Conifer No.	Mixed Conifer Freq.	Sage/ Grass No.	Sage/ Grass Freq.	Sage/ Grass No.	Sage/ Grass Freq.	Service-berry No.	Service-berry Freq.	Total No.	Total Freq.
CB	Brewer's Sparrow	14	(0.30)	2	(0.33)	34	(1.48)	1	(0.50)	3	(1.00)	211	(2.34)	3	(1.00)	268	(1.54)
CB	Vesper Sparrow	3	(0.06)	2	(0.33)	41	(1.78)	1	(0.50)	2	(0.67)	193	(2.14)			242	(1.39)
CB	Green-tailed Towhee	39	(0.83)	11	(1.00)	53	(2.30)	1	(0.50)	2	(0.67)	88	(0.92)	14	(4.67)	185	(1.00)
CB	Warbling Vireo	71	(1.51)	7	(1.17)	9	(0.39)	4	(2.00)			4	(0.04)			95	(0.55)
CB	American Robin	41	(0.87)	2	(0.33)	8	(0.35)					4	(0.04)	2	(0.67)	57	(0.33)
PB	Yellow-rumped Warbler	26	(0.55)	7	(0.50)	9	(0.39)					2	(0.02)			37	(0.20)
CB	Western Meadowlark									2	(0.67)	31	(0.31)			33	(0.17)
PB	Dusky Flycatcher	19	(0.40)	2	(0.33)	5	(0.22)	1	(0.50)			3	(0.03)	1	(0.33)	31	(0.18)
CB	Sage Thrasher	1	(0.02)			2	(0.09)					28	(0.31)			31	(0.18)
CB	House Wren	28	(0.60)			1	(0.04)									29	(0.17)
CB	Brown-headed Cowbird	12	(0.26)									10	(0.11)	2	(0.67)	27	(0.14)
CB	Northern Flicker	14	(0.30)	3	(0.50)							6	(0.07)			23	(0.13)
PB	Black-billed Magpie	4	(0.09)									10	(0.20)			22	(0.10)
PB	Western Tanager	13	(0.28)	2	(0.33)	4	(0.17)	1	(0.50)					1	(0.33)	21	(0.12)
PB	Black-headed Grosbeak	12	(0.26)									8	(0.08)			20	(0.11)
CB	Horned Lark					4	(0.17)					16	(0.18)			20	(0.11)
	Unkn. Flycatcher	15	(0.32)			2	(0.09)					2	(0.02)			19	(0.11)
CB	Orange-crowned Warbler	15	(0.32)	1	(0.11)	2	(0.09)									18	(0.10)
CB	Common Raven	9	(0.19)	3	(0.50)							5	(0.06)			17	(0.10)
CB	Ruby-crowned Kinglet	15	(0.32)	2	(0.50)											17	(0.10)
CB	Mountain Bluebird	5	(0.11)			6	(0.26)	1	(0.50)			3	(0.03)			15	(0.09)
Unk	Yellow Warbler	15	(0.32)													15	(0.09)

Table 3 cont.

ST.	Common Name	Aspen No.	Aspen Freq.	Aspen No.	Aspen Freq.	Grass No.	Grass Freq.	Mixed Conifer No.	Mixed Conifer Freq.	Sage/ Grass No.	Sage/ Grass Freq.	Sage No.	Sage Freq.	Service-berry No.	Service-berry Freq.	Total No.	Total Freq.
CB	Clark's Nutcracker	2	(0.04)			3	(0.13)	6	(3.00)			3	(0.03)			14	(0.08)
PB	Tree Swallow	5	(0.11)			1	(0.04)			6	(2.00)	2	(0.02)			14	(0.08)
CB	Sage Grouse					8	(0.35)					5	(0.06)			13	(0.07)
PB	Cassin's Finch	8	(0.17)			2	(0.09)					1	(0.01)	1	(0.33)	12	(0.07)
CB	Mourning Dove	2	(0.04)			1	(0.04)	2	(1.00)			5	(0.06)	2	(0.67)	12	(0.07)
PB	Violet-green Swallow	3	(0.06)							7	(2.33)	4	(0.04)			14	(0.07)
CB	Rock Wren	7	(0.15)			1	(0.04)			2	(0.67)	1	(0.01)			11	(0.06)
CB	Red-tailed Hawk	3	(0.06)					1	(0.50)	1	(0.33)	4	(0.04)			9	(0.05)
PB	Mountain Chickadee	7	(0.15)	1	(0.11)											8	(0.05)
Unk	Cliff Swallow											7	(0.08)			7	(0.04)
PB	White-crowned Sparrow	1	(0.02)									5	(0.05)			6	(0.03)
PB	Black-capped Chickadee	6	(0.13)													6	(0.03)
PB	Brewer's Blackbird	1	(0.02)									5	(0.06)			6	(0.03)
PB	MacGillivray's Warbler	6	(0.13)													6	(0.03)
CB	Sandhill Crane					4	(0.17)					2	(0.02)			6	(0.03)
PB	Spotted Towhee	5	(0.11)			1	(0.04)									6	(0.03)
Unk	Turkey Vulture											4	(0.04)	2	(0.67)	6	(0.03)
	Unkn Woodpecker	5	(0.11)									1	(0.01)			6	(0.03)
PB	Chipping Sparrow	2	(0.04)	3	(0.50)											5	(0.03)
PB	Golden-crowned Kinglet	5	(0.11)													5	(0.03)
PB	Hammond's Flycatcher	4	(0.09)					1	(0.50)							5	(0.03)
Unk	Red-naped Sapsucker	3	(0.06)			1	(0.04)					1	(0.01)			5	(0.03)
	Unkn. Sparrow					2	(0.09)					1	(0.01)	2	(0.67)	5	(0.03)
PB	American Kestrel					1	(0.04)					3	(0.03)			4	(0.02)

Table 3 cont.

ST.	Common Name	Aspen No.	Aspen Freq.	Unk No.	Unk Freq.	Grass No.	Grass Freq.	Mixed Conifer No.	Mixed Conifer Freq.	Sage/ Grass No.	Sage/ Grass Freq.	Sage No.	Sage Freq.	Service-berry No.	Service-berry Freq.	Total No.	Total Freq.
Unk	Gray Flycatcher	3	(0.06)	1	(0.17)											4	(0.02)
CB	Say's Phoebe											4	(0.04)			4	(0.02)
CB	Western Wood-Pewee	2	(0.04)			2	(0.09)									2	(0.02)
PB	Swainson's Thrush					3	(0.13)									3	(0.02)
PB	Cordilleran Flycatcher	2	(0.04)													2	(0.01)
PB	Dark-eyed Junco	1	(0.02)					1	(0.50)							2	(0.01)
PB	Northern Harrier											2	(0.02)			2	(0.01)
PB	Steller's Jay	1	(0.02)	1	(0.17)											2	(0.01)
	Unkn. Empidonax	1	(0.02)	1	(0.17)											2	(0.01)
	Unkn. Swallow											2	(0.02)			2	(0.01)
	Unkn. Warbler	2	(0.04)													2	(0.01)
PB	Brown Creeper	1	(0.02)													1	(0.01)
CB	Broad-tailed Hummingbird	1	(0.02)													1	(0.01)
M	California Gull											1	(0.01)			1	(0.01)
PB?	Cooper's Hawk	1	(0.02)													1	(0.01)
PB	Golden Eagle									1	(0.33)					1	(0.01)
Unk	Great-tailed Grackle					1	(0.04)									1	(0.01)
M	Hooded Warbler	1	(0.02)													1	(0.01)
M	Lazuli Bunting	1	(0.02)													1	(0.01)
PB	Red-breasted Nuthatch			1	(0.17)											1	(0.01)
M	Swainson's Hawk					1	(0.04)									1	(0.01)
PB	White-breasted Nuthatch			1	(0.17)											1	(0.01)
	Total / Average No. Detections	436 Total	9.28 Ave.	50 Total	8.33 Ave.	212 tot.	9.22 Ave.	21 Total	10.5 Ave.	26 Total	8.67 Ave.	671 Total	6.71 Ave.	30 Total	10.0 Ave.	Total 473	
	Total / Average No. Species	46 Total	9.3 Ave.	18 Total	8.3 Ave.	28 Total	9.2 Ave.	12 Total	10.5 Ave.	9 Total	8.7 Ave.	36 Total	6.7 Ave.	9 Total	10.0 Ave.	Tot No. Spp.= 64	

Table 3a. Species and number of birds detected only during incidental surveys at Fossil Butte National Monument, May – July 2001 and 2002.

	Species	Aspen	Grassland	Mixed Conifer	Sage	Total
PB	Barn Swallow				3	3
PB	Downy Woodpecker	1				1
PB	Hairy Woodpecker	1				1
CB	Mallard	1	9			10
PB	Pine Siskin			2		2
PB	Plumbeous Vireo			1		1
PB	Prairie Falcon			1		1
PB	Pygmy Nuthatch			1		1
PB	Golden Eagle		3		4	7
PB	Killdeer		1		5	6
PB	Ferruginous Hawk		3			3
PB	Loggerhead Shrike		2		1	3
PB	Hermit Thrush			2		2
PB	Chukar		1		1	2
Pb	Northern-Rough-winged		2			2
PB	Sharp-shinned Hawk		1			1
PB	Blue Grouse		1			1
PB	Spotted Sandpiper			1		1
PB	Red-necked Phalarope				1	1
M	Franklin's Gull				1	1
PB	Western Scrub-Jay				1	1
PB	Townsend's Solitaire			1		1
M	Cedar Waxwing			1		1
PB	Sage Sparrow				1	1
M	Song Sparrow		1			1
	25 Species					

Table 3b. Species and number detected during crepuscular and nighttime surveys at FOBU; May – July 2001 and 2002.

	Species	Mixed Conifer	Sagebrush	Total
PB	Common Nighthawk CONI		10	10
PB	Common Poorwill COPO	1	6	7
PB	Long-eared Owl LEOW	3		3
PB	Great Horned Owl GHOW	1		1
	Total 4 Species	5	16	21

Species Abundance (density estimates)

To determine density we used the program DISTANCE, and by using unlimited-radius detections, we obtained CVs of under 40% for 6 species in 3 habitat types (aspen, grassland, and sagebrush). For those 6 species we obtained robust results (well balanced variance sources and <3 parameters) in the detection-curve model that incorporated the complete data sets. We truncated the data at various distances for all 6 species, except for Green-tailed Towhees in

aspen and grassland habitats and Brewer's Sparrows in grassland habitat (Table 3c). These density estimates represent baseline data for comparison with results from future monitoring programs within FOBU or other managed lands (i.e. other National Parks, BLM and State lands) with habitats similar to FOBU.

Table 3c. Numbers of individual birds detected per habitat and the estimated densities of bird species at Fossil Butte National Monument 2001 and 2002. N = number of individuals detected; D = estimated density / hectare, CI = 95% confidence interval; and, CV(%) = percent coefficient of variation.

Species	Truncation Distance (m)	N	Density	CI		D CV
American Robin (all habitats)	10% (325)	49	2.51	1.59	3.97	23.2
Green-tailed Towhee (aspen)	0%	38	4.65	2.58	8.41	28.5
Green-tailed Towhee (grassland)	0%	53	2.95	1.75	4.97	26.2
Green-tailed Towhee (sagebrush)	5% (15)	60	2.2	1.59	3.04	16.0
Vesper Sparrow (grassland)	5% (73)	38	2.59	1.37	4.87	32.2
Warbling Vireo (aspen)	5% (7)	66	4.35	2.91	6.51	20.4
Brewer's Sparrow (grassland)	0%	34	4.81	3.18	7.27	20.0
Brewer's Sparrow (sagebrush)	5% (160)	186	7.23	5.17	10.12	17.1
Yellow-rumped Warbler (all habitats)	5% (72)	39	3.55	2.53	4.98	16.5

Jackknife Estimators of Species Richness

In 2001, the mixed conifer and sagebrush habitats showed the greatest differences between the actual number of species observed and the Jackknife estimate, while aspen habitats showed intermediate differences (Table 3d). When combining 2001 and 2002 surveys, mixed conifer again showed the greatest differences while sagebrush habitat showed very little difference. Aspen habitats were not surveyed in 2002 since we neared our goal of 90% in this habitat in 2001. We therefore concentrated on grassland habitat, which showed intermediate differences in 2002 and may require additional sampling in order to come closer to the 90% mark.

By comparing the Jackknife estimate with the number of species detected per habitat, we can determine the percent of species detected versus the estimated number of species likely to be present. The results of this calculation are presented in the last column of Table 3d. For the 2001 surveys, we detected 85.3%, 74.7%, and 68.8% of the species present in aspen, sagebrush, and mixed conifer, respectively. Combining both 2001 and 2002 data, we detected 89.1% and 69% of the species present in Sagebrush and mixed conifer, respectively. We observed improvement in the Sagebrush habitat but very little improvement in the mixed conifer. In Aspen 85.3% of the estimated total number of species were detected in 2001 and we felt that all but the most rare species had been detected. Thus Aspen habitat was not surveyed in 2002. In Grasslands (74.2% of the estimated total number of species were detected in 2002 and this habitat may need one more field season in order to achieve the goal of 90% coverage.

For the entire park we achieved our 90% level of inventory using Jackknife estimates (Table 3d). However some habitats at Fossil Butte still fall below the 90% documentation level of species estimated to be present in the park.

Table 3d. Comparison of observed number of species and first-order jackknife estimates for all habitats and two habitat types at Fossil Butte National Monument during breeding season 2001 and 2002.

Habitat	# of Observed Species	Jackknife Estimate	% Increase of Estimate from Observed	% Species Observed vs. Estimate
Fossil Butte (all habitats) 2001-02	56.0	60.9	8.0	92.0
Aspen (2001)	50	58.6	14.7	85.3
Grassland (2002)	25	33.7	25.8	74.2
Sagebrush (2001)	34	45.5	25.3	74.7
Sagebrush (2001-02)	32	35.9	10.9	89.1
Mixed Conifer (2001)	15	21.8	31.2	68.8
Mixed Conifer (2001-02)	16	23.0	30.4	69.6

Non-Breeding Winter Surveys

We conducted 20 hours of non-breeding winter bird surveys for 2000, 2001 and 2002 at Fossil Butte NM. All winter surveys were conducted on the dates between November and February using the area-search methodology. During these surveys, we documented habitat use and time of survey. We detected 62 individuals of 8 species (Table 3e).

Table 3e. Summary data of winter incidental search data, Fossil Butte National Monument, 2001-2003. Shaded lines indicate species that are considered year-round inhabitants. An “X” indicates whether a species was detected during a particular year.

Rank	Species	2001	2002	2003	No. Detections
1	Dark-eyed Junco		X	X	27
2	Gray-crowned Rosy-finch		X		13
3	Common Raven	X	X	X	7
4	Golden Eagle	X	X	X	5
5	Mountain Chickadee	X	X		5
6	Black-capped Chickadee	X			2
7	Rock Wren			X	1
8	Black-billed Magpie	X			1

Golden Spike NHS (GOSP)

During the 2001 breeding season, 48 VCP point count surveys were conducted in a grassland habitat, the dominant habitat type at Golden Spike. Four incidental surveys were conducted in a small narrow ravine in the southwest corner of the park and in the vicinity of a small stream (Blue Creek) at the far east end of the Central Pacific grade and at the visitor center/residential area. Four night surveys were also completed.

During the 2002 breeding season, 60 point count surveys were carried out in 3 main habitat types: sagebrush, aspen and mixed-conifer. All points were randomly generated in 2002. Six incidental surveys were also completed with an emphasis on habitat that was not adequately covered during point count surveys. Four crepuscular and nighttime surveys were also completed in 2002.

Species Richness

At Golden Spike National Historic Monument we detected 1053 birds of 38 species during point count surveys (Table 4). Incidental surveys focused on habitat not covered by point count surveys and revealed an additional 16 species that were not detected during point count surveys (Table 4a). Four species were detected during crepuscular and nocturnal surveys, the Common Nighthawk was also detected during incidental surveys (Table 4b). Therefore, we detected a total of 57 species for both 2001 and 2002 at Golden Spike. There were no U.S. Fish and Wildlife Service (USFWS) species of concern were detected. However, 3 State of Utah species of concern were detected: Burrowing Owl (*Athene cunicularia*), Short-eared Owl (*Asio flammeus*), and Sage Grouse (*Centrocercus urophasianus*).

Of the 54 species detected during point count and incidental surveys at Golden Spike, 14 species were detected in all three habitat types (Grassland/shrub, shrub/grassland, riparian), 12 species were detected in two habitat types, and 38 species were detected in only one habitat type (Table 4, 4a). Including both point count and area search surveys 70% of all species detected were in grassland habitat, 28% in the sage/grassland, and 2 % at Blue Creek.

Table 4. Species distribution across habitats, Golden Spike National Monument, 2001-2002. Numbers in parentheses are average abundances. Average abundance = Frequency = (total # individuals detected) / (total # of point count surveys conducted in that habitat).

	Common Name	Grassland		Mix Sage/Grassland		Total	
Status	Species	No.	Freq.	No.	Freq.	Tot. No.	Tot. Freq.
CB	Western Meadowlark	248	(3.59)	108	(4.00)	356	(3.71)
CB	Cliff Swallow	100	(1.45)	6	(0.22)	106	(1.10)
CB	Lark Sparrow	89	(1.29)	10	(0.37)	99	(1.03)
CB	Mourning Dove	65	(0.94)	31	(1.15)	96	(1.00)
CB	Long-billed Curlew	64	(0.93)	8	(0.30)	72	(0.75)
CB	Horned Lark	46	(0.67)	18	(0.67)	64	(0.67)
CB	Brewer's Sparrow	34	(0.49)	25	(0.93)	59	(0.61)
CB	Rock Wren	29	(0.42)	4	(0.15)	33	(0.34)
CB	Common Raven	24	(0.35)	8	(0.30)	32	(0.33)
CB	Brewer's Blackbird	3	(0.04)	24	(0.89)	27	(0.28)
M	California Gull			17	(0.63)	17	(0.18)

Table 4. cont.

	Common Name	Grassland		Mix Sage/Grassland		Total	
Status	Species	No.	Freq.	No.	Freq.	Tot. No.	Tot. Freq.
CB	Chukar	5	(0.07)	9	(0.33)	14	(0.15)
CB	Sage Thrasher	3	(0.04)	7	(0.26)	10	(0.10)
PB	Ring-necked Pheasant			6	(0.22)	6	(0.06)
PB	Barn Swallow			5	(0.19)	5	(0.05)
CB	Black-billed Magpie	5	(0.07)			5	(0.05)
CB	House Finch			5	(0.19)	5	(0.05)
PB	Loggerhead Shrike	5	(0.07)			5	(0.05)
PB	Northern Rough-winged Swallow	4	(0.06)	1	(0.04)	5	(0.05)
	Unkn. Sparrow	4	(0.06)			4	(0.04)
M	Sandhill Crane	3	(0.04)			3	(0.03)
PB	Vesper Sparrow	3	(0.04)			3	(0.03)
PB	Western Kingbird	1	(0.01)	2	(0.07)	3	(0.03)
Unk	Willet	3	(0.04)			3	(0.03)
PB	American Kestrel	2	(0.03)			2	(0.02)
CB	European Starling			2	(0.07)	2	(0.02)
Unk	Gray Partridge	2	(0.03)			2	(0.02)
PB	Killdeer	2	(0.03)			2	(0.02)
PB	Mallard	2	(0.03)			2	(0.02)
CB	American Robin			1	(0.04)	1	(0.01)
CB	Brown-headed Cowbird	1	(0.01)			1	(0.01)
PB	Bullock's Oriole	1	(0.01)			1	(0.01)
PB	Common Nighthawk	1	(0.01)			1	(0.01)
Unk	Northern Mockingbird			1	(0.04)	1	(0.01)
M	Orange-crowned Warbler	1	(0.01)			1	(0.01)
M	Red-necked Phalarope	1	(0.01)			1	(0.01)
M	Snowy Egret	1	(0.01)			1	(0.01)
M	Turkey Vulture			1	(0.04)	1	(0.01)
	Unkn. Swallow	1	(0.01)			1	(0.01)
PB	Violet-green Swallow			1	(0.04)	1	(0.01)
	Tot. and Ave. No. of Det.	753 Tot.	11.2 Ave.	300 Total	11.1 Ave.	Tot. Det.=1053	
	Total and Average No. Species	31 Total	0.46 Ave.	23 Total	0.85 Ave.	Tot. Spp.= 38	

Table 4a. Species and number of birds detected only during area search surveys at Golden Spike National Historic Monument, May – July 2001 and 2002.

Status	Species	Grassland	Mixed Sage/Grassland	Riparian	Tot. Detect.
M	Canada Goose			7	7
M	White-crowned Sparrow		6		6
M	Great Blue Heron			5	5
PB	Canyon Wren	3			3
PB	Northern Flicker	1		2	3
PB	Burrowing Owl	2			2
PB	Northern Harrier	2			2
PB	Red-tailed Hawk	2			2
Unk	California Quail		1		1

Table 4a. cont.

Status	Species	Grassland	Mixed Sage/Grassland	Riparian	Tot. Detect.
CB	Golden Eagle	1			1
PB	Prairie Falcon	1			1
PB	Sage Grouse	1			1
PB	Say's Phoebe	1			1
PB	Spotted Towhee			1	1
PB	Yellow Warbler			1	1
	Total 16 Species	15	7	18	40 detect.

Table 4b. Species and number detected during crepuscular and nighttime surveys at GOSP, May – July 2001.

	Species	No. Detected
PB	Short-eared Owl SEOW	2
CB	Great-horned Owl GHOW	7
PB	Common Poorwill	2
PB	Common Nighthawk CONI	1
	Total 4 Species	5

Relative Abundance across Habitats

Combining the point count, area search and nocturnal surveys, twenty-nine species were detected in Grassland habitat of which 15 species were only detected in this habitat, 23 species were detected sage/grassland area of which 9 were only detected there, and 6 species at were detected at Blue Creek of which 5 were only detected at Blue Creek (Tables 4, 4a).

Species Abundance (density estimates)

To determine density for species with >40 detections, we used the program DISTANCE, and by using unlimited-radius detections, we obtained CVs of under 40% for 6 species in 3 habitat types (aspen, grassland, and sagebrush) (Table 4c). For those 6 species we obtained robust results (well balanced variance sources and <3 parameters) in the detection-curve model that incorporated the complete data sets. We attempted to optimize CVs, by truncating outliers at various distances for individual species, which decreases the number of parameters included in the models, and balancing the two sources of variance: sample size and probability of detection. We truncated the data at various distances for all 6 species (Table 4c). Using this data as a baseline for a future monitoring program, we can provide estimates to detect population trends for targeted species at Golden Spike NHM or in other managed lands (i.e. other National Parks, BLM and State lands) with habitats similar to Golden Spike.

Table 4c. Number of individual birds detected per habitat and the estimated densities of bird species at Golden Spike National Historic Monument. n = number of individuals detected; D = estimated density / hectare, CI = 95% confidence interval; and, CV(%) = percent coefficient of variation.

Species	Truncation % Distance (m)	n	Density	CI		CV%
Brewer's Sparrow (all habitats)	5% (26)	56	1.89	1.35	2.63	16.6
Lark Sparrow (all habitats)	5% (14)	83	4.64	3.25	6.62	17.8
Long-billed Curlew (all habitats)	10% (50)	29	0.52	0.26	1.06	36.0
Horned Lark (all habitats)	5% (14)	61	4.70	2.66	8.29	28.6

Table 4c. cont.

Species	Truncation % Distance (m)	n	Density	CI		CV%
Morning Dove (grass)	5% (40)	53	1.65	1.09	2.25	17.0
Morning Dove (sage/grass mix)	5% (20)	29	0.75	0.48	1.19	20.9
Western Meadowlark (grass)	5% (38)	234	6.66	5.00	8.87	14.5
Western Meadowlark (sage/grass mix)	5% (60)	103	8.77	6.12	12.31	17.8

Jackknife Estimators of Species Richness

By comparing the Jackknife estimate with the number of species detected per habitat, we can determine the percent of species detected versus the estimated number of species likely to be present. The results of this calculation are presented in the last column of Table 4d. For the 2001 surveys, we detected 81.3% of the species estimated to be present in grassland habitat. When combining 2001 and 2002, we detected 82% of the species estimated to be present in grassland habitat, which was the main habitat at Golden Spike. This percentage falls below the goal of documenting at least 90% of the species present. This may be due to the difficulty in detecting species that are inconspicuous and/or rare.

Table 4d. Comparison of observed number of species and first-order jackknife estimates for the two habitat types at Golden Spike National Historic Monument during breeding season 2001.

Habitat	# of Observed Species	Jackknife Estimate	% Increase of Estimate from Observed	% Species Observed vs. Estimate
Grassland (2001)	17	20.8	18.3	81.3
Grassland (2001-02)	27	32.8	17.7	82.3

Non-Breeding Winter Surveys

We conducted 20 hours of non-breeding winter bird surveys for 2000, 2001 and 2002 at Golden Spike NHM. All winter surveys were conducted on the dates between November and February using the area-search methodology. During these surveys, we documented habitat use and time of survey. We detected 212 individuals of 8 species (Table 4e).

Table 4e. Summary data of winter incidental search data, Golden Spike National Historic Monument, 2001-2002. Shaded lines indicate species that are considered year-round inhabitants. An “X” indicates whether a species was detected during a particular year.

Rank	Species	2001	2002	No. Detections
1	Cassin’s Finch		X	60
2	Common Raven		X	57
3	Horned Lark	X		40
4	Chucker	X	X	16
5	Morning Dove		X	7
6	Gray Partridge	X		6
7	Western Meadowlark	X	X	6
8	Dark-headed Junco		X	6
9	Northern Harrier		X	2
10	Rough-legged Hawk		X	2

Table 4e. cont.

Rank	Species	2001	2002	No. Detections
11	American Kestrel	X		2
12	American Tree Sparrow	X	X	2
13	Golden Eagle		X	1
14	Ring-necked Pheasant		X	1
15	Sharp-tailed Grouse		X	1
16	Rock Wren		X	1
17	Song Sparrow		X	1
18	House Finch	X		1

Timpanogos Cave NM (TICA)

During the 2001 breeding season, 10 area search and incidental surveys were conducted in riparian, mountain mahogany-oak shrublands, and mixed-conifer forests. Four crepuscular/nighttime surveys were also completed. During the 2002 field season, four incidental surveys were completed in three general habitat types (riparian, mountain mahogany-oak, and mixed-conifer). Due to the small area size of Timpanogos Cave NM we did not use variable circular plot point counts. We decided that parks that were <500 acres did not fit the criteria to complete point count surveys, mainly due to the limited number of sample points that could be completed in an area this small.

At Timpanogos Cave National Monument we detected 424 birds of 50 species during incidental search surveys (Table 5). No U.S. Fish and Wildlife Service (USFWS) species of concern or state of Utah species of concern were detected.

Species Richness

A total of 50 species were detected at Timpanogos Cave National Monument during the 2001 and 2002 breeding seasons, thirty species were detected in mixed-conifer habitat of which 15 were only detected in this habitat, 25 species were detected in mountain mahogany/oak scrub of which 10 were detected only in this habitat type, 5 species in the riparian habitat of which 3 were detected only in riparian habitat, and 2 species were detected in the cliffs above the monument (Table 5).

Relative Abundance across Habitats

Of the 50 species detected at Timpanogos, no species were detected in all four habitat types, one species was detected in three habitat types, 15 species were detected two habitat types and 30 species were detected in one habitat type, while rest were detected as flyovers or unknown (Table 5). Thirty nine percent of all detections were noted in mixed conifer habitats, 29% in mountain mahogany/oak scrub, 3% in riparian habitats, 0.5% in the cliffs above the monument and 19% were detected as either unknown habitat or flyovers.

Table 5. Bird species and number of birds detected in different habitats during area search surveys at Timpanogos Cave Monument, May–July 2001-02.

Status	Common Name	Mahogany/ Oak Scrub	Mixed Conifer	Cliff	Riparian	Unknown	Flyover	Total
CB	Western Tanager	1	41					50
CB	Warbling Vireo		29					29
PB	Orange-crowned Warbler	25	2			2		29
PB	Broad-tailed Hummingbird	9	3		1		13	26
PB	American Robin	2	19					21
PB	Violet-green Swallow	3					15	18
PB	Tree Swallow				5		12	17
PB	Mountain Chickadee	15						15
PB	Yellow-rumped Warbler	2	11			3		14
PB	Black-headed Grosbeak	4	4			4	2	14
BP	Virginia's Warbler	12	1					13
CB	Dark-eyed Junco	2	11					13

Table 5. cont.

Status	Common Name	Mahogany/ Oak Scrub	Mixed Conifer	Cliff	Riparian	Unknown	Flyover	Total
PB	Chipping Sparrow	6	7					13
CB	Steller's Jay	1	9			1		11
PB	Cassin's Finch		11					11
PB	Lazuli Bunting	3	3			3	1	10
PB	Townsend's Solitaire		8					8
PB	Cordilleran Flycatcher		8					8
PB	Clark's Nutcracker		6			2		8
PB	White-throated Swift		1				6	7
PB	Pine Siskin	7						7
PB	Spotted Towhee	6						6
PB	Ruby-crowned Kinglet		4			2		6
PB	Red-breasted Nuthatch		3				3	6
PB	Hermit Thrush	6						6
PB	Hammond's flycatcher	6						6
PB	Green-tailed Towhee	6						6
PB	American Dipper		2		4			6
Unk	Calliope Hummingbird	1	3				1	4
PB	MacGillivray's Warbler	3				1		4
Unk	Golden-crowned Kinglet		4					4
Unk	Black-capped Chickadee	1	3					4
Unk	Swainson's Thrush		3					3
PB	Northern Flicker		2			1		3
PB	Canyon Wren	1		1			1	3
PB	Black-throated Gray Warbler		3					3
Unk	Yellow Warbler				2			2
PB	Rock Wren			1		1		2
PB	White-breasted Nuthatch		1					1
Unk	Sharp-shinned Hawk						1	1
PB	Red-tailed Hawk						1	1
PB	Pygmy Nuthatch		1					1
PB	Plumbeous Vireo						1	1
PB	House Wren	1						1
Unk	Gray Flycatcher		1					1
Unk	Golden Eagle						1	1
Unk	Calliope Hummingbird	1	3				1	4
M	Brewer's Sparrow	1						1
PB	Belted Kingfisher				1			1
PB	American Goldfinch		1					1
	50 Species	124	167	2	13	20	59	424

Jackknife Estimators of Species Richness

Because point counts were not completed at Timpanogos cave, no Jackknife Estimators were calculated.

Non-Breeding Winter Surveys

We conducted 20 hours of non-breeding winter bird surveys for 2001 and 2002 at Timpanogos NM. All winter surveys were conducted on the dates between November and February using the area-search methodology. During these surveys, we documented habitat use and time of survey. We detected 34 individuals of 6 species (Table 5a).

Table 5a. Summary data of winter incidental search data, Timpanogos Cave National Monument, 2001-2003. Shaded lines indicate species that are considered year-round inhabitants. An “X” indicates whether a species was detected during a particular year.

Rank	Species	2001	2002	No. Detections
1	Mountain Chickadee	X	X	20
2	Ruby-crowned Kinglet	X		7
3	Townsend’s Solitaire		X	3
4	Black-capped Chickadee	X		2
5	Rock Wren		X	1
6	Yellow-rumped Warbler	X		1

DISCUSSION

Below we discuss the findings of the avian inventory as they relate to the specific objectives of the project.

Document through existing, verifiable data and field investigations the occurrence of at least 90 percent of the bird species currently estimated to occur in the parks; CEBR, FOBU, GOSP and TICA.

Baseline inventories were assembled for Northern Colorado Plateau National Parks (Cedar Breaks N.M., Fossil Butte N.M, Golden Spike N.H.M. and Timpanogos Cave N.M.) that previously had little reliable information concerning bird species richness. One of the primary goals of this project was to document the occurrence of at least 90% of the bird species currently estimated to occur in each habitat in each park.

In 2001, Jackknife estimates revealed that our point count surveys in each park detected, on average, 76.9% of the species likely to be present; we suggested that this percentage of species detected represents the common species, and we anticipated that further surveying in 2002 would detect the rare and inconspicuous species in each park (Tables 2c, 3d, 4d).

Below we will discuss each park individually and the different methods used to achieve a 90% level of inventory. We also discuss what would be required to achieve the 90% mark in those parks that fell below the mark.

Cedar Breaks NM

For the entire park we were slightly below (89.1%) our goal of documenting 90% of the total number of bird species occupying the park, estimated using Jackknife estimates (Table 2c). This was also the case in all habitats sampled at Cedar Breaks, which still falls below the 90% level of species currently present in the park. As mentioned above, Jackknife estimates are highly sensitive to species only detected once, and therefore most of these species are eliminated from the analysis with the exception of the confirmed breeders. To increase the number of detections for these inconspicuous and rare species would require additional years of inventory conducting more extensive surveys (i.e. additional point counts), which is presently beyond the financial restraints of this study.

Fossil Butte NM

For the entire park we achieved our 90% level of inventory (Table 3d). However the number of detected species in some habitats at Fossil Butte still fall below the 90% level of species estimated to be in each habitat. As mentioned above, Jackknife estimates are highly sensitive to species only detected once, and therefore most of these species are eliminated from the analysis with the exception of the confirmed breeders. To increase the number of detections for these inconspicuous and rare species in these habitats (mixed conifer, grassland and aspen) would require additional years of inventory conducting more extensive surveys (i.e. additional point counts), which is presently beyond the financial restraints of this study.

Golden Spike NHM

For Jackknife estimates at Golden Spike, we lumped all grassland and sage habitats together. This shrub steppe habitat, with differing proportion of grass and sage, covers Golden Spike (Table 4d). When examining Jackknife estimates we were below (82.3%) the 90% level. As mentioned above, Jackknife estimates are highly sensitive to species only detected once, and therefore most of these species are eliminated from the analysis with the exception of the confirmed breeders. To increase the number of detections for these inconspicuous and rare species would require additional years of inventory conducting extensive surveys (point counts), which is beyond the financial restraints of this study.

Using systematic surveys, document presence/absence of bird species, and their distribution and abundance in habitats that were historically under-sampled or not sampled.

To document the presence/absence of bird species and the species richness (total number of species) of individual parks and major habitats within each park, we used VCP point count, area search, and nocturnal surveys. VCP point counts surveys are extremely useful in providing discrete sampling units, with standardized effort. Nevertheless, this sampling method tends to under sample species that are rare and/or secretive. Therefore, we augmented the point count data with incidental searches (that included documenting species seen in-between, before, and after point count surveys) and nocturnal surveys to document species richness. In addition, it should be noted that an equal amount of time was not spent in each habitat due to the fact that some habitats covered larger areas than others, and thus had more point counts, and/or more time and area was covered during incidental searches. Since the amount of time spent in a habitat, and the amount of area sampled can affect the total number of species detected (species richness), it is best not to directly compare species richness across habitats. Instead this information should be used for general comparisons across habitats within parks. (Above we discuss Jackknife estimates for species richness).

The relative abundance of species across habitats was calculated in two ways. We calculated densities, using DISTANCE for those species that met the models requirements (see Methods, Results, above). Additionally, we can use the point count data to look at the relative abundance (the average number of detections per point count) of individual species across habitats.

Relative Abundance (Density estimates)

An effective large-scale monitoring program must be able to provide reliable estimates of relative abundance and population trends over the entire ranges of many species. Currently the BBS (Breeding Bird Survey) has the capability of providing these estimates for a large number of North American species (Peterjohn, Sauer and Robbins 1995). However the BBS program has major shortcomings (James, McCulloch, and Wiedenfield 1996); it does not measure habitat-specific relative abundance and often population-trend data cannot be analyzed.

Obtaining density estimates through distance sampling is one way of obtaining relative abundance and population trend data for a targeted species and the specific habitat it occupies. Distance sampling is an integrated approach encompassing study design, data collection, and statistical analysis that avoids many pitfalls of index counts such as those used in BBS surveys (Rosenstock et. al 2001). When applied properly and critical assumptions are met, distance sampling provides direct estimates of bird density that are not confounded by detectability.

The density estimates we collected in Cedar Breaks, Fossil Butte and Golden Spike gives us a baseline for at least 17 species in various habitats that can be used in a monitoring program that targets these species and the habitats they occupy. This should be used on a larger scale than merely the parks that were most recently inventoried. To document population trends of birds using distance sampling (density) should be applied in similar habitat types but in larger parks (i.e. Canyonlands), or larger tracks of state and/or private lands, and other federal lands (BLM, Forest Service).

There are some limitations in using distance sampling when monitoring bird population. The program used (DISTANCE) is highly sensitive to low sample sizes, and therefore rare and inconspicuous species are not usually applied. Another drawback is that it may take up to 10-15 years of data collection to actually detect population trends. (See also, monitoring recommendations, below).

Cedar Breaks National Monument (CEBR)

At CEBR we categorized habitat as either mix-conifer/meadow (found in the upland area or mix-conifer/riparian (found in the Ashdown area). The bird communities of these two habitats are relatively unique; Forty-seven percent of the species detected in mix-conifer/meadow habitat were found exclusively within that habitat. Likewise, 22.8% of the species found in the mix-conifer/riparian were detected only within that habitat. These two habitats differ in elevation: the mix-conifer/meadow habitat is where the visitor center is located (3109 m) and the Ashdown area (2499 m) is where mixed conifer/riparian habitat exists. Elevation, in turn, affects the species composition and structure of the vegetation. Thus, much of the species distributional differences at CEBR exist according to the effects of elevation, including vegetation distribution. For example, the lower, Ashdown area had riparian vegetation and pinyon-juniper woodlands, which does not exist in the park but is adjacent to the park in the Ashdown area. Where riparian habitat exists, we detected Spotted Sandpiper, and American Dippers (*Cinclus mexicanus*), Warbling Vireo, Nashville Warbler. Pinyon associated species were also documented in this area: the Pinyon Jay, Black-throated Gray Warbler, Spotted Towhee.

The overall abundance of birds was slightly higher in the mix-conifer/meadow habitat, with an average of 8.4 detections per point count, while the mix-conifer/riparian had an average abundance of 5.3 species per point count. Nevertheless, individual species showed varied patterns (see Table 2). For instance, Cordilleran Flycatchers were much more abundant in the mixed conifer with a riparian vegetation element (0.73/pt.ct. versus 0.10/pt.ct.), while Yellow-rumped Warblers were nearly twice as abundant in mix-conifer/meadow habitat than in mix-conifer/riparian, and Three-toed Woodpeckers were fairly abundant in the upland mix-conifer/meadow habitat and not recorded at all in the other. All of the woodpeckers and most of the canopy foliage gleaners were more abundant in the mix-conifer/meadow habitat, which may be a reflection of the increased food abundance due to the recent Spruce Budworm outbreak within this habitat. Lastly, none of the species at CEBR had adequate sample sizes to compare densities between habitats.

Fossil Butte NM (FOBU)

FOBU has a diverse array of habitat types including aspen, mix-conifer, fir, grassland, sage and grassland mix, sage-dominated habitats, and small patches of dense serviceberry. This wide array greatly contributes to the park's overall bird species richness (a total of 93 species).

Although aspen forest accounts for a small portion of the total area of the monument these patches tend to be associated with springs or seeps that have a structurally complex and diverse understory, all of which are favorable breeding habitat characteristics for many bird species. In fact, aspen forests in FOBU provide habitat for over half of its bird species (52.7), 12 of which were detected only in aspen woodlands. Likewise, sage-dominated areas were used by 50% of the species detected, and 11 species were found nowhere else. Grassland had a slightly lower species richness (38 species; 41%). Mix-conifer habitat had significantly lower species richness, providing habitat for only 25% of all species. Yet this habitat has the highest number of obligate species (found only in one habitat) of all of FOBU's habitats: 43.5% of the species detected in mix-conifer were not detected in any other habitat. In addition the fir habitat had two species (the Red-breasted Nuthatch and the White-breasted Nuthatch) that were found nowhere else in the park.

The pattern of relative abundance of birds across habitats differs from species richness. Aspen forests had the highest species richness, yet had the third highest abundance of birds (an average of 9.28 individuals detected per point counts). The habitat with the greatest number of detections/point count was the mixed conifer habitat. Interestingly, the Service Berry habitat had the second highest average number of detections (10 individuals/point count). Although this may be partly due to the small number of surveys conducted there, it may also indicate the importance of these small areas for specific species such as the Green-tailed Towhee, that depend on dense shrubs for nesting, and American Robin and Western Tanagers that eat their berries.

Considering the relative abundance of individual species across habitats in FOBU, by far the most species, sixteen, were detected most frequently in aspen woodlands. These species are typically associated with, and nest in, deciduous forest in general (e.g. House Wren, Tree Swallow, Black-capped Chickadee, Black-headed Grosbeak, Orange-crowned Warbler, Yellow Warbler) and some are considered aspen associates (i.e., Red-naped Sapsucker). Fir forest, mixed conifer, and sage habitats each had an equal number of species that were most frequently detected in each habitat. Species found most commonly in fir forest include Yellow-rumped Warbler, Common Raven, Chipping Sparrow, Steller's Jay, Red-breasted Nuthatch and White-breasted Nuthatch. Those detected most in mixed conifer include Western Tanager, Mountain Bluebird, Clark's Nutcracker, and Hammond's Flycatcher, all of which are associated with conifer forests throughout their breeding ranges.

Sage habitats, including shrub steppe areas of sage and grass mosaic, are known to harbor a relatively unique bird community, with many bird species that are found only where sage is present (Paige and Ritter 1999). This is true of FOBU's sage habitat. Of the thirteen species that are more abundant in sage and sage/grass habitats, the Sage Grouse, Brewer's Sparrow and Sage Thrasher are considered sage obligates and would likely not be in the park if sagebrush habitat did not exist. Likewise, Vesper Sparrow, Western Meadowlark, and Golden Eagle are shrub steppe associates and most commonly found there, while grassland areas provide breeding habitat for Sandhill Cranes. Thus this park, with its landscape of extensive sagebrush areas with patches of aspen, mix-conifer, fir, serviceberry and grasslands comprises a unique mosaic of habitats and bird communities.

We were able to determine density estimates in more than one habitat for both the Green-tailed Towhee and the Brewer's Sparrow. The Green-tailed Towhee had the highest density in aspen, then grassland, then sage. When just relative abundance was considered it had its greatest in grassland, then aspen and sage. All of these habitats had a considerable shrub component that this species requires. The Brewer's Sparrow is a sage associate and had a higher density in the sage habitat (7.2 individuals per hectare) than in the grassland (4.8 individuals/ha.) reflecting the fact that the grassland areas had much fewer, more scattered shrubs.

Golden Spike NHS (GOSP)

Mostly grasslands, with varying amounts of sagebrush, and a few juniper trees, cover GOSP. It also has a small amount of riparian habitat. We categorized the vegetation into two major habitat types: grassland and mixed sage/grassland. In addition, we conducted surveys in riparian habitat. The greatest species richness was found in grasslands. A total of 41 species was detected in this habitat, including 17 species (42% of the species detected in grassland) that were detected only in this habitat. These species include many typical grassland species, including many typical grassland species: Gray Partridge, Killdeer, Sandhill Crane, and Vesper Sparrow. The mixed sage/grassland had 11 exclusive species, none of which are considered sage obligates (e.g., European Starling, American Robin, House Finch). The bird communities in the two habitats are both more typical of grassland than dense shrub habitats, and 13 species were detected in both habitats. In the small amount of riparian habitat three additional species were detected including Tree Swallow, Yellow Warbler, and Rock Wren. Thirty-four percent of all species were found in more than one habitat.

The similarity between the mixed sage/grassland and the grassland habitat is also illustrated by the fact that they had virtually the same relative abundance of birds (an average of 11.2 and 11.1 individuals per point count, respectively). Yet, individual species sometimes differed in relative abundance. Some species were more abundant in the sage/grassland habitat (e.g., House Finch, Brewer's Blackbird) likely due to the greater structural diversity provided by sage shrubs. Still other species are more abundant in the sage-dominated habitat because their ecologies are closely tied to sage. These sage obligates include the Brewer's Sparrow and the Sage Thrasher.

Two species at GOSP, the Mourning Dove and the Western Meadowlark had adequate sample sizes to calculate their densities within the two major habitat types. Mourning Doves had a higher density in the grassland habitat than the sage/grass habitat. The Western Meadowlark density was higher in the sage/grass habitat. This is an interesting finding because their relative abundances in each habitat were virtually identical (an average of 3.59 detections per point count in grassland and 4.00 in sage/grassland).

Timpanogos Cave NM (TICA)

The vegetation communities within TICA include riparian, mixed-conifer forests, and mountain mahogany-oak shrublands. Within these habitats the mixed conifer habitat had the highest species richness 31 species (62% of all species detected). Of these, 16 species were found only in this habitat type and are typical of coniferous habitats (e.g., Cassin's Finch, Cordilleran Flycatcher, Clark's Nutcracker, Red-breasted Nuthatch). The riparian areas had far fewer species, six, yet four of these were found exclusively in riparian habitat: Tree swallow, Yellow Warbler, and Gray Flycatcher. The American Dipper, though also detected in mixed-conifer, also depends on riparian habitat. Species richness is also influenced by mountain mahogany-oak shrublands. Although these shrublands are patchily distributed and comprise a relatively small area, 25 species were recorded in them and eleven of these species, (44%) were only detected there.

Due to the limited size of TICA, no point counts surveys were conducted and we relied on area search surveys. As mentioned above, without point counts, it is problematic to compare relative abundances across habitats because of unequal sampling effort. Nevertheless, the total number of detections can be used to examine general patterns. Several species had considerably more detections in the mixed-conifer forests than other habitat types including Warbling Vireo, American Robin, Yellow-rumped Warbler, Dark-eyed Junco, Steller's Jay, Cassin's Finch, Townsend's Solitaire, Cordilleran Flycatcher, and Clark's Nutcracker.

Also, mountain mahogany-oak shrublands have been shown to provide for a diverse and relatively abundant insect community within the surrounding habitat context, which is often coniferous habitat. As mentioned above 44% of the species recorded in this habitat were found in no other. In addition, two species were significantly more abundant in mountain mahogany-oak shrublands and, although recorded in small numbers in other habitats, likely depend on these habitats for food and/or nesting sites. These are the Orange-crowned Warbler and the Virginia's Warbler.

In sum, the avian community of TICA is fairly complex. While thirty percent of all the species detected in TICA were found in more than one habitat, others were tied to specific habitats and the features they provide.

Identify critical habitats (i.e., document locations of key breeding and non-breeding habitats where current records are lacking).

As is evident from the discussion above, each habitat within each of the parks included in this inventory contributes to avian diversity across the landscape. And, when identifying critical habitats, it is appropriate to look beyond the parks' boundaries, especially in light of the fact that most of the parks are relatively small National Monuments and National Historic Monuments. Therefore, we identified critical habitats by researching which habitats are of concern in western North America and the Colorado Plateau. Habitats of critical concern that are represented in the inventoried parks include sagebrush/grassland/grassland, aspen woodlands, riparian woodlands, and coniferous forests. We will summarize the ecology and conservation concerns of each of these habitats below.

Sagebrush/Grassland/Grassland

Sagebrush/Shrubsteppe/Grassland habitats (SSG habitats), composed of native shrubs and shrubsteppe (areas of shrubland/grassland mosaic with differing degrees of shrub cover), cover approximately 150 million acres of the American West, and comprise one of the most extensive ecosystems in North America. This "sagebrush sea" extends from the east side of the Cascade Mountains in Washington and Oregon, east to western and central Wyoming, southwest Montana, and the western edge of the Dakota grasslands, and south into western Colorado, northern New Mexico, and Arizona. Many of these habitats within the inventoried parks are distinctive in that they are comprised of sagebrush at or near the limits of its distribution. Thus they represent unique and important habitat, especially for birds, as bird specialists may be poorly equipped to tolerate conditions beyond those experienced in the core of their geographic range (Brown 1995, Pavlacky et al. 2001).

For many decades, range scientists believed that grasslands originally dominated the Intermountain West, and that sagebrush invaded because of heavy grazing. As a result,

numerous projects were undertaken to clear sagebrush from areas. More recently it has become evident that sagebrush, not grasslands, was dominant and widespread, and that the boundaries of sagebrush habitats were generally the same as they are today; the proportion of sage to grass was mainly determined by the natural fire regime. Furthermore, it is now recognized that sagebrush habitats provide important habitat to many plant and animal species. In fact, many sagebrush birds live nowhere else (Paige and Ritter 1999).

Unfortunately, though widespread throughout the west, sagebrush habitats are threatened throughout their range. They have experienced habitat loss, fragmentation, and degradation due to agriculture, livestock grazing, and the invasion of exotic annual plants. Nationally, grassland and shrubland birds show the most consistent population declines over the last 30 years of any group of bird species. Across the U.S. the populations of 63 percent of shrubland and shrub-dependent birds are declining (Paige and Ritter 1999). In the intermountain west, more than 50 percent of grassland and shrubland bird species show downward population trends (Sauer et al. 1996, ALA)

The predominant impact of agricultural development is the conversion of shrubland areas to grasslands and croplands and the subsequent fragmentation of once contiguous shrublands. Yet, agricultural development plays a less obvious but destructive role in the introduction and spread of alien plants into natural habitats, which may now be the most serious threat to these habitats (Rotenberry 1998). Agricultural areas, and their associated roads, serve as continually renewable sources for immigrant alien species of plants (Janzen 1986, Alberts et al. 1993, Rotenberry 1998). Additionally, agricultural areas apparently extend the landscape-level distribution of Brown-headed Cowbirds (an avian brood parasite, and corvids such as Common Ravens and American Crows, which can be major predators of the nests of songbirds (Marzluff et al. 1994, Rotenberry 1998).

Livestock grazing impacts SSG habitats in several interrelated ways. It can influence bird communities by creating habitat for foraging Brown-headed Cowbirds as well as greatly affecting native vegetation. Because the vast majority of western SSG habitats did not evolve under grazing pressure from large ungulates such as Bison, the impact due to livestock grazing has been detrimental to native vegetation (Mack and Thompson 1982, Rotenberry 1998, Paige and Ritter 1999). It disturbs the soil and results in selective removal of plant biomass, thus altering competitive relationships among species and can lead to and increase in unpalatable species. In addition, it destroys microbiotic crust that usually forms on the soil and thus adversely influences water infiltration, erosion, and nitrogen fixation (Harper and Marble 1988, Rotenberry 1998). This destruction can have long-term effects: recovery from grazing, that includes a well developed crust community, can take a decade or more, depending on the type of disturbance, presence of inoculants from nearby crust communities, and occurrence of invasive weeds (Belnap 1993, St. Clair and Johansen 1993, Kaltenecker 1997, Paige and Ritter 1999).

Soil disturbance from grazing also promotes the germination of annual plant seeds and thus promotes the invasion of exotic annual plants into otherwise undisturbed areas. This process has resulted in perhaps the greatest impact on western shrublands: the establishment of the invasive, exotic cheatgrass (*Bromus tectorum*). Cheatgrass first appeared in the early to mid 1800s, probably as a contaminant in grain seed (Mack 1981) and quickly spread among agricultural areas and along roads and railroads. But it spread into otherwise undisturbed shrublands through widespread livestock grazing and the disturbance of the soils surface.

Cheatgrass' principle impact has been to alter the fire ecology of SSG ecosystems. Native bunchgrasses do not provide continuous cover of fuel, fires do not spread easily, thus large fires in pristine native shrublands were relatively rare (Whisenant 1990, Rotenberry 1998). Conversely, cheatgrass provides a continuous surface cover of relatively fine fuel that carries fire into and over much larger areas than likely occurred historically (Whisenant 1990, www.ut.blm.gov/FireRehab). It matures and dries earlier than native bunchgrass, increasing the chance of fire earlier in the season (Knick and Rotenberry 1997). Also, because it does not catch and hold snow like a diverse perennial stand of vegetation, the site becomes drier (desertification; www.ut.blm.gov/FireRehab). In fact, shrublands infested with cheatgrass are 20 times more likely to burn than those without (Stewart and Hull 1949; Whisenant 1990). That cheatgrass invasion and the resulting increased risk of fire in shrublands is of urgent concern is illustrated by the fact that the acres of Utah Bureau of Land Management (BLM) land burned by wildfire increased from 4,549 acres in 1991 to 308,457 acres in 1996 (www.ut.blm.gov/FireRehab).

In addition to increasing the probability of fire, the establishment of cheatgrass reduces the average fire-return intervals to less than five years, and reduces the chances for sagebrush and native bunchgrasses to regenerate (Whisenant 1990). Post-fire survivorship of cheatgrass is high because it is a winter annual that matures and sets seed by the onset of summer fires, which shatter the seed heads. Conversely, native perennial grasses mature in the summer, and have low survivorship after fires. The establishment of cheatgrass in an area makes the area more likely to burn again. Thus, once cheatgrass becomes a part of an ecosystem, it is highly likely to remain a part of it (Rotenberry 1998). Unlike cheatgrass, sagebrush after a fire must be re-established by wind-dispersed seeds or by seeds in the soil. A second fire within 5-8 years can destroy any viable sagebrush seeds in the seed bank. Thus, subsequent recovery of sagebrush can only come from other living sagebrush. Sage seeds are disbursed by wind, and disperse about 30 m from a seed source (Meyer 1994, Paige and Ritter 1999). Additionally, sagebrush may take several years to mature before producing seed. Thus repeated, frequent fires can eliminate sagebrush entirely, cheatgrass becomes established and creates uniform annual grasslands perpetuated by large, frequent fires and void of native plant communities (Whisenant 1990, Paige and Ritter 1999). Restoring native plants is then extremely difficult if not impossible (West 1988, Paige and Ritter 1999).

Presently, non-native grasses and agricultural conversion now dominate much of the sagebrush lands in the Intermountain West (Paige and Ritter 1999). This conversion of sagebrush landscapes to a new state dominated by exotic annual grasslands and high fire frequencies (Knick and Rotenberry 1997) results in changes in the avian composition from communities composed of shrubland obligates to those composed of grassland species (such as Meadowlarks and Horned Larks). Sagebrush habitat has been found to support more species, have a greater bird density, and a greater individual density for most species, than cheatgrass habitat types (Schuler et al. 1993). Correspondingly, the bird species perhaps in the most need of conservation attention are those most typical of undisturbed shrubsteppe including Sage Grouse, Brewers Sparrows, Sage Sparrows, Black-throated sparrows, and Sage Thrashers (Rotenberry 1998, Paige and Ritter 1999).

FOBU and GOSP have considerable sage and shrubsteppe habitat, with the grassland component (including cheatgrass) dominating much GOSP. The sage obligates that breed within FOBU are Sage Grouse, Sage Thrasher, and Brewer's Sparrow. A Sage Sparrow was

also detected, and they may breed there. The abundance of sage obligates has been found to be related to the density and distribution of sage in the landscape and although the same sage obligates were detected at GOSP, they were in lower numbers, reflecting the fact that GOSP has a greater grassland component with fewer shrubs. Also, we had adequate sample sizes to calculate density of Brewer's Sparrows in each park and this species appears to be a good indicator of the differences in the two parks' sagebrush community. Brewer's Sparrows have been shown to prefer areas dominated by shrubs compared to areas dominated by grass (Paige and Ritter 1999). We found that they had a much higher density in FOBU, in both the sage (7.2 individuals/ha.) and the grassland habitats (4.8 individuals/ha.), while GOSP's density of Brewer's Sparrow's was 1.9 individuals/ha.

The shrubsteppe/grassland associates at FOBU include Vesper's Sparrow, Western Meadowlark, Golden Eagle, Long-eared Owl and Sandhill Crane. These same species were detected at GOSP. GOSP had additional species, most of which are associated with grassland-dominated habitats and indicate the pervasiveness of this habitat at GOSP, including Ferruginous Hawk, Short-eared Owl, Northern Harrier, and Burrowing Owl.

Because non-native grasses and agricultural conversion now dominate so much area in the Intermountain West, it is especially important to sustain remaining native plant communities in a healthy state to support native birds and other wildlife (Paige and Ritter 1999). Establishing and maintaining a healthy sagebrush community and its associated wildlife would require protecting and sustaining biological crust communities by minimizing sources of soil disturbance, such as off-road vehicle use or heavy grazing. Rehabilitating sites depleted of native grasses and forbs may require seeding native species, using local, native genotypes that are competitive with non-native weeds, and temporarily eliminating or reducing livestock grazing. In addition, avoidance of the processes that degrade or destroy natural water flow or the vegetation in and around seeps, springs, wet meadows and riparian vegetation is also critical for the many bird species that depend on forbs and insects available in moist places in arid landscapes. Finally, ground squirrel and prairie dog colonies provide nesting burrows for burrowing owls, and maintain small mammal populations as prey for many bird and mammal predators in habitats (see Paige and Ritter 1999).

Aspen

There are about 2.8 million hectares of aspen-dominated woodlands across the western U.S. Loss of aspen stands and the decline of aspen regeneration have occurred throughout the west due to fire suppression, cutting and development (CPIF 2000).

Fire is the primary disturbance agent of Aspen regeneration; in the absence of significant disturbance, aspen clones may deteriorate as longer-lived conifer species establish in the shade of seral aspen stands and eventually dominate the overstory. Thus, fire suppression during the last 75 years has dramatically reduced the rate of conversion of conifer stands back to early-seral aspen. Additionally, while few aspen stands are regenerating due to the lack of fire, older stands of aspen may be replaced by shade-tolerant conifers (Muldavin et al. 1999, TNC 1999, Rogers 2002). The rate of stand conversion depends on site conditions, proximity to conifer seed sources, and the rate that conifer seedlings grow into the stand canopy (CPIF 2000). Thus, as a result of continuing fire suppression and successional processes, the extent of aspen across

the western landscape is probably declining and will continue to do so unless direct management actions are taken (CPIF 2000).

Grazing by livestock and native herbivores, particularly elk, can have significant impacts on aspen regeneration and shrub-forb structure of aspen-dominated woodlands. Grazing may change the composition and relative abundance of understory vegetation species, the structure of the forb and shrub understory, and damage aspen suckers and halt regeneration (Shepperd and Fairweather 1994, CPIF 2000, Rogers 2002). In addition, grazing can alter understory fuels sufficiently and greatly impact fire spread on the landscape (Kay and Bartos 2000, Rogers 2002) that, in turn, can reduce available forage in some conifer types such as ponderosa pine, and increase browsing pressure in adjacent aspen stands where forage is more readily available (Shepperd and Fairweather 1994, CPIF 2000).

The value of aspen habitats to wildlife is directly related to the structural diversity of the aspen stand (Mueggler 1989, CPIF 2000) and the structural diversity of the stand is related to its successional stage. As conifer begin to dominate a stand, less light reaches the understory, and the understory plant diversity and abundance tend to decline (CPIF 2000).

Aspen stands are patchily distributed and in and of themselves constitute a relatively small proportion of the landscape. Yet their value to wildlife is disproportionate to their area. They add species diversity and structural diversity to the habitat mosaic in which they are embedded, often coniferous habitats. Likewise, the birds found in aspen are often a composite of those typically found in aspen and those found in the surrounding habitat. Few species are limited to aspen forests, but some reach their highest density here (CPIF 2000), especially primary and secondary cavity nesters that preferentially use aspen with heartwood decay.

FOBU has aspen habitat and we found that although aspen forest accounts for a small portion of the total area of the monument, these patches provided habitat for over half of its bird species (52.7), 12 of which were detected only in aspen woodlands. Considering the relative abundance of individual species across habitats in FOBU, by far the most species, sixteen, were detected most frequently in aspen woodlands. Many of these species are cavity nesters, including primary cavity nesters (typically associated with, and nest in, deciduous forest in general (e.g., Red-naped Sapsucker) and secondary cavity nesters (e.g., House Wren, Tree Swallow, Black-capped Chickadee). Other species are associated with the deciduous vegetation that aspen provides (e.g., Black-headed Grosbeak, Orange-crowned Warbler, Yellow Warbler).

Thus, aspen habitat greatly contributes to avian biodiversity of FOBU and the region. Yet, as discussed above, it is a relatively threatened habitat. If successional processes such as fire is not reestablished in the region, the cumulative effects of aspen loss may lead to a regional decline in biodiversity of aspen-dependent communities.

Conifer Forests

When considered at the regional scale, the coniferous habitats in CEBR, FOBU, and TICA represent a fraction of the coniferous habitat available to coniferous bird communities. Yet, at the landscape scale, and within the parks, they contribute to avian diversity, and many species we detected would not be there if not for the habitat resources that coniferous forests provide. The relationships between coniferous habitats and their associated bird communities have been

extensively studied. Therefore, we will limit this discussion to some particular aspects of the coniferous forests involved in this inventory.

Of particular interest is the spruce budworm outbreak in the Engelmann spruce (*Picea Englemannii*) in the mixed coniferous uplands of CEBR. Foliage gleaning birds such as warblers (e.g. Yellow-rumped Warbler) and bark gleaners (Red-breasted Nuthatch, Three-toed Woodpecker) are predators of spruce budworm larvae and pupae and have been found to increase in response to outbreaks (Crawford et al. 1983, Rotenberry et al. 1995). In fact, bird predation can have a noticeable impact on spruce budworm populations (Cambell et al. 1983) and are capable of dampening the seriousness of infestations. Yet this only possible when habitats are suitable for supporting adequate populations of these effective predators (Crawford and Jennings 1989).

The most significant negative effects of insect outbreaks are likely due to changes in habitat suitability resulting from the removal of vegetation (cutting of infested trees) and tree mortality (Rotenberry et al. 1995). Another potential negative impact to birds is the use of pesticides in response to insect outbreaks due to loss of prey and direct negative effects of the pesticides (Rotenberry et al. 1995).

Another habitat component found within coniferous forest habitats that contributes disproportionately to avian diversity is mountain mahogany and Gambel oak woodlands. These shrublands are an important resource for wildlife, including many bird species. Many of the shrubs produce edible fruits that birds eat. And birds such as Steller's Jay, Western Scrub Jay, and Green-tailed Towhees feed on their acorns (CPIF 2000). In addition, oak woodlands support a unique and abundant insect fauna and many insectivorous birds forage in these areas more frequently than the surrounding coniferous forest. Others, such as the Virginia's Warbler feed and nest there (Olsen et al. 1999).

Gambel Oak reproduces by suckering and whole mountainsides can be populated by clones. It is extremely fire-tolerant and resprouts following fire. In fact, fire suppression associated with timber management and the limitation of postfire succession can degrade or eliminate mountain mahogany and Gambel oak woodlands. Additionally, over the last century, livestock grazing in mountain mahogany/oak scrub has altered vegetation composition, age structures and fire patterns (West 1988) and has potential, although unknown, consequences for the birds associated with this habitat.

Identifying species of concern (i.e. document presence/absence of birds of special management concern that are known or expected to occur in the park units based on habitat or historic records). Identify park-specific species of special concern, which could become part of future "vital signs" monitoring.

The following species are recognized by Federal and State wildlife agencies and the conservation community as species of concern in the Colorado Plateau region.

American Peregrine Falcon (*Falco peregrinus anatum*) (CEBR)

After 28 years, on August 20, 1999 the Department of the Interior removed the Peregrine Falcon from the Endangered Species List.

Range:

The American Peregrine Falcon breeds from non-Arctic portions of Alaska and Canada south to Baja California (except on the coast of southern Alaska and in British Columbia), throughout Utah, central Arizona and Mexico (locally), and locally along the east coast of the United States. Distribution is also local in the southern boreal forests of Canada. This falcon winters chiefly in its breeding range, except that the more northern birds move south.

Habitat:

A cliff or series of cliffs that tends to dominate the surrounding landscape constituted typical nesting habitat in the western United States. However, other forms of nesting habitat have also been utilized, such as river cutbanks, trees, and manmade structures including tall towers and the ledges of tall buildings (USFW Recovery Plan 1987).

Threats:

The principal cause of the peregrine's decline was due to the presence of chlorinated pesticides, especially DDT and its metabolite DDE, which have accumulated in peregrines as a result of feeding on contaminated prey (USFW Recovery Plan 1987). Adult mortalities increased but the principal effect was damage to the reproductive potential through interference with calcium metabolism. Eggs were laid with thin shells, rendering them easily broken, and consequently, greatly affecting the species' reproductive success. Other factors in the decline included shooting, natural predators (the great horned owl in particular), egg collecting, disease, falconers, human disturbance at nesting sites, and loss of habitat to human encroachment (USFW Recovery Plan 1987).

Greater Sage Grouse (*Centrocercus urophasianus*) (FOBU, GOSP)

Range:

Greater Sage Grouse occur only in western North America. Historically, they occurred from western Oklahoma and northern New Mexico north through western Colorado into Wyoming, Nebraska, the Dakota's into Saskatchewan and Alberta. They occurred in all states of the intermountain West including eastern areas of Washington, Oregon and California and Utah. Sage Grouse have been extirpated from Nebraska, New Mexico and Oklahoma and most likely from Kansas and Arizona.

Breeding:

Breeding activities occur from mid March to early June depending on elevation. Male sage grouse display on leks (strutting grounds) in early morning and late evening to attract hens. The mating system is polygamous where only a few males actually breed. The average number of males per lek is about 20-25, but in areas of good habitat over 100 males have been counted on individual leks. After breeding in late March-early April hens disperse from lek sites and choose nest sites from 650-980 feet to over 5 miles from the lek of mating.

Sage Grouse nests are usually placed at the base of a live sagebrush bush. Other shrubs and even clumps of grass have been used for nest cover but sagebrush cover has predominated in all nest studies. Clutch size range from 6-10 eggs with 7-9 being the most common.

Habitat:

Sage Grouse are dependent upon Sagebrush (*Artemisia spp.*), primarily subspecies of big sagebrush (*Artemisia tridentata*) during breeding and non-breeding periods. The importance of wet meadow habitats for breeding sage grouse has been demonstrated throughout their range (Klebenow 1969, Wallestad 1971). Studies have shown that leaving a 100 m strip of live sagebrush around the edges of meadows is very important for Sage Grouse breeding habitat. Wet meadows have been shown to be particularly important when summer rainfall decreases (Wallestad 1971).

Sage Grouse movement in the fall and winter (September-December) sometimes exceed 20 miles. As winter progresses, Sage Grouse forage in sagebrush in valleys and lower flat areas and roost in shorter sagebrush along ridge tops.

Threats:

There is a potential that the U.S. Fish and Wildlife Service will list the Greater Sage Grouse as threatened or endangered in some areas. Evidence from throughout the distribution of Sage Grouse indicates that habitat loss (i.e. land conversion from sagebrush steppe to roads, reservoirs, agriculture, urban development) and habitat fragmentation caused by roads, powerlines and land treatments have decreased Greater Sage Grouse populations with no sustained increases in population size (Braun et al. 1977).

Long-billed Curlew (*Numenius madagascariensis*) (GOSP)

Range:

Breeds from southwestern Canada, south to eastern Washington, northeastern California, Nevada, Utah, southern Colorado, New Mexico and northern Texas, and east to southwestern Kansas. Winters from central California, southern Arizona (rarely), northern Mexico, and parts of Gulf Coast states, south to southern Mexico, and irregularly to Central America. (Godfrey 1986).

Habitat:

Found in prairies and grassy meadows, generally near water. Tall thick patches of grasses and shrubs are avoided, and preferred sites have low vegetative cover, usually on flat grassy uplands, open ridges and hillsides. The nest is a depression in the ground, lined with bits of grass and occasionally twigs. Broods tend to be reared in relatively moist habitats, such as seepage sites and hay fields (Godfrey 1986, Cannings et al. In prep.). During migration and in winter, also found on beaches and mudflats. In Idaho and Utah, prefers open, recently-grazed shrubsteppe containing short vegetation for nesting; often feeds in agricultural areas.

Threats:

Habitat loss through intensive agricultural development and overgrazing by livestock is considered responsible for general population decline. Continued habitat losses are likely,

particularly in areas with rapid urban and agricultural development and areas where there is forest encroachment into grasslands (Cannings et al. In prep.).

Short-eared Owl (*Asio flammeus*) (GOSP)

Range:

Breeds in North America from northern Alaska to northern Labrador, south to California, Arizona, New Mexico and Mexico. Winters south to central Mexico.

Habitat:

Breeds in broad expanses of open land with low vegetation for nesting and foraging. Habitat types frequently mentioned as suitable include fresh and saltwater marshes, bogs, dunes, prairies, grassy plains, old fields, tundra, moorlands, river valleys, meadows, savanna, open woodland, and heathland (Mikkola, H., and S. Sulkava. 1969, Holt and Melvin 1986). In general, any area that is large enough, has low vegetation with some dry upland for nesting, and that supports suitable prey may be considered potential breeding habitat, although many will not have breeding Short-eared Owls. Roosts by day on the ground and on low open perches under low shrubs or in mixed conifer. Many nests are near water but generally are on dry sites. The same nest site may be used in successive years. Moves into and breeds in areas with high rodent densities.

Threats:

Habitat loss is the biggest threat. Declining in many parts of the range due to destruction and degradation of marshes, grasslands, and low-use pastures (Ehrlich et al. 1992). This may be a result of development, changing land-use patterns (e.g., farmlands to woodlands, or to development), changing farming practices (e.g., hay fields to row crops), reforestation, wetland loss, or a combination of these factors. Loss of open grasslands to later successional stages of community development reduces available hunting and breeding habitat. Prey abundance may be a limiting factor in the owl's distribution and breeding success (Melvin et al. 1989).

Burrowing Owl (*Athene cunicularia*) (GOSP)

Range:

Breeds locally throughout the western United States, prairie states and Canada; also Florida, south to central Mexico. Winters mainly in southern California, Arizona, and New Mexico, Texas, south to central America.

Habitat:

Ranges from well-drained grasslands, steppes, desert prairies and agricultural lands (Haug et al. 1993). Main breeding habitat consists of dry open shortgrass and treeless plains that are often associated with burrowing mammals. Burrowing Owls can be found in golf courses, cemeteries, airports, and vacant lots in residential areas and university campuses. Presence of a nest burrow is a critical requirement for western Burrowing Owls (Thomsen 1971, Martin 1973, Zarn 1974, Wedgewood, 1978, Haug 1985).

Threats:

Burrowing Owl numbers have declined, mainly due to intensive cultivation of grasslands and native prairies (Bent 1938). Factors that have contributed to these declines include: shooting and trapping, pesticides and degradation of breeding and wintering habitat. Prairie Dog control has also been very harmful, destroying owl nesting habitat throughout the western United States (Butts 1973). Evidence of population declines due to habitat destruction, pesticides and predators has been noted in New Mexico, Texas, Arizona and Utah. Burrowing Owls are listed as species of special concern due to declining populations in Utah.

Three-toed Woodpecker (*Picoides tridactylus*) (CEBR)

Range:

Breeds in North America from northern Alaska across Canada, south to southern Oregon, eastern Nevada, north-central Utah, central Arizona, and southern New Mexico (AOU 1998).

Habitat:

Breeds in coniferous forest (primarily spruce), less frequently mixed forest. Optimal habitat includes areas with 42-52 snags per 100 acres, with snags occurring in clumps, measuring 12-16 inches dbh and 20-40 feet tall, and mostly with bark still present (Spahr et al. 1991). Cavity nests placed in dead (occasionally live) tree (commonly conifer or aspen). Sometimes nests in utility poles.

Population eruptions are associated with fires, large-scale insect outbreaks such as spruce budworm, or disease (Leonard 2001). It is found less frequently in mixed forest, and occasionally in willow thickets along streams. Also found in high elevation aspen groves, bogs, and swamps. Found in mixed conifer composed of Rocky Mountain fir (*Abies lasiocarpa*) and Engelmann's spruce (*Picea engelmannii*) (Ryan, pers. comm.) in the Navajo Nation area. Also prefers dense stands of spruce-larch where it feeds on dead and live trees (Yunick 1985).

Threats:

Threats include incompatible forestry practices, deforestation. This species association with spatially unpredictable disturbance (e.g., fire, insect outbreaks) and its large home range make it sensitive to timber harvesting (removal of habitat) and forest fragmentation; both ultimately reduce food availability. Fire suppression, salvage logging (cutting of burned trees), and suppression logging (cutting of insect infested trees) all reduce or remove the dead and dying trees on which this species depends (Leonard 2001). May be detrimentally affected by fire suppression (Spahr et al. 1991). In Oregon, the liquidation of old growth lodgepole pine due to its infestation with the mountain pine beetle may reduce or eliminate habitat for this species.

Brewers Sparrow (*Spizella breweri*) (FOBU)

Range:

Breeding: Montana, and southwestern North Dakota, Wyoming, south to southern California (northern Mojave Desert), southern Nevada, central Arizona, northwestern New Mexico, central Colorado, southwestern Kansas, northwestern Nebraska, and southwestern South Dakota (AOU 1983, Rotenberry et al. 1999).

Habitat:

Breeding: Strongly associated with sagebrush over most of range, in areas with scattered shrubs and short grass. Can also be found to lesser extent in mountain mahogany, rabbit brush, bunchgrass grasslands with shrubs, bitterbrush, ceonothus, manzanita and large openings in pinyon-juniper (Rising 1996; Sedgwick 1987; USDA Forest Service 1994).

Habitat average canopy height usually < 1.5 meter (Rotenberry et al. 1999). Is Positively correlated with shrub cover, above-average vegetation height, bare ground, and horizontal habitat heterogeneity (patchiness); negatively correlated with grass cover, spiny hopsage, and budsage (Wiens 1985; Wiens and Rotenberry 1981). Brewer's Sparrows prefer areas dominated by shrubs rather than grass. Prefers sites with high shrub cover and large patch size, but thresholds for these values are not quantified (Knick and Rotenberry 1995). In Montana, Brewers Sparrow's preferred sagebrush sites averaging 13 percent sagebrush cover (Bock and Bock 1987). This sparrow is strongly associated throughout range with high sagebrush vigor (Knopf et al. 1990).

Brewers Sparrows nests are low in sagebrush (preferred), other shrub, or cactus, from a few centimeters to about 1 meter from the ground. Also places nests higher in taller sagebrush (Rich 1980). Brewers Sparrow's perches in live sagebrush shrubs that are taller and denser than neighboring shrubs (Castrale 1983).

Non-breeding: In migration and winter uses low, arid vegetation, desert scrub, sagebrush, creosote bush (Rotenberry et al. 1999).

Threats:

Direct cause of widespread decline of Brewers Sparrows on breeding grounds is uncertain, but possibly linked to widespread degradation of sagebrush habitats.

Habitat loss and fragmentation: Large scale reduction and fragmentation of sagebrush habitats is occurring due to a number of activities, including land conversion to tilled agriculture, urban and suburban development, and road and power-line right of way. Range improvement programs removing sagebrush by burning, herbicide application, mechanical treatment, and replacing sagebrush with annual grassland that promote forage for livestock.

Grazing: Grazing can trigger a cascade of ecological changes, where invasion of non-native grasses escalates the fire cycle and converts sagebrush shrublands to annual grasslands. Historical heavy livestock grazing has altered much of the sagebrush range, changing plant composition and densities. West (1996) estimates less than 1 percent of sagebrush steppe habitats remain untouched by livestock; 20 percent is lightly grazed, 30 percent moderately grazed with native understory remaining, and 30 percent heavily grazed with understory

replaced by invasive annuals. Effects of grazing in sagebrush habitats depends on intensity, season, duration and extent of alteration to native vegetation.

Invasive Grasses: Cheatgrass readily invades disturbed sites, and has come to dominate the grass-forb community of more than half the sagebrush region in the West, replacing native bunchgrasses (Rich 1996). Crested wheatgrass and other non-native annuals have also fundamentally altered the grass-forb community in many areas of sagebrush shrub-steppe, which is altering shrubland habitats.

Fire: Cheatgrass has altered the natural fire regime in the western range, increasing the frequency, intensity, and size of range fires. Fire kills sagebrush and where non-native grasses dominate, the landscape can be converted to annual grassland as the fire cycle escalates, removing preferred habitat (Paige and Ritter 1998).

Brood Parasitism: An occasional host for Brown-headed Cowbirds (*Molothrus Ater*); nests are usually abandoned, resulting in loss of the entire clutch (Rotenberry et al. 1999). Prior to frequency of parasitism varies geographically, the extent of impact on productivity is unknown (Rotenberry et al. 1999). In Alberta, patchy sagebrush habitat interspersed with pastures and riparian habitats increases the rate of brood parasitism reported (Biermann et al. 1987).

Recommend an effective monitoring program so that Resource Management staff at each park can assess the condition of bird populations over time, and detect significant changes in those populations.

The following are recommendations for designing an avian monitoring program for the northern Colorado Plateau.

Overview

National Park Service policy requires that park managers know the condition of natural resources under their stewardship and monitor long-term trends in those resources in order to fulfill the NPS mission of conserving parks unimpaired (www.nature.nps.gov).

Direct estimates of physical parameters such as CO₂ levels, air and water temperature, and rates of erosion provide critical inputs in the analysis of sustainability, but many potential environmental problems are too subtle to be revealed in this manner. Trends in plant and animal, including bird, populations provide additional information that can be used in concert with trends in physical parameters more effectively than either can be used alone (WAMAP In prep).

In general, birds are considered a valuable monitoring tool because their dynamics closely parallel those of the ecosystem, they are sensitive enough to provide an early warning of change, they provide continuous assessment over a wide range of stresses and have dynamics that can be attributed to either natural cycles or anthropogenic stressors. They are also distributed over a wide geographical area/or are very numerous, can be accurately estimated, have costs of measurement that are not cost prohibitive, have measurement methodologies that are low-impact, and can have measurable results that are repeatable.

In addition, numerous laws and regulations mandate that bird populations be monitored and maintained. In the U.S., federal laws of this sort include the National Environmental Policy

Act, the Endangered Species Act, the National Forest Management Act, the Fish and Wildlife Conservation Act, the Migratory Bird Treaty Act, and the National Park Service Organic Act. Also, most States also have laws and regulations specifying that they monitor wildlife populations and take steps to insure that wildlife populations are maintained (WAMAP In prep). For these reasons, birds are an appropriate choice for indicators of change throughout the Colorado Plateau.

Developing monitoring and research programs that provide information on what is there, how things are changing, and what can be reasonably managed for, is a challenging task. The monitoring program should provide data that enables the detection of environmental change, provides insights to the ecological consequences of these changes, and helps decisionmakers determine if the observed changes warrant changes in management practices (Noon et al. 1999).

To develop monitoring protocols to adequately monitor long-term avian population trends for just one park and its surrounding area would be problematic. A larger area must be considered in order to provide the information needed. However, there are some factors that can be monitored on a local scale that can contribute to the conservation of the local avian population. For example, it may be appropriate in some parks to monitor the effects of Brown-headed Cowbirds, a brood parasite, on avian community productivity. Local issues such as this can have large effects on the avian population within a park and surrounding lands. However, these problems are on a very small scale and cannot adequately evaluate avian population trends on a larger scale. An appropriate larger scale would encompass the Colorado Plateau or even the western United States. A coordinated bird Monitoring plan for the western United States is currently being developed (see WAMAP In prep) and the National Park Service could enhance its ability to monitor long-term avian population trends by participating in this large-scale program.

Many bird monitoring programs are designed, and data collected, in a “bottom-up” approach, focusing on a specific species (i.e., Southwest Willow Flycatcher) within the area to be monitored. Yet, recognizing the complexity of multi-species/multi-resource management, many conservationists and scientists have acknowledged the need for a combination of “top-down”/coarse filter biogeographical and regional approaches and “bottom-up”/fine filter species-specific management to conserve biological diversity (Thompson et al. 2000). This combined approach is especially appropriate for developing monitoring programs and adapting management strategies concerning the avifauna throughout the Colorado Plateau, as the ecological processes that affect the avian community of this area occur at multiple spatial and temporal scales. For example, many bird species may utilize portions of a park, the landscape, and even the Colorado Plateau and its resources for only part of each year (i.e., wintering or breeding seasons), and are likely influenced by processes occurring beyond the confines of the area to be monitored. Thus, it would be appropriate to incorporate information about breeding bird population trends across multiple scales, thereby enhancing the ability to identify factors affecting the species of concern and to prioritize conservation and management efforts. Therefore, the following recommendations for designing a monitoring program are meant to be applied at both a large scale such as the Colorado Plateau, that encompasses the Northern Colorado Plateau Network Parks and surrounding areas, and a smaller, within-park scale.

The development of a comprehensive design for future monitoring and management of the avifauna throughout the Colorado Plateau will require the cooperation of many land management agencies (i.e., National Park Service, Native American Tribal Lands, Bureau of

Land Management, State of Utah). The design of a monitoring program at this scale should incorporate both a top-down planning effort, based on assessments or patterns at larger spatial and ecological scales, and bottom-up effort based on patterns or data at smaller scales.

The steps involved in designing a monitoring program should include the following key components, following the suggestions of Noon et al. (1999):

- 1.) Identification of stressors relating to management goals.
- 2.) Development of a conceptual model linking stressors to ecological responses.
- 3.) Identification of avian indicators responsive to environmental stressors.
- 4.) Estimation of the status and trend of avian indicators/Establishment of sample design.
- 5.) Definition of response criteria/Calculation of benchmark conditions.
- 6.) Linkage of monitoring results to decisionmaking.

1.) Identification of Stressors Relating to Management Goals.

An initial step in designing a monitoring program should be the identification of anticipated extrinsic environmental stressors, both natural and human-induced, that may compromise ecosystem integrity and alter its component species and resources. If the effects of these stressors exceed the resilience or adaptational limits of the ecosystem, the ecosystem will change. This change may result in management goals being compromised, necessitating adapting management actions (Noon et al. 1999). Therefore, it is essential to identify potential stressors, at the ecosystem level down to the within-habitat level, focusing on those stressors that are subject to management decisions (e.g. livestock grazing, recreational use, land-use patterns in surrounding uplands, fire management). The NCP network has already identified stressors to the system.

The next step in monitoring design involves identifying the ecological resources expected to be affected by these stressors (e.g., scrubland habitat, riparian vegetation, soils, water resources). The National Park Service will need to compile an inventory, based on a thorough review of published and unpublished information, including this report, of the ecological attributes (both habitat components and avian resources) of all habitats that are likely to be affected by stressors within the area to be monitored. It is also helpful to identify the temporal scale associated with each of the different stressors and the resources they affect. We identify in our discussion of critical habitats and bird species of concern, many of the stressors associated with each habitat and the habitat components and birds species (ecological resources) that are affected by these stressors.

2.) Development of a Conceptual Model Linking Stressors to Ecological Responses.

Conceptual models of the resources of concern are a key tool for designing a monitoring program and form the basis for selecting indicators for monitoring. Using the information gathered during step one, above, conceptual models will need to be developed of the linkages among stressors and ecosystem resources. Specifically, the linkages among the avifauna and resource components of concern must be identified.

In order to determine linkages and develop conceptual models, it is useful to employ a bottom-up/fine filter evaluation of current information regarding avian species-specific attributes. Many programs for inventorying and monitoring avifauna have used assemblage-level measures of avian populations as their response variables, including species richness (the number of species), abundance (the number of individuals), and diversity indices. Yet, it is species-specific life history traits that affect at least some community-wide patterns, and interpreting diversity index patterns such as these can only be accomplished by looking at changes in each individual species and determining how these changes affect the diversity values (Wiens 1989, Morrison et al. 1992, Sogge et al. 1998). Furthermore, a monitoring program that tracks populations of species assemblages, without measuring populations of specific species, may mask trends affecting individual species. In the situation where the population of one species is declining, this represents a potentially large risk (Block et al. 1995). Therefore, in order to better understand linkages between avian populations and vegetation/habitat parameters, there is a need to identify what constitutes a resource on species-specific basis, and the factors that may influence the linkages between the abundance, availability, and use of that resource (Wiens 1989). This will enable the determination of appropriate response variables to measure and monitor in order to make inferences about the effects of management actions/disturbance events on birds throughout the Colorado Plateau.

3.) Identification of Avian Indicators Responsive to Environmental Stressors

The ultimate success or failure of a monitoring program may be determined by this one step of selecting indicators (Noon et al. 1999). The identification of stressors, the ecological resources affected by them, and the development of conceptual models will enable selection of avian indicators. Indicators should reflect ecological resources and be able to indicate changes that would warrant management action. To aid in the selection of indicators one should ask: Do the avian parameters measured by the monitoring program provide insights to the ecological consequences of disturbance events? Do they enable prediction of how changes in abundance and availability of ecological resources may affect bird species and assemblages?

Thus, it is possible through this process to select individual species to serve as indicators for monitoring. In addition, it may be appropriate to examine species-specific data and identify assemblages, if any, of species that are similarly linked to key resource attributes and/or stressors. For example, we suggest monitoring sage obligates and sage associates in addition to Sage Grouse (a species of special concern) populations as indicators of the sagebrush ecosystem health.

4.) Estimation of the Status and Trend of Avian Indicators/Establishment of Sample Design.

As part of the process of developing an avian monitoring program it is necessary to determine the number of samples needed to yield statistically significant results in trend analysis. Often these analyses will only be possible for the most abundant breeding species (Johnson et al. 2001a and 2001b) and the ability of an avian monitoring program to track trends in populations would be enhanced by considering populations at multiple scales, including larger scales. Therefore, it would be beneficial to incorporate the within-park trend information (from VCP point counts) with trend information from multiple spatial and temporal scales. By cooperating in a coordinated bird monitoring program for the western United States, the National Park Service could enhance its ability to monitor long-term avian population trends.

In addition, one can then assess which species found within the Colorado Plateau are of concern at a state-wide, regional, and national scale using Breeding Bird Survey trend results for the period from 1966 to 2001 (Sauer et al. 2001), Partners in Flight national, state-wide, and regional (Colorado Plateau) Bird Conservation Plans, and expert opinions. Comparing the patterns of these trends will determine if the trends are due to local perturbations/disturbances, or are likely the result of factors occurring at larger scales, beyond the confines of the park in question. Also, by combining this information one can determine if these species can be effectively monitored using existing protocols/methodologies, or if new methodologies need to be developed. This information will also enable the appraisal of the Network Parks' role in providing important habitat (i.e. sagebrush) for species of concern when considered at the local, ecosystem-wide, state-wide, regional, and national scale. Concomitantly, the National Park Service should attempt to identify attributes specific to each park and its surrounding area that may contribute to its ability to provide long-term conservation benefits and maintain sensitive avian populations. All of this information will greatly enhance the ability of the National Park Service to prioritize conservation and management efforts. In this report we identify bird species of special concern and their habitat associations within the parks. This information can then be incorporated into the NCP network's development of a monitoring plan.

Appropriate sampling protocols, based on specific monitoring objectives, should then be developed as needed. The sampling methods chosen will depend upon which resources were determined to be of the most interest, and what indicators were chosen to monitor changes. For example, livestock grazing could be identified as a major stressor of the shrubland ecosystem. An indicator used to monitor its effects could be the abundance of Brown-headed cowbirds locally, at the landscape level, and regionally. Sampling could then be developed to adequately measure Brown-headed Cowbird abundance at multiple spatial scales. Sampling could also include nest finding and monitoring of species of concern in the habitat of concern, in order to measure the effects of cowbirds on avian productivity and population trends. Additionally, as discussed above, sampling should be designed so that it provides useful measures of a resource that can be used to guide management action. In this example, a threshold value (i.e., a specific abundance of cowbirds, or a nest productivity rate) would be identified. When this figure was exceeded, management action would be taken.

When developing a sampling design, what constitutes a "biologically significant" trend must be determined; values from literature tend to range between 3-5% (Eagle et al. 2000). It is essential to evaluate whether the monitoring program, as designed, can detect a change of this magnitude, especially for sensitive species. Avian monitoring programs often depend on

standardized count data such as point-count data to attempt to measure trends. Tools exist for analyzing this type data to determine its ability to detect biologically significant trends. For example, the program Monitor, a software package for estimating the power of biological monitoring programs to detect trends in abundance, can be used to explore the relationships between power, sample size, and estimated variance, counts per year, precision criteria, and desired trend level (Eagle et al. 2000). This information can assist in refining avian monitoring protocols as needed to produce meaningful, useful results.

5.) Definition of Response Criteria/Calculation of Expected Values and Trends.

The avian monitoring program to be developed should include the generation of expected values (i.e. benchmark conditions) for avian monitoring, as generation of expected values is an essential component of a monitoring program. Only by comparing observed and expected values or trends can a determination be made about the effectiveness of management practices (Noon et al. 1999). Estimation of expected values, such as the benchmark values for avian populations, is problematic, especially in a system such as Colorado Plateau that has experienced significant human-induced and natural change. Yet, selection must be based on the best available information, and benchmark conditions for avian populations may be best categorized by target distributions rather than threshold values (see Noon et al. 1999). The monitoring program should allow for periodic estimates of the direction and magnitude of indicator change, providing an ongoing evaluation of the effectiveness of management strategies.

6.) Linkage of Monitoring Results to Decisionmaking.

For a monitoring program to be of value it must be of use to decisionmakers. Thus, the avian monitoring program should be designed to provide the information required by the National Park Service to adjust management activities to mitigate unplanned and undesirable outcomes.

The specific objective for an avian monitoring program is to identify an optimal design for an efficient and effective long-term avian monitoring program for the National Parks throughout the Colorado Plateau, and lands surrounding these parks, that can be implemented by the National Park Service. This includes ensuring that the avian monitoring program provides the actual information needed by decisionmakers, in a format that is easily interpreted and useable. A well-designed monitoring program, developed following the steps described above, will directly contribute to the National Park Services meeting the statutory requirements of the National Parks Omnibus Management Act of 1998. This recent legislation and National Park Service policy requires that park managers know the condition of natural resources under their stewardship and monitor long-term trends in those resources in order to fulfill the NPS mission of conserving parks unimpaired (www.nature.nps.gov).

Summarize bird information in appropriate formats to contribute to the population of National Park Service, service-wide databases including NPSpecies, Dataset Catalog, NRBib, and ANCS+.

We updated the NPSpecies master list for each park involved in this inventory (Appendix 7a, 7b, 7c, and 7d). The update of this list consisted of comparing the Npspecies master list to this inventory (2001-02) and to examine how close our effort was to the 90% level of species according the Npspecies master list for each park. For this report, the NPSpecies summary of each park was broken down as either breeding or non-breeding. Specific NPSpecies summary information for each park is reported below.

2001-02 SUMMARY OF THE NPSPECIES MASTER BIRDS LISTS CEBR, FOBU, GOSP, TICA

Cedar Breaks NM

There was a total of 136 species on the original master bird list (breeding and non-breeding birds) for CEBR, including those Present in the Park and Probably Present in the Park (Appendix 7a). The 2001-02 inventory added four new species to the list, the Spotted Sandpiper (*Actitis macularia*), Black-chinned Hummingbird (*Archilochus alexandria*), Olive-sided Flycatcher (*Contopus cooperi*), and Nashville Warbler (*Vermivora ruficapilla*) bringing the total number of species to 140.

Thirty-six species, 26% of the master list, were classified as “Probably Present in Park”. The 2001-02 Inventory confirmed that 6 (11.6%) (breeding and non-breeding birds) of these species are found in the Park.

Apart from the new species, 99 species were known to be present in the park. The 2001-02 Inventory detected 49% (49/99) (breeding and non-breeding birds) of these species.

In summary, the new confirmed number of species in the park is 109 (99 from the master list, 4 new species, 6 previously unconfirmed). Out of a new total of 140 species listed as either in the park or likely to occur there, 43 % (60/140) (breeding and non-breeding birds) species was detected during the 2001-02 inventory.

Fossil butte NM

There was a total of 185 species on the original master bird list (breeding and non-breeding birds) for FOBU, including those Present in the Park and Probably Present in the Park (Appendix 7b). The 2001-02 Inventory added five species to the list, the California Gull (*Larus californicus*), Pygmy Nuthatch (*Sitta pygmaea*), Northern rough-wing Swallow (*Stelgidopteryx serripennis*), Great-tailed Grackle (*Quiscalus mexicanus*) and Hood Warbler (*Wilsonia citrina*) bringing the total number of species to 190.

Forty-one species, were classified as “Probably Present in Park”. The 2001 Inventory confirmed that 23 (22%) (breeding and non-breeding birds) of these species are found in the Park.

Apart from the two new species, 133 species on the list were known to be present in the park. The 2001-02 Inventory detected 62% (83/133) (breeding and non-breeding birds) of these species.

In summary, the new confirmed number of species in the park is 161 (133 from the master list, 5 new species, 23 previously unconfirmed). Out of a new total of 190 species listed as either in the park or likely to occur there, 48% (91/190) (breeding and non-breeding birds) was detected during the 2001-02 inventory.

Golden Spike NHM

There was a total of 97 species on the original master bird list (breeding and non-breeding birds) for GOSP, including those Present in the Park and Probably Present in the Park (Appendix 7c). The 2001-02 Inventory added six species to the list, the Sand-hill Crane (*Grus Canadensis*), Great Blue Heron (*Ardea herodias*), Snowy Egret (*Egretta thula*), Red-necked Phalarope (*Phalaropus lobatus*), Willet (*Catoptrophorus semipalmatus*), California Quail (*Callipepla californica*), Sage Grouse (*Centrocercus urophasianus*) Bullock's Oriole (*Icterus bullocki*), Canyon Wren (*Catherpes mexicanus*), Orange-Crowned Warbler (*Vermivora celata*), Yellow Warbler (*Dendrioca petechia*), and the bringing the total number of species to 108.

Thirty-six species, 37 % of the master list, were classified as "Probably Present in Park". The 2001-02 Inventory confirmed that 13 (36%) (breeding and non-breeding birds) of these species are found in the Park.

Apart from the 11 new species, 61 species on the list were known to be present in the park. The 2001-02 inventory detected 65% (40/61) (breeding and non-breeding birds) of these species.

In summary, the new confirmed number of species in the park is 85 (61 from the master list, 11 new species, 13 previously unconfirmed). Out of a new total of 108 species listed as either in the park or likely to occur there, 52% (56/108) (breeding and non-breeding birds) were detected during the 2001-02 inventory.

Timpanogos Cave NM

There was a total of 163 species on the original master bird list (breeding and non-breeding birds) for TICA, including those Present in the Park and Probably Present in the Park (Appendix 7d). The 2001-02 Inventory added one species to the list, the Brewer's Sparrow (*Spizella breweri*), bringing the total number of species to 164.

Thirty-six species, 22% of the master list, were classified as "Probably Present in Park". The 2001-02 Inventory confirmed that 5 (13%) (breeding and non-breeding birds) of these species are found in the Park.

Apart from the one new species, 127 species on the list were known to be present in the park. The 2001-02 Inventory detected 35% (44/127) (breeding and non-breeding birds) of these species.

In summary, the new confirmed number of species in the park is 133 (127 from the master list, 1 new species, 5 previously unconfirmed). Out of a new total of 163 species listed as either in the park or likely to occur there, 31% (50/163) (breeding and non-breeding birds) of these species were detected during the 2001-02 inventory.

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APPENDICES

Appendix 1. Species distribution across all parks (CEBR, FOBU, GOSP, TICA) 2001-2002.

Species	CEBR	FOBU	GOSP	TICA
American Dipper	X			X
American Goldfinch				X
American Kestrel		X	X	
American Robin	X	X	X	X
Barn Swallow		X	X	
Belted Kingfisher				X
Black-billed Magpie		X	X	
Black-capped Chickadee	X	X		X
Black-chinned Hummingbird	X			
Black-headed Grosbeak		X		X
Black-throated Gray Warbler	X			X
Brewer's Blackbird		X	X	
Brewer's Sparrow		X	X	X
Broad-tailed Hummingbird	X	X		X
Brown Creeper	X	X		
Brown-headed Cowbird		X	X	
Bullock's Oriole			X	
Burrowing Owl			X	
Canyon Wren			X	X
California Gull		X	X	
California Quail			X	
Calliope Hummingbird				X
Canada Goose			X	
Cassin's Finch	X	X		X
Chipping Sparrow	X	X		X
Chukar			X	
Clark's Nutcracker	X	X		X
Cliff Swallow	X	X	X	
Common Nighthawk		X	X	
Common Poorwill		X	X	
Common Raven	X	X	X	
Cooper's Hawk		X		
Cordilleran Flycatcher	X	X		X
Dark-eyed Junco	X	X		X
Downy Woodpecker		X		
Dusky Flycatcher	X	X		
European Starling			X	
Evening Grosbeak	X			
Golden Eagle	X	X	X	X
Golden-crowned Kinglet		X		X
Grace's Warbler	X			
Gray Flycatcher		X		X
Gray Partridge			X	
Great Blue Heron			X	

Appendix 1. cont.

Species	CEBR	FOBU	GOSP	TICA
Great Horned Owl			X	
Great-tailed Grackle		X		
Green-tailed Towhee		X		X
Hairy Woodpecker	X	X		
Hammond's Flycatcher	X	X		X
Hermit Thrush	X			X
Hooded Warbler		X		
Horned Lark		X	X	
House Finch			X	
House Wren	X	X		X
Killdeer			X	
Lark Sparrow			X	X
Lazuli Bunting		X		
Lincoln Sparrow	X			
Loggerhead Shrike			X	
Long-billed Curlew			X	
MacGillivray's Warbler	X	X		X
Mallard		X	X	
Mountain Bluebird	X	X		
Mountain Chickadee	X	X		X
Mourning Dove		X	X	
Nashville Warbler	X			
Northern Flicker	X	X	X	X
Northern Harrier		X	X	
Northern Mockingbird			X	
Northern Pygmy-Owl	X			
Northern Rough-winged Swallow	X		X	
Olive-sided Flycatcher	X			
Orange-crowned Warbler		X	X	X
Peregrine Falcon	X			
Pine Siskin	X	X		X
Pinyon Jay	X			
Plumbeous Vireo	X	X		X
Prairie Falcon		X	X	
Pygmy Nuthatch	X	X		X
Red Crossbill	X			
Red-breasted Nuthatch	X	X		X
Red-naped Sapsucker		X		
Red-necked Phalarope			X	
Red-tailed Hawk	X	X	X	X
Ring-necked Pheasant			X	
Rock Wren	X	X	X	X
Ruby-crowned Kinglet	X	X		X
Rufous Hummingbird	X			
Sage Grouse		X	X	
Sage Thrasher		X	X	
Sandhill Crane		X	X	
Say's Phoebe		X	X	
Sharp-shinned Hawk				X

Appendix 1. cont.

Species	CEBR	FOBU	GOSP	TICA
Short-eared Owl			X	
Snowy Egret			X	
Spotted Sandpiper	X			
Spotted Towhee	X	X	X	X
Steller's Jay	X	X		X
Swainson's Hawk		X		
Swainson's Thrush		X		X
Three-toed Woodpecker	X			
Townsend's Solitaire	X			X
Tree Swallow		X		X
Turkey Vulture		X	X	
Vesper Sparrow	X	X	X	
Violet-green Swallow	X	X	X	X
Virginia's Warbler	X			X
Warbling Vireo	X	X		X
Western Bluebird	X			
Western Kingbird			X	
Western Meadowlark		X	X	
Western Tanager	X	X		X
Western Wood-Pewee	X	X		
White-breasted Nuthatch	X	X		X
White-crowned Sparrow	X	X	X	
White-throated Swift	X			X
Willet			X	
Yellow Warbler	X	X	X	X
Yellow-rumped Warbler	X	X		X

Appendix 2. Point count ID number, UTM location and dominant habitat type at each point count station at Cedar Breaks NM, 2001-02.

Point ID	UTM Easting	UTM Northing	Dominant Habitat
2001			
92RB	338475	4163865	Mixed Conifer/Meadow
86RB	338675	4164365	Mixed Conifer/Meadow
78RB	338775	4164765	Mixed Conifer/Meadow
67RB	339175	4165665	Mixed Conifer/Meadow
65RB	338775	4165765	Mixed Conifer/Meadow
63RB	338630	4165939	Mixed Conifer/Meadow
50RB	338774	4166465	Mixed Conifer/Meadow
54RB	338775	4166265	Mixed Conifer/Meadow
56RB	339075	4166165	Mixed Conifer/Meadow
91R	337975	4163865	Mixed Conifer/Meadow
99R	337975	4163565	Mixed Conifer/Meadow
97R	338175	4163665	Mixed Conifer Meadow
100R	337075	4163465	Mixed Conifer/Meadow
95R	337375	4163665	Mixed Conifer/Meadow
47RB	339375	4166665	Mixed Conifer/Meadow
43RB	339075	4166865	Mixed Conifer/Meadow
ASH01	335188	4166762	Mixed Conifer/Riparian
ASH02	335442	4166678	Mixed Conifer/Riparian
ASH03	335641	4166540	Mixed Conifer/Riparian
ASH53R	335775	4166265	Mixed Conifer/Riparian
ASH04	335978	4166085	Mixed Conifer/Riparian
ASH05	336283	4165977	Mixed Conifer/Riparian
ASH06	336453	4165785	Mixed Conifer/Riparian
89R	336575	4164065	Mixed Conifer
94R	336675	4163665	Mixed Conifer
90R	336575	4163865	Mixed Conifer
2002			
ASHB01	335329	4167108	Mixed Conifer/Riparian
ASHB02	335553	4167207	Mixed Conifer/Riparian
ASHB03	335810	4167185	Mixed Conifer/Riparian
ASHB04	335967	4167386	Mixed Conifer/Riparian
ASHB05	336237	4167736	Mixed Conifer/Riparian
ASHB06	336599	4167568	Mixed Conifer/Riparian
ASHB07	336862	4167580	Mixed Conifer/Riparian
ASHB08	337082	4167925	Mixed Conifer/Riparian
ASH33R	337010	4167663	Mixed Conifer/Riparian
ASH38R	336210	4167363	Mixed Conifer/Riparian
C01	337180	4169854	Mixed Conifer/Meadow
C02	336686	4169890	Mixed Conifer/Meadow
RC01	337709	4169663	Mixed Conifer/Meadow
RC02	338409	4169564	Mixed Conifer/Meadow

Appendix 2 cont.

Point ID	UTM Easting	UTM Northing	Dominant Habitat
RC03	335210	4169464	Mixed Conifer/Meadow
RC06	336710	4169363	Mixed Conifer/Meadow
RC08	336209	4169363	Mixed Conifer/Meadow
RC09	339109	4169363	Mixed Conifer/Meadow
RC11	338209	4169263	Mixed Conifer/Meadow
RC13	338810	4169263	Mixed Conifer/Meadow
RC26	339210	4168763	Mixed Conifer/Meadow
RC28	339109	4168463	Mixed Conifer/Meadow

Appendix 3. Point count ID number, UTM location and dominant habitat type at each point count station at Fossil Butte NM, 2001-02.

Point ID	UTM Easting	UTM Northing	Dominant Habitat
2001			
FB41A	519309	4634645	Sagebrush
FB41B	518680	4635250	Sagebrush
FB41C	518854	4635251	Aspen
FB41D	518927	4635122	Serviceberry
FB41E	518973	4634985	Sagebrush
FB41F	518961	4634898	Sagebrush
FB41G	519090	4634810	Sagebrush
FB41H	518825	4634915	Sagebrush
FB41I	518769	4634843	Sagebrush
FB17A	520384	4636209	Serviceberry
FB17B	520201	4636242	Mixed Conifer
FB17C	520025	4635277	Mixed Conifer
FB17D	519852	4636272	Aspen
FB17E	519650	4636345	Mixed Conifer
FB17F	519494	4636364	Serviceberry
FB17G	519559	4636215	Mixed Conifer
FB17H	519918	4636129	Serviceberry
FB17I	520047	4636173	Serviceberry
FB17J	520246	4636173	Mixed Conifer
FB74	519517	4631950	Sagebrush
FB72	519278	4632160	Sagebrush
FB73	518497	4632100	Sagebrush
FB77	519367	4631650	Sagebrush
FB80	519547	4631650	Sagebrush
FB83	519847	4631080	Sagebrush
FB84	519697	4631050	Sagebrush
FB88	519547	4630900	Sagebrush
FB86	519307	4630900	Sagebrush
FB87	519067	4630900	Sagebrush
FB5.1	518360	4637080	Sagebrush
FB5.2	518119	4636977	Sagebrush
FB5.3	517871	4636998	Sagebrush
FB5.4	517678	4636973	Sagebrush
FB5.5	517472	4636985	Sagebrush
FB5.6	518589	4637284	Sagebrush
FB5.7	518862	4637330	Sagebrush
FB5.8	519137	4637270	Sagebrush
FB5.9	519378	4637262	Sagebrush
FB5.11	519316	4637106	Sagebrush

Fossil Butte Appendix 3 cont.

Point ID	UTM Easting	UTM Northing	Dominant Habitat
2002			
394	522397	4630480	Sagebrush
314	518797	4636480	Grassland
307	518407	4636960	Sagebrush
306	516397	4637020	Sagebrush
313	516007	4636540	Sagebrush
316	516877	4636390	Sagebrush
310	517057	4636780	Sagebrush
302	518227	4637590	Grassland
301	518197	4638010	Sagebrush
328	519367	4635910	Grassland
329	518677	4635550	Grassland
340	519367	4634740	Grassland
334	519037	4635280	Grassland
318	518437	4636180	Grassland
327	518677	4635940	Sagebrush
397	521017	4630330	Sagebrush
362	518077	4633240	Sagebrush
345	518257	4634470	Sagebrush
337	518167	4635130	Sagebrush
325	518107	4636000	Sagebrush

Appendix 4. Point count ID number, UTM location and dominant habitat type at each point count station at Golden Spike NHM, 2001-02.

Point ID	UTM Easting	UTM Northing	Dominant Habitat
2001			
GOSP1	363951	4603997	Grassland/sage
GOSP2	364117	4603997	Grassland/sage
GOSP3	364260	4603291	Grassland/sage
GOSP4	364499	4602778	Grassland/sage
GOSP5	364796	4602706	Grassland/sage
GOSP6	365225	4602861	Grassland/sage
GOSP7	365722	4602664	Grassland/sage
GOSP8	366043	4602664	Grassland/sage
GOSP9	366430	4603081	Grassland/sage
GOSP10	366728	4603378	Grassland/sage
GOSP21	374693	4604192	Grassland/sage

Point ID	UTM Easting	UTM Northing	Dominant Habitat
2002			
221	375811	4608585	Grassland
218	375603	4608770	Grassland
220	375022	4608682	Grassland
213	374753	4609681	Grassland/shrub mix
210	376105	4609827	Grassland/shrub mix
207	375180	4610251	Grassland/shrub mix
205	376112	4610463	Grassland
208	376297	4610136	Grassland
204	377277	4610506	Grassland
201	379458	4614206	Grassland
225	369371	4606496	Grassland
206	373602	4610280	Grassland
226	368708	4605493	Grassland/shrub mix
228	364999	4602820	Grassland/shrub mix
227	364177	4603684	Grassland
222	371397	4608457	Grassland/shrub mix
223	371263	4608297	Grassland/shrub mix
224	370938	4608080	Grassland/shrub mix
229	364588	4602106	Grassland/shrub mix
230	364858	4602016	Grassland

Appendix 5. Point count ID number, UTM location and dominant habitat type at each point count station at Timpanogos Cave NM, 2001-02.

Point ID	UTM Easting	UTM Northing	Dominant Habitat
TICA1	440046	4477038	Mixed Conifer
TICA2	439468	4476752	Mixed Conifer/mountain scrub
TICA3	439589	4476705	Mixed Conifer/mountain scrub
TICA4	439616	4476649	Mixed Conifer/Riparian
TICA5	439894	4476577	Mountain Scrub

Appendix 6. Survey effort during according to number of days, spent at each Northern Colorado Plateau National Park (Cedar Breaks NM, Fossil Butte NM Golden Spike NM, and Timpanogos Cave NM) and sampling season, time of day and method used during bird breeding and winters of 2001 and 2002.

Appendix 6a. Cedar Breaks NM.

National Park			
Cedar Breaks NM	Date	Sampling Season	Sampling Time of Day and Method
	12/30/2001	Winter	Day Area Search
	2/15/02	Winter	Day Area Search
	5/31/2001	Breeding	Day Area Search
	6/1/2001	Breeding	Day Point counts/Area Search, Nocturnal Owl Survey
	6/2/2001	Breeding	Day Point counts/Area Search
	6/11/2001	Breeding	Day Area Search
	6/12/2001	Breeding	Day Point counts/Area Search
	6/13/2001	Breeding	Day Point counts/Area Search
	6/15/2001	Breeding	Day Area Search
	6/28/2001	Breeding	Day Point counts/Area Search
	6/29/2001	Breeding	Day Area Search
	6/30/2001	Breeding	Day Point counts/Area Search
	7/1/2001	Breeding	Day Point counts/Area Search
	7/13/2001	Breeding	Day Point counts/Area Search, Nocturnal Owl Survey
	7/14/2001	Breeding	Day Point counts/Area Search
	6/5/2002	Breeding	Day Point counts/Area Search, Nocturnal Owl Survey
	6/6/2002	Breeding	Day Point counts/Area Search
	6/7/2002	Breeding	Day Point counts/Area Search
	6/20/2002	Breeding	Day Point counts/Area Search
	6/21/2002	Breeding	Day Point counts/Area Search
	7/9/2002	Breeding	Day Point counts/Area Search, Nocturnal Owl Survey
	1/15/03	Winter	Day Area Search
Total	22 days		

Appendix 6b. Fossil Butte NM.

National Park			
Fossil Butte NM	Date	Sampling Season	Survey Time of Day and Method
	12/16/2001	Winter	Day Area Search
	1/30/2002	Winter	Day Area Search
	5/23/2001	Breeding	Day Area Search
	5/24/2001	Breeding	Day Point Counts/Area Search/nocturnal Owl Surveys
	5/25/2001	Breeding	Day Area Search
	6/04/2001	Breeding	Day Area Search
	6/5/2001	Breeding	Day Point Count-Area Search
	6/6/2001	Breeding	Day Point Count-Area Search
	6/7/2001	Breeding	Day Point Count-Area Search
	6/8/2001	Breeding	Day Point Count-Area Search
	6/19/2001	Breeding	Day Area Search
	6/20/2001	Breeding	Day Point Count-Area Search
	6/21/2001	Breeding	Day Point Counts/Area Search/nocturnal Owl Surveys
	6/22/2001	Breeding	Day Point Count-Area Search
	6/23/2001	Breeding	Day Point Count-Area Search
	7/02/2001	Breeding	Day Area Search

Appendix 6b. Fossil Butte NM cont.

	7/3/2001	Breeding	Day Point Counts-Area Search/nocturnal Owl Surveys
	7/4/2001	Breeding	Day Point Count-Area Search
	7/5/2001	Breeding	Day Point Count-Area Search
	7/6/2001	Breeding	Day Point Count-Area Search
	5/30/2002	Breeding	Day Point Counts-Area Search/nocturnal Owl Surveys
	5/31/2002	Breeding	Day Point Count-Area Search
	6/12/2002	Breeding	Day Point Count-Area Search
	6/13/2002	Breeding	Day Point Count-Area Search
	6/27/2002	Breeding	Day Point Counts-Area Search/nocturnal Owl Surveys
	6/28/2002	Breeding	Day Point Count-Area Search
	12/15/2002	Winter	Day Area Search
Total	27 Days		

Appendix 6d. Golden Spike NHM.

ParkCode			
Golden Spike NM	Date	Survey Period	Survey Time of Day and Method
	12/29/01	Winter	Day Area Search
	01/15/02	Winter	Day Area Search
	5/15/2001	Breeding	Day Point Count-Area Search
	5/16/2001	Breeding	Day Point Counts-Area Search/Nocturnal Owl Surveys
	5/29/2001	Breeding	Day Point Count-Area Search
	5/30/2001	Breeding	Day Point Count-Area Search
	6/11/2001	Breeding	Day Point Counts-Area Search/Nocturnal Owl Surveys
	6/12/2001	Breeding	Day Point Count-Area Search
	6/13/2001	Breeding	Day Point Count-Area Search
	6/27/2001	Breeding	Day Point Count-Area Search
	6/29/2001	Breeding	Day Point Counts-Area Search/Nocturnal Owl Surveys
	5/23/2002	Breeding	Day Point Counts-Area Search/Nocturnal Owl Surveys
	5/24/2002	Breeding	Day Point Count-Area Search
	6/4/2002	Breeding	Day Point Count-Area Search
	6/5/2002	Breeding	Day Point Count-Area Search
	6/25/2002	Breeding	Day Point Counts-Area Search/Nocturnal Owl Surveys
	6/26/2002	Breeding	Day Point Count-Area Search
	12/18/02	Winter	Day Area Search
Total Days	18 days		

Appendix 6b. Timpanogos Cave NM.

National Park			
Timpanogos Cave NM	Date	Survey Period	Survey Time of Day and Method
	12/14/2001	Winter	Day Area Search
	01/29/2002	Winter	Day Area Search
	5/17/2001	Breeding	Day Area Search/Nocturnal Owl Surveys
	5/18/2001	Breeding	Day Area Search
	5/31/2001	Breeding	Day Area Search
	6/01/2001	Breeding	Day Area Search
	6/14/2001	Breeding	Day Area Search/Nocturnal Owl Surveys
	6/15/2001	Breeding	Day Area Search
	5/28/2002	Breeding	Day Area Search
	6/6/2002	Breeding	Day Area Search
	7/03/2002	Breeding	Day Area Search/Nocturnal Owl Surveys
	12/16/2002	Winter	Day Area Search
Total Days	12 days		

Appendix 7. Updated bird species lists and master lists for each park (Appendix 7a-7d; Cedar Breaks NM, Fossil Butte NM, Golden Spike NHM, and Timpanogos NM) based on 2001-02 avian inventory and historic NPSpecies lists. Below the possible values are followed by the standard NPSpecies definitions.

Appendix 7A. Cedar Breaks NM Master List of Bird Species.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Present in Park	Unknown	Native	Unknown
Golden Eagle	<i>Aquila chrysaetos</i>	Present in Park	Possible Breeder	Native	Rare
Cooper's Hawk	<i>Accipiter cooperii</i>	Present in Park	Possible Breeder	Native	Unknown
Northern Goshawk	<i>Accipiter gentilis</i>	Present in Park	Possible Breeder	Native	Unknown
Ferruginous Hawk	<i>Buteo regalis</i>	Present in Park	Unknown	Native	Unknown
Red-tailed Hawk	<i>Buteo jamaicensis</i>	Present in Park	Probable Breeder	Native	Uncommon
Swainson's Hawk	<i>Buteo swainsoni</i>	Present in Park	Migratory	Native	Uncommon
American Kestrel	<i>Falco sparverius</i>	Present in Park	Unknown	Native	Unknown
Merlin	<i>Falco columbarius</i>	Present in Park	Winter Resident?	Native	Unknown
Prairie Falcon	<i>Falco mexicanus</i>	Present in Park	Possible Breeder	Native	Rare
Peregrine Falcon	<i>Falco peregrinus</i>	Present in Park	Possible Breeder	Native	Unknown
Wild Turkey	<i>Meleagris gallopavo</i>	Present in Park	Unknown	Native	Uncommon
Blue Grouse	<i>Dendragapus obscurus</i>	Present in Park	Possible Breeder	Native	Unknown
Killdeer	<i>Charadrius vociferus</i>	Present in Park	Migratory	Native	Unknown
Spotted Sandpiper	<i>Actitis macularia</i>	Present in Park	Probable Breeder	Native	Rare
Band-tailed Pigeon	<i>Columba fasciata</i>	Present in Park	Possible Breeder	Native	Unknown
Mourning Dove	<i>Zenaidura macroura</i>	Present in Park	Migratory	Native	Unknown
Great Horned Owl	<i>Bubo virginianus</i>	Present in Park	Probable Breeder	Native	Uncommon
Northern Pygmy-owl	<i>Glaucidium gnoma</i>	Present in Park	Probable Breeder	Native	Rare
Northern Saw-whet Owl	<i>Aegolius acadicus</i>	Present in Park	Unknown	Native	Rare
Common Nighthawk	<i>Chordeiles minor</i>	Present in Park	Possible Breeder	Native	Uncommon
Common Poorwill	<i>Phalaenoptilus nuttallii</i>	Present in Park	Possible Breeder	Native	Unknown
White-throated Swift	<i>Aeronautes saxatalis</i>	Present in Park	Probable Breeder	Native	Common
Black-chinned Hummingbird	<i>Archilochus alexandri</i>	Present in Park	Possible Breeder	Native	Rare
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	Present in Park	Confirmed Breeder	Native	Common
Rufous Hummingbird	<i>Selasphorus rufus</i>	Present in Park	Migratory	Native	Rare
Northern Flicker	<i>Colaptes auratus</i>	Present in Park	Confirmed Breeder	Native	Common
Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>	Present in Park	Unknown	Native	Unknown
Downy Woodpecker	<i>Picoides pubescens</i>	Present in Park	Possible Breeder	Native	Unknown

Appendix 7a. Cedar Breaks NM Master List of Birds cont.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
Hairy Woodpecker	<i>Picoides villosus</i>	Present in Park	Confirmed Breeder	Native	Common
Pileated Woodpecker	<i>Dryocopus pileatus</i>	Present in Park	Vagrant	Native	Unknown
Three-toed Woodpecker	<i>Picoides tridactylus</i>	Present in Park	Confirmed Breeder	Native	Uncommon
Olive-sided Flycatcher	<i>Contopus cooperi</i>	Present in Park	Probable Breeder	Native	Uncommon
Western Wood-Pewee	<i>Contopus sordidulus</i>	Present in Park	Probable Breeder	Native	Uncommon
Hammond's flycatcher	<i>Empidonax hammondii</i>	Present in Park	Probable Breeder	Native	Uncommon
Dusky Flycatcher	<i>Empidonax oberholseri</i>	Present in Park	Probable Breeder	Native	Rare
Cordilleran Flycatcher	<i>Empidonax occidentalis</i>	Present in Park	Confirmed Breeder	Native	Common
Western Kingbird	<i>Tyrannus verticalis</i>	Present in Park	Migratory	Native	Occasional
Black Phoebe	<i>Sayornis nigricans</i>	Present in Park	Possible Breeder	Native	Rare
Northern Shrike	<i>Lanius excubitor</i>	Present in Park	Winter Resident	Native	Occasional
Plumbeous Vireo	<i>Vireo plumbeus</i>	Present in Park	Unknown	Native	Uncommon
Warbling Vireo	<i>Vireo gilvus</i>	Present in Park	Possible Breeder	Native	Uncommon
Steller's Jay	<i>Cyanocitta stelleri</i>	Present in Park	Probable Breeder	Native	Uncommon
Gray Jay	<i>Perisoreus canadensis</i>	Present in Park	Possible Breeder	Native	Unknown
Clark's Nutcracker	<i>Nucifraga columbiana</i>	Present in Park	Confirmed Breeder	Native	Common
Pinyon Jay	<i>Gymnorhinus cyanocephalus</i>	Present in Park	Migratory	Native	Rare
Common Raven	<i>Corvus corax</i>	Present in Park	Probable Breeder	Native	Common
Horned Lark	<i>Eremophila alpestris</i>	Present in Park	Unknown	Native	Unknown
Tree Swallow	<i>Tachycineta bicolor</i>	Present in Park	Possible Breeder	Native	Unknown
Violet-green Swallow	<i>Tachycineta thalassina</i>	Present in Park	Probable Breeder	Native	Abundant
Cliff Swallow	<i>Hirundo pyrrhonota</i>	Present in Park	Probable Preeder	Native	Uncommon
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	Present in Park	Probable Breeder	Native	Rare
Barn Swallow	<i>Hirundo rustica</i>	Present in Park	Migratory	Native	Uncommon
Juniper Titmouse	<i>Baeolophus ridgwayi</i>	Present in Park	Migratory	Native	Unknown
Black-capped Chickadee	<i>Poecile atricapillus</i>	Present in Park	Possible Breeder	Native	Rare
Mountain Chickadee	<i>Poecile gambeli</i>	Present in Park	Confirmed Breeder	Native	Abundant
Brown Creeper	<i>Certhia americana</i>	Present in Park	Confirmed Breeder	Native	Common
White-breasted Nuthatch	<i>Sitta carolinensis</i>	Present in Park	Probable Breeder	Native	Uncommon
Red-breasted Nuthatch	<i>Sitta canadensis</i>	Present in Park	Probable Breeder	Native	Uncommon
Pygmy Nuthatch	<i>Sitta pygmaea</i>	Present in Park	Probable Breeder	Native	Rare

Appendix 7a. Cedar Breaks NM Master List of Birds cont.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
House Wren	<i>Troglodytes aedon</i>	Present in Park	Probable Breeder	Native	Uncommon
Rock Wren	<i>Salpinctes obsoletus</i>	Present in Park	Probable Breeder	Native	Uncommon
Canyon Wren	<i>Catherpes mexicanus</i>	Present in Park	Unknown	Native	Unknown
American Dipper	<i>Cinclus mexicanus</i>	Present in Park	Confirmed Breeder	Native	Uncommon
Golden-crowned Kinglet	<i>Regulus satrapa</i>	Present in Park	Possible Breeder	Native	Uncommon
Ruby-crowned Kinglet	<i>Regulus calendula</i>	Present in Park	Confirmed Breeder	Native	Common
Western Bluebird	<i>Sialia mexicana</i>	Present in Park	Probable Breeder	Native	Uncommon
Mountain Bluebird	<i>Sialia currucoides</i>	Present in Park	Confirmed Breeder	Native	Common
Townsend's Solitaire	<i>Myadestes townsendi</i>	Present in Park	Confirmed Breeder	Native	Uncommon
Swainson's Thrush	<i>Catharus ustulatus</i>	Present in Park	Possible Breeder	Native	Rare
Hermit Thrush	<i>Catharus guttatus</i>	Present in Park	Confirmed Breeder	Native	Common
American Robin	<i>Turdus migratorius</i>	Present in Park	Confirmed Breeder	Native	Abundant
American Pipit	<i>Anthus rubescens</i>	Present in Park	Unknown	Native	Unknown
Orange-crowned Warbler	<i>Vermivora celata</i>	Present in Park	Possible Breeder	Native	Unknown
Nashville Warbler	<i>Vermivora ruficapilla</i>	Present in Park	Migratory	Native	Occasional
Virginia's Warbler	<i>Vermivora virginiae</i>	Present in Park	Possible Breeder	Native	Rare
Yellow-rumped Warbler	<i>Dendroica coronata</i>	Present in Park	Probable Breeder	Native	Common
Black-throated Gray Warbler	<i>Dendroica nigrescens</i>	Present in Park	Migratory	Native	Occasional
Townsend's warbler	<i>Dendroica townsendi</i>	Present in Park	Migratory	Native	Unknown
Yellow Warbler	<i>Dendroica petechia</i>	Present in Park	Possible Breeder	Native	Rare
MacGillivray's Warbler	<i>Oporornis tolmiei</i>	Present in Park	Possible Breeder	Native	Uncommon
Wilson's Warbler	<i>Wilsonia pusilla</i>	Present in Park	Possible Breeder	Native	Rare
Western Tanager	<i>Piranga ludoviciana</i>	Present in Park	Probable Breeder	Native	Common
Green-tailed Towhee	<i>Pipilo chlorurus</i>	Present in Park	Possible Breeder	Native	Unknown
Spotted Towhee	<i>Pipilo maculatus</i>	Present in Park	Possible Breeder	Native	Uncommon
Chipping Sparrow	<i>Spizella passerina</i>	Present in Park	Confirmed Breeder	Native	Abundant
Fox Sparrow	<i>Passerella iliaca</i>	Present in Park	Unknown	Native	Unknown
Lincoln's Sparrow	<i>Melospiza lincolnii</i>	Present in Park	Possible Breeder	Native	Uncommon
Vesper Sparrow	<i>Pooecetes gramineus</i>	Present in Park	Migratory	Native	Uncommon
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	Present in Park	Confirmed Breeder	Native	Abundant

Appendix 7a. Cedar Breaks NM Master List of Birds cont.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
Dark-eyed Junco	<i>Junco hyemalis</i>	Present in Park	Confirmed Breeder	Native	Abundant
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	Present in Park	Unknown	Native	Unknown
Lazuli Bunting	<i>Passerina amoena</i>	Present in Park	Probable Breeder	Native	Unknown
Turkey Vulture	<i>Cathartes aura</i>	Present in Park	Migratory	Native	Uncommon
Western Meadowlark	<i>Sturnella neglecta</i>	Present in Park	Migratory	Native	Occasional
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	Present in Park	Unknown	Native	Unknown
Bullock's Oriole	<i>Icterus bullockii</i>	Present in Park	Migratory	Native	Unknown
Black Rosy-Finch	<i>Leucosticte atrata</i>	Present in Park	Unknown	Native	Unknown
Cassin's Finch	<i>Carpodacus cassinii</i>	Present in Park	Probable Breeder	Native	Uncommon
House Finch	<i>Carpodacus mexicanus</i>	Present in Park	Possible Breeder	Native	Unknown
Red Crossbill	<i>Loxia curvirostra</i>	Present in Park	Possible Breeder	Native	Uncommon
Pine Grosbeak	<i>Pinicola enucleator</i>	Present in Park	Possible Breeder	Native	Unknown
Pine Siskin	<i>Carduelis pinus</i>	Present in Park	Confirmed Breeder	Native	Abundant
American Goldfinch	<i>Carduelis tristis</i>	Present in Park	Possible Breeder	Native	Unknown
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	Present in Park	Probable Breeder	Native	Uncommon

Appendix 7b. Fossil Butte NM Master List of Birds.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
Pied-billed Grebe	<i>Podilymbus podiceps</i>	Present in Park	Unknown	Native	Unknown
Great Blue Heron	<i>Ardea herodias</i>	Present in Park	Unknown	Native	Unknown
White-faced Ibis	<i>Plegadis chihi</i>	Present in Park	Migratory	Native	Unknown
Canada Goose	<i>Branta canadensis</i>	Present in Park	Unknown	Native	Unknown
Mallard	<i>Anas platyrhynchos</i>	Present in Park	Confirmed Breeder	Native	Uncommon
Gadwall	<i>Anas strepera</i>	Present in Park	Unknown	Native	Rare
Green-winged Teal	<i>Anas crecca</i>	Present in Park	Unknown	Native	Rare
Northern Pintail	<i>Anas acuta</i>	Present in Park	Unknown	Native	Unknown
Cinnamon Teal	<i>Anas cyanoptera</i>	Present in Park	Unknown	Native	Unknown
Lesser Scaup	<i>Aythya affinis</i>	Present in Park	Unknown	Native	Unknown
Ruddy Duck	<i>Oxyura jamaicensis</i>	Present in Park	Unknown	Native	Unknown
Turkey Vulture	<i>Cathartes aura</i>	Present in Park	Possible Breeder	Native	Rare
Northern Harrier	<i>Circus cyaneus</i>	Present in Park	Probable Breeder	Native	Common
Golden Eagle	<i>Aquila chrysaetos</i>	Present in Park	Probable Breeder	Native	Common
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Present in Park	Unknown	Native	Unknown
Sharp-shinned Hawk	<i>Accipiter striatus</i>	Present in Park	Probable Breeder	Native	Rare
Cooper's Hawk	<i>Accipiter cooperii</i>	Present in Park	Probable Breeder	Native	Rare
Northern Goshawk	<i>Accipiter gentilis</i>	Present in Park	Unknown	Native	Unknown
Red-tailed Hawk	<i>Buteo jamaicensis</i>	Present in Park	Confirmed Breeder	Native	Common
Swainson's Hawk	<i>Buteo swainsoni</i>	Present in Park	Probable Breeder	Native	Unknown
Ferruginous Hawk	<i>Buteo regalis</i>	Present in Park	Probable Breeder	Native	Rare
American Kestrel	<i>Falco sparverius</i>	Present in Park	Probable Breeder	Native	Uncommon
Prairie Falcon	<i>Falco mexicanus</i>	Present in Park	Probable Breeder	Native	Uncommon
Peregrine Falcon	<i>Falco peregrinus</i>	Present in Park	Unknown	Native	Unknown
Chukar	<i>Alectoris chukar</i>	Present in Park	Probable Breeder	Non-Native	Uncommon
Blue Grouse	<i>Dendragapus obscurus</i>	Present in Park	Probable Breeder	Native	Rare
Sharp-tailed Grouse	<i>Pedioecetes phasianellus</i>	Present in Park	Possible Breeder	Native	Unknown
Greater Sage-Grouse	<i>Centrocercus urophasianus</i>	Present in Park	Confirmed Breeder	Native	Common
Sora	<i>Porzana carolina</i>	Present in Park	Unknown	Native	Rare

Appendix 7b. Fossil Butte NM Master List of Birds cont.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
American Coot	<i>Fulica americana</i>	Present in Park	Possible Breeder	Native	Unknown
Sandhill Crane	<i>Grus canadensis</i>	Present in Park	Confirmed Breeder	Native	Rare
Whooping Crane	<i>Grus americana</i>	Present in Park	Unknown	Native	Unknown
Killdeer	<i>Charadrius vociferus</i>	Present in Park	Probable Breeder	Native	Common
Spotted Sandpiper	<i>Actitis macularia</i>	Present in Park	Probable Breeder	Native	Uncommon
Common Snipe	<i>Gallinago gallinago</i>	Present in Park	Possible Breeder	Native	Rare
Red-necked Phalarope	<i>Phalaropus lobatus</i>	Present in Park	Migratory	Native	Rare
Franklin's Gull	<i>Larus pipixcan</i>	Present in Park	Migratory	Native	Unknown
Ring-billed Gull	<i>Larus delawarensis</i>	Present in Park	Migratory	Native	Unknown
California Gull	<i>Larus californicus</i>	Present in Park	Migratory	Native	Occasional?
Herring Gull	<i>Larus argentatus</i>	Present in Park	Migratory	Native	Unknown
Forster's Tern	<i>Sterna forsteri</i>	Present in Park	Unknown	Native	Unknown
Common Tern	<i>Sterna hirundo</i>	Present in Park	Migratory	Native	Unknown
Rock Dove	<i>Columba livia</i>	Present in Park	Probable Breeder	Non-Native	Unknown
Mourning Dove	<i>Zenaidura macroura</i>	Present in Park	Confirmed Breeder	Native	Common
Short-eared Owl	<i>Asio flammeus</i>	Present in Park	Probable Breeder	Native	Unknown
Long-eared Owl	<i>Asio otus</i>	Present in Park	Probable Breeder	Native	Uncommon
Great Horned Owl	<i>Bubo virginianus</i>	Present in Park	Probable Breeder	Native	Rare
Common Nighthawk	<i>Chordeiles minor</i>	Present in Park	Probable Breeder	Native	Common
Common Poorwill	<i>Phalaenoptilus nuttallii</i>	Present in Park	Probable Breeder	Native	Common
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	Present in Park	Confirmed Breeder	Native	Uncommon
Calliope Hummingbird	<i>Stellula calliope</i>	Present in Park	Unknown	Native	Unknown
Belted Kingfisher	<i>Ceryle torquata</i>	Present in Park	Possible Breeder	Native	Unknown
Northern Flicker	<i>Colaptes auratus</i>	Present in Park	Confirmed Breeder	Native	Common
Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>	Present in Park	Probable Breeder	Native	Uncommon
Downy Woodpecker	<i>Picoides pubescens</i>	Present in Park	Probable Breeder	Native	Uncommon
Hairy Woodpecker	<i>Picoides villosus</i>	Present in Park	Probable Breeder	Native	Uncommon
Olive-sided Flycatcher	<i>Contopus cooperi</i>	Present in Park	Possible Breeder	Native	Unknown
Western Wood-pewee	<i>Contopus sordidulus</i>	Present in Park	Confirmed Breeder	Native	Uncommon
Hammond's flycatcher	<i>Empidonax hammondi</i>	Present in Park	Probable Breeder	Native	Common

Appendix 7b. Fossil Butte NM Master List of Birds cont.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
Gray Flycatcher	<i>Empidonax wrightii</i>	Present in Park	Probable Breeder	Native	Rare
Dusky Flycatcher	<i>Empidonax oberholseri</i>	Present in Park	Probable Breeder	Native	Common
Cordilleran Flycatcher	<i>Empidonax occidentalis</i>	Present in Park	Probable Breeder	Native	Uncommon
Say's Phoebe	<i>Sayornis saya</i>	Present in Park	Confirmed Breeder	Native	Uncommon
Western Kingbird	<i>Tyrannus verticalis</i>	Present in Park	Possible Breeder	Native	Unknown
Eastern Kingbird	<i>Tyrannus tyrannus</i>	Present in Park	Possible Breeder	Native	Unknown
Loggerhead Shrike	<i>Lanius ludovicianus</i>	Present in Park	Probable Breeder	Native	Uncommon
Northern Shrike	<i>Lanius excubitor</i>	Present in Park	Winter Resident	Native	Rare
Plumbeous Vireo	<i>Vireo plumbeus</i>	Present in Park	Probable Breeder	Native	Uncommon
Warbling Vireo	<i>Vireo gilvus</i>	Present in Park	Confirmed Breeder	Native	Common
Steller's Jay	<i>Cyanocitta stelleri</i>	Present in Park	Probable Breeder	Native	Uncommon
Clark's Nutcracker	<i>Nucifraga columbiana</i>	Present in Park	Confirmed Breeder	Native	Common
Western Scrub-jay	<i>Aphelocoma californica</i>	Present in Park	Probable Breeder	Native	Uncommon
Pinyon Jay	<i>Gymnorhinus cyanocephalus</i>	Present in Park	Possible Breeder	Native	Unknown
Black-billed Magpie	<i>Pica pica</i>	Present in Park	Probable Breeder	Native	Common
American Crow	<i>Corvus brachyrhynchos</i>	Present in Park	Possible Breeder	Native	Unknown
Common Raven	<i>Corvus corax</i>	Present in Park	Confirmed Breeder	Native	Common
Horned Lark	<i>Eremophila alpestris</i>	Present in Park	Confirmed Breeder	Native	Common
Tree Swallow	<i>Tachycineta bicolor</i>	Present in Park	Probable Breeder	Native	Common
Violet-green Swallow	<i>Tachycineta thalassina</i>	Present in Park	Probable Breeder	Native	Common
Cliff Swallow	<i>Hirundo pyrrhonota</i>	Present in Park	Probable Breeder	Native	Common
Northern Rough-winged Swallow	<i>Stegidopteryx serripennis</i>	Present in Park	Probable Breeder	Native	Uncommon
Barn Swallow	<i>Hirundo rustica</i>	Present in Park	Probable Breeder	Native	Common
Black-capped Chickadee	<i>Parus atricapillus</i>	Present in Park	Probable Breeder	Native	Uncommon
Mountain Chickadee	<i>Parus gambeli</i>	Present in Park	Probable Breeder	Native	Common
Brown Creeper	<i>Certhia americana</i>	Present in Park	Probable Breeder	Native	Rare
White-breasted Nuthatch	<i>Sitta carolinensis</i>	Present in Park	Probable Breeder	Native	Uncommon
Red-breasted Nuthatch	<i>Sitta canadensis</i>	Present in Park	Probable Breeder	Native	Uncommon
Pygmy Nuthatch	<i>Sitta pygmaea</i>	Present in Park	Probable Breeder	Native	Occasional?
House Wren	<i>Troglodytes aedon</i>	Present in Park	Confirmed Breeder	Native	Common

Appendix 7b. Fossil Butte NM Master List of Birds cont.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
Rock Wren	<i>Salpinctes obsoletus</i>	Present in Park	Confirmed Breeder	Native	Common
Marsh Wren	<i>Cistothorus palustris</i>	Present in Park	Possible Breeder	Native	Unknown
Golden-crowned Kinglet	<i>Regulus satrapa</i>	Present in Park	Probable Breeder	Native	Uncommon
Ruby-crowned Kinglet	<i>Regulus calendula</i>	Present in Park	Confirmed Breeder	Native	Common
Mountain Bluebird	<i>Sialia currucoides</i>	Present in Park	Confirmed Breeder	Native	Common
Townsend's Solitaire	<i>Myadestes townsendi</i>	Present in Park	Probable Breeder	Native	Rare
Swainson's Thrush	<i>Catharus ustulatus</i>	Present in Park	Probable Breeder	Native	Rare
Hermit Thrush	<i>Catharus guttatus</i>	Present in Park	Probable Breeder	Native	Uncommon
American Robin	<i>Turdus migratorius</i>	Present in Park	Confirmed Breeder	Native	Common
Sage Thrasher	<i>Oreoscoptes montanus</i>	Present in Park	Confirmed Breeder	Native	Common
European Starling	<i>Sturnus vulgaris</i>	Present in Park	Possible Breeder	Non-Native	Common
Bohemian Waxwing	<i>Bombycilla garrulus</i>	Present in Park	Winter Resident	Native	Unknown
Cedar Waxwing	<i>Bombycilla cedrorum</i>	Present in Park	Migratory	Native	Unknown
Orange-crowned Warbler	<i>Vermivora celata</i>	Present in Park	Confirmed Breeder	Native	Common
Yellow-rumped Warbler	<i>Dendroica coronata</i>	Present in Park	Probable Breeder	Native	Unknown
Townsend's Warbler	<i>Dendroica townsendi</i>	Present in Park	Migratory	Native	Unknown
Yellow Warbler	<i>Dendroica petechia</i>	Present in Park	Probable Breeder	Native	Common
MacGillivray's Warbler	<i>Oporornis tolmiei</i>	Present in Park	Probable Breeder	Native	Uncommon
Hooded Warbler	<i>Wilsonia citrina</i>	Present in Park	Migratory	Native	Occasional
Western Tanager	<i>Piranga ludoviciana</i>	Present in Park	Probable Breeder	Native	Common
Green-tailed Towhee	<i>Pipilo chlorurus</i>	Present in Park	Confirmed Breeder	Native	Common
Spotted Towhee	<i>Pipilo maculatus</i>	Present in Park	Probable Breeder	Native	Uncommon
American Tree Sparrow	<i>Sprizella arborea</i>	Present in Park	Winter Resident	Native	Unknown
Chipping Sparrow	<i>Spizella passerina</i>	Present in Park	Probable Breeder	Native	Common
Brewer's Sparrow	<i>Spizella breweri</i>	Present in Park	Confirmed Breeder	Native	Abundant
Sage Sparrow	<i>Amphispiza belli</i>	Present in Park	Probable Breeder	Native	Uncommon
Song Sparrow	<i>Melospiza melodia</i>	Present in Park	Possible Breeder	Native	Unknown
Vesper Sparrow	<i>Pooecetes gramineus</i>	Present in Park	Confirmed Breeder	Native	Abundant
White-throated Sparrow	<i>Zonotrichia albicollis</i>	Present in Park	Migratory	Native	Unknown
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	Present in Park	Probable Breeder	Native	Rare

Appendix 7b. Fossil Butte NM Master List of Birds cont.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
Dark-eyed Junco	<i>Junco hyemalis</i>	Present in Park	Probable Breeder	Native	Common
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	Present in Park	Probable Breeder	Native	Common
Lazuli Bunting	<i>Passerina amoena</i>	Present in Park	Probable Breeder	Native	Uncommon
Western Meadowlark	<i>Sturnella neglecta</i>	Present in Park	Confirmed Breeder	Native	Common
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>	Present in Park	Possible Breeder	Native	Unknown
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	Present in Park	Possible Breeder	Native	Unknown
Common Grackle	<i>Quiscalus quiscula</i>	Present in Park	Unknown	Native	Unknown
Rusty Blackbird	<i>Euphagus carolinus</i>	Present in Park	Migratory?	Native	Unknown
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	Present in Park	Probable Breeder	Native	Common
Brown-headed Cowbird	<i>Molothrus ater</i>	Present in Park	Confirmed Breeder	Native	Common
Bullock's Oriole	<i>Icterus galbula</i>	Present in Park	Probable Breeder	Native	Unknown
Black Rosy-finch	<i>Leucosticte atrata</i>	Present in Park	Unknown	Native	Unknown
Cassin's Finch	<i>Carpodacus cassinii</i>	Present in Park	Probable Breeder	Native	Common
Red Crossbill	<i>Loxia curvirostra</i>	Present in Park	Possible Breeder	Native	Unknown
Pine Grosbeak	<i>Pinicola enucleator</i>	Present in Park	Unknown	Native	Rare
Pine Siskin	<i>Carduelis pinus</i>	Present in Park	Probable Breeder	Native	Uncommon
House Sparrow	<i>Passer domesticus</i>	Present in Park	Possible Breeder	Non-Native	Unknown

Appendix 7c. Golden Spike NHM Master List of Birds.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
Snowy Egret	<i>Egretta thula</i>	Present in Park	Migratory ?	Native	Uncommon
Great Blue Heron	<i>Ardea herodias</i>	Present in Park	Possible Breeder	Native	Common
Canada Goose	<i>Branta canadensis</i>	Present in Park	Migratory	Native	Uncommon
Mallard	<i>Anas platyrhynchos</i>	Present in Park	Probable Breeder	Native	Uncommon
Turkey Vulture	<i>Cathartes aura</i>	Present in Park	Unknown	Native	Uncommon
White-tailed Kite	<i>Elanus leucurus</i>	Present in Park	Vagrant	Native	Occasional
Northern Harrier	<i>Circus cyaneus</i>	Present in Park	Probable Breeder	Native	Common
Golden Eagle	<i>Aquila chrysaetos</i>	Present in Park	Probable Breeder	Native	Uncommon
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Present in Park	Unknown	Native	Uncommon
Red-tailed Hawk	<i>Buteo jamaicensis</i>	Present in Park	Possible Breeder	Native	Common
Swainson's Hawk	<i>Buteo swainsoni</i>	Present in Park	Possible Breeder	Native	Common
Rough-legged Hawk	<i>Buteo lagopus</i>	Present in Park	Winter Resident	Native	Uncommon
American Kestrel	<i>Falco sparverius</i>	Present in Park	Probable Breeder	Native	Common
Prairie Falcon	<i>Falco mexicanus</i>	Present in Park	Possible Breeder	Native	Common
Chukar	<i>Alectoris chukar</i>	Present in Park	Confirmed Breeder	Non-Native	Uncommon
Gray Partridge	<i>Perdix perdix</i>	Present in Park	Probable Breeder	Non-Native	Uncommon
Greater Sage-Grouse	<i>Centrocercus urophasianus</i>	Present in Park	Probable Breeder	Native	Rare
Ring-necked Pheasant	<i>Phasianus colchicus</i>	Present in Park	Probable Breeder	Non-Native	Common
Sharp-tailed Grouse	<i>Tympanuchus phasianellus</i>	Present in Park	Unknown	Native	Uncommon
California Quail	<i>Callipepla californica</i>	Present in Park	Probable Breeder	Native	Uncommon
Sandhill Crane	<i>Grus canadensis</i>	Present in Park	Possible Breeder	Native	Uncommon
Killdeer	<i>Charadrius vociferus</i>	Present in Park	Probable Breeder	Native	Uncommon
Willet	<i>Catoptrophorus semipalmatus</i>	Present in Park	Possible Breeder	Native	Uncommon
Long-billed Curlew	<i>Numenius americanus</i>	Present in Park	Confirmed Breeder	Native	Common
Common Snipe	<i>Gallinago gallinago</i>	Present in Park	Possible Breeder	Native	Uncommon
Red-necked Phalarope	<i>Phalaropus lobatus</i>	Present in Park	Migratory	Native	Rare
Franklin's Gull	<i>Larus pipixcan</i>	Present in Park	Unknown	Native	Uncommon
California Gull	<i>Larus californicus</i>	Present in Park	Migratory	Native	Common
Rock Dove	<i>Columba livia</i>	Present in Park	Unknown	Non-Native	Uncommon

Appendix 7c. Golden Spike NHM Master List of Birds cont.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
Mourning Dove	<i>Zenaida macroura</i>	Present in Park	Confirmed Breeder	Native	Common
Barn Owl	<i>Tyto alba</i>	Present in Park	Unknown	Native	Common
Short-eared Owl	<i>Asio flammeus</i>	Present in Park	Probable Breeder	Native	Common
Long-eared Owl	<i>Asio otus</i>	Present in Park	Possible Breeder	Native	Unknown
Great Horned Owl	<i>Bubo virginianus</i>	Present in Park	Confirmed Breeder	Native	Uncommon
Burrowing Owl	<i>Athene cunicularia</i>	Present in Park	Probable Breeder	Native	Uncommon
Common Nighthawk	<i>Chordeiles minor</i>	Present in Park	Probable Breeder	Native	Common
Common Poorwill	<i>Phalaenoptilus nuttallii</i>	Present in Park	Probable Breeder	Native	Common
Black-chinned Hummingbird	<i>Archilochus alexandri</i>	Present in Park	Possible Breeder	Native	Common
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	Present in Park	Possible Breeder	Native	Rare
Northern Flicker	<i>Colaptes auratus</i>	Present in Park	Probable Breeder	Native	Common
Downy Woodpecker	<i>Picoides pubescens</i>	Present in Park	Unknown	Native	Rare
Say's Phoebe	<i>Sayornis saya</i>	Present in Park	Probable Breeder	Native	Common
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>	Present in Park	Possible Breeder	Native	Common
Western Kingbird	<i>Tyrannus verticalis</i>	Present in Park	Probable Breeder	Native	Common
Eastern Kingbird	<i>Tyrannus tyrannus</i>	Present in Park	Possible Breeder	Native	Rare
Loggerhead Shrike	<i>Lanius ludovicianus</i>	Present in Park	Probable Breeder	Native	Common
Black-billed Magpie	<i>Pica pica</i>	Present in Park	Confirmed Breeder	Native	Common
Common Raven	<i>Corvus corax</i>	Present in Park	Confirmed Breeder	Native	Common
Horned Lark	<i>Eremophila alpestris</i>	Present in Park	Confirmed Breeder	Native	Common
Violet-green Swallow	<i>Tachycineta thalassina</i>	Present in Park	Probable Breeder	Native	Unknown
Cliff Swallow	<i>Hirundo pyrrhonota</i>	Present in Park	Confirmed Breeder	Native	Abundant
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	Present in Park	Probable Breeder	Native	Common
Barn Swallow	<i>Hirundo rustica</i>	Present in Park	Probable Breeder	Native	Common
Rock Wren	<i>Salpinctes obsoletus</i>	Present in Park	Confirmed Breeder	Native	Common
Canyon Wren	<i>Catherpes mexicanus</i>	Present in Park	Probable Breeder	Native	Uncommon
American Robin	<i>Turdus migratorius</i>	Present in Park	Confirmed Breeder	Native	Common
Northern Mockingbird	<i>Mimus polyglottos</i>	Present in Park	Probable Breeder	Native	Uncommon
Sage Thrasher	<i>Oreoscoptes montanus</i>	Present in Park	Confirmed Breeder	Native	Common
European Starling	<i>Sturnus vulgaris</i>	Present in Park	Confirmed Breeder	Non-Native	Common

Appendix 7c. Golden Spike NHM Master List of Birds cont.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
Orange-crowned Warbler	<i>Vermivora celata</i>	Present in Park	Migratory	Native	Rare
Yellow Warbler	<i>Dendroica petechia</i>	Present in Park	Unknown	Native	Rare
Spotted Towhee	<i>Pipilo maculatus</i>	Present in Park	Probable Breeder	Native	Uncommon
Brewer's Sparrow	<i>Spizella breweri</i>	Present in Park	Confirmed Breeder	Native	Common
Lark Sparrow	<i>Chondestes grammacus</i>	Present in Park	Confirmed Breeder	Native	Common
Vesper Sparrow	<i>Poocetes gramineus</i>	Present in Park	Probable Breeder	Native	Uncommon
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	Present in Park	Probable Breeder	Native	Unknown
Western Meadowlark	<i>Sturnella neglecta</i>	Present in Park	Confirmed Breeder	Native	Abundant
Common Grackle	<i>Quiscalus quiscula</i>	Present in Park	Unknown	Native	Unknown
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	Present in Park	Confirmed Breeder	Native	Common
Brown-headed Cowbird	<i>Molothrus ater</i>	Present in Park	Confirmed Breeder	Native	Common
Bullock's Oriole	<i>Icterus bullockii</i>	Present in Park	Probable Breeder	Native	Uncommon
House Finch	<i>Carpodacus mexicanus</i>	Present in Park	Confirmed Breeder	Native	Common
House Sparrow	<i>Passer domesticus</i>	Present in Park	Possible Breeder	Non-Native	Common

Appendix 7d. Timpanogos Cave NM Master List of Birds.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
Canada Goose	<i>Branta canadensis</i>	Present in Park	Migratory	Native	Uncommon
Mallard	<i>Anas platyrhynchos</i>	Present in Park	Unknown	Native	Rare
Green-winged Teal	<i>Anas crecca</i>	Present in Park	Migratory	Native	Unknown
Canvasback	<i>Aythya valisineria</i>	Present in Park	Migratory	Native	Rare
Common Goldeneye	<i>Bucephala clangula</i>	Present in Park	Migratory	Native	Rare
Common Merganser	<i>Mergus merganser</i>	Present in Park	Migratory	Native	Rare
Turkey Vulture	<i>Cathartes aura</i>	Present in Park	Unknown	Native	Uncommon
Golden Eagle	<i>Aquila chrysaetos</i>	Present in Park	Possible Breeder	Native	Uncommon
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Present in Park	Migratory	Native	Rare
Sharp-shinned Hawk	<i>Accipiter striatus</i>	Present in Park	Possible Breeder	Native	Rare
Cooper's Hawk	<i>Accipiter cooperii</i>	Present in Park	Possible Breeder	Native	Unknown
Northern Goshawk	<i>Accipiter gentilis</i>	Present in Park	Possible Breeder	Native	Rare
Red-tailed Hawk	<i>Buteo jamaicensis</i>	Present in Park	Possible Breeder	Native	Rare
Ferruginous Hawk	<i>Buteo regalis</i>	Present in Park	Unknown	Native	Unknown
American Kestrel	<i>Falco sparverius</i>	Present in Park	Possible Breeder	Native	Rare
Prairie Falcon	<i>Falco mexicanus</i>	Present in Park	Migratory	Native	Rare
Peregrine Falcon	<i>Falco peregrinus</i>	Present in Park	Possible Breeder	Native	Rare
Ruffed Grouse	<i>Bonasa umbellus</i>	Present in Park	Possible Breeder	Native	Rare
Blue Grouse	<i>Dendragapus obscurus</i>	Present in Park	Possible Breeder	Native	Uncommon
Killdeer	<i>Charadrius vociferus</i>	Present in Park	Possible Breeder	Native	Rare
Long-billed Curlew	<i>Numenius americanus</i>	Present in Park	Migratory	Native	Rare
Ring-billed Gull	<i>Larus delawarensis</i>	Present in Park	Vagrant	Native	Rare
Mourning Dove	<i>Zenaida macroura</i>	Present in Park	Migratory	Native	Rare
Long-eared Owl	<i>Asio otus</i>	Present in Park	Migratory	Native	Rare
Great Horned Owl	<i>Bubo virginianus</i>	Present in Park	Possible Breeder	Native	Uncommon
Flammulated Owl	<i>Otus flammeolus</i>	Present in Park	Possible Breeder	Native	Rare
Northern Pygmy-Owl	<i>Glaucidium gnoma</i>	Present in Park	Possible Breeder	Native	Rare
Common Nighthawk	<i>Chordeiles minor</i>	Present in Park	Migratory	Native	unknown
Common Poorwill	<i>Phalaenoptilus nuttallii</i>	Present in Park	Possible Breeder	Native	Uncommon

Appendix 7d. Timpanogos Cave NM Master List of Birds cont.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
White-throated Swift	<i>Aeronautes saxatalis</i>	Present in Park	Probable breeder	Native	Common
Black-chinned Hummingbird	<i>Archilochus alexandri</i>	Present in Park	Confirmed breeder	Native	Common
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	Present in Park	Possible breeder	Native	Common
Calliope Hummingbird	<i>Stellula calliope</i>	Present in Park	Probable breeder	Native	Uncommon
Rufous Hummingbird	<i>Selasphorus rufus</i>	Present in Park	Migratory	Native	Common
Belted Kingfisher	<i>Ceryle alcyon</i>	Present in Park	Possible breeder	Native	Uncommon
Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	Present in Park	Migratory ?	Native	Rare
Lewis' Woodpecker	<i>Melanerpes lewis</i>	Present in Park	Unknown	Native	Rare
Northern Flicker	<i>Colaptes auratus</i>	Present in Park	Confirmed breeder	Native	Uncommon
Williamson's Sapsucker	<i>Sphyrapicus thyroideus</i>	Present in Park	Possible breeder	Native	Uncommon
Downy Woodpecker	<i>Picoides pubescens</i>	Present in Park	Probable breeder	Native	Rare
Hairy Woodpecker	<i>Picoides villosus</i>	Present in Park	Possible breeder	Native	Uncommon
Three-toed Woodpecker	<i>Picoides tridactylus</i>	Present in Park	Possible breeder	Native	Uncommon
Olive-sided Flycatcher	<i>Contopus cooperi</i>	Present in Park	Possible breeder	Native	Uncommon
Western Wood-Pewee	<i>Contopus sordidulus</i>	Present in Park	Possible breeder	Native	Rare
Willow Flycatcher	<i>Empidonax traillii</i>	Present in Park	Possible breeder	Native	Rare
Hammond's flycatcher	<i>Empidonax hammondi</i>	Present in Park	Probable breeder	Native	Rare
Gray Flycatcher	<i>Empidonax wrightii</i>	Present in Park	Unknown	Native	Rare
Cordilleran Flycatcher	<i>Empidonax occidentalis</i>	Present in Park	Probable breeder	Native	Rare
Say's Phoebe	<i>Sayornis saya</i>	Present in Park	Possible breeder	Native	Rare
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>	Present in Park	Possible breeder	Native	Uncommon
Western Kingbird	<i>Tyrannus verticalis</i>	Present in Park	Migratory	Native	Rare
Eastern Kingbird	<i>Tyrannus tyrannus</i>	Present in Park	Unknown	Native	Rare
Loggerhead Shrike	<i>Lanius ludovicianus</i>	Present in Park	Migratory	Native	Rare
Black-capped Vireo	<i>Vireo atricapilla</i>	Present in Park	Vagrant	Native	Occasional
Plumbeous Vireo	<i>Vireo plumbeus</i>	Present in Park	Probable breeder	Native	Uncommon
Warbling Vireo	<i>Vireo gilvus</i>	Present in Park	Probable breeder	Native	Uncommon
Red-eyed Vireo	<i>Vireo olivaceus</i>	Present in Park	Migratory	Native	Rare
Steller's Jay	<i>Cyanocitta stelleri</i>	Present in Park	Probable breeder	Native	Common
Gray Jay	<i>Perisoreus canadensis</i>	Present in Park	Unknown	Native	Rare

Appendix 7d. Timpanogos Cave NM Master List of Birds cont.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
Clark's Nutcracker	<i>Nucifraga columbiana</i>	Present in Park	Confirmed breeder	Native	Uncommon
Pinyon Jay	<i>Gymnorhinus cyanocephalus</i>	Present in Park	Migratory	Native	Uncommon
Black-billed Magpie	<i>Pica pica</i>	Present in Park	Unknown	Native	Rare
Common Raven	<i>Corvus corax</i>	encroaching	Possible Breeder	Native	Unknown
Tree Swallow	<i>Tachycineta bicolor</i>	Present in Park	Probable Breeder	Native	Uncommon
Violet-green Swallow	<i>Tachycineta thalassina</i>	Present in Park	Probable Breeder	Native	Common
Purple Martin	<i>Progne subis</i>	Present in Park	Possible Breeder	Native	Uncommon
Cliff Swallow	<i>Hirundo pyrrhonota</i>	Present in Park	Possible Breeder	Native	Uncommon
Black-capped Chickadee	<i>Poecile atricapillus</i>	Present in Park	Confirmed Breeder	Native	Abundant
Mountain Chickadee	<i>Poecile gambeli</i>	Present in Park	Probable Breeder	Native	Common
Brown Creeper	<i>Certhia americana</i>	Present in Park	Unknown	Native	Rare
White-breasted Nuthatch	<i>Sitta carolinensis</i>	Present in Park	Probable Breeder	Native	Uncommon
Red-breasted Nuthatch	<i>Sitta canadensis</i>	Present in Park	Probable Breeder	Native	Uncommon
Pygmy Nuthatch	<i>Sitta pygmaea</i>	Present in Park	Probable Breeder	Native	Rare
House Wren	<i>Troglodytes aedon</i>	Present in Park	Probable Breeder	Native	Uncommon
Rock Wren	<i>Salpinctes obsoletus</i>	Present in Park	Probable Breeder	Native	Uncommon
Canyon Wren	<i>Catherpes mexicanus</i>	Present in Park	Probable Breeder	Native	Rare
American Dipper	<i>Cinclus mexicanus</i>	Present in Park	Confirmed Breeder	Native	Common
Golden-crowned Kinglet	<i>Regulus satrapa</i>	Present in Park	Probable Breeder	Native	Common
Ruby-crowned Kinglet	<i>Regulus calendula</i>	Present in Park	Confirmed Breeder	Native	Uncommon
Western Bluebird	<i>Sialia mexicana</i>	Present in Park	Unknown	Native	Occasional
Mountain Bluebird	<i>Sialia currucoides</i>	Present in Park	Possible Breeder	Native	Uncommon
Townsend's Solitaire	<i>Myadestes townsendi</i>	Present in Park	Probable Breeder	Native	Abundant
Swainson's Thrush	<i>Catharus ustulatus</i>	Present in Park	Possible Breeder	Native	Rare
Hermit Thrush	<i>Catharus guttatus</i>	Present in Park	Probable Breeder	Native	Uncommon
American Robin	<i>Turdus migratorius</i>	Present in Park	Confirmed Breeder	Native	Common
Northern Mockingbird	<i>Mimus polyglottos</i>	Present in Park	Migratory	Native	Uncommon
Gray Catbird	<i>Dumetella carolinensis</i>	Present in Park	Migratory	Native	Uncommon
Sage Thrasher	<i>Oreoscoptes montanus</i>	Present in Park	Migratory	Native	Uncommon
Bohemian Waxwing	<i>Bombycilla garrulus</i>	Present in Park	Winter Resident	Native	Unknown

Appendix 7d. Timpanogos Cave NM Master List of Birds cont.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
Cedar Waxwing	<i>Bombycilla cedrorum</i>	Present in Park	Migratory	Native	Unknown
Orange-crowned Warbler	<i>Vermivora celata</i>	Present in Park	Probable Breeder	Native	Uncommon
Nashville Warbler	<i>Vermivora ruficapilla</i>	Present in Park	Migratory	Native	Occasional
Virginia's Warbler	<i>Vermivora virginiae</i>	Present in Park	Probable Breeder	Native	Uncommon
Yellow-rumped Warbler	<i>Dendroica coronata</i>	Present in Park	Probable breeder	Native	Uncommon
Black-throated Gray Warbler	<i>Dendroica nigrescens</i>	Present in Park	Unknown	Native	Rare
Yellow Warbler	<i>Dendroica petechia</i>	Present in Park	Probable breeder	Native	Uncommon
MacGillivray's Warbler	<i>Oporornis tolmiei</i>	Present in Park	Probable breeder	Native	Uncommon
Wilson's Warbler	<i>Wilsonia pusilla</i>	Present in Park	Possible breeder	Native	Rare
Yellow-breasted Chat	<i>Icteria virens</i>	Present in Park	Migratory	Native	Uncommon
Western Tanager	<i>Piranga ludoviciana</i>	Present in Park	Probable breeder	Native	Common
Green-tailed Towhee	<i>Pipilo chlorurus</i>	Present in Park	Probable breeder	Native	Uncommon
Spotted Towhee	<i>Pipilo maculatus</i>	Present in Park	Probable breeder	Native	Uncommon
American Tree Sparrow	<i>Spizella arborea</i>	Present in Park	Possible winter resident	Native	Uncommon
Chipping Sparrow	<i>Spizella passerina</i>	Present in Park	Probable breeder	Native	Uncommon
Brewer's Sparrow	<i>Spizella breweri</i>	Present in Park	Migratory	Native	Rare
Lark Sparrow	<i>Chondestes grammacus</i>	Present in Park	Migratory	Native	Uncommon
Sage Sparrow	<i>Amphispiza belli</i>	Present in Park	Migratory	Native	Uncommon
Fox Sparrow	<i>Passerella iliaca</i>	Present in Park	Possible breeder	Native	Rare
Vesper Sparrow	<i>Pooecetes gramineus</i>	Present in Park	Migratory	Native	Rare
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	Present in Park	Possible breeder	Native	Uncommon
Dark-eyed Junco	<i>Junco hyemalis</i>	Present in Park	Confirmed breeder	Native	Common
Snow Bunting	<i>Plectrophenax nivalis</i>	Present in Park	Winter resident	Native	Occasional
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	Present in Park	Probable breeder	Native	Rare
Lazuli Bunting	<i>Passerina amoena</i>	Present in Park	Probable breeder	Native	Uncommon
Western Meadowlark	<i>Sturnella neglecta</i>	Present in Park	Migratory	Native	Occasional
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	Present in Park	Migratory	Native	unknown
Bullock's Oriole	<i>Icterus bullockii</i>	Present in Park	Unknown	Native	unknown
Gray-crowned Rosy Finch	<i>Leucosticte tephrocotis</i>	Present in Park	Winter resident	Native	Unknown
Black Rosy Finch	<i>Leucosticte atrata</i>	Present in Park	Unknown	Native	Occasional

Appendix 7d. Timpanogos Cave NM Master List of Birds cont.

Common Name	Scientific Name	Park Status	Residency	Nativity	Abundance
Cassin's Finch	<i>Carpodacus cassinii</i>	Present in Park	Probable breeder	Native	Uncommon
House Finch	<i>Carpodacus mexicanus</i>	Present in Park	Encroaching possible breeder	Native	Rare
Red Crossbill	<i>Loxia curvirostra</i>	Present in Park	Possible breeder	Native	Uncommon
Pine Grosbeak	<i>Pinicola enucleator</i>	Present in Park	Possible breeder	Native	Uncommon
Pine Siskin	<i>Carduelis pinus</i>	Present in Park	Probable breeder	Native	Common
Common Redpoll	<i>Carduelis flammea</i>	Present in Park	Migratory	Native	Occasional
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	Present in Park	Possible breeder	Native	Rare
House Sparrow	<i>Passer domesticus</i>	Present in Park	Possible breeder	Non-Native	Uncommon

PERSONNEL CREDENTIALS

Matthew J. Johnson, Wildlife Biologist. Matthew has 11 years of experience studying avian populations and behavior. He has conducted numerous research projects throughout the western United States, Mexico, and Central America, as well as in Africa. A considerable proportion of this work has involved conducting surveys of both Willow Flycatchers and Yellow-billed Cuckoos and observing their behavior. He has conducted surveys for Yellow-billed Cuckoos: along the San Juan River in 1998 and 2002; along the Green River and the upper Colorado River in 1999 and 2000; and as part of the AGFD/CPFS surveys in 1998 and 1999. In addition, he is co-author of the Western Yellow-billed Cuckoo Natural History Summary and Survey Methodology (Haltermann et al. 2002). His primary research interests include avian ecology, population studies, and inventory and monitoring of birds. Much of his work has been with federal land management agencies, principally the National Park Service. He has contributed to large-scale inventory and population monitoring studies, including the program at Canyonlands National Park and Montezuma Castle National Monument, the Southern Colorado Plateau Network of the Park Service, the Northern Colorado Plateau Network of the Park Service, and the USGS Grand Canyon Research and Monitoring Center. Since 1992, Matthew has been with what is today the USGS Biological Resources Division's Southwest Biological Science Center, Colorado Plateau Field Station on the Northern Arizona University campus in Flagstaff.

Maureen Stuart, Biological Technician. Maureen has 5 years of experience studying avian populations and behavior. She has conducted numerous research projects throughout the western United States. A considerable proportion of this work has involved conducting surveys of Yellow-Billed Cuckoos and observing their behavior. Much of her work has been with federal land management agencies, principally the Bureau of Land Management and National Park Service. She has contributed to large-scale inventory and population monitoring studies, including programs with the Southern Colorado Plateau Network and the Northern Colorado Plateau Network of the Park Service.

Jennifer A. Holmes, Wildlife Biologist. Jennifer has over 18 years experience working as an avian ecologist. She has supervised numerous field crews: crews of 5-7 while working for the Intermountain Research Station, Missoula, Mt, studying avian nesting ecology and the effects of forest fragmentation; a crew of 10 nest-searchers on the Mogollon Rim of Arizona, and a crew of 12 nest-searchers and monitors in Argentina; a crew of 3-5 field biologists monitoring birds in riparian habitat of the Grand Canyon; and supervising 3 biologist/technicians conducting field work for the Hopi Tribe. She has extensive experience monitoring nests of multiple species in a wide variety of habitats, and recording behavioral observations of birds. She has conducted research on avian ecology and habitat use throughout the West, Mexico, Argentina, and Uganda. In addition, she has considerable experience working in southwest riparian areas in the Grand Canyon, the National Parks of the Southern Colorado Plateau Network, and along the San Juan River.

Martin Barr, Biological Technician. Martin has 7 years of experience studying avian populations and behavior. He has conducted numerous research projects throughout the western United States. A considerable proportion of this work has involved conducting surveys of Northern Spotted Owl and observing their behavior. Much of his work has been with federal land management agencies, principally the Bureau of Land Management, U. S. Forest Service and National Park Service. He has contributed to large-scale inventory and population monitoring studies, including a program in the Great Basin of Nevada and the Northern Colorado Plateau Network of the Park Service.