National Park Service
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Natural Resource Program Center

Klamath Network Landbird Monitoring Protocol

Natural Resource Report NPS/KLMN/NRR—2010/187



ON THE COVER
Winter Wren (*Troglodytes troglodytes*)
Photograph by: Jim Livaudais©

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Change History

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

It will be necessary to periodically revise both the protocol narrative and associated SOPs. Documentation of revisions is critical to identify consistency or changes in data collection and management procedures. The format of a protocol narrative complemented by SOPs simplifies the revision process. Because the narrative is a general overview of the planning, sampling, and data management methodologies, it will only require revisions if large changes are made to the SOPs. The SOPs, in contrast, are very specific and may require more frequent minor revisions. Instructions for making protocol revisions are in SOP #18: Revising the Protocol. A revision log is included on the cover page of this narrative and at the beginning of each SOP to track what changes were made and why. In addition, SOP revisions will require updating of the version numbers and the names of each document that was changed.

1. Background and Objectives

This protocol narrative outlines the rationale, sampling design, and methods for monitoring landbirds in the Klamath Inventory and Monitoring Network (KLMN or the Network) of the National Park Service (NPS). It has been prepared in accordance with NPS guidance and standards (Oakley et al. 2003, Mohren 2007, and Sarr et al. 2007). The KLMN includes Crater Lake National Park (CRLA), Lassen Volcanic National Park (LAVO), Lava Beds National Monument (LABE), Oregon Caves National Monument (ORCA), Redwood National and State Parks (RNSP), and Whiskeytown National Recreation Area (WHIS), hereafter known collectively as the parks. The parks, located in southern Oregon and northern California, extend across a broad range of topography, elevation, and corresponding climate and vegetation. This region is recognized for its rich biodiversity, which is represented by a diverse bird fauna (Trail et al. 1997, DellaSala et al. 1999).

1.1 Landbird Monitoring Rationale

The overall purpose of natural resource monitoring in national parks is to develop scientifically sound information on the current status and long-term trends in the composition, structure, and function of park ecosystems. Use of monitoring information will increase confidence in managers' decisions, improving their ability to manage park resources. This increased knowledge will allow managers to confront and mitigate threats to the park and operate more effectively in legal and political arenas. Very few landbird projects have been completed within the parks of the KLMN and there have been even fewer long-term monitoring projects. Without this information, park managers will have difficulty determining the status and trends of these species within their boundaries, they will not have statistically vigorous data available to compare landbird communities within their boundaries to those communities outside their boundaries, and they will not have a clear understanding of how the management practices in the park are affecting landbirds. This protocol will provide park managers with data and information that can be utilized to help better address these issues.

Birds were among the 10 highest ranked vital signs in the KLMN vital signs selection process (Odion et al. 2005). Selection of landbird communities is consistent with the consensus to monitor the status and trends in structure, function, and composition of focal communities, the second highest ranking monitoring question for the Network (Sarr et al. 2007). Landbirds were selected as a focus group for bird monitoring in the KLMN because they provide cost-effective information about ecological conditions of interest (Alexander et al. 2007) and they are well represented in the major terrestrial habitats in the parks. In addition, the status and trends of other bird populations not monitored by this protocol (e.g., sea bird colonies, Bald Eagles, Peregrine Falcons, Northern Spotted Owls) are already being monitored by the parks or by other agencies.

One approach to designing monitoring projects is to focus on groups of organisms that can provide cost-effective information about ecological conditions of interest (Vos et al. 2000, Gram et al. 2001). Landbirds are an effective tool for monitoring because: (1) many species are easily and inexpensively detected, (2) standardized sampling protocols have already been developed, (3) landbird species respond to a wide variety of habitat conditions, and (4) measuring status and trends for many species with different ecological requirements can inform landscape scale conservation strategies (Hutto 1998). The potential for landbirds to serve as effective ecological

indicators is noted in *Recommended Methods for Inventorying and Monitoring Landbirds in National Parks* (Fancy and Sauer 2000). In this publication, Fancy and Sauer put forth the justification for monitoring bird communities within the National Park Service Inventory and Monitoring (I&M) Program:

> Birds are an important component of park ecosystems, and their high body temperature, rapid metabolism, and high ecological position in most food webs make them a good indicator of the effects of local and regional changes in ecosystems. Moreover, birds have a tremendous following among the public, and many parks provide information on the status and trends of birds in the park through their interpretive program.

1.2 Landbird Monitoring History in KLMN Parks

The KLMN, working with the Klamath Bird Observatory (KBO), implemented landbird inventory projects in each of the parks using multiple survey methodologies, including those set forth in this protocol. In 2002 and 2003, KBO, in conjunction with U.S. Forest Service Redwood Sciences Laboratory, completed this inventory effort (Sarr et al. *in review*). Prior to this effort, the Point Reyes Bird Observatory (PRBO) implemented two inventory projects at LAVO that examined landbird communities (King et al. 2001, Humple et al. 2001). Results of these inventory studies provided baseline information of bird abundance, and at some parks, additional information such as habitat associations, response to fuels management, and nesting success of focal species. Beyond these inventory efforts, KBO has been operating a mist netting station during breeding and migration seasons at ORCA since 2002, to monitor bird population trends and demographic factors at that park. In addition, the NPS has been monitoring bird population trends and demographic factors at a mist netting station in LAVO since 1997.

As part of the 12 Basic Inventories outlined by the Inventory and Monitoring Program, data from these efforts, along with historical records and data from previous and current park monitoring projects, were used in the recent compilation of a certified bird species lists for each park (Appendix D). A description of this inventory and the species list for each park is located in NPSpecies (http://science.nature.nps.gov/im/apps/npspp/). Results from these projects have informed the development of this protocol (Appendices A-D, F).

1.3 Links to Partners in Flight

The KLMN landbird monitoring effort is designed to contribute to monitoring objectives and goals associated with the Partners in Flight (PIF) landbird conservation initiative and PIF bird conservation plans (Table 1). Through implementing the NPS mission to preserve natural resources unimpaired for future generations, KLMN parks are meeting regional and continental PIF habitat-based bird conservation objectives (e.g., protecting high quality riparian habitat and protecting existing alpine habitat from anthropogenic disturbance) (Altman 1999, 2000, CalPIF 2002a, 2002b, 2004, 2005, RHJV 2004, Rich et al. 2004). Data collected through bird monitoring efforts in the parks will provide insight into the relative contribution that the parks make towards PIF's objectives.

Of the bird species identified as conservation focal species or species of conservation concern in the Klamath region by Partners in Flight (Altman 1999, 2000, CalPIF 2002a, 2002b, 2004, 2005, RHJV 2004) and/or by the states of Oregon and California (CDFG 2005, ODFW 2005), 85

species (58%) were among the 146 species detected during the recent landbird inventory of the parks (Appendix A). Within the KLMN monitoring program, landbirds will serve as indicators of ecological condition and landbird monitoring efforts will provide information about the status and trends of these conservation focal species and/or species of conservation concern within the parks.

Monitoring landbirds in the Klamath Network will provide important information about avian community composition in the parks and long-term population trends of specific species. Long-term patterns will help illuminate regional and continental bird population trends. While this monitoring program is not designed to assess the effects of specific habitat changes, it will provide insights into the relationships between land management activities and bird communities. Over time, landbird monitoring will also provide opportunistic information about the effects of natural disturbances and global warming in the parks.

Bird monitoring in the parks will provide a unique dataset in the Klamath region because the parks represent relatively protected landscapes compared to adjacent lands. Landbird monitoring in the KLMN parks will therefore provide insight into the relative contribution that the parks make towards regional and national bird conservation objectives. In addition, data collected through bird monitoring efforts in the parks will inform future revisions of the PIF conservation plans.

The NPS is an active participant in the Partners in Flight international bird conservation program. Through the integration of birds as vital signs within the Inventory and Monitoring Program (Fancy and Sauer 2000, Sarr et al. *in review*), the National Park Service is contributing to national bird monitoring goals that include integrating bird monitoring with management and conservation practices and organizations across spatial scales (US NABCI 2007). Thus, the NPS is meeting obligations to implement the Migratory Bird Treaty Act (Clinton 2001).

Table 1. Partners in Flight conservation plans and California and Oregon conservation strategies that apply to parks in the Klamath Network.

	Klamath Network Parks					
	CRLA	**ORCA**	**LABE**	**LAVO**	**RNSP**	**WHIS**
Partners in Flight Conservation Plans						
Continental PIF Intermountain West[1]	X		X	X		X
Continental PIF Pacific[1]		X			X	X
Cal PIF Riparian[2]				X	X	X
Cal PIF Oak Woodland[3]					X	X
Cal PIF Coniferous[4]			X	X	X	X
CAL PIF Coastal Scrub[5]					X	
Cal PIF Sagebrush[6]			X			
OR / WA PIF Coniferous[7]	X	X				
OR / WA PIF East-Slope[8]	X					
California and Oregon Conservation Strategies						
CDFG Wildlife Action Plan[9]			X	X	X	X
ODFW Conservation Strategy West Cascades[10]	X					
ODFW Conservation Strategy Klamath Mountains[10]		X				
ODFW Conservation Strategy East Cascades[10]	X					

[1]Rich et al. 2004, [2]RHJV 2004, [3]CalPIF 2002b, [4]CalPif 2002a, [5]CalPIF 2004, [6]CalPIF 2005, [7]Altman 1999, [8]Altman 2000, [9]CDFG 2005, [10]ODFW 2005

1.4 Contributing to Regional and National Efforts

In addition to providing information about landbirds at each park, the KLMN landbird monitoring effort will contribute to and benefit from regional and continental bird monitoring programs. For over 15 years, The Klamath Bird Observatory and U.S. Forest Service Redwood Sciences Laboratory have been coordinating a bird monitoring partnership in the Klamath-Siskiyou Bioregion. Known as the Klamath Bird Monitoring Network (KBMN), this effort has yielded a substantial regional dataset with information about landbird distribution, population trends, and population demographics (Alexander et al. 2004). This monitoring effort also fits within continental monitoring programs, including the Landbird Monitoring Network of the Americas (www.klamathbird.org/lamna/) (Alexander and Ralph 2005) and Monitoring Avian Productivity and Survivorship (DeSante et al. 2004). Data will be contributed to these programs through the Klamath Bird Observatory/Redwood Sciences Laboratory Avian Data Center. Implementing the KLMN landbird monitoring effort within the range of these and other bird monitoring programs (e.g., the Breeding Bird Survey [Sauer et al. 2005] and the Christmas Bird Count [National Audubon Society 2007]) and using comparable sampling methods will provide an opportunity to interpret results at multiple scales that are directly relevant to landbird status and trends. Regional and continental scale assessments can provide insights into the broad scale movements and seasonal habitat requirements of landbirds, which will provide context for interpreting park-specific monitoring results.

1.5 Vital Signs Objectives

As described in the KLMN Vital Signs Monitoring Plan, it is not the intent of the KLMN to develop protocols that are designed to be stand alone projects. It is our intent to show that relationships between status and trend patterns can be observed between protocols providing us with a better understanding of the dynamic nature and condition of our park ecosystems (Sarr et al. 2007). In order to meet this goal, the KLMN has selected landbird monitoring locations to be co-located with monitoring locations from our Vegetation (six parks) (Odion et al. *in development*) and Water Quality and Aquatic Communities (one park) monitoring projects (Dinger et al. *in development*). While co-located sites vary by park, it is our goal to be able to examine trend data from the landbird project and compare that to trend data from the other protocols to help us determine some potential driving forces that are causing the landbird trends. As an example, the sampling design for the vegetation protocol is probabilistic and represents all park habitats (Sarr et al. 2007); the data may be useful for modeling of landbird habitat relations. In addition to these protocols, severe alterations of habitat types will be documented in the KLMN Land Cover Protocol, which may help explain trends in landbird assemblages or individual species. The KLMN plans to develop a Comprehensive Synthesis Report that integrates information from multiple vital signs after the completion of three to five sampling cycles for each protocol (Sarr et al. 2007).

1.6 Management Objectives

In 2003, the Klamath Network began a three phase process for developing a long-term monitoring program. As part of this process, KLMN held a series of scoping meetings and went through a two-step prioritization process that allowed selection of prioritized vital signs to monitor. This process required a broad multi-taxa, multi-ecosystem perspective and careful scientific review. The two steps to prioritize vital signs included: 1) an extensive review with outside scientists in the region, and 2) a final internal review by park and network natural

resources staff. During this process, park resource staff proposed several monitoring questions or topics related to landbirds that they would like this protocol to address. These questions included 1) What are the long-term trends in abundance and distribution of focal and non-native species and communities; 2) What are the demographic trends (especially productivity) of focal species/communities; and 3) What are the status and trends in structure, function, and composition of focal communities. Based on these questions, the Network developed the following objectives to inform park management:

1. Track status and trend information to help managers determine if landbird species are increasing, decreasing, or remaining stable.
2. Present landbird data that will allow managers to determine if landbird assemblages are changing over time.
3. Collect data in a manner that they can be integrated with other regional and national datasets so managers can determine if landbird species/communities are behaving similarly inside and outside their parks.
4. Provide information and outreach materials that can be used by interpretive staff to educate the public about landbirds at each park.

1.7 Measurable Landbird Monitoring Objectives

This monitoring protocol was designed at the individual park scale to inform park managers of changes in composition, distribution, and abundance of landbirds and landbird assemblages. This protocol is designed to meet three measurable objectives further detailed with specific goals that directly relate to park information needs and management:

1. Monitor breeding landbird richness, relative abundance, and density.
   - Determine the status of breeding landbird richness and relative abundance every 3 years within the sampling frame of each park.
   - Provide quantitative information about the distribution and composition of landbird assemblages within 3 years.
   - Determine long-term trends of species richness, relative abundance, and density for abundant breeding landbirds at year 15 and repeated periodically in future years.
   - Provide long-term trends in similarity of landbird assemblages within the sampling frame at each park by year 15 and repeated periodically in future years.

2. Co-sample habitat parameters and integrate bird and vegetation monitoring to aid in interpretation of landbird status and trends.
   - Co-sample habitat parameters every 3 years to provide information about potential causes of landbird trends.
   - Integrate landbird and vegetation monitoring data to aid in the development of the KLMN Comprehensive Synthesis Report.

3. Determine status and trends in demographic parameters (productivity, adult survival, and recruitment) for selected landbird species in a mixed-conifer and riparian habitat at ORCA.
   - Determine the breeding status of landbirds annually.
   - Determine long-term trends of relative abundance, productivity, survival, recruitment, and fitness in abundant breeding landbirds.

2. Sampling Design

2.1 Rationale for Selecting this Sampling Design

This monitoring protocol incorporates multiple standard avian sampling methods (Ralph et al. 1993). These include variable circular plot point counts, area search surveys, mist netting, species checklists, and habitat surveys. All of these methods gather information about multiple bird species with varying life histories. Using complementary methods within the parks will optimize the amount of information gathered about birds. The application of methods also varies by park to complement historic monitoring efforts and to reflect the diversity in park sizes. These approaches are cost-effective, feasible, and yield rich avifaunal information.

During the breeding season (early May through mid July), point count stations will be sampled using 5-minute count periods following the variable circular plot (VCP) methodology that incorporates distance sampling (Reynolds et al. 1980, Fancy 1997, Nelson and Fancy 1999). The VCP methodology has become the standard for spatially extensive sampling under the NPS I&M Program (Fancy and Sauer 2000) because distance sampling facilitates the estimation of detection probability, a parameter that may vary greatly by species, habitat, observer, or other factors (Buckland et al. 2001). Estimates of detection probability in turn permit the estimation of absolute density or relative abundance of birds across the landscape.

The variable circular plot sampling design balances tradeoffs among spatial and temporal sampling intensity, efficiency, funding, and safety. The sampling design is integrated with the design being developed for the KLMN Vegetation Monitoring Protocol, which will provide detailed habitat information at landbird monitoring locations (Sarr et al. 2007). In all parks, point count routes will be established around one or more KLMN vegetation monitoring stations. In addition, sampling frames selected for this protocol match sampling frames developed for the Vegetation Monitoring Protocol. Co-location of these protocols will allow for direct comparison of changes in bird communities and vegetation communities over time.

We evaluated a long-term point count dataset provided by Klamath Bird Observatory from a landscape in the Klamath region to inform sampling design decisions regarding the appropriate number of stations per route and the number of routes required to make defensible estimates of status and trends for common species and select species of concern (Appendix E). Results suggest the minimum number of survey routes for a target population in a park in a specific year is approximately 25. The number of stations per route should not be less than 10, in order to observe enough birds to make inferences (15 or more stations would be optimal). In addition, working with Montana State University, we developed several models based on pilot study and Breeding Bird Survey data to investigate the number of routes and years of sampling needed to achieve 80% power to detect a 50% decline in relative abundance of individual species. Results suggest that using 25-35 routes, with 6-12 points per route, will give us enough power to detect trends within 15 years for those species will little site-by-year variance. Species that are more variable from year-to-year will take longer (30+ years) to determine trends (Appendix J). During the PRBO inventory efforts at LAVO, 13 different habitat types were examined and the number of points needed to detect 100% of the species ranged from approximately seven (Dry Meadow) to 48 (Red Fir). For wet meadow habitats, similar to the habitat type that will be monitored

within this protocol, 10.95 points were necessary to detect 80% of the species in wet meadow habitats and 18.94 points were needed to detect 100% of the species (Humple et al. 2001).

We used the results from the power analyses to inform how many stations would be included along a route, but ultimately our decision was heavily dependent on logistics as well. All stations on a route must be sampled in a given morning, and typically it is not possible to complete more than 12 stations in a survey morning. Based on logistics and the finding above that 11 stations was the lower threshold in both analyses, 12 stations were selected as the benchmark for this study design. It is recognized that a variety of factors (habitat type, travel time, etc.) can further limit the number of points along a route and in challenging terrain the number of points per route may be as low as six.

The stations are placed 250 m apart, which nearly eliminates the likelihood of double counting birds (Scott et al. 1981). Since routes are spatially balanced across the sampling frame and spatial coordinates and distances among sample points will be known, the effects of spatial autocorrelation can be determined explicitly in subsequent data analyses (Legendre et al. 2002). The analysis unit (i.e., whether the stations within a route will be grouped) will vary by analysis depending on the stated objective. For example, after correcting for spatial autocorrelation, individual point count stations can be used independently for analyses that correlate with vegetation characteristics or can be grouped to reduce variance in analyses for improved trend detection.

With the exception of ORCA, 25 to 35 routes will be located in each park depending on the complexity of its landbird sampling frame. In refining the sampling frame in which survey routes are randomly placed for each park, we solicited recommendations from park specialists and evaluated the landbird inventory data and Partners in Flight focal species that would be well monitored in each area of interest. This informed which sampling frame best met the needs of each park under the budget constraints. It is our goal to determine status and trends at the park scale so sampling frames that may vary between parks was not considered an issue.

A constant effort monitoring station, which includes mist netting and banding birds, was established as the best method to monitor birds within ORCA, due to its small size. Constant effort mist netting provides information on bird abundance between years and yields long-term population trend information during both the breeding and migration seasons. It provides information on population demographic measures, such as productivity and estimates of survivorship for breeding populations of landbirds (DeSante et al. 2004). In addition to monitoring breeding birds, mist netting monitors patterns of abundance and population trends for species occurring in the park during the post-breeding and migration seasons, which contributes to greater understanding of the population demographics of a broader suite of species. Operation of an ongoing constant effort monitoring station following standard protocols (Ralph et al. 2004) will continue at ORCA during the breeding season (early May through early August) as well as during the fall dispersal and migration seasons (mid August through mid October). Mist netting, along with VCP point counts, area searches, species checklists, and habitat surveys, will be completed at this station. This more intensive methodology is particularly suitable for a small park such as ORCA (196 hectares [484 acres]). In addition to the mist netting effort, four VCP point count routes will be completed at ORCA following the methods described above.

Threats to landbirds act on multiple scales, as is evident when considering the primary conservation issues for birds in the PIF Pacific Avifaunal Biome, which include loss and fragmentation of habitat and impacts of fire suppression, prescribed fire, recreation, urban and residential development, contamination of freshwater wetlands, and exotic species (Rich et al. 2004). This monitoring plan focuses on the park scale (i.e., within parks) to inform park managers of changes in composition, distribution, and abundance due to natural or anthropogenic habitat changes, including effects of climate change.

2.2 Site Selection

Sampling Frames: The sampling frame and corresponding populations being sampled were selected based on a variety of criteria. Recognizing park needs and logistical, safety, statistical, and funding constraints, we limited the sampling frame based on four criteria. First, route starting points must be greater than 100 m and less than 1000 m from a road or trail (except at WHIS). Our parks are small to medium in size and the road and trail networks bisect the major environmental gradients in the parks. Consequently, the sampling frames are broadly representative of the parks. Next, both for safety concerns and to avoid damage to understory vegetation, we excluded areas having a slope in excess of 30 degrees, talus slopes, and lava flows (Sarr et al. 2007). In an effort to integrate the data collected as part of the KLMN Vegetation and Aquatic Monitoring Protocols, routes must co-locate with sites selected as part of the vegetation and water quality monitoring efforts when applicable. Finally, sampling frames were selected to include as many Oregon/Washington Partners in Flight (PIF) focal bird species, continental PIF bird species of concern, Oregon Department of Fish and Wildlife (ODFW) conservation strategy bird species, and California conservation strategy bird species as possible.

The sampling frames for the parks average between 40% and 63% of the total area and cover a comparable range in biophysical conditions (Sarr et al. 2007). Although not every area and potential vegetation type in the parks will likely be sampled, the sampling frames are consistent with KLMN vegetation monitoring objectives in that they do not introduce a systematic bias in the environments sampled.

Three potential sampling frames were further delineated and considered for sampling in each park, as appropriate. These delineations included high elevation areas (only in CRLA, LAVO, and WHIS), riparian areas (perennial streams, lakes, ponds, and springs), and matrix areas (everything that was not captured in the high elevation or riparian sampling frames). Figure 1 provides an example of the potential sampling frames for Crater Lake. Finally, we examined our ability to detect PIF Focal Species and Species of Concern and ODFW and California Wildlife Conservation Strategy Species, logistic constraints, safety issues, budgetary constraints, and priorities developed by park specialists to determine which of the three frames to survey within each park.

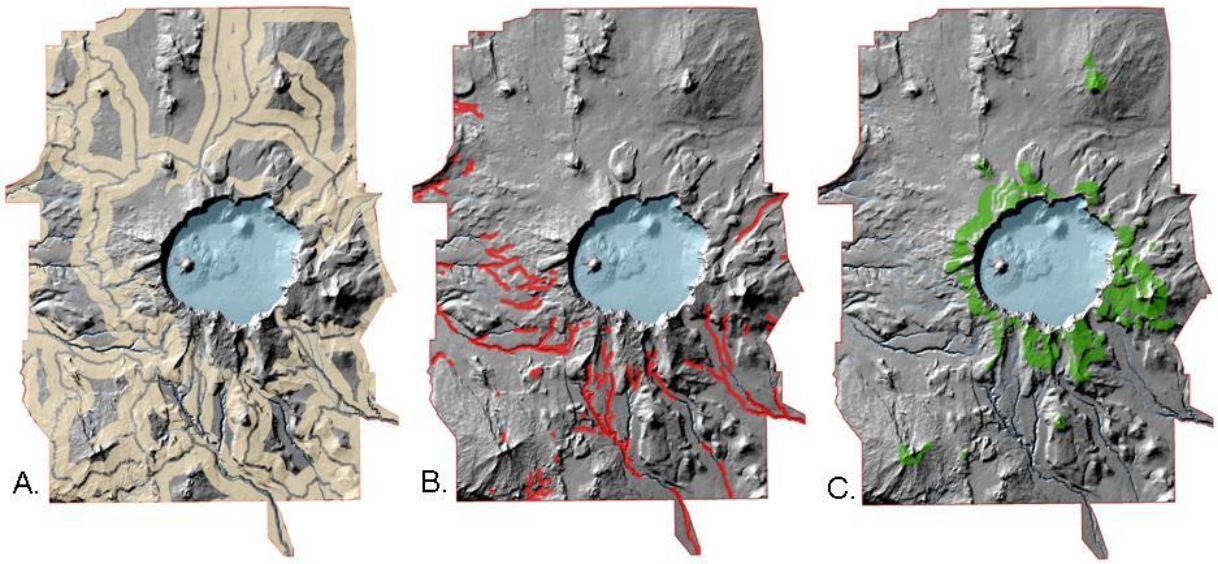


Figure 1. Potential sampling frames for CRLA. We selected one to two sampling frames for each park, which may include (A) Matrix, (B) Riparian, or (C) High Elevation areas.

At CRLA, we excluded riparian areas and established monitoring stations in the matrix and high elevation sampling frames (Figure 1 A and C). Based on the bird inventory conducted in 2002-2003, riparian species were not among the top 15 most abundant bird species in the park. In addition, riparian vegetation only occupies a small area around most of the streams in CRLA. Inventories in 2002-2003 show 10 OR/WA PIF Focal Species, eight Continental PIF Species of Concern, and two ODFW Conservation Strategy Species were detected in the matrix and high elevation areas. The high elevation sampling frame (>6750 ft) was deemed a high priority habitat by the park staff because of the whitebark pine habitat that occurs in this area.

For ORCA and LABE, the sampling frame includes the entire park. ORCA is a small park and we felt that by implementing a few VCP point count routes and the constant effort monitoring station, we could gain information on density and richness as well as demographic information. LABE does not contain any water or high elevation areas; therefore, the matrix area covers the entire park. We examined sampling at cave entrances but determined that these areas would not contain markedly different bird communities.

At LAVO, the sampling frame is limited to riparian populations. We excluded high elevation areas (>8000 ft) due to logistical constraints. Based on previous inventories, matrix and riparian areas were found to contain 11 PIF California coniferous focal or riparian focal species (Humple et al. 2001, Burnett and King 2004). The riparian sampling frame was chosen over the matrix frame because riparian and wetland habitat is very widespread in the park and park staff consider these aquatic environments and edges to host the majority of the park's biological diversity (Sarr et al. 2007).

The matrix frame was selected for monitoring at RNSP, which lacks high elevation areas. The riparian areas at RNSP only contain four PIF riparian focal species and logistical constraints (e.g., steep slopes, downed logs, thick vegetation impeding access, and stream noise) were considered prohibitive for sampling. The matrix areas contain 11 PIF focal species, eight Continental PIF Species of Concern, and two ODFW Conservation Strategy Species.

At WHIS, the matrix and high elevation frames were originally selected for sampling. WHIS has a small amount of high elevation (>5000 ft) habitat that was considered a priority by park staff. Riparian areas contain only three PIF riparian focal species. The matrix areas contain 13 PIF focal species in oak and conifer habitats, four Continental PIF Species of Concern, and two California Wildlife Conservation Strategy Species. However, due to safety concerns of park staff related to the ongoing marijuana activity, the sampling frame at WHIS was redefined to all roads and trails, which cover the majority of the park and allow us to sample the matrix areas throughout the elevation range of the park.

Population Being Sampled: The population being sampled utilizing the VCP point count method is limited to breeding birds in the above sampling frames that are likely to be sampled using point count methodology. These birds include passerines (songbirds) and near passerines (e.g., hummingbirds, woodpeckers). Mist netting techniques and area search methods implemented at the constant effort monitoring station in ORCA sample the same populations as point counts and, in addition, monitor birds during the dispersal and migration period.

By maintaining comprehensive species checklists while conducting point counts and operating the mist netting station, supplemental presence/absence data on all species encountered during a survey effort are provided. For a list of species likely to be detected using these monitoring methodologies in each park, see Appendices C and D.

Analysis of the population will vary considerably depending on the distribution and abundance of species. Initially, trend analysis will only be meaningful for species composition and for the species with little year-to-year variance while status estimates of relative abundance can be applied to all species. Prior to completing a trend analysis, a power analysis will be conducted, based on data collected as part of this approved protocol, to determine precisely the species on which trend analysis will be completed. In addition, an analysis on species composition of landbird assemblages will be completed in year fifteen. After year fifteen, these analyses will be repeated periodically in future years.

Procedures for Selecting Sampling Locations: For choosing VCP sampling locations, we used a Generalized Random Tessellation Stratified (GRTS) design (Stevens and Olsen 2003, 2004) to develop spatially balanced sampling locations within each selected sampling frame for each park. To establish a systematic random sampling route around each GRTS point, 11 adjacent points are placed 250 m apart, according to a set of rules (Appendix L). These rules ensure that a route is set up as closely around the GRTS sample as possible, using a systematic, random approach within constraints in the sampling frame already defined (Figure 2). For example, in matrix sampling frames the rules enforce that the route forms a block (Figure 2A), whereas along roads and trails sampling frame the routes are linear (Figure 2B). GRTS points and the associated route were ground-truthed for accessibility and safety and unsuitable sites were replaced using previously selected overflow points when necessary. Details for locating and marking VCP field sites are in SOP #4: Locating and Marking Field Sites.

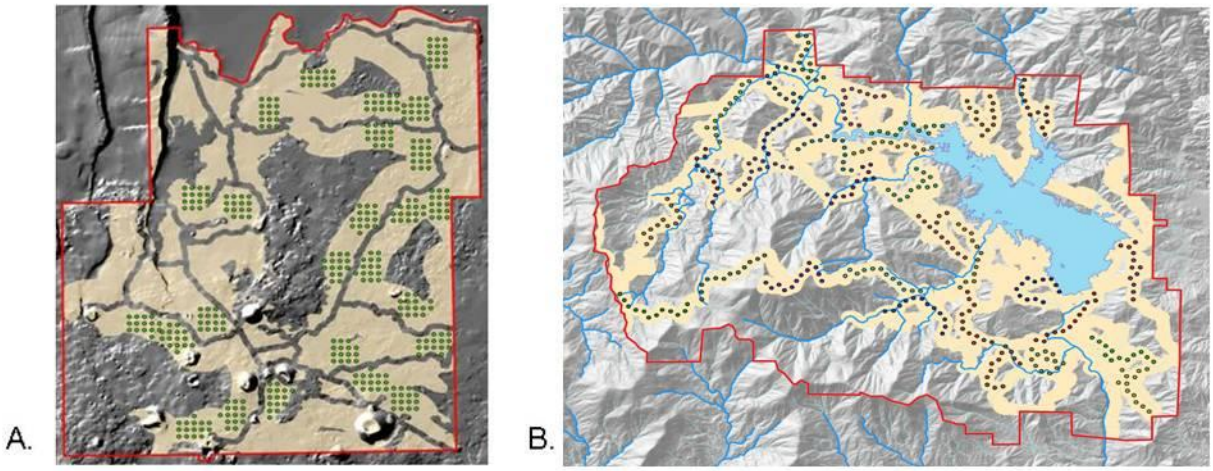


Figure 2. Point count survey routes in the matrix sampling frame at (A) Lava Beds National Monument and (B) Whiskeytown National Recreation Area.

The ORCA constant effort monitoring station is a Sentinel site. Sentinel sites are defined as locations of special interest to sample, or where historical monitoring efforts warrant continuity in sampling. They are selected subjectively on the basis of being representative of a particular habitat or environment of interest and accessibility. The ORCA constant effort monitoring station is characteristic of the mixed-conifer and riparian habitats within the park. In addition, there is a history of bird monitoring activities at the site that the park and the Network would like to continue. For additional details on marking and locating the mist net site, see SOP #4: Locating and Marking Field Sites.

2.3 Sampling Frequency and Replication

To meet the desired spatial sampling regime under budget constraints, VCP point count routes will be surveyed once every 3 years (Appendix E). While it would be ideal to survey each route twice in a given year, funding limitations prevent us from utilizing this method. Two parks will be surveyed each year: RNSP and LABE in year one, LAVO and WHIS in year two, and CRLA and ORCA in year three (Table 2). The constant effort monitoring station at ORCA will be sampled every year (Table 2).

Table 2. The sampling frequency and number of routes and stations to be sampled using VCP point counts and mist netting methods during the first six years of the effort.

Park	Routes/Stations	2008	2009	2010	2011	2012	2013
Crater Lake NP	35 / 420			X			X
Lava Beds NM	25 / 300	X			X		
Lassen Volcanic NP	25 / 300		X			X	
Oregon Caves NM							
Point Counts	4 / 48			X			X
Mist Netting	1 / 10 (nets)	X	X	X	X	X	X
Redwood NSP	30 / 192	X			X		
Whiskeytown NRA	30 / 360		X			X	

VCP routes will be visited one time between early May and mid July every third year. To the degree possible, routes will be sampled approximately the same date in each revisit year. In each

year, sampling will begin with the lower elevation routes in each park; observers will gradually progress upslope throughout the season. This strategy will help ensure monitoring at each site occurs at or near the peak of the breeding season. Surveys will begin during the 15 minutes following local sunrise and be conducted during the following 3-4 hours (SOP #5: Conducting Variable Circular Plot Point Count Surveys).

The number of VCP routes that are established at all parks, besides ORCA, will meet or exceed 25, with 6-12 stations per route (Table 2). Larger parks and more complex sampling frames were allotted additional routes beyond the minimum to increase statistical power. The number of routes per park is: CRLA (n=35), LABE (n=25), LAVO (n=25), ORCA (n=4), RNSP (n=30), and WHIS (n=30).

The constant effort mist netting at ORCA is operated from late-May through mid-October each year. The mist nets are operated within 15 minutes of official sunrise and continuing for 5 consecutive hours, weather permitting. The site is run once in a 10 day period during the breeding season (May - August) and weekly during fall migration (September - October) (SOP #6: Mist Netting).

2.4 Level of Change That Can Be Detected

The number of VCP sampling stations necessary to determine status and trends in breeding bird species richness and density in the parks depends on the frequency of sampling, the quantity and dispersion of birds, and the likelihood of detection. We determined sampling routes to be the appropriate sample unit for monitoring of landbird communities because they provide more robust estimates of the species. Our approach of aggregating samples into routes or clusters of 12 should increase precision of parameter estimates at the route level. With this sampling design, we will be able to detect trends (i.e., 80% power to detect 50% decline over 20 years at a significance level of 0.10 [Bart et al. 2004]) for some of the species that are less variable from year-to-year within 15 years of monitoring. However, species with more year-to-year variability in abundance and density will take longer. An example of this is provided in the power analysis in Appendix J. As the third example provided in memo three shows, the Western Meadowlark at LABE is not highly variable from year-to-year and it would only take 15 years (four visits) of sampling 20 routes with 12 points per route to reach our goal of 80% power to detect 50% decline over 20 years at a significance level of 0.10. However, for species such as the Brown-headed Cowbird that were more variable at LABE from year-to-year, such as is shown in example two of this memo, it may take over 30 years to determine a trend.

To determine and evaluate the efficacy of the constant effort monitoring station at ORCA, we performed a power analyses on five commonly captured species at ORCA. Results indicate there is sufficient power to detect trends for three species following recommendations established by Bart et al. (2004) (i.e., 80% power to detect 50% decline over 20 years at a significance level of 0.10). Data provide sufficient power to detect trends for adult McGillivray's Warblers during breeding season, adult and juvenile Dark-eyed Juncos during the breeding season, and Dark-eyed Junco and Hermit Thrush populations during the post-breeding season (Appendix F). These results suggest that this mist netting site will yield important trend information over time, as well as contribute to the trends detected by larger regional mist net monitoring efforts conducted by the Klamath Bird Observatory.

2.5 Monumenting Bird Monitoring Sites

In 2008 and 2009, KBO working with the KLMN, permanently monumented stations along each of the point count routes we plan on surveying as part of this protocol. Points along the route were monumented in a variety of ways, depending on the park, and included small 1" brass tags with "KLMN" and the point count station number engraved on them or 5"x5" yellow signs with the phrase "This site is part of the long-term landbird monitoring project being conducted by the NPS-Klamath Network Inventory and Monitoring Program" and included the route and site name written using a permanent paint marker. In addition to one of the markers, in some cases flagging was used to help guide the surveyor into the station or to make the station more visible. A GPS coordinate, directions, and site characteristics were recorded for each point along a route (Appendix I).

3. Field Methods

3.1 Schedule

In January of each year, the Project Lead will apply for permits at each park that will be surveyed that year. The Project Lead should also contact the Park Contact to see if housing or camp sites will be available. At that time, the Investigator Annual Reports will be submitted for work completed the year prior.

In order to ensure the data collected using the VCP point count survey techniques described above is accurate, it is important to hire technicians that are skilled in visual and audio bird identification. The mist netting effort at ORCA provides an opportunity to train biologists less skilled with bird identification. Therefore, interns hired to support the mist netting effort do not need the full complement of skills required to conduct the VCP point count surveys. However, it is important to have individuals skilled in conducting mist netting techniques available to help the interns learn about and operate the mist netting station. To ensure skilled biologists are available, hiring of technicians and interns should occur during the winter prior to starting the field season. Upon hiring of field personnel, the Project Lead will mail this protocol to each crew member (SOP #1: Preparation and Equipment). Prior to sending the crews into the field, each crew member should undergo a rigorous training program. For more information on training technicians and interns, see section 6.2 of this narrative and SOP #2: Training Observers.

A schedule, including date ranges for conducting VCP point count surveys in each park, and a delineation of the constant effort monitoring 10-day breeding season and 1-week migration season periods, will be completed by the Project Lead in April, prior to the onset of the survey season. This schedule must allow enough flexibility to account for surveys cancelled due to weather or other unforeseen logistical circumstances. It shall also outline training and testing days. Additional scheduling information can be found in SOP #1: Preparation and Equipment, SOP #10: Post Field Season, and SOP #16: Data Transfer, Storage, and Archiving.

3.2 Variable Circular Plot Point Count Surveys

The details for completing VCP point count surveys are included in SOP #5: Conducting Variable Circular Plot Point Count Surveys. For each point count route, a folder will be compiled to include a map, geographic coordinates for each station, and copies of written descriptions of the route. This information will be duplicated and compiled into an office binder as a record of each route. Prior to the field season training, each surveyor will review this entire protocol, study or review the identification of western birds by sight and sound, and follow other directions for preparing for field work specified in SOP #1: Preparations and Equipment. Surveyors will participate in a 2-day training course that focuses on calibrating distance estimates and assuring proficiency in implementing all aspects of this protocol. Each surveyor will be tested for bird identification, hearing capacity, and ability to follow the protocol before conducting surveys (SOP #2: Training Observers). If an individual does not pass the test, he or she will be given the opportunity to retest after going through additional training.

Crews will go into the field for a 10-20 day sampling trip before returning to the field office to prepare for the next sampling period. Surveyors conducting VCP point count surveys should arrive at the route's starting location in time to begin surveying before dawn, preferably the

afternoon or evening before the count. The stations should be located by using the site description forms, a GPS unit with geographic coordinates, maps and by determining the location of the monumented stations.

The first survey will begin within 15 minutes of sunrise. Before conducting each survey, observers shall use digital rangefinders to establish distance reference points at each station. During a 5-minute count period, all birds detected by sight or sound are identified to species and recorded on data forms, along with the horizontal distance to each bird, estimated as accurately as possible, and rounded to the nearest meter. The time of detection, detection type (e.g., visual, song, call), and breeding status are also recorded for each individual detected.

Once a count is complete, the surveyor walks to the next station for subsequent counts. Point count surveys should be completed within 3-4 hours of sunrise. The corresponding vegetation surveys may be completed the afternoon before the point count survey or on the day of the survey, after the survey has been completed. Before leaving the route, datasheets shall be checked for completeness. Field forms will be stored in a secure location while in the field and turned in at the end of each field trip.

3.3 Constant-Effort Mist Net Monitoring

The details for operating the constant effort monitoring station at ORCA are included in SOP #6: Mist Netting. Equipment and copies of the site description forms for the mist netting site and banding should be prepared prior to the field season as specified in SOP #1: Preparations and Equipment. A visit to the constant effort monitoring station should be scheduled prior to the first survey effort in order to prepare mist net lanes and trails. The preparation for the mist netting field season, training, protocols, and equipment needs are detailed in SOP #1: Preparations and Equipment, SOP #2: Training Observers, and SOP #6: Mist Netting.

The mist netting station consists of 10 nets set in an array to optimize bird capture and meet logistical constraints. Mist nets are opened within 15 minutes of local sunrise and operated for 5 hours. Nets are not operated during inclement weather conditions that might affect capture rates or bird mortality in the nets (e.g., high winds, rain, or extreme cold or heat). Captured birds are identified to species and unbanded birds are banded with a U.S. Geological Survey Bird Banding Laboratory aluminum butt-end leg band. Each bird is then aged and sexed according to Pyle (1997) and checked for signs of breeding condition (i.e., cloacal protuberances and brood patches). Additional biometrics is collected and all data, including band number, are recorded on datasheets. Birds are then released.

3.4 Area Search Surveys

The area search methodology is described in detail in SOP #7: Conducting Area Search Surveys. In conjunction with mist netting, two area search surveys are completed at the constant effort monitoring station on each day the site is operated. The surveys are conducted within the same time period that the mist nets are operated. This method provides information about birds using the site that are not often captured in the nets (e.g., canopy-dwelling warblers). The area search survey is completed within a 20-minute period in which all birds seen or heard in the designated search area are recorded. During an area search, the surveyor moves around the designated area

so they can track down cryptic birds. Multiple observers can conduct area search surveys, providing an excellent opportunity for training.

3.5 Species Checklists

Refer to SOP #9: Completing Species Checklists for details about developing species checklists. Species checklists will be completed in conjunction with point count surveys, area searches, and mist netting. Species checklists provide information on common and rare species that may or may not have been detected using the other survey techniques but were observed at any time during the field day. Surveyors should use the checklist forms to keep a comprehensive list of all birds encountered during their time spent at a survey location (i.e., VCP point count route or constant effort monitoring station). Surveyors should also note the breeding status of each species encountered. The species checklist adds value to survey data by accounting for all species encountered during an effort, whether detected during an actual point count, area search, or mist netting survey.

3.6 Vegetation Surveys

Refer to SOP #8: Conducting Vegetation Surveys for detailed methodology and the field protocol. Vegetation surveys are completed at each point count station and at the constant effort monitoring station. The vegetation relevé is a method of assessing habitat characteristics in an efficient and timely manner. It is flexible so that it can be applied to any habitat type, including shrublands, grasslands, and forests found in the parks. The information collected describes the vegetation composition and structure of the habitat being surveyed and can be used to determine the plant association type. Vegetation data will be gathered using ocular estimates of cover and height for all vegetation layers, tree and shrub species, and other plant forms. Other pertinent variables will be collected, including snag counts, presence of water, evidence of burns, and tree size and height. The data have been designed to account for habitat aspects associated with the feeding and nesting requirement of birds.

In addition to the relevé plots, point count surveys will be co-located with vegetation plots sampled under the KLMN Vegetation Monitoring Protocol (in development). As part of the KLMN Vegetation Monitoring Protocol, the KLMN will sample vegetation at one or more points along each survey route using the Modified-Whittaker plot design. The plots will measure 20 m by 50 m (1000 m^2) and contain nested subplots of three different sizes. These plots will provide additional detailed vegetation information that can be used to conduct analysis on co-varying bird and vegetation trends. Vegetation plots will be surveyed in the same year that the landbird routes are surveyed.

3.7 Post Season

Details for closing out the field season can be found in SOP #10: Post Field Season. In general, at the end of the field season, the Field Lead should prepare a brief report to the Project Lead that includes details regarding the field season logistics, interesting observations, and suggestions for future improvements. The Project Lead is responsible for making certain all surveys have been completed, organizing and copying field forms, and assuring site folders are in order for the following season.

4. Data Management

Data management for a monitoring project is a cyclic process that begins during the planning phase of a project and continues until the close-out of the season. This process is then repeated each year the project is implemented and includes data collection and entry, validation and verification processes, documentation, distribution of project products, storage, and archiving (Mohren 2007). This section provides an overview on data handling, analysis, and report development with details on these processes located in the related SOPs. It is important to ensure that project personnel understand all necessary data management methodologies, including who is responsible for implementing the methods and the timelines they are expected to follow when conducting data management. SOP #16: Data Transfer, Storage, and Archive and Appendix G list the target dates and responsibilities for each individual and product. The stages of the data management cycle are described in greater depths later in this narrative and in several associated SOPs, but can be briefly summarized as follows:

Preparation – Training, logistics planning, printing forms and maps
Data acquisition – Field trips to acquire data
Data entry & processing – Data entry and uploads into the working copy of the database, GPS data processing, etc.
Quality review – Validation and verification methods are used to review the data for quality and logical consistency
Metadata – Documentation of the year's data collection and results of the quality review
Data certification – Data are certified as complete for the period of record
Data delivery – Certified data and metadata are delivered for archival and upload to the master project database
Data analysis – Data are summarized and analyzed
Product development – Reports, maps, and other products are developed
Product delivery – Deliver reports and other products for posting and archival
Posting & distribution – Distribute products as planned and/or post to NPS clearinghouses
Archival & records management – Review analog and digital files for retention (or destruction) according to NPS Director's Order 19; rename and store retained files as needed
Season close-out – Review and document needed improvements to project procedures or infrastructure, complete administrative reports, and develop work plans for the coming season (Siegel et al. 2007)

4.1 Preparation

It is the Project Lead's responsibility to create a detailed work plan for each 10-20 day sampling trip prior to sending the technicians into the field. The Project Lead will ensure technicians have all the required gear and the most up-to-date field forms (Survey Forms, Data Entry Log, Photograph Metadata Log, etc.). The Project Lead needs to make certain that site folders are organized and complete (SOP #1: Preparation and Equipment). Each crew member will confirm that they have the site folders for all sites they could potentially visit in the 10-20 day survey period prior to leaving for the field.

It is the Project Lead's responsibility to make certain all field equipment (e.g., laser range finders, GPS units, etc.) are calibrated and properly set up prior to heading into the field (SOP

#3: Using the Global Positioning System). The Project Lead will work with each field technician to make certain target locations are loaded into the GPS units. The Project Lead will work with the technicians to make sure it is clear where everyone is going, what is expected to be completed, and timelines for when the work should be finished.

4.2 Data Collection and Entry

Details on how to collect, enter, and verify data can be found in SOP#12: Data Entry and SOP#13: Data Validation and Verification. In general, technicians and interns will record field data on standardized datasheets for each type of survey. Datasheets should be reviewed before leaving the point count route or mist netting site to make certain they are complete. At the end of a 10-20 day sampling trip (for VCP point count surveys) or end of the week (for mist netting), data forms are submitted to the Project Lead. The Project Lead should examine the datasheets for completeness and accuracy prior to the crew going back into the field. At the end of each week, interns will enter the mist net data into the appropriate Access databases (Section 5.3). Technicians should enter point count data into the database at the end of each sampling period, unless prior arrangements have been made with the Project Lead. Data should be entered as soon after surveys as possible to help keep current with data entry tasks and to catch any errors or problems as close to the time of data collection as possible (SOP #12: Data Entry). After entering the data from the datasheet into the computer, each record should be checked for completeness and accuracy before moving on to the next datasheet. A data entry log must be maintained during data entry (SOP #12: Data Entry).

4.3 Overview of Database Design

While collecting data throughout the field season, we will use six relational databases developed by KBO to store the variety of field data that will be collected as part of this protocol. Five of the databases are associated with each survey methodology (Point Count, Mist Net, Vegetation, Area Search, and Checklist) and one of the databases is used to store location information for each site. These databases are consistent with those designed for the Klamath Bird Monitoring Network (KBMN). This will give the KLMN and the KBMN the opportunity to analyze data not only at the park scale, but also at a regional level. Once the data have been entered into the six relational databases, a series of programs will be used to initiate a number of verification processes (SOP #13: Data Validation and Verification). Once this is complete, a copy of the verified, validated, and certified data will be uploaded into a single database managed by the Klamath Network (Appendix H).

The Klamath Network Landbird database is a relational database that was developed using the NPS, Natural Resource Database Template (NRDT) (SOP #16: Data Transfer, Storage, and Archive). A functional comparison of the KLMN Landbird database and the six relational databases used for data entry are included in Table 3. The KLMN database includes an automated process to upload the data from the six KBO databases. During the upload process, a quality control report is developed and issues are addressed as needed. Once all issues are addressed, the data are uploaded to a master database that contains all the data from previous years. The master database is a replicate of the annual database and has all the same features. However, it will include some additional reporting and exporting tools.

Table 3. Functional comparison of the data entry databases and the KLMN Landbird database.

Project database functions and capabilities	6 relational databases for data entry	KLMN Landbird Database
Software platform for back-end data	MS Access	MS Access
Contains full list of sampling locations and taxa		X
Portable for remote data entry	X	X
Forms for entering and editing current year data	X	X
Quality assurance and data validation tools	X	X
Preliminary data summarization capabilities	X	
Full analysis, summarization and export tools		X
Pre-formatted report output		X
Contains certified data for all observation years		X
Limited editing capabilities, edits are logged	X	
Full automated backups and transaction logging		X

4.4 Documentation

Metadata and data dictionaries are completed for each of the six datasets used to enter field data and for the KLMN Landbird database (Appendix H) at the onset of implementing the Landbird Monitoring Protocol. It is the Project Lead's responsibility to update and submit the data dictionary (if needed) and to submit a new Metadata Interview form at the end of each field season. The Metadata Interview form will be submitted each year and will be used to indicate if changes have occurred to the metadata or data dictionary. If changes have occurred, it is the Data Manager's responsibility to archive and update the metadata for each database. Details for metadata development and delivery are described in SOP #14: Metadata Guidelines and SOP #16: Data Transfer, Storage, and Archive.

4.5 Field Forms

Field forms will be submitted to the Project Lead at the end of each 10-20 day sampling trip (for VCP point counts) or at the end of each week or 10-day period (for mist netting), and stored in their proper file cabinet. Once the data have been entered into the relational databases and subjected to all quality control processes, and the datasheets have been corrected, they will be transferred to the Network Data Manager. It is the Data Manager's responsibility to scan the datasheets into several PDF documents following the guidance in SOP #16: Data Transfer, Storage, and Archive.

4.6 Data Verification and Validation

After collecting the field data, but prior to leaving the site, the field technician or interns will review all data forms to make sure they are complete. After the end of the sampling period, the Project Lead will review the datasheets. The technicians or interns will enter the data into the proper databases, where each record will be examined for completeness and to make sure it matches the hardcopy field forms prior to entering the next record. At the end of the season, the Project Lead will compile data from each of the crew member's Access databases and compile the information into one dataset for each survey type (e.g., VCP point count, vegetation). These compiled datasets undergo further proofing, using automated computer programs (run in R, SAS, and Access) that were developed to check the data for completeness and accuracy. These programs verify station names and survey dates, assuring multiple survey types conducted at stations are in order. The programs also assure the data make biological sense (e.g., confirm that

age and sex classes assigned to birds are biologically possible based on date of capture). The process for proofing and editing data is detailed in SOP #13: Data Validation and Verification. Once all validation and verification methods have been implemented, the databases will be transferred to the KLMN Data Manager where they will be uploaded to the KLMN Landbird database. While uploading the data into the database, the data will be subject to automated data quality process that will flag potential missing sites, invalid data, and data in an improper format.

4.7 Backup Process

During the field season, field forms will be submitted to the Project Lead and stored in cabinets at the end of each sampling trip. At the end of the field season, these datasheets will be scanned into PDF documents and stored in the Landbird project folder located on the Klamath Network server. The information stored on this server is subject to the daily, weekly, and quarterly backup process described in the Klamath Network Data Management Plan.

Each day that data are entered into any database, a copy is made and stored on the server at the Project Lead's office. Once the databases are transferred to the KLMN Data Manager, they are loaded into the KLMN Landbird Database. This is stored in the Landbird project folder, which is backed up following the process described in the KLMN Data Management Plan.

Prior to the start of a new field season, all products from the prior field season will be transferred to the Network Contact (SOP #16: Data Transfer, Storage, and Archive). The Network Contact will work with the Data Manager to make certain that products are stored in their proper location on the KLMN server. Once on the server, all products will be subject to nightly, weekly, and quarterly backups as outlined in the Klamath Network Data Management Plan.

4.8 Image Handling Procedures

Images collected to document field sampling, site setup, and species vouchering should be collected in a Joint Photographic Experts Group (JPEG) format at a minimum photographic resolution of four megapixles whenever possible. When submitting images to the Data Manager, an Excel form should be included that provides the metadata for each image. When transferred to the Data Manager, images and corresponding metadata will be stored in the landbird monitoring project folder. It will be the responsibility of the Data Manager to upload these images and metadata to the KLMN Photograph Library for use by the Network staff. Details on image management are provided in SOP #11: Photo Management.

4.9 GPS Data Processes

The location of each mist net and survey station are captured digitally with a Trimble GeoXT GPS unit to document the location of the site. This is the only GPS data that will be collected as part of this protocol. As GPS technology improves, station and net locations may be resurveyed to collect the most accurate locations possible. GPS processes are listed in SOP #3: Using the Global Positioning System. If a crew member cannot find the location of the permanent marker, but based on the site description forms and maps feels he or she is in the correct location, that individual should capture GPS coordinates (and record them on the datasheet) so his or her actual location can be determined at a later date. The Project Lead should look at the new coordinates and compare them to the previously documented location of the survey point and determine if the field personnel were in the proper location.

4.10 Data Certification

Data certification is a benchmark in the project information management process that indicates: (1) the data are complete for the period of record; (2) they have undergone and passed the quality assurance checks; and (3) they are appropriately documented and in a condition for archiving, posting, and distributing as appropriate. Certification is not intended to imply that the data are completely free of errors or inconsistencies. Rather, it describes a formal and standardized process to track and minimize errors.

To ensure that only quality data are included in reports and other project deliverables, the data certification step is an annual requirement for all data. The Project Lead is primarily responsible for completing the data certification form, available on the KLMN web sites. This brief form should be submitted with the certified data according to the timeline in SOP #16: Data Transfer, Storage, and Archive.

4.11 Product Distribution

It will be the KLMN Data Manager's responsibility to utilize the season's certified raw data along with the materials presented in the annual report, analysis report, data dictionary, and Metadata Interview form to populate or update the NPS I&M databases including NPSpecies, NatureBib, and the NPS Data Store. Details on distribution can be found in SOP #16: Data Transfer, Storage, and Archiving. In general:

- All reports will be posted on the NPS Data Store and KLMN Internet and Intranet web pages.
- The full report will be sent to the Resource Chiefs of each park and to any park staff that are associated with the project.
- A short, one-page summary of the report will be sent to all park staff.
- One record will be created in NatureBib for each annual report, comprehensive report, and third year analysis and synthesis report and linked to the corresponding species in NPSpecies.
- The raw data and reports will be used to determine if any bird species was observed that is not currently recorded in NPSpecies for each park. Observations of previously unrecorded bird species will be updated in NPSpecies following park-specific guidance.
- Metadata for each database will be created and updated based on the Metadata Interview form and data dictionary provided by the Project Lead each year. Metadata for the project database will be posted at the NPS Data Store.
- Photographs and metadata provided for photographs will be stored in the project folder located on the Klamath Network shared drive, where only the Data Manager will have write access but all KLMN employees will have read access.

4.12 Holding Period

To permit sufficient time for priority in publications, when data are sent to the park staff or the public, it will be with the understanding that these data are not to be used for publication without contacting the Network Contact. After each 3-year survey cycle, all certified, non-sensitive data will be posted to the NPS Data Store. Note that this hold only applies to raw data and not to metadata, reports, or other products that are posted to NPS clearinghouses immediately after being received and processed.

4.13 Sensitive Information

Certain project information related to the specific locations of rare or threatened taxa may meet criteria for protection and as such should not be shared outside NPS, except where a written confidentiality agreement is in place prior to sharing. Before preparing data in any format for sharing outside NPS, including presentations, reports, and publications, the Project Lead should refer to the guidance in SOP #15: Sensitive Data. Certain information that may convey specific locations of sensitive resources may need to be screened or redacted from public versions of products prior to release. All official FOIA requests will be handled according to NPS policy. The NPS Lead will work with the Data Manager and the FOIA representative(s) of the park(s) for which the request applies.

4.14 Data Analysis and Reporting

Working with the park specialist and landbird experts from the Klamath Bird Observatory, we have developed a comprehensive strategy to analyze and report the data and information collected and developed from this protocol over the next 15 years. There will be two elements of reporting for the KLMN landbird monitoring project: (1) an annual summary report and (2) an analysis and synthesis report submitted every third year. These reports are intended to address the objectives of the KLMN landbird monitoring efforts and inform the KLMN annual administrative report and vital signs comprehensive synthesis reports. In addition, the parks' landbird monitoring efforts will be integrated into the Klamath Bird Observatory's comprehensive effort reports that summarize bird monitoring efforts conducted throughout the Klamath-Siskiyou Bioregion. A summary of the various reports are provided below. However, details about individual reports and analyses can be found in SOP #17: Data Analysis and Reporting.

4.15 Annual Reports

The annual reports will provide summaries of monitoring efforts for each sampling year and will be due on March 1 of the following year. The annual report will include: (a) an executive summary; (b) an introduction referencing the protocol; (c) a summary of the current year's monitoring efforts; (d) a summary of past efforts; (d) a summary of bird detections and associated Partners in Flight status; (f) a list of additional birds detected only on species checklists; (f) public interest highlights; (h) a summary of relevant outreach, reports, publications, and presentations; (i) the current year's datasets; and (j) documentation of any changes made to the protocol.

4.16 Analysis and Synthesis Reports

Analysis and synthesis (A&S) reports are being developed in a way that each complements and builds upon previous reports. The first of five analysis and synthesis reports, prepared in 2010, will focus on 3 years of data collected at the VCP point count stations during the 2008-2010 field seasons. The report will contain three related analyses that will inform us about the nature of bird communities in the parks of the Klamath Network, as well as the feasibility and efficiency of our sampling regime. The first analysis will explore detectability and will result in density estimates by point, route, and park, and spatial patterns of species density using habitat data, and landbird community structure in the parks.

In year six, the second analysis and synthesis report will focus on 10 years of data collected between 2002 and 2012 at the Oregon Caves constant effort monitoring station. We will conduct trend analyses for breeding and migrating species and compare results with trends generated from the area search data collected at the station, as well as trend information generated from Klamath Bird Monitoring Network and Breeding Bird Survey data. Productivity indices generated from the ORCA data will be related to the trends to evaluate the relationships between breeding success and population abundance.

The third analysis and synthesis report, completed in 2016, will consist of a power analysis undertaken with monitoring data from years 2008 to 2016. Through this analysis, we will determine the probability of detecting a 50% decline in breeding season densities of focal species occurring within 20 years at a significance level of 0.10. These trend metrics have been put forth as a standard goal for Partners in Flight coordinated monitoring efforts (Bart et al. 2004). While a power analysis was completed to help design this protocol, the purpose of this report is to redo the power analysis using data collected following this protocol to 1) ensure the methods being used support the conclusions of the prior power analysis, and 2) determine which species we will have sufficient data on to provided trend estimates that will be developed starting with the fifth analysis and synthesis report, and 3) to determine the timeframe that the trend analysis should be repeated after the first 15 years.

The fourth analysis and synthesis report will be completed in 2019. It was determined that data collected during the first 12 years of this effort (four surveys per park) would not provide enough information to conduct an adequate analysis of trends on the landbird community at this point in time. In addition, based on the selected survey methods, we recognize we will be collecting a large variety of data and information that can be analyzed and reported in a multitude of methods. Therefore, we have decided not to designate a specific report or analysis for the 12 year report. Upon completing the third analysis and synthesis report, KLMN and park staff will meet with the Klamath Bird Observatory to examine what we have already learned and what information gaps still need to be filled. At that time, we will determine what report and associated analysis should be completed.

In year 15 (5 sample periods), we expect to have a sufficient time series to begin the detection of trends in the composition of landbird assemblages and potentially in the densities of our species (Appendix J). As outlined in Appendix J, a mixed model approach can be used to model deterministic trends in relative abundance for a species or a suite of species. For trend detection the hypothesis of interest is for a nonzero slope of the year covariate. A mixed model analysis can accommodate additional covariate information (vegetation data) that may help explain or reduce the variability across years and among sites. In Appendix J we assumed the error distribution was Gaussian, however a Poisson distribution or negative binomial could be used for data that display inconsistencies with such an assumption via residual analysis. For those birds that are sufficiently abundant over time, geostatistical-temporal modeling (Kyriakidis and Journel 1999) will also be used to identify whether or not the spatial patterns in mean responses are changing over time (e.g., to compare "maps" of mean values developed from different field seasons). Few trends are expected to be significant at this point in time (five data points), but it may be possible to detect trends in some of the most common species and in the landbird assemblages. In addition, one of the goals of this report is to document the methods utilized to

complete this analysis with the hope of developing an automated process so the analysis can easily be repeated in future years. Once complete, this analysis will be run periodically in the future so we can continue to document in-park trends of species and landbird assemblages. One of our goals is to be able to achieve 80% power to detect a 50% decline in relative abundance of individual species. While significant trend patterns for individual species and landbird assemblages will be documented each time this analysis is completed, special care will be taken to highlight and make management aware of those individuals or assemblages that show a 50% or greater decline.

4.17 Report Format

The protocol, annual reports, and third year analysis reports will use the NPS Natural Resource Publications templates, a pre-formatted Microsoft Word template document based on current NPS formatting. The protocol will be formatted using the Natural Resource Report (NRR) template. Third year analysis and synthesis reports and other peer-reviewed technical reports that are not submitted to a journal will be formatted using the Natural Resource Technical Report (NRTR) template. Annual reports will be formatted using the Natural Resource Data Series (NRDS) template. These templates and documentation of the NPS publication standards are available at: http://www.nature.nps.gov/publications/NRPM/index.cfm.

5. Personnel Requirements and Training

5.1 Roles and Responsibilities

This protocol will be implemented through Cooperative Agreement H8482070095, between the Klamath Bird Observatory and the National Park Service, Klamath Network. The Klamath Bird Observatory will provide the Principal Investigator and they will work closely with the KLMN Data Manager, who will serve as the Government Technical Representative and the Network Contact. The KLMN and KBO will jointly implement this long-term monitoring program for the foreseeable future. Implementation of the Landbird Monitoring Protocol will include the following roles and responsibilities, addressed in greater detail in Appendix G.

The Principal Investigator will be responsible for supervising the Project Leads, hiring technicians and interns, conducting analyses, meeting reporting requirements, and fulfilling all requirements associated with the KBO/NPS agreement. Project Leads will be identified each year for the point count and mist netting projects.

A Project Lead for the point count surveys will coordinate implementation of annual field efforts, establish a field season schedule, assure that all equipment is available and in working order, train and supervise the VCP point count field crews, and complete data management requirements. The Project Lead for the mist net project will be responsible for operating the constant effort monitoring station at ORCA. The Project Lead will coordinate implementation of mist netting efforts, establish a field season schedule for the ORCA site, assure all equipment is available and in working order, train and supervise the mist netting field crews, and complete data management requirements associated with data collected at the constant effort monitoring station. The Project Leads will assure data quality standards are consistently met and will assure all safety considerations (Appendix K) are met.

Field interns and field technicians will be responsible for completing VCP point count surveys, mist netting, and area search surveys. They will be responsible for checking and entering monitoring data and adhering to all safety procedures.

The Network Contact is responsible for representing the KLMN in all issues related to this protocol. The Network Contact should be in constant communication with project and park staff to make certain the protocol is being properly implemented. It is the responsibility of the Network Contact to be familiar with all aspects of the protocol and provided assistance to the Network, KBO, and parks when necessary.

The KLMN Data Manager is responsible for uploading the data into the KLMN Landbird database and conducting QA/QC processes on the data. The KLMN Data Manager will ensure all products get stored in the project folder, will post information in the National I&M databases, and will manage the information on the web sites as well as manage all data submitted.

Each park within the KLMN has designated a Park Contact for the landbird project. It is the responsibility of the Network Contact or Project Lead to contact the Park Contact when necessary. Park Contacts will help support the KLMN Landbird Monitoring project, when necessary, by participating in meetings related to this project, helping with logistical planning at

their associated parks, and providing assistance with any miscellaneous tasks that might involve park staff participation.

5.2 Hiring, Qualifications, and Training

Field personnel should be in good physical condition and able to work and camp in inclement weather. Positions associated with implementing this protocol should be advertised in the Ornithological Newsletter, I&M Listserv, and other like forums no later than January 31 of each year, with employment agreements made no later than April 1 of each year. VCP point count efforts will require two field technicians, in combination, completing up to 55 days of counts. Constant-effort monitoring will require 18 days of time of the Field Lead and two interns.

5.2.1 VCP Point Count Field Technicians

Highly qualified biologists, experienced with conducting breeding bird surveys using distance estimates and proficient with identification of Klamath Region birds by sight and sound, should be hired to conduct the VCP point count surveys outlined in this protocol. Typically, they have at least 1 year of experience completing point count surveys. In addition, they must be willing to work in strenuous field conditions and camp on a regular basis. Field technicians will attend a 2-day training prior to the onset of the field season, where they will be tested for bird identification skills. In addition, training will focus on estimating distance to standing objects as well as a variety of singing species in various habitats. During this training, methodology for vegetation sampling will be reviewed and the group will practice ocular estimate methods for cover and tree height. For new field technicians and technicians that cannot pass the test associated with the 2-day training, additional training days will be completed to assure their bird identification skills and to provide more extensive vegetation survey training. The Project Lead or Field Lead will oversee all hiring. For more detailed information on qualification, hiring, and training see SOP #1: Preparation and Equipment and SOP #2: Training Observers.

5.2.2 Bird Banding Field Interns

For operation of the ORCA constant effort monitoring station, two intern students will be hired to assist the Project Lead. The Project Lead will oversee the intern hiring process (SOP #1: Preparation and Equipment). Field interns will be part of a more extensive mist netting internship program. Interns collect high quality data while gaining educational field experience. Historically, many applicants arrive to the program with general field skills and this experience provides training on specific knowledge and skills of bird monitoring. Training of field interns, supervised by the Field Lead, is rigorous and ongoing. Training follows the North American Banding Council's training guidelines (NABC 2001a, 2001b, and 2001c) and banding training (NABC 2001d). SOP #2: Training Observers provides further details about the field intern training program.

5.3 Safety

Safety of field personnel should always be the first concern in conducting a sampling program and in the selection of sampling sites. Numerous safety issues and concerns are associated with implementing a long-term, service-wide monitoring program that includes extensive fieldwork and sampling by network staff or other cooperators/contractors. Field work requires an awareness of potential hazards and knowledge of basic safety procedures. Field personnel routinely come in direct and indirect contact with rough terrain, potentially hazardous plants and

animals, and adverse weather conditions. Advanced planning can reduce or eliminate many safety hazards. Prior to going into the field, the PI should review safety procedures and job hazard analyses (Appendix K) with all field crew personnel. The Klamath Network will work to meet the goals and adhere to the beliefs of the NPS NPSafe program.

6. Operational Requirements

6.1 Annual Workload and Field Schedule

Preparation for the field season must begin well in advance of the pre-season training session. The process of recruiting and hiring qualified crew members should begin in late November or early December of the preceding year (SOP #1: Preparations and Equipment). Crew training should take place the week prior to the onset of surveys (SOP #1: Preparations and Equipment). Equipment should be inventoried, stocked, and repaired as needed prior to starting the field season (SOP #1: Preparations and Equipment and SOP #10: Post Field Season). When applicable, permits should be submitted no later than 2 months prior to conducting field work.

Sampling utilizing the mist net methodology and associated area survey methodology should take place between late May and mid-October (SOP #6: Mist Netting, SOP #7: Conducting Area Search Surveys, SOP #8: Conducting Vegetation Surveys, and SOP #9: Completing Species Checklist). Surveys using the VCP point count methodology should be implemented between early May and early July (SOP #5: Conducting Variable Circular Plot Point Count Surveys, SOP #7: Conducting Area Search Surveys, SOP #8: Conducting Vegetation Surveys, and SOP #9: Completing Species Checklist).

Data collected during the surveys should be entered on hardcopy datasheets, validated before leaving the site, and entered into the corresponding database as soon as possible (SOP #12: Data Entry). Once the data have been entered into the database, validation and verification processes should be implemented (SOP #13: Data Validation and Verification). After all attempts have been made to ensure the data are of high quality, data should be transferred to the Data Manager. In addition, analysis and report development should be completed following the instructions in SOP #17: Data Analysis and Reporting. Reports should be distributed to a broad audience following requirements outlined in SOP #16: Data Transfer, Storage, and Archiving.

In order to accomplish the variety of tasks that are associated with this protocol and to ensure products are produced in a timely fashion, it is important to recognize who is responsible for each task and what are the submission dates for products. The Narrative and associated SOPs provide details on the responsibilities of each individual associated with this protocol. In addition, Appendix G outlines the roles and responsibilities of each person working on this project. Table 1 in SOP #17: Data Transfer, Storage, and Archiving provides a list of deliverables and timelines for those deliverables and designates the primary person responsible for those products.

6.2 Facilities and Equipment Needs

This project requires minimal special facilities and equipment. The crew will require camp sites or housing in the vicinity of each park for several weeks during the point count survey season (early May- mid July) and throughout the survey season at ORCA (early May – late October). Crew members will provide their own camping gear. Computer access and personal vehicles will be provided by the field technicians and by KBO for the interns. Specialized equipment will be provided to both point count surveyors and the banding crew as detailed in SOP #1: Preparations and Equipment. If NPS facilities or equipment is required, the Project Lead should contact the Network Contact the winter before field work begins so arrangements can be made.

6.3 Budget Considerations

This project will incur relatively low startup costs beyond the present cooperative agreement between NPS and KBO. The estimated cost of fully implementing this program by KBO for 3 years (2008 - 2010) is approximately $161, 872. The total cost of this project includes KLMN staff time (~$9,000) and a cost-share between ORCA ($15,000) and the KLMN ($137,872) provided to KBO through a Cooperative Agreement (Table 4).

Table 4. A breakdown of the operational budget needed to implement the landbird monitoring protocol from 2008 through 2010.

Klamath Network Bird Monitoring Budget	Year 1	Year 2	Year 3
Administration			
Administrative Assistant Salary (1 week year 1/2, 1.5 weeks year 3)	806	806	1505
Seasonal Preparation			
Banding			
Project Lead Salary (0.25 month)	1003	1003	1003
Point Counts			
Project Lead Salary (0.25 month)	1350	1350	1350
Crew Training and Certification			
Banding			
Project Lead Salary (0.25 month)	1003	1003	1003
Intern Stipends	300	300	300
Point Counts			
Project Lead Salary (0.25 month)	1350	1350	1350
Contractor Wages (4 days)	640	640	640
Data Collection			
Banding			
Intern Stipends	1200	1200	1200
Housing	1000	1000	1000
Travel	3750	3750	3750
Point Counts			
Project Lead Salary (0.5 month)	2700	2700	2700
Contractor Wages (55 days year 1/2, 39 days year 3)	8800	8800	6240
Travel	2750	2750	1950
Data Management			
Banding			
Project Lead Salary (0.25 months)	1003	1003	1003
Point Counts			
Project Lead Salary (0.5 month)	2700	2700	2700
Data Analysis and Reporting			
Principal Investigator Salary (4 month)			31295
Project Lead Salary (0.5 month)	2700	2700	2700
KLMN Personnel			
Network Contact (GS-11, 0.5 pp)	1300	1300	1300
Data Manager (GS -11, 1.0 pp)	2600	2600	2600
KBO Subtotal	33058	33058	61691
KBO Overhead	5785	5785	10796
KLMN Subtotal	3900	3900	3900
Total Annual Budget	42743	42743	76386
Total 3-year budget			161872

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Standard Operating Procedures

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #1: Preparations and Equipment

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains what procedures will be completed prior to implementing the field season, including reviewing the budget, hiring the field crew, reviewing equipment needs, preparing site description forms and maps, preparing data forms, setting up equipment, meeting park requirements, planning the training, and scheduling field crews.

Reviewing the Budget

The Principal Investigator will work with the Network Coordinator each year to review the budget and ensure it meets salary, equipment, mileage, and miscellaneous field expenses. In the foreseeable future, the Klamath Network will implement a cooperative agreement with the Klamath Bird Observatory (KBO) that outlines the funding available to conduct all fieldwork, analysis, and report writing. Under the cooperative agreement, task agreements will be completed no later than one month prior to the start of the field season.

Hiring the Field Crew

Point Count Surveys

For the initial years of this program, KBO will provide the Project Leads, technicians, and interns. If at all possible, priority consideration should be given to previous years' Project Leads and technicians, to maximize year-to-year consistency in field operations and methods.

Hiring the Field Lead

If the Project Lead is to be a seasonal employee, rather than year-round staff member, then the Project Lead recruiting process should begin in late November or early December of the preceding year. Qualities to seek in potential Project Leads include the following:

1. Proficiency at identifying western landbirds by sight and sound.

2. Bird survey experience, preferably conducting point counts with distance estimation.
3. Substantial backcountry orienteering and backpacking experience.
4. High level of physical fitness.
5. Familiarity with one or more of the KLMN parks.
6. Familiarity with plant communities in the Klamath Region.
7. Leadership experience.
8. Strong organizational skills.
9. Ability to get along well with others in a field crew setting.
10. Knowledge of (or preferably, certification in) wilderness first aid.
11. Possession of a reliable vehicle. Note that unless NPS vehicles are available for field work, all members of the crew will need to provide personal vehicles.
12. Ability to manage field crews for long periods of time.

Once selected, the Project Lead should review the protocol and discuss any questions with the Principal Investigator.

Hiring the Technicians

Recruitment of the technicians should begin by late December of the preceding year. As with hiring the Project Lead, initiating the recruitment process early is critical for ensuring that well qualified candidates can be found. Although the technicians do not need to have the same level of experience, nor all of the required skills, as the Project Lead, similar general qualities should be sought:

1. Nearly proficient at identifying western landbirds within the KLMN by sight and sound, or be proficient at identifying landbirds of other regions by sight and sound and be able to demonstrate enthusiasm and ability to learn to identify new species. If a full pre-season training session is planned (SOP #2: Training Observers), then this requirement may be relaxed *slightly*.
2. High level of physical fitness.
3. Ability to get along well with others in a field crew setting.
4. Bird survey experience, preferably conducting point counts with distance sampling. If a full training session is planned, this requirement can be eliminated. However, experience with some kind of formal data collection is still highly desirable.
5. Backpacking experience and proficiency at backcountry orienteering. The orienteering requirement may be waived if orienteering will be emphasized during training.
6. Familiarity with one or more of the KLMN parks.
7. Familiarity with plant communities within the Klamath Region.
8. Knowledge of (or preferably, certification in) wilderness first aid.
9. Possession of a reliable vehicle. Note that unless NPS vehicles are available for field work, all members of the crew will need to provide personal vehicles.

While the first three of the above qualities should be considered mandatory, the others are desirable but not strictly required.

Soon after being hired, technicians should be sent the following:

1. A written description of expectations, duties, and responsibilities, to be signed and returned.
2. A list of all bird species likely to be encountered during the field season (SOP #2: Training Observers).
3. A list of required and recommended resources for bolstering their bird identification skills prior to and during the field season.
4. A list of required and recommended personal equipment.
5. A copy of the Landbird Monitoring Protocol.

Mist Netting

If at all possible, priority consideration should be given to previous years' Project Leads and interns, to maximize year-to-year consistency in field operations and methods. Once selected, the Project Lead, especially if new, should review all relevant sections of the protocol and discuss any questions with the Principal Investigator.

Hiring the Field Lead

The Project Lead will have an identified liaison at Oregon Caves National Monument (usually the lead park wildlife biologist or resource specialist) that will be the key contact for planning and logistics. If the Project Lead is to be a seasonal, rather than year-round, staff member, then the Project Lead recruiting process should begin in late November or early December of the preceding year. Qualities to seek in potential Project Leads include the following:

1. Proficiency at identifying western landbirds by sight and sound.
2. Mist netting experience (preferably certified as a Bander and Trainer by the North American Banding Council).
3. High level of physical fitness.
4. Leadership experience.
5. Strong organizational skills.
6. Ability to get along well with others in a field crew setting.
7. Knowledge of (or preferably, certification in) wilderness first aid.
8. Possession of a reliable vehicle.

Hiring the Interns

Recruitment of interns should begin by late December of the preceding year. As with hiring the Project Lead, initiating the recruitment process early is critical for ensuring that well qualified candidates can be found. Although the interns do not need to have the same level of experience, nor all of the required skills, as the Project Lead, similar general qualities should be sought:

1. Some experience with bird identification and strong interest in ornithology.
2. High level of physical fitness.
3. Ability to get along well with others in a field crew setting.
4. General fieldwork experience.
5. Knowledge of (or preferably, certification in) wilderness first aid.
6. Possession of a reliable vehicle. Note that unless NPS vehicles are available for field work, all members of the crew will need to provide personal vehicles.

While the first three of the above qualities should be considered mandatory, the others are desirable but not strictly required.

Soon after being hired, interns should be sent the following:

1. A written description of expectations, duties, and responsibilities, to be signed and returned.
2. A list of all bird species likely to be encountered during the field season (SOP #2: Training Observers).
3. A list of required and recommended resources for bolstering their bird identification skills prior to and during the field season.
4. A list of required and recommended personal equipment.

Equipment Needs

Equipment will be organized and made ready for the field season by the Project Lead several weeks in advance of the training session. This allows time to make needed repairs and order equipment.

Point Count Surveys

Equipment

The following is the list of equipment needed for each point count surveyor. Asterisks indicate items that crew members are currently required to supply for themselves.

- Binoculars*
- Rangefinder
- Celsius thermometer*
- GPS unit
- Watch or clock timer*
- Clipboard*
- Pens and pencils*
- Red pencils*
- Flagging
- Compass*
- First aid kit*
- Tent*
- Sleeping bag*
- Sleeping pad*
- Stove and fuel*
- Cookware*
- Bag and rope to hang food*
- Water filter*
- Backpack*
- Daypack*
- Oregon Gazetteer*
- California Gazeteer*
- Field notebook

In addition to the equipment specified above, surveyors need field guides to aid them in bird and plant identification. Recommended field guides and reference materials for bird surveys and associated vegetation assessments in the KLMN parks are listed below.

Books

Jensen, E. C., W. R. Randall, R. F. Keniston, and D. N. Bever. 2002. Manual of Oregon trees and shrubs. John and Bell Associates, Oregon. 305p.

Sibley, D. A. 2003. The Sibley field guide to birds of western North America. Alfred A. Knopf, New York. 471p.

Stuart, J. D., and J. O. Sawyer. 2001. Trees and shrubs of California. University of California Press, California. 467p.

CDs

Peterson, R. T. 1999. Peterson field guides: Western bird songs. Houghton Mifflin Audio and Cornell Lab of Ornithology.

Pugh, E. A. 1993. Western Oregon bird songs and calls. Lichen Coop Corporation, Oregon.

Pugh, E. A. 1998. Similar sounding species west side. Lichen Coop Corporation, Oregon.

Pugh, E. A. 1989. Warblers of the West. Lichen Coop Corporation, Oregon.

Mist Netting

Equipment

The following is the list of equipment that will be provided for the mist netting crew.

- 200 size 0A bands
- 200 size 0 bands
- 200 size 1C bands
- 200 size 1 bands
- 200 size 1B bands
- 200 size 1A bands
- 200 size 2 bands
- 50 size 3 bands
- 10 size 3B bands
- 10 size 3A bands
- 10 size 4 bands
- 10 size 4L bands
- 10 size 5 bands
- 10 size 5L bands
- 10 size 6L bands
- 2 size 0-1A banding pliers
- 1 size 2-3A banding pliers
- 1 size 3B-4 banding pliers
- 2 size 15 cm wing rulers
- 2 size 30 cm wing rulers
- Calipers
- Leg gauge
- 2 Mechanical pencils, 0.7 mm
- Extra pencil lead
- 2 Pencils
- Pencil sharpener
- 2 Permanent markers
- 3 Scissors
- 2 Hummingbird food bottles
- 4 Sugar packs
- Scotch tape
- 2 Lighters
- Water bottle
- Net repair kits
- SL4 high intensity flashlight
- 2 Optivisors
- Making tape
- Camera

- 3 Headlamps
- Electronic scale
- Weighing cups
- 12 AA batteries
- 8 C batteries
- 4 Nine-volt batteries
- 10 one quart Ziploc bags
- Clip board
- 40 Coin envelopes for feather collection
- ¼" Masking tape
- Binder
- 20 Journal forms (in data binder)
- 20 Banding data entry forms (in data binder)
- 4 Empidonax data entry forms (in data binder)
- 40 Area search forms (in data binder)
- 8 Vegetation survey forms (in data binder)
- 1 Site description form (in data binder)
- Site map (in data binder)
- Oregon Gazetteer road map
- Monitoring handbook
- Bird topo and data codes
- Sunrise chart
- Beaufort wind scale
- Skull ossification dates
- Species code list and recommended band sizes
- Tabular Pyle 2002
- Sibley 2000
- Pyle ID Guide to North American Birds 1997
- 3 Two-way radios
- 15 nets, 36 mm, 12 m
- 4 nets, 61 mm, 12 m
- 40 Swivel snap shackles, ¾"
- 15 Net bags
- 9 Six-foot sections extra rope
- 24' Length extra rope
- Flagging tape
- Hand clippers
- 40 8x10" Bird bags
- 6 10x14" Bird bags
- 4 each Clothespins labeled # 1-13
- 2 each Orange clothespins labeled # 1-13
- Insulated bag
- 12 Hand warmers
- First aid kit
- Chemistry stand
- Tarp
- 3 Pairs gloves
- Hand saw
- Hedge shears
- Mallet
- 4 18x3/8" Rebar
- 4 12x3/4" PVC
- Duct tape
- 4 Connectors for short poles
- 3 Folding chairs
- Roll-up table
- 8 Extra short net poles
- 18" Machete
- Long-handled loppe

In addition, each member of the mist netting crew will need to provide the following equipment for themselves:

- Binoculars
- Tent
- Sleeping bag
- Sleeping pad
- Stove and fuel
- Cookware

Recommended field guides and reference materials for mist netting in the KLMN parks are listed below.

Books

Jensen, E. C., W. R. Randall, R. F. Keniston, and D. N. Bever. 2002. Manual of Oregon trees and shrubs. John and Bell Associates, Oregon. 305p.

Pyle, P. 1997. Identification guide to North American birds, Part I. Slate Creek Press. Bolinas, California. 732p.

Sibley, D. A. 2000. The Sibley guide to birds. Alfred A. Knopf, New York. 544p.

Stuart, J. D., and J. O. Sawyer. 2001. Trees and shrubs of California. University of California Press, California. 467p.

Ralph, C. J., G. R. Geupel, P. Pyle, T. E. Martin, and D. F. DeSante. 1993. Handbook of field methods for monitoring landbirds. Gen. Tech. Rep. PSW-GTR-144. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture. 41p.

Sakai, W., and C. J. Ralph, editors. 2003. The Tabular Pyle. Klamath Bird Observatory, Ashland, Oregon.

CDs

Peterson, R. T. 1999. Peterson field guides: Western bird songs. Houghton Mifflin Audio and Cornell Lab of Ornithology.

Pugh, E. A. 1993. Western Oregon bird songs and calls. Lichen Coop Corporation, Oregon.

Pugh, E. A. 1998. Similar sounding species west side. Lichen Coop Corporation, Oregon.

Pugh, E. A. 1989. Warblers of the West. Lichen Coop Corporation, Oregon.

Prepare Site Descriptions and Maps

A folder for each point count route and mist netting site should be developed and include a site description and map. Field site descriptions are completed by surveyors the first year a field site is surveyed. Site descriptions include directions to the site, UTM coordinates in NAD 83 Zone 10, and a written description to help locate the survey stations. If there is more than one site description form, they should be stapled together with the most recent on the top. The map of the field site should be sufficient to navigate from the parking spot to all of the survey stations and

should include nearby roads or landmarks. All of this information will be duplicated and kept in a binder at the office, for reference and to provide replacements, if necessary. In addition, site descriptions, driving directions, and UTM locations will be entered into the Klamath Network Landbird database. It is the responsibility of the Project Lead to make sure project folders are complete prior to the start of the field season and at the end of the field season.

Prepare Data Forms

An adequate number of data forms to fulfill training needs and provide for the first 7-10 day tour (at least) should be printed or copied. Additional data forms will need to be copied or printed throughout the field season, if they are not produced in advance. Extra field forms from the previous years' field work will be stored in the project folder. Care should be taken to ensure the old field forms represent the current data collection parameters before using them.

Prepare UTM Coordinates

The Project Lead will prepare the GPS units for the field season. Using the Waypoint Express extension in Arcview or ArcGIS, the Project Lead will create a waypoint text file of UTMs for each point count station and mist net. A separate text file should be created for each park. The Project Lead will upload the appropriate UTMs onto each surveyor's GPS unit. Refer to SOP#3: Using the Global Positioning System for additional details.

Park Requirements

In January, the Project Lead should communicate with the Network Contact to determine the contact person for each park**.** The Project Lead should contact each park to inform them of the survey schedule and to determine:

1. Whether housing or campground sites are available.
2. Whether permits are necessary to camp in the backcountry.
3. Whether keys are needed to access survey sites.
4. Whether the standard flagging and marking scheme is acceptable.
5. Whether permits are needed to conduct research in the parks.

Prepare for and Schedule Training

The training sessions should be scheduled and materials should be prepared as detailed in SOP #2: Training Observers.

Scheduling Field Work

Point Count Surveys

Breeding season point counts should be conducted during the months of May, June, and the first week in July. Lower elevation sites should be surveyed earlier in the season and higher elevation sites later in the season. By sampling the Network's low elevation sites first, then the mid elevation sites, and finally the high elevation sites, crews can ensure that sampling coincides with the peak of breeding activity for most species within each elevation zone. Point count routes should be scheduled at the onset of the field season, such that a surveyor will go out on a field trip for 10 to 20 days at a time. The park contact should be consulted as to whether any bridges have been washed out and especially if heavy snow pack or other factors might alter the accessibility of any routes. As much as possible, routes should be scheduled within a 7-day

window each year and the schedule should be arranged to minimize travel requirements. Unpredictable weather precludes the scheduling of sampling events to specific annual dates, as point counts cannot be conducted in the rain. The schedule must be flexible enough to account for survey days lost to weather or other unforeseen problems. After each field trip, the schedule should be revised if necessary. A tentative schedule of the entire season will be given out at the beginning of the season, but it is subject to change and only the work assigned for a single field trip should be completed before further instruction from the Project Lead.

Mist Netting

Mist netting to be conducted during the breeding season (May-August) should be scheduled at the onset of the field season, such that a field crew will go out on a station visit once every 10-day cycle (cycles beginning May 1) beginning within the forth or fifth cycle (determined by melt of snow cover). Consecutive efforts at a station during the breeding season should be separated by at least 3 days. Mist netting to be conducted during the fall migration season (August-October) should be scheduled at the onset of the field season, such that a field crew will go out on a station visit once every 7-day cycle (cycles beginning mid-August and ending mid-October). Consecutive efforts at a station during the migration season should be separated by at least 1 day. The schedule must be flexible enough to account for station visit days lost to weather or other unforeseen problems. After each station visit, the schedule should be revised if necessary. A tentative schedule of the entire season will be given out at the beginning of the season, but it is subject to change.

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #2: Training Observers

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedures for training observers, including survey training, first aid, safety, emergency procedures, backcountry rules and ethics, data entry, and training tracking.

Survey Training

Point Count Surveys

Training will cover point count, distance estimation, vegetation survey, and data entry methodology. It is the responsibility of the Project Lead to set up and conduct the training associated with point count surveys.

Bird Identification

For this monitoring program to produce meaningful results, all observers must be fully competent at identifying landbirds within the Klamath Network (KLMN) by sight and sound (Appendix D lists bird species likely to be encountered at each KLMN park). Every effort must be made to recruit and hire observers who are proficient or nearly proficient at identifying species in the Klamath Region by sight and sound. If they are not skilled at identifying birds in the Klamath Region, then they should be proficient at identifying birds from other regions by sight and sound and demonstrate enthusiasm and an ability to quickly learn to identify new species (SOP #1: Preparations and Equipment). No matter how well executed the training session is, most observers who do not have substantial birding experience will not be adequately prepared to conduct point counts by the end of the training session.

Soon after being hired, technicians should be sent training materials (SOP #1: Preparations and Equipment) and be urged to begin preparing themselves prior to the start of the training session. In addition to observing and listening to birds in the field, field technicians and interns should spend time studying field guides, listening to recordings, and using instructional software to review plumages and vocalizations to test themselves.

Point Count Survey Protocol

In addition to honing bird identification skills, point count surveyors should review this protocol prior to the point count training. Surveyors will attend a 2-day point count training workshop lead by the Project Lead. During the training, simultaneous point count surveys and vegetation surveys will be completed in the field. Throughout the training session, every day will begin with the technicians completing simultaneous point count surveys at sunrise, either with the trainer(s) (usually the Project Lead, perhaps with assistance from the NPS Contact, or another qualified person) or in small groups. While conducting these practice point counts, technicians should adhere to all aspects of the field protocol (SOP #5: Conducting VCP Point Count Surveys) with one possible exception; it is often more useful to shorten the duration of the practice point counts to 3 minutes rather than 5 minutes. This makes it easier for observers to remember when and where they heard specific vocalizations when they are discussing their results after the point count. The crew should visit as wide a variety of habitats and locales as possible during the training session, to maximize the number of species encountered in the field.

Distance Estimation

Training to estimate distances to birds should follow a series of steps. For observers who are already competent at identifying birds by sight and sound, one full day of training following these guidelines is usually all that is necessary to be able to estimate distances within ±10%. Surveyors recalibrate themselves the afternoon before a bird survey begins.

1. Begin by placing flagging at 10 m, 25 m, 50 m, and 100 m from a central point and having observers estimate distances to trees, rocks, and flagging from the "station."

2. Have each observer place flagging at four or five locations visible from the station, and then have everyone in the group record distances to each flag in a field book. Distances should be estimated to the nearest meter. Then, use a tape measure or laser rangefinder to measure the distance to each flag, and have each person compare his or her initial estimate to the actual distance. Repeat this exercise at several sites with both open and closed vegetation until observers can consistently estimate distances to within ±10% of the actual distance.

3. Half of the group should place themselves at various distances away from the station, and quietly wait until a bird vocalizes near them. The other half of the group should remain at the station, and estimate the distance to any birds that vocalizes. Horizontal distances should be estimated, as if a plumb bob was lowered to the ground from the bird's location. If possible, observers should visually identify the tree or branch where they think the bird is, and estimate the horizontal distance to an object that they can see directly below where they think the bird is vocalizing. If the vegetation is too thick to see the tree or shrub, the observer should not move around to get a better view, but rather estimate the distance from where they are standing. The observer closest to the bird should then indicate where the bird was vocalizing from and measure the distance to the point directly under the bird from the station using a tape measure or laser rangefinder. This is a slow but important part of the training and should be repeated until observers have experience with estimating distances to a number of different species and call or song types.

4. Continue distance estimation training during simultaneous point count surveys. Divide observers into small groups (five people or less) and conduct 5-minute counts from the same location. At the end of each count, have the observers compare notes and discuss any discrepancies in the species detected and the estimated distances. Remember that the distance to where the bird was first detected should be recorded, so if a bird flies towards the station, the distance where it was first heard or seen is recorded, not the closest distance or where it lands. Continue these simultaneous counts until there is consistency among observers with regards to the species and distances recorded.

Vegetation Survey Protocol

Technicians should be proficient with identification of trees and shrubs in the Klamath Region or be proficient with using a taxonomic key to identify all plants (SOP #1: Preparations and Equipment). Training will include a presentation of the specifics of the protocol. The crew should also practice collecting habitat data, as a group, in order to standardize number of vegetation layers, canopy cover assessment, and DBH estimates (SOP #8: Conducting Vegetation Surveys). Practice should occur in multiple habitats and should continue until crew-wide standardization is achieved.

Recording Data

Technicians must be instructed on how to complete each of the data forms and have an opportunity to practice completing them during training, so that questions can arise and be resolved before official data collection begins.

Certifying Observers to Conduct Point Counts

Before they can collect point count data for the KLMN landbird monitoring program, technicians must pass a rigorous bird identification exam. The exam involves identifying approximately 60 recorded vocalizations, including all the more common landbird species in the parks and many of the rarer ones. In addition, two or more groups of approximately 10 recordings each will be grouped together in rapid succession to produce "simulated point counts," which test a crew member's ability to rapidly identify vocalizations, as is often required in the field. Technicians will also have to identify 30-40 photographic images of birds, generally rarer species or less obvious female plumages (computer CD ROM programs work well for this). Passing the exam should require a near perfect score. Technicians who do not pass should be given feedback on which species they misidentified and be allowed to take the full exam again after they have had a few days to study. The exam needs to be remade (i.e., the order, if not the identity, of the recordings and pictures needs to be changed) before it can be administered again.

Survey Training

Mist Netting

The mist netting Project Lead and interns should review the pertinent components of this protocol prior to the onset of the field season. The mist netting crew will be supervised and trained by the Field Lead. Inexperienced banders are trained intensively at the onset of their internship, with continued training until they are proficient at bird extraction and handling, bird identification, and data collection. Training continues throughout the season by pairing less experienced banders with more experienced crew members and by working with their supervisor.

Banding Birds

The Project Lead is responsible for instructing interns on all procedures and techniques involved in running the station.

The Project Lead should have read and be familiar with The North American Banders' Study Guide (The North American Banding Council 2001a), The North American Banders' Manual for Banding Passerines and Near Passerines (The North American Banding Council 2001b), The Instructor's Guide to Training Passerine Bird Banders in North America (The North American Banding Council 2001c), and The Field Lead's Syllabus (Ralph et al. 1993). Project Leads should ensure that all trainees have read and understand these documents, excluding The Instructor's Guide to Training Passerine Bird Banders in North America. Copies of these documents should be in each banding kit.

Training will include:

1. Removal from nets. Until trainees are fully competent, they should never be left alone to remove a bird. Instead, the Project Lead should supervise; when a person has not made progress on a bird within 10 seconds, the Project Lead should remove the bird, discuss his/her technique, and then return the bird to the trainee.
2. Recording. Trainees should rapidly become familiar with the data collected, to the point where they anticipate data and do not have to be told the data appropriate for each column (e.g., when told the skull is full, they should automatically and correctly write down the age and how aged).
3. Processing. Trainees should quickly become competent in processing. Training in processing should depend on the number of birds: (A) when only a few birds are to be processed, the Project Lead should record while the trainee bands; (B) with moderate numbers, the Project Lead records for the trainee while also banding; and (C) when it is busy, the trainee records for the Project Lead, while also banding. This enables the trainee to make progress continuously, not just be a spectator.

Bird Identification

Interns at a mist netting site may have little bird identification skills at the onset of the season and will have ongoing training throughout the season. Prior to the season, interns should review the species list from the Oregon Caves National Monument station (Appendix C). Bird identification skills can be improved by (1) studying field guides and bird song recordings, (2) birding in the field and taking the time to locate birds with unknown songs or calls, and (3) accompanying advanced birders in the field whenever the opportunity arises.

Area Searches

The mist netting field crew will undergo training on the area search survey methodology (SOP #7: Conducting Area Search Surveys) at the mist net site. Surveyors will accompany an experienced searcher until they have learned the area search survey methodology and can identify many of the local birds. Area search surveys allow a surveyor time to locate birds that he or she cannot identify by song or call. Hence, an intern completing area searches does not need the expert birding skills of a point count technician, allowing novice birders to complete accurate surveys and improve their bird identification skills.

Recording Data

Interns must be instructed on how to complete each of the data forms and have an opportunity to practice completing them during training, so that questions can arise and be resolved before official data collection begins (SOP #12: Data Entry).

First Aid, Safety, and Emergency Procedures

All Project Leads, technicians, and interns will be working in remote areas; it is therefore essential that everyone, to the extent possible, be prepared for emergency situations. Although providing full-scale training in wilderness first aid is beyond the scope of the landbird monitoring training program, we recommend requiring the crew to read and discuss in detail a simple wilderness first aid booklet prior to beginning field work. Crews should also brainstorm potential responses to theoretical emergency situations and have a clear understanding of what to do if they or someone else on the crew becomes seriously injured or goes missing.

Backcountry Rules and Ethics

Project Leads, technicians, and interns should receive instruction on backcountry regulations for the parks, including permit requirements and procedures, campsite restrictions, food storage, fire season restrictions, etc. Note that some of these rules differ among the parks. If possible, arrangements should be made for a backcountry ranger or other qualified Park Service employee to meet with the crew to discuss these topics. Regardless, it is the Project Lead's responsibility to make sure that all crew members understand the rules they must follow.

Data Entry

Project Leads, technicians, and interns will be trained in data entry according to SOP #12: Data Entry at the onset of the field season. As a group, the data entry protocol will be reviewed. Each pertinent database will be demonstrated on the computer by entering several example records. Time will be allotted for the field crew to practice the data entry system and for questions to be answered.

Training Tracking

The Project Lead will track the training of technicians and interns by recording the trainees' names, dates, and training events in an Excel spreadsheet. For mist netting where training is continuous throughout the season, dates will be recorded for the onset of training and when proficiency is achieved for three overarching topics; bird extraction and handling, bird identification, and data collection.

Literature Cited

North American Banding Council (NABC). 2001a. The North American banders' study guide. North American Banding Council Publications Committee, Point Reyes Station, CA.

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Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #3: Using the Global Positioning System

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedures for use of the Global Positioning System, including set-up of Garmin 10XL GPS units, uploading and downloading coordinates, locating field sites, and marking locations. It is the responsibility of the Project Lead to set up the Garmin units prior to the start of the field season. Each technician and intern should be familiar with the GPS unit settings and should check the settings prior to using the GPS unit each morning.

Set-up of Garmin 10XL GPS Units

1. Use PAGE button to get to Main Menu
2. Use arrows to highlight SETUP MENU and press ENTER into SETUP MENU
3. Highlight SYSTEM and press ENTER into SYSTEM SETUP
4. Assure the following settings are correct:
   a. MODE: Normal
   b. OFFSET: -07:00
   c. DATE: Verify that the date is correct
   d. TIME: Verify that the time is correct
   e. HOURS: 24
   f. LIGHT: 15 SEC
   g. TONE: NONE
5. Press PAGE to exit SYSTEM SETUP
6. Highlight NAVIGATION and press ENTER into NAV SETUP
7. Assure the following settings are correct:
   a. POSITION FRMT: UTM/UPS
   b. MAP DATUM: NAD 83 CONUS
   c. CDI: +/-0.25 or +/- 0.02
   d. UNITS: METRIC
   e. HEADING: AUTO
8. Press PAGE to exit NAV SETUP
9. Highlight ALARMS and press ENTER into ALARMS SETUP
10. Assure the following settings are correct:

    a. Arrival: Off
    b. CDI Alarm: Off
11. Press PAGE twice to return to MAIN MENU
12. Press PAGE three times to get to MAP PAGE
13. Press RIGHT ARROW twice to highlight OPT and press ENTER
14. Highlight MAP SETUP and press ENTER into MAP SETUP
15. Assure the following settings are correct:
    a. MAP: TRACK UP
    b. RINGS: NO
    c. ROUTE: NO
    d. NEAREST: YES
    e. NAMES: YES
    f. TRACK LOG: NO
16. Press PAGE to return to MAP PAGE
17. Highlight OPT and press ENTER
18. Highlight TRACK SETUP and press ENTER into TRACK SETUP
19. Assure the following settings are correct:
    a. RECORD: OFF
    b. METHOD: AUTO
20. Press PAGE to return to MAP PAGE

Uploading and Downloading Coordinates

1. If necessary, download Waypoint Express from the Internet. The software is at: http://www.tapr.org/~kh2z/Waypoint/. Follow the instructions on the site in order to download and install.
2. Creating a text file from an ArcView GIS shapefile:
    a. Open ArcView or ArcGIS and load the Waypoint Express extension from the FILE – EXTENSIONS menu
    b. Make sure that the theme you want to convert is active, then select the points that you want either using the select tool on the map or the select tool on the table
    c. Go to WAYPOINT EXPRESS – SHAPEFILE – WAYPOINT and follow prompts
        I. Select the theme containing the points
        II. Select the field with the unique field site code (this code cannot exceed six characters, if it does it will be truncated)
        III. Select the appropriate projection: NAD 83 UTM Zone 10
        IV. Select name and location for file
3. Uploading a text file:
    a. Turn on the GPS unit and link to your computer using the interface cable
    b. Open the program Waypoint Plus (shareware available at http://www.tapr.org/~kh2z/Waypoint/)
    c. Go to FILE – OPEN and open the text file (you will need to go to FILE – CLEAR – WAYPOINTS in order to upload subsequent files)
    d. Select WAYPOINTS – UPLOAD
    e. Check your GPS unit to assure the transfer was successful
4. Downloading coordinates:
    a. Turn on the GPS unit and link to your computer using the interface cable

b. Open the program Waypoint Plus
c. Go to WAYPOINTS – DOWNLOAD and save as a comma delimited file under a pathway
d. The coordinates should be named with the observers initials and the date (e.g., jls 20070401) and saved into the folder:

c/GPS/downloads/year/

Locating Field Sites

1. Press GOTO
2. Scroll to the waypoint that you are locating and press ENTER
3. Use the direction heading and distance to navigate to the site using a compass

Marking Locations

1. Make sure that the SATELLITE PAGE reads 3D (2D minimum) and had EPE less than 12
2. Press MARK
3. Highlight AVERAGE and press ENTER
4. Write the waypoint number in GPS # on Point Count Route Description Form, or highlight WAYPOINT and enter an appropriate name for your point (always use standard codes combining station/route and point number as they appear on Point Count Data Form [e.g., GERB01: Station/Route = GERB, Point Number = 1])
5. Note accuracy in +/- on the Site Description Form before pressing ENTER
6. Press ENTER to finish marking waypoint
7. Press PAGE to MAIN MENU
8. Highlight NEAREST WPTS and press ENTER into NEAREST WPTS list
9. Highlight the waypoint on the top of the list, which should be the one you just marked, and press ENTER
10. Mark UTMs in UTMs on Site Description Form
11. Copy down the name of your waypoint and the accuracy in your field notebook
12. Highlight SAVE and press ENTER
13. PAGE to the MAP PAGE and highlight your new waypoint name and press ENTER
14. Copy down the UTM location in your field notebook.

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #4: Locating and Marking Field Sites

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedures for locating and marking point count stations, locating and marking mist net lanes, locating area search plots, and re-marking field sites and the associated Waypoint Tracking Form.

Locating and Marking Point Count Stations

New Routes

All field sites will be established and permanently marked prior to the commencement of field surveys. UTM coordinates and a map will be provided by the Project Lead for all point count stations along the route. Transects of 6-12 point count stations will be established at each location with stations placed ~250 m apart. If there is GPS coverage, each station will be laid out using GPS. If there is no GPS coverage, the observer will take a compass bearing and use a combination of pacing and a rangefinder to locate subsequent stations. If you encounter a station that is not possible or unsafe to reach, drop that station and use an over sample station as provided.

Completing the Site Description Form

A Site Description Form must be completed upon establishment of each route. This form includes UTMs and a written description of how to move from one station to another (SOP #1: Preparations and Equipment).

When surveying points that have been previously surveyed, it is necessary to complete the Site Description Form only if the following circumstances arise:

1. In the field, it is discovered that all or part of an established transect has become inaccessible due to some change (e.g., a landslide) since the time it was last visited. It is necessary to re-route the transect.
2. You believe that you are not at the location where the previous observer conducted the point count, for whatever reason you are unable to get to that location, and hence you

complete the count where you are. This situation should be avoided. If it does occur, mark the new location following the instructions outlined in SOP# 3: Using the Global Positioning System and include detailed notes on the Site Description Form describing the situation.

3. You wish to correct or improve upon the previous observer's description of the point or the travel features (see explanation of the Site Description Form, below).

The Site Description Form is attached at the end of this SOP and should be filled out as follows:

Page: The page number of current page and the total pages for the site description.

Site Code: The code for the point count route or mist net site.

Site Name: The name of the point count route or mist net site.

Month-Day-Year: The date of the survey using two numbers for month and day and four numbers for year.

State: The two letter abbreviation for the state where the field site is located.

Project/Region: The code for the project, NPLTM.

Observer Initials: The first, middle, and last name initials of the observer.

Datum: The map datum used to record the UTM coordinates. NAD 83 (North American Mean Datum 1983) UTM should be used unless otherwise instructed.

Point: The point count station number or mist net number.

UTM E (Easting): The six number UTM Easting coordinate value for the location taken from a GPS unit or map.

UTM N (Northing): The seven number UTM Northing coordinate value for the location taken from a GPS unit or map.

Gps Error (+/-): The accuracy of GPS unit's UTM location, recorded in meters.

Description: A brief description of how to get to the station and other notes that will help relocate points (the description should take up more than one line of the form if needed). Please make special note of any situations that will be helpful when revisiting routes, such as hazards, access issues (e.g., need key, land owner permission, four-wheel drive, mountain bike), sensitive wildlife issues, color of flagging used to mark stations, etc.

Bearing: The compass bearing for the direction of a mist net from the point location. This will be left blank for point count routes.

Installing Permanent Markers

Mark each station as per the permit agreement with each park. This may include marking each station with a tag and/or flagging around the bole of a medium or large live tree that is nearest to the permanent marker and write the route and station number, along with "bird" and the year with a permanent black marker. Additional flagging should be hung from branches, to blow in the wind and increase visibility if the station is in a densely vegetated area.

If there are trees within 20 m of the point, use a metal tag to mark the nearest tree or another nearby tree if for some reason it is more prominent than the nearest tree. Use a paint pen or grease pencil to inscribe the tag with the following information:

1. Route name or mist net site name
2. Station number or net number

Then use a paint pen or grease pencil to write the same information again on the other side of the tag. Nail the tag to the back side of the tree you selected, being sure to fold it so it juts out perpendicular from the trunk, leaving both the inscribed label and the permanent marker label visible. The nail should not be hammered all of the way into the tree; instead, ½" of the nail should be protruding from the tree.

If there are no trees within 20 m of the origin point, mark the nearest shrub. Use paint pen or grease pencil to write the information indicated above on a metal tag and secure the tag to the shrub.

At each location, it is necessary to complete the Permanent Marker Information Form (attached at the end of this SOP) as follows:

Marker Number: Record the route name and station number or mist net site name and net number. If for some reason you did not mark a point that did not already have a marker, write "None" in this field and provide explanation at the bottom of the form, after "Marker Comments."

Install Date: Today's date in the mm/dd/yyyy format.

Removal Date: Leave blank unless removing a pre-installed marker, in which case enter the current date.

Marker Type: Indicate "metal tag."

Marker Substrate: Indicate the scientific name of the tree or shrub species to which the tag was nailed.

Height Above Ground: Indicate the approximate height above ground that the tag was placed on the tree or shrub, in meters.

Offset Dist: Indicate the distance between the actual survey point and the marker, in meters.

Offset Bearing: Indicate the declinated compass bearing *from the point to the marker.*

Marker Comments: Provide any additional information that might help someone find the marker in the future, including a brief description of how to find the marker from the sampling point.

Existing Routes

Use the GPS unit (refer to SOP #3: Using the Global Positioning System for details), compass, and previous years' written Field Site Description to locate an existing point count station that will be marked with a metal tag and may or may not be flagged in the field. If flagged, the flagging will include the route and station number, along with "bird" and the year the flagging was hung. If flagging is torn, faded, or missing, remove the old flagging and hang two pieces of new flagging around the bole of a medium or large live tree that is nearest to the UTM coordinates and mark the flagging with the information listed above using a permanent black marker. Each point count stations will have one of two possible metal tags, either a 5"x5" yellow sign that lists the route and site or a 1" circular brass tag that is stamped with "KLMN" and the point count number.

Locating the Mist Net Site

The mist net lanes have already been established as part of the ongoing Klamath Network Bird Inventory project at Oregon Caves. The array of mist net lanes has been located in areas that maximize bird captures. The lanes will be relocated each year by a biologist that has previously banded at the site. The mist net lanes have been delineated with waypoints in a GIS database. Maps and UTM coordinates can also be used to locate mist net lanes. Two area search plots have already been established within the mist net array. These plots were established so that area search surveys could be completed in conjunction with checking mist nets. Area search plots are delineated using a map, with mist net lanes and other landmarks as reference. The location information is included at the end of this SOP.

Re-marking Field Sites

Occasionally, field crews will encounter a field site where coordinates, maps, or written descriptions can be recorded with better accuracy than in previous years. In this instance, the map or written description should be re-created and stapled in front of the existing record and/or new UTM coordinates should be taken. This may occur in areas where routes were laid out with poor or no GPS coverage. In such instances, do not move the station on the ground; instead, take a new GPS reading. A new UTM coordinate should be taken for a station only if the new reading (taken with good satellite cover and low error rate) places the station more than 50 m from the current UTM coordinate. However, if improved technology becomes available that results in more accurate readings, then new coordinates should be recorded. Whenever a new UTM is recorded for an existing station, fill out the Waypoint Tracking Form with the date, your initials, the route and station number, old UTMs, new UTMs and error, and a detailed explanation of why the new UTM was recorded. This form is attached at the end of this SOP. In the rare instance that this occurs, it should be brought to the attention of the Project Lead. The Project Lead will then be responsible for updating the Location database following guidelines outlined in SOP #13: Data Validation and Verification.

SITE DESCRIPTION FORM

Page of

Site (Code) | Site (Name) | Month | Day | Year

State | Project/Region | Obs. Initials | Datum

Point	UTM	GPS Error (+/-)	Description	Bearing
	E N	.		
	E N	.		
	E N	.		
	E N	.		
	E N	.		
	E N	.		
	E N	.		
	E N	.		
	E N	.		
	E N	.		
	E N	.		
	E N	.		

jls20070627

Observer Name | Checked | Copied | Entered

Permanent Marker Information

Project_____ Route_____ Observer_____ Date_____

Marker Number:_____ Install Date:_____ Removal Date:_____

Marker Type:_____ Marker Substrate:_____

Marker Location Information: Height Above Ground:_____(cm) Offset Dist:_____(m) Offset Bearing: _____º

Marker Comments:
_____

_____

Elevation_____ Aspect_____ Slope_____

Marker Number:_____ Install Date:_____ Removal Date:_____

Marker Type:_____ Marker Substrate:_____

Marker Location Information: Height Above Ground:_____(cm) Offset Dist:_____(m) Offset Bearing: _____º

Marker Comments:
_____

_____

Elevation_____ Aspect_____ Slope_____

Marker Number:_____ Install Date:_____ Removal Date:_____

Marker Type:_____ Marker Substrate:_____

Marker Location Information: Height Above Ground:_____(cm) Offset Dist:_____(m) Offset Bearing: _____º

Marker Comments:
_____

_____

Elevation_____ Aspect_____ Slope_____

Waypoint Tracking Form

Date	Initials	Route	Station	Old Easting	Old Northing	New Easting	New Northing	Error
Explanation								
Date	Initials	Route	Station	Old Easting	Old Northing	New Easting	New Northing	Error
Explanation								
Date	Initials	Route	Station	Old Easting	Old Northing	New Easting	New Northing	Error
Explanation								

Oregon Caves Mist Net Site Description

Station Code: ORCA
7.5 Minute USGS Quadrangle:
Location: Oregon Caves
Mileage and Direction from nearest town:
County: Josephine **State**: OR
Ownership: NPS
Contact:
Name(s):
Address:
Phone:
Other info:

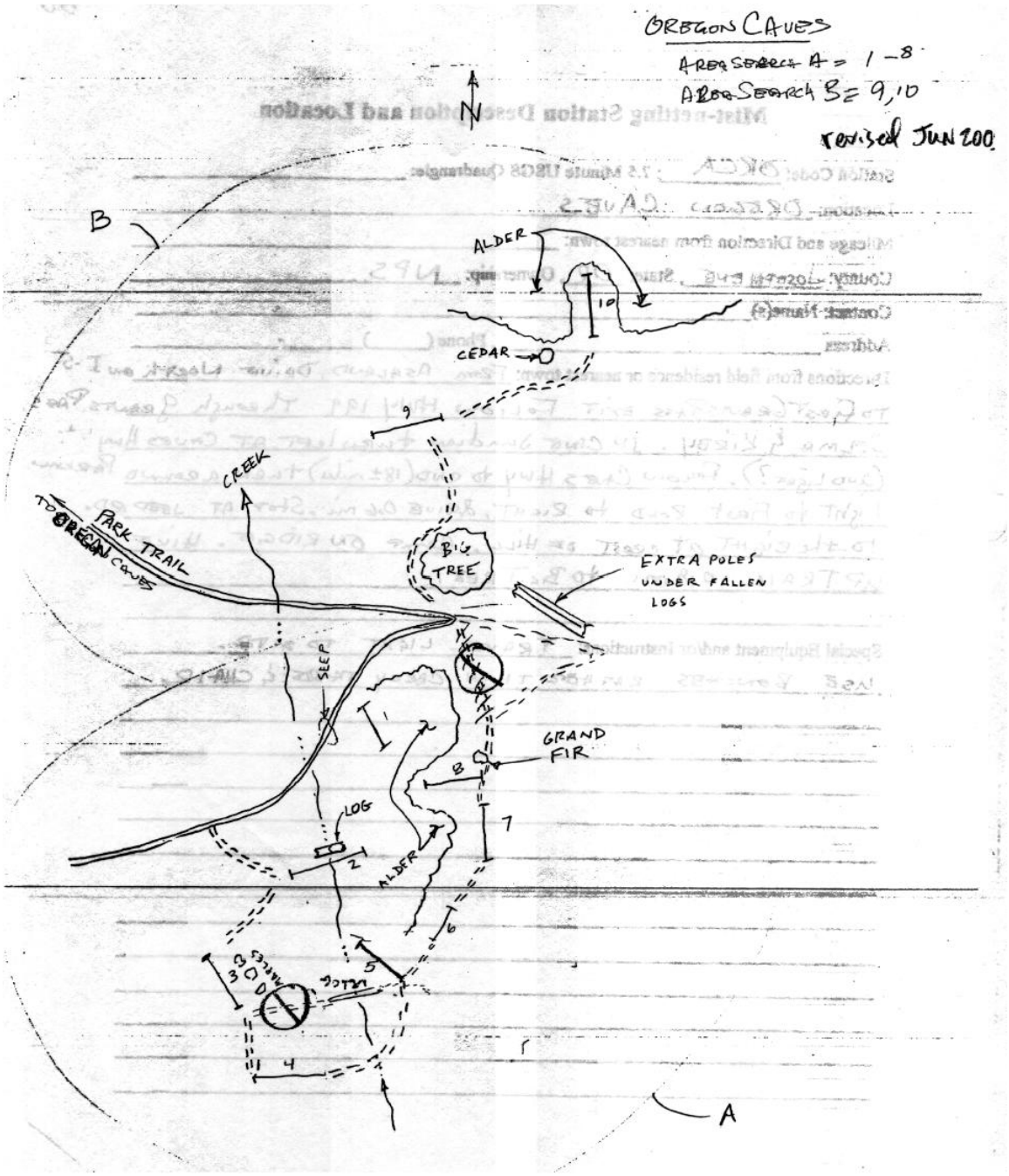
Directions from field residence or nearest town

From Ashland: Drive North on I-5 to first Grants Pass exit. Follow Hwy 199 through Grants Pass, Selma, and Kirby. In Cave Junction, turn left at Caves Hwy (second light). Follow Caves Hwy to end (18 + or – miles), continue to Visitor Center parking lot and turn around. Head back in same direction and take first right onto Forest Service access road. Drive 0.6 miles. Stop at Jeep Rd. to the right at crest of the hill. Camp on ridge. Hike up trail for about 0.8 miles to the big tree.

Special Equipment and/or Instructions:
Travel light to site. Use benches rather than carry tables and chair.

Driving Time:

ORCA Map


OREGON CAVES
AREA SEARCH A = 1-8
AREA SEARCH B = 9,10
revised JUN 200
N
B
ALDER
10
CEDAR
9
CREEK
A
PARK TRAIL
TO OREGON CAVES
BIG TREE
EXTRA POLES UNDER FALLEN LOGS
SEEP
1
GRAND FIR
8
LOG
2
ALDER
7
6
5
300 MARKS
METAL
4
A

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #5: Conducting Variable Circular Plot Point Count Surveys

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP gives step-by-step instructions for surveying birds with unlimited-radius, 5-minute point counts using distance sampling, including completion of the Point Count Data Form, which is provided at the end of the SOP. Procedures for locating point count stations are described in SOP #4: Locating and Marking Field Sites. Point count procedures are based on standard point count protocols (Alexander et al. 2004, Fancy 1997, Peitz et al. 2002, Ralph et al. 1993).

Introduction

This survey utilizes 5-minute, unlimited-radius point counts with distance sampling. Recording the distance to each bird detected allows estimation of detection probability, an essential analytical component of this study. Data collected using the standardized Variable Circular Plot (VCP) survey methodology can be directly compared with those collected using the traditional fixed radius plot. Partitioning the data into birds detected within each minute of the 5-minute point count facilitates comparison with results from the continent-wide Breeding Bird Survey (BBS), which utilizes 3-minute point counts and allows for additional analyses of detection probabilities using mark-recapture occupancy models.

Conditions of the Survey

VCP point count surveys are to start during the 15 minutes following local sunrise and be conducted during the following three to four hours. Birds should not be surveyed when rain or wind interfere with the audibility of bird sounds, when fog or rain interferes with visibility, or when cold weather shuts down bird song activity.

Conducting the Point Count Survey

The Project Lead and/or technicians should approach the survey point with as little disturbance to the birds as possible. When you arrive at a point, make yourself comfortable by taking off your backpack and situating binoculars so that they are in a comfortable and accessible position around your neck. However, remain as quiet as possible; if you need to repack your things or add or remove clothing, try to postpone doing so until after the point count. Take a minute and use your rangefinder to determine several reference points (the observer will not use the rangefinder during the count). No attracting devices or techniques (e.g., "phishing") should be used during a point count survey. During the count, be sure to periodically rotate your body so that you do not spend the entire point count facing the same direction; you must do your best to track birds around you in all directions. Place the Point Count Data Form on the top of your clipboard and complete the top portion of the form (if it was not completed at a previous station) as follows:

Page: The page number of current page and the total pages for the survey route.

State: The two letter abbreviation for the state where the field site is located.

Project/Region: The code for the project, NPLTM.

Site Code: The code of the survey route.

Site Name: The name of the survey route.

Month-Day-Year: The date of the survey using two numbers for month and day and four numbers for year.

Observer Initials: The first, middle, and last name initials of the observer.

Temp. (Temperature): The temperature at the beginning of the survey and/or at the top of each new data form page, recorded in degrees Celsius.

Cloud Cover %: Record the estimated percent of cloud cover at the beginning of the survey and/or at the top of each new data form page.

Ppt (Precipitation): Record the type of precipitation at the beginning of the survey and at the top of each new data form page; N = None, F = Fog, M = Mist, D = Drizzle, R = Rain.

Wind: Record the wind at the beginning of the survey and at the top of each new data form page using the Beaufort Wind Scale class. 0 = calm, smoke rises vertically and the sea is mirror smooth. 1 = light air, smokes moves slightly with breeze and shows direction of wind. 2 = you can feel wind on your face and hear the leaves start to rustle. 3 = gentle breeze, small branches start to sway, wind extends a light flag. 4 = moderate breeze, loose dust or sand on the ground will move and larger branches will sway. >4 = Do not survey, too much wind.

When you are ready, set your stop watch and begin the count. During the 5-minute point count, record data as follows:

Station: The point number of the station where the count was conducted.

N: The noise experienced at the beginning of the count; 1 = none, 2 = moderate, 3 = too much noise, cannot hear birds >15 m away from point (do not complete the point count if there is too much noise). If the cause of the noise is expected to be a continuous problem at this point over time, then you will need to move the station away from the source of the noise following the methods described in SOP #4: Locating and Marking Field Sites.

Time: The time (using a 24-hour clock) recorded at the beginning of the count to denote time blocks and at the end of the count. When recording the birds within the count period, separate detections made during each minute of a 5-minute count. When doing so, do not record individuals twice (i.e., in each time block), only record individuals in a subsequent minute of the count if they were not detected previously during that count.

Species Code: The standard four letter species code as found in the North American Bird Banding Manual, http://www.pwrc.usgs.gov/bbl/manual/sect5.htm (Gustafson et al. 1997). Observers should carry and reference the Master Species List (SOP #12: Data Entry) for unknown or uncommon species. Codes for animals other than birds should also be recorded. The most common species are included in the Master Species List for your reference.

If the observer is unable to identify an individual during a count, he/she may spend no more than 10 minutes attempting to track the bird after completing the 5-minute count. Flocks may also be followed for no more than 10 minutes to determine composition and size. Unidentified birds should be documented as such on the Point Count Data Form, with the appropriate species code that can also be found in the Master Species List (e.g., UNKN = unknown species, UNAC = unknown Accipiter species, UYRW = Unknown Yellow-rumped Warbler, etc.).

Species Name Abr: A short clear abbreviation for the bird species common name should be recorded if the surveyor is not absolutely certain of the species code. Species name should always be recorded for uncommon birds and non-bird species.

Distance: When an individual bird is detected, its distance should be quickly estimated. A bird's distance from the station is determined by visualizing a plumb bob dropped from the bird's location; the distance from the observer to where the plumb bob would touch the ground is the distance recorded. The distance recorded for each individual is the distance to where the bird was first detected, regardless of its movements during the count period. Estimate distances to the nearest meter; do not round distances to the nearest 5 or 10 m interval or estimate distances within bands.

Individuals are written down in the order they are observed. The number of individuals is recorded when more than one of a species is detected at the same moment at the same location. In this case, fill in the appropriate Distance, Detection Type, and Location in the first available

boxes, then on the same line record an "x" (times) and the number of individuals (e.g., x48 = 48 individuals of that species). If a bird flushes when the observer arrives at the point, the bird should be included according to its take-off place. If a bird is flushed within 50 m of a station's center as an observer leaves, it should be counted only if no other individual of that species was seen during the count period.

> **DT (Detection Type):** The first behavioral cue that alerted the observer to the presence of the species; S = Song, C = Call, V = Visual, W = Wing (e.g., Mourning Dove or hummingbird wing whir), D = Drumming, F = Fly over.

Here, we provide guidelines for differentiating songs from calls. Most songbirds have a typical song that is generally not confused with typical call notes. An example is the Black-headed Grosbeak, whose song can be described as a high, drunken, rolling warble and whose call is a high, sharp *pik* note. Groups of birds that we will often encounter in the field that have less well-defined songs and calls include hawks and falcons, grouse and quail, owls, woodpeckers, flycatchers, jays and crows, and chickadees (particularly Chestnut-backed Chickadee). The general rule for distinguishing between songs and calls is to defer to vocalization descriptions provided in *The Sibley Field Guide to Birds of Western North America*, with a few clarifications, as described below.

- Hawks and falcons: Never sing. Regard all vocalizations as calls.

- Grouse and quail: Low hoot of Sooty Grouse and drumming of Ruffed Grouse classified as song, all other vocalizations classified as calls. *Quark* of Mountain Quail and *Chi go* of California Quail classed as songs, all other vocalizations are calls.

- Owls: Songs are defined as the typical series of hoots a male would give when defending territory. This does not include any of the female and juvenile calls. The Northern-pygmy Owl's "submarine sonar" vocalizations and Flamulated Owl's *poop* are included as songs.

- Woodpeckers: Songs are limited to rattles for most species. Calls are defined as all contact calls, drumming, and any other vocalizations. For Northern Flicker and Pileated Woodpecker, the similar sounding *wuk wuk wuk wuk wuk* vocalizations are classified as songs; all other vocalizations are calls.

- Flycatchers: Well-defined by Sibley. Typical two and three note vocalizations from *Empidonax* flycatchers are classified as songs.

- Jays and crows: Never sing. Regard all vocalizations as calls.

- Chickadees: Song includes Mountain Chickadee's *cheeseburger*, and Black-capped Chickadee's *fee bee fee beeyee*. All other vocalizations for these two species should be classified as calls. Chestnut-backed Chickadee is more ambiguous and may not have a structured song at all; regard all vocalizations as calls.

Loc (Location): If a point count station is near a riparian area, record which detections are located in the riparian habitat with an "R." The portion of a station that is considered riparian for associating detections is determined by the presence of water or the presence of at least two riparian-associated plant species (e.g., willow, alder, etc.). As with determining distance, if the plum bob is dropped from a bird detected at the top of a conifer and falls within a portion of VCP considered to be riparian, the detection is noted as such.

Prev (Previously Detected Individuals): Individual birds that are detected during a survey, and that have been detected at a previous station, are noted with a P.

Breed (Breeding Status): Any breeding evidence observed during the count should be recorded. N = current year's Nest found with eggs or young, in the process of being built, or already depredated or abandoned; M = adult seen gathering or carrying nesting Material to a likely nest site in the study area; F = adult seen carrying Food or Fecal sac to or from a likely nest site in the study area; D = Distraction display or injury feigning by an adult bird; L = a young bird incapable of sustained flight (a "Local") in the study area or very young (stub-tailed) fledglings being fed by parents in the study area; C = Copulation or Courtship observed of a species within its breeding range; T = other Territorial behavior observed; S = territorial Song or drumming heard.

Notes: Any notes regarding unidentified birds, birds observed between points, or other useful information. Be sure and write a note explaining any unexpected or rare species detected. When applicable, notes and species code should be labeled with a number so that the note is entered in the database with the appropriate record.

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Point Count Data Form

Page ☐☐ of ☐☐

State ☐☐ Project/Region ☐ Site Code ☐ Site Name ☐ Month ☐☐ Day ☐☐ Year ☐☐☐☐

Observer ☐☐☐ Temp. (Cel.) ☐☐ Cloud Cover % ☐☐☐ Ppt. (N,F,M,D,R) ☐ Wind (Beaufort) ☐

Station	N	Time	Species Code	Sp. Name	Distance	DT	Loc	Prev	Distance	DT	Loc	Prev	Distance	DT	Loc	Prev	Breed

Notes:

rev.JLS 20070301

Precipitation (Ppt.): **N = N**one, **F = F**og, **M = M**ist, **D = D**rizzle, **R = R**ain. Noise Factor (N): **1** = No noise **2** = Moderate **3** = Too much noise, do not survey

Wind (Beaufort): **0** = calm, **1** = light air, **2** = leaves start to rustle, **3** = small branches start to sway, **4** = moderate breeze, **>4** Do not survey

Previous (Prev): **P** = Detected at previous station Detection Type (DT): **S = S**ong, **C = C**all, **V = V**isual, **W = W**ing, **D = D**rumming, **F** = **F**ly over.

Breeding Status (Breed): **N** = active **N**est, **M** = carrying nesting **M**aterial, **F** = carrying **F**ood or **F**ecal sac, D = Distraction display/feigning,

L = **L**ocal young (limited flight or stub-tailed fed by parents), **C** = **C**opulation or **C**ourtship observed, **T** = **T**erritorial behavior, **S** = territorial **S**ong or drumming.

Observer Full Name______________________ Checked________ Copied________ Entered_______

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #6: Mist Netting

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP provides the methods for conducting mist netting.

Introduction

This SOP gives step-by-step instructions for mist netting and banding birds, including completion of the data form, which is provided at the end of the SOP. The location of the mist net site is described in SOP #4: Locating and Marking Field Sites. Mist net procedures are based on standard protocols allowing contribution of data to various networks (DeSante et al. 2001, IBP 2007, KDMN 2007, LaMNA 2007, Ralph et al. 1993).

Equipment and Maintenance

Equipment

Each banding kit should have an equipment checklist that includes everything that is taken into the field, including net lane clearing and maintenance tools (SOP #1: Preparations and Equipment). Equipment and materials used in this program are expensive, difficult to replace, and should be handled with care. If any equipment is needed or requires replacement, the Project Lead should be notified as soon as possible.

Banding Kit Inventory

It is the responsibility of the Primary Bander (the bander in charge) of each crew to ensure the kit inventory is completed in a timely manner. The Banding Kit Inventory Form (see attached) is completed for each kit at the conclusion of every banding period (e.g., week, 10-day) by the crew who used it during that period. Each item on the list is necessary at one time or another, so it is important to ensure the kit is complete. Kit items that have less than the required amount (you should note this in parentheses next to each item on the form) must be replenished from the supply inventory. All equipment and materials that are removed from the supply inventory must be checked out. If any items needed are not available, the Project Lead should be notified as soon as possible so that the shortage can be resolved before it becomes a problem.

Bird Bags

Banders should always have some bird bags with them while nets are open (or being opened). Avoid placing more than one bird into a bag at a time (see NABC manual for the rare exceptions; NABC 2001a, NABC 2001b). Using a bag more than once is fine, but as it becomes overly soiled, it should be turned inside out and segregated from the rest of the bags.

At the end of a banding period, bird bags should be laundered. Turn the bags inside out and shake debris away. Loosely fill a mesh (lingerie) washing bag with the soiled bird bags (so they don't unravel or become severely tangled together) and wash on the gentle cycle in hot water with a small amount of detergent and chlorine bleach. Leave bags inside the washing bag for drying. After drying, reverse the bags so that the raw edges of the seams are on the outside. Trim excess frayed or loose threads to reduce tangling on the birds. Be sure to remove damaged bags (without strings and/or with holes or unraveled seams) that cannot be wrapped shut, or from which a bird could escape, from the kit. Repair them if possible, or else dispose.

If a suspected diseased or bleeding bird is captured, it is important to put that bag aside until it has been washed and disinfected. Also take the time to wash and disinfect your hands with the antiseptic towelettes or lotion provided in the banding kit before handling other birds or any tools and equipment. Periodically take the time to clean your hands during the banding session.

Net Repairs

Mist nets are quite expensive, but with proper handling and regular maintenance, they should last a long time. It is very important that damaged nets be repaired as soon as possible or be removed from the kit until such time they can be repaired. Damaged nets pose a danger to birds that become entangled in them. Mesh holes and broken or undone trammel lines can cause extreme tangles that unnecessarily threaten bird safety and take much longer to untangle. Net repair kits are included in each banding kit and should be out and used as frequently as is necessary. A description of common net repair techniques (Appendix A; Ralph et al. 2004) is included in this document to supplement training. Realize that nets cost about $60 each, so a half-hour of repair more than pays for itself. A good rule of thumb to determine if a net should be repaired is estimating the time necessary to complete the repair. If the repair will take about five minutes (about the time that one would spend extracting a couple birds), then repair it right away; if a longer time is necessary, then wait until after the netting session so that capture rates are not affected by net location disturbance. If banders do not have time to repair the net immediately or sometime during the banding session, then while closing the nets, mark any damaged nets with flagging. Make notes on the flagging using a sharpie pen indicating the size and location of the damage. Then, as soon as possible, repair it! Primary Banders (the banders in charge) have the responsibility to make sure that net repair, instruction, and practice are a regular part of the banding effort schedule, whether during the banding session, afternoons, or on office/maintenance days.

Net Lanes

Net lanes should be cleared of vegetation to approximately one meter on either side of the net and at least one meter above the height of an open net. Net lanes must be maintained throughout the season. Cut back any new growth so that it does not become entangled in the net. Net lanes should be discreetly marked with flagging labeled with the station code and net number written in permanent ink.

It is necessary to set up and remove the nets for each banding session. One end of the lane should be established as the fixed end and one end as the moveable end (Figure 1 A). This allows for adjustment to accommodate variations in net length and adjusting net position within the lane. You will need two 10'x ½" diameter conduit section poles, one 1'x ¾" diameter PVC pipe section, three 2'x $^{3}/_{8}$" (or ½") diameter steel rebar sections bent 90º at one end, three 8' sections of ¼" diameter unmanila (three-strand twisted polypropylene) rope, and two ¾" swivel snaps for each net. Install a PVC section at what will be the fixed end of the net lane (Figure 1 B). This should be placed at the end where there is the least public traffic. The PVC should be installed at a slight angle away from the direction the net is running. This will help maintain the pole in a vertical position against the tension of the opened net. At the fixed end, install one guy line directly in line with the net. Using the #3 mallet, drive the rebar into the ground approximately 1.5 m away from the PVC at an angle facing away from the net. Tie a section of rope to the rebar and make an adjustable slipknot at the net pole end of the rope. Measure the length of the lane using an old net, a net-length section of rope, or by pacing. Install two guy lines at approximately 120° angles to the pole, forming a triangle with the pole. The rebar stakes should be driven in at angles of 50° to 60° to the substrate, away from the net and poles at each end. If it is not possible to drive the rebar stake into the ground, as will happen at areas with a rocky substrate, the stakes must be buried, or an appropriately situated stone or tree used to anchor the guy line(s).

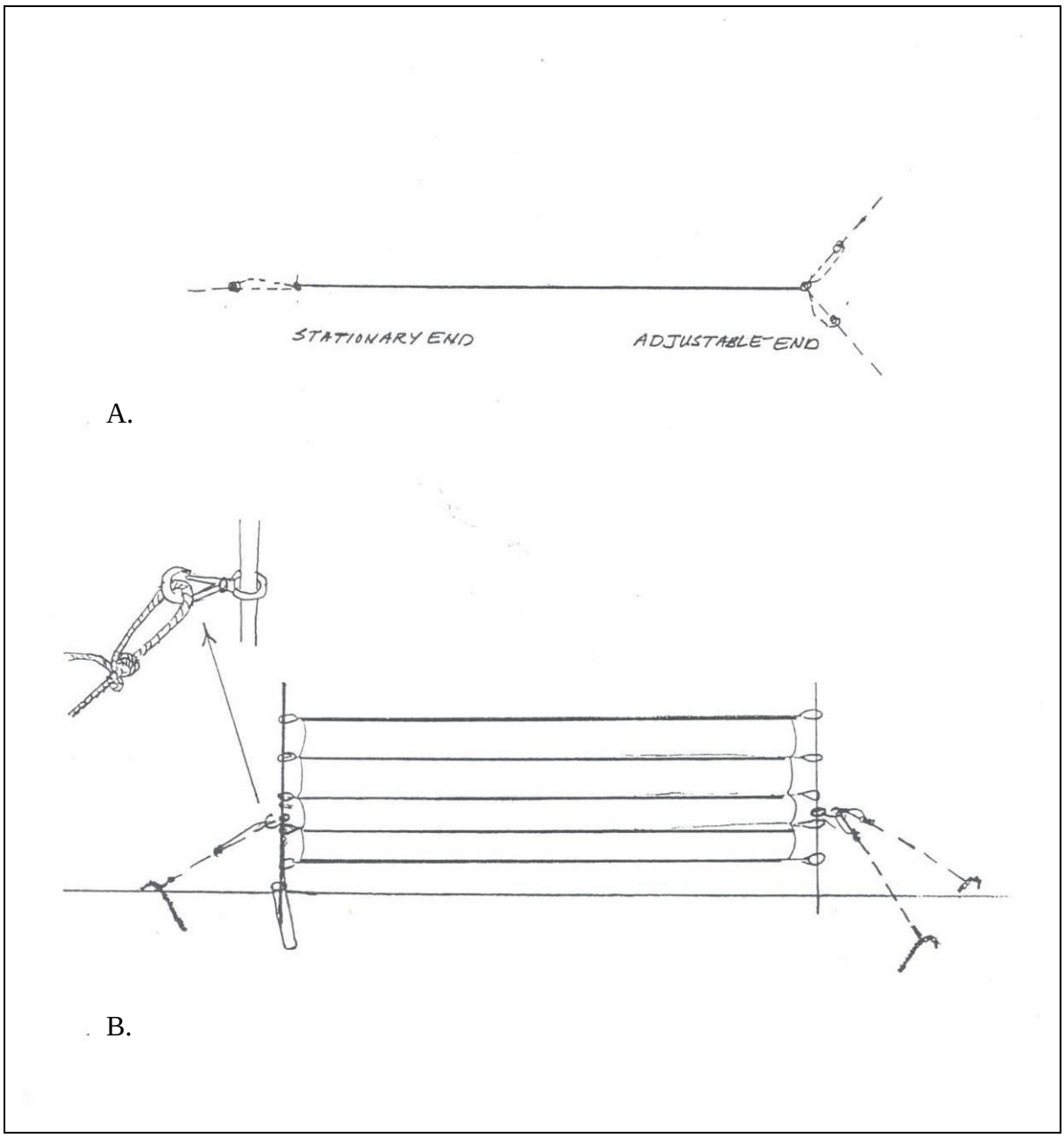


Figure 1. Net installation, shown as (A) birds eye view and (B) side view with detail of swivel snap.

Net Set-up

Using the method involving the plastic bag (Appendix B; Blackshaw 1993) and the pole-guy line-shackle arrangement described above, a net should be set up in about 2 minutes. As the net lane is approached, locate and lay out the poles and guy lines at each end of the net lane. Two ¾" shackles (a.k.a. swivel snaps) are slipped onto the poles and used to connect guy line ropes to the poles. Starting at the fixed end, insert the pole through the net loops and then put the shackle on the pole. Set the pole into the PVC and attach the guy line. Walk to the moveable end, feeding the net out of the bag as you go, being sure to keep enough tension on the net to keep it from dragging on the ground. When you reach the moveable end of the lane, place the net and then the

shackle on the pole. Usually two net loops are placed below the shackle. Attach the two guy lines to the shackle, pull the net taut, and slide the shackle up the pole to tighten the guy lines. Nets made of nylon stretch out after opening and will most likely need to be tightened on the next net check.

Since two people set up a net only slightly faster than one, it is much more efficient for banders to split up (rather than leap-frog) and work toward one another from opposite ends of the net array. However, factors such as a bander who is unfamiliar with net locations or a planned area search may make other arrangements desirable. What is important is that the nets are opened as rapidly as possible and that banders at the station are in communication with one another. The plastic (grocery) net storage bag should be left at the net, bunched up, and secured under a rock or under the rebar stake at the moveable end of the net and out of sight. It is important to stash the bag so that it is not loose to blow in a breeze and disturb nearby birds.

Trails at each station must be kept cleared of hazards such as sapling stumps, low branches, loose stones, and thorny vegetation. The trails should be safe to move quickly through without tripping and ducking. Banders should be aware that brushing against thorny vegetation such as blackberry or hawthorn could possibly injure a bird in a bag. Diligence in trimming new growth during the late spring and summer vegetation-growing season is necessary to maintain safe conditions at netting stations. If a treefall or other event causes a trail (or net lane) blockage, notify the Project Lead or support staff as soon as possible so that the problem can be resolved.

Running the Station

All banders running the stations should read and thoroughly understand the following station management procedures, The Handbook of Field Methods For Monitoring Landbirds (Ralph et al. 1993), The North American Banders' Study Guide (NABC 2001a), The North American Banders' Manual for Banding Passerines and Near Passerines (NABC 2001b), and the Introduction section (pp. 1-40) of the Identification Guide to North American Birds, Part I (Pyle 1997). The importance of the information contained in these documents cannot be stressed enough. Understanding this information will ensure consistency in station management and data collection and will protect the health, safety, and wellbeing of the birds.

Opening Nets

The objective is to operate each net for 5 hours. Banders should be at the station 20-30 minutes prior to local sunrise, begin opening the nets 15 minutes prior to local sunrise, and shut down operation so that each single net is operated for 5 hours. Be sure to have cached at each banding station (or otherwise have on hand) spare equipment (poles, rope, stakes, etc.) to get every net set up promptly every session. Banders must have bird bags and hand nipper-shears on their person at the opening and throughout the banding session for early captures and minor vegetation trimming. At least a couple net-numbered clothespins should be brought to each net at opening as well.

Rainy Day Procedures

1. If the scheduled banding session is interrupted by rain *or other events*, please use the following guidelines. This is especially important if one is at or near the end of a sampling period, or the station is very remote.

2. The major objective of a constant effort station is to usually run each net for a certain 5 hours each week or 10-day period, starting 15 minutes prior to local sunrise. If you have to close nets shy of the magic number of hours, we suggest the following, in order of priority.

3. Attempt to operate each net for the standard number of hours, within the first 7 hours following local sunrise.

4. We suggest that you operate each net for at least 1 hour within the 2 hours following local sunrise to include the maximum capture rate.

5. If possible, operate each net for a minimum of 60% of the standard number of hours (i.e., 3 hours) during the first 7 hours following local sunrise.

6. If a net or nets cannot be operated (e.g., flooding, treefall), then a temporary replacement(s) should be set up as near as possible until such time the detriment to the original net(s) is removed. Secondarily, other nets should be operated for the minimum 60% of the standard number of hours during the first 7 hours following local sunrise. Every effort should be made to restore the original net array as soon as possible.

7. If you cannot meet the above criteria, we suggest that you operate the nets on the next available day, during the hours missed.

8. At times, it is impossible to complete the netting at a station within the prescribed period.

9. In this case, we strongly suggest that you do a make-up, by operating very early in the next period, rather than not take a sample at all for that previous period. Then, to get in the netting session for the current period, wait at least 3 days before operating the nets again.

Checking Nets

1. Several factors should be kept in mind when checking nets. Nets should be checked every 20-40 minutes depending on environmental conditions, numbers of birds, and the experience level of the personnel. Environmental conditions to be considered include wind, rain, and temperature extremes (Ralph et al. 1993). If a bird is incidentally seen in a net, it should be removed immediately with the capture time recorded as the next scheduled net round. Personnel should always be in communication with each other at the station. Carry and use the two-way radios provided in the banding kit. Personnel should always carry the small pair of scissors provided in the banding kits to use in the event of an extremely tangled bird, a dropper bottle of sugar water to revive stressed hummingbirds, and hand nipper-shears for net lane maintenance pruning.

2. Most importantly, schedule the next net round and write it down as a reminder on the journal page immediately upon returning to the banding station.

Busy Day Procedure

The purpose of a busy day procedure is to provide guidelines that clearly outline steps for a Primary Bander to consider when high volumes of birds are captured at a station. When faced with large numbers of birds, the primary concern for banders is bird safety and this procedure should be implemented in order to avoid leaving a net unattended for more than 45 minutes and to avoid holding birds for more than 2 hours due to a backlog. When followed, these guidelines will allow banders to efficiently and safely deal with large numbers of birds, while assuring that the most valuable data are accurately collected. Examples of the considerations taken into account by this procedure include:

1. Data collected from capturing the more uncommon birds are more valuable than taking complete data on, or even banding common species, certainly more than 10 birds of a species; and

2. Data collected on a recaptured individual are much more valuable than data collected on newly banded individuals.

Options to consider when faced with large numbers of birds include making more frequent net rounds, adjusting the allocation of personnel, taking minimum data, and releasing birds unbanded. Specifically, we want banders to:

1. Remove birds from nets as quickly as possible, as they can remain quite healthy in shaded bags for one hour, perhaps longer under ideal conditions.

2. Take minimum data until the capture rate slows down if too many birds are encountered in nets for processing before the next round. Be sure to maintain quality of data, especially of species, age, and sex determination. If more than 10 birds of one species are captured in a day, the remainder can, but only if you have quite a few birds that day, be released without banding. Try to age and sex these birds, if possible, and always record them on the "Unbanded Birds" sheet.

3. Close two to four nets, including those with high and low capture rates, and in different habitats, if possible, if too many birds are captured even with taking minimum data. No matter which nets are closed, the normal net checking route(s) should be maintained in order to avoid confusion about which nets have been checked.

4. Try to do net rounds as quickly as possible. Every 15-20 minutes is not too often, in order to minimize each bird's net time and degree of entanglement.

5. Use personnel effectively. Two people working together can process much more than twice the number of birds that a single person can, so long as one person records for the other. If it is time for another net round and there are still birds to be processed, it is best for both people to go on the net round, rather than just one. The birds are safer and less stressed inside of the bags than hanging in the nets.

6. Close further nets if more than about 10 birds are still in bags after 1.5 hours.

7. Reopen the nets once the number of birds hanging in bags has reached about 10.

As a general rule, birds should not remain unprocessed in bags for more than 1 hour from the time they were brought to the processing station. Keep in mind that a bird could have been caught in a net immediately after the net was last checked, and the total time in a bag can be considerable.

Under certain conditions, there may not be time to fully process each bird. In these situations, the bander must at least record the band number, species, age, sex, and net number of the bird. In a given situation, the need to collect minimal data will vary with numbers and experience of the banders. Just remember, the health of the netted birds is paramount.

Processing Birds

Efficient Banding Station Set-up

One of the most critical elements in station management is setting up the banding station to run efficiently, so that you minimize any stress on the birds (and yourself!). There are many things banders can do to reduce confusion, thus increasing efficiency and bird safety, at a banding station.

1. There are benches at ORCA that are used for the banding station and provide seating and a table work surface.

2. In order to determine skull ossification accurately, additional light is essential, not optional. The banding kits are equipped with high intensity flashlights for skulling. Set up the light with the chemistry stand or hang it from a tree branch close enough to the table so that the bander can use it without moving from the processing place.

3. Set up the essential banding tools on the table and set up the references within easy reach. The birds should be hung in a sheltered place within easy reach of the bander. You should not have to get up from the table or walk to where they are hung to get under a light to skull. This is to ensure that the birds are processed as rapidly as possible.

4. Lay out the tools where you find them most accessible on a small towel or bird bag and, for easy access, put them back in the same place when you are finished using them. Be sure to set up the scale within reach so that you do not have to get up to weigh the birds. When removing birds from bags, have a spot away from the immediate processing area where you pile the empty bags. This will keep the bags out of the way of the processing, where they will be handy for the next net round.

Order of Processing

1. Certain birds should be recognized as sensitive to the capture process and processed before other birds as a priority in processing order. Banders should be very familiar with which species possibly captured at their stations can be sensitive to the capture process. At ORCA, this group of birds includes hummingbirds, kinglets, wrens, juncos, towhees, and any other bird that appears stressed. Other birds that should be considered potentially sensitive include juveniles (especially of small warblers and finches), adult females with

fully developed brood patches, and individuals that are continually struggling and/or screaming. The bags containing such birds must be marked with an orange, red, or other brightly colored clothespin. These bagged birds should be segregated at the banding table area and brought to the attention of whoever is processing birds at the time. After priority birds are completed, birds should be processed generally in order of their increasing size (e.g., Bushtits before sparrows, before tanagers, etc.).

2. Banders should always collect and record data in the order that they are on the banding data form in order to maximize processing efficiency.

Use of the Tabular Pyle

The Tabular Pyle (Sakai and Ralph 2003) binder should be out and accessible at all times during the banding session. Banders should refer to it for each species as those species are processed. The Tabular Pyle is the authoritative reference for correct species codes and recommended band sizes, in addition to being a concise, comprehensive ageing and sexing key guide. Trainers should always use it as an example for trainees and for working through every bird possible as a learning experience. The original Pyle (1997) is in the banding kit for those rare or unusual birds and for supplemental reading when time allows, but the tabular version is designed for fast reference during the banding session. Regular and frequent study of the Tabular Pyle accounts on the top 20-30 species captured will prepare banders for timely, accurate, and safe processing of captured birds.

Empidonax Flycatchers

Keying out *Empidonax* flycatchers can be challenging but fun. If at all possible, every *Empidonax* bird banded should be given a band from the string designated as the "Empid string" and recorded on the special *Empidonax* data form (see attached). This data form and the table of body and plumage characteristics in the Tabular Pyle facilitate accurate identification of this (at times) confusing genus. It is not necessary to fill in all data columns for each bird; rather, record just those characteristics which you need to arrive at a species' identification. We suggest this approach: if you have an educated guess about the species identification based on your experience, start out with those characteristics that separate that species from its conspecifics. You can stop measuring and recording when you feel confident about your decision. If you're inexperienced with the flycatchers, or you've captured a bird that refuses to fit neatly into our classification scheme, then more effort will be needed. Be prepared for waves of *Empidonax* flycatchers (and *Catharus* thrushes), and familiarize yourself in advance with the measurement techniques and special data requirements. **Do not** record a bird as "*Empidonax* species" or "*Catharus* species!" All of these birds can be identified to species with the required certainty. If you know in advance exactly which characters and/or measurements are required to separate similar species and you are overwhelmed by a wave of birds, take the minimum amount of data and later identify each bird to species based on the data you have taken. Do not put a band on a bird you will not be able to identify!

Importance of Age

Virtually all analyses of banding data first divide the birds into age classes, usually just Hatch Year (HY)/Second Year (SY) vs. After Hatch Year (AHY)/After Second Year (ASY). While plumage, molt of wing feathers, feather wear, and breeding condition can all contribute to your decision or actually determine the age, the degree of skull ossification is the most certain. All

banders should **wear** and **use** Optivisors continuously whenever processing birds. Banders should be familiar with the Target Species list (Appendix C) that classifies species that can be precision-aged (e.g., SY versus ASY, After Third Year (ATY), etc.). For other species, while it is possible to determine SY or ASY ages (and we encourage this with time and safety allowing), the minimum data should be young versus adult. Always use absolute criteria. Using questionable criteria will be less than useful and will introduce problematic variables into the dataset when age or sex categories are determined with varying degrees of confidence. If the criteria are insufficient to make correct determinations at least 95% of the time, do not waste the time trying to make a determination.

The code for "Juvenal Plumage" refers to the easily seen plumage that can be positively differentiated as juvenal versus adult. Use the code "U" if the plumage was examined, but it was unknown if plumage is juvenal or not. Use "9" if you didn't take data on plumage. Under no circumstances use a dash ("-"), as it could mean "not known" (same as U) or "9" (data not taken). Use continuation lines (diagonal from upper left to lower right) where appropriate.

Recognizing and Treating Capture-related Stress and Other Common Injuries

1. *Capture-related Stress.*--All banders must be familiar with the symptoms displayed by captured birds (see NABC 2001a). If a bird is stressed, take minimum data and release. Be certain to release such birds at ground-level and be ready to recapture the bird if it doesn't fly. If a bird is stressed to the point of inability to fly, first try gently jostling the bird or tossing the bird in the air a few inches or so back into your hand. This often gets the bird's wings moving, stimulating its heart, and releasing it from shock so it flies away. If this does not work, then activate a hand-warmer packet (follow directions on package), place it inside a bird bag to one side of the warming box (e.g., a plastic-insulated cooler pack), and place the bird inside, but not next to the warmer. Cover the open box and set it away from the banding table in a safe, quiet place. Check on the bird after 10 minutes or so. Another alternative is to place the bird in the bag and put the bag under your shirt. Eyedropper bottles and a supply of sugar are in each banding kit for hummingbirds. If a captured hummingbird is displaying symptoms of stress, banders should consider giving it sugar water. The solution to be used is 4:1 water:sugar. The solution should be offered to the bird by squeezing a drop out of the dropper and holding it at the bill tip, inserting the bill tip or tongue tip into the drop no more than a millimeter. The hummingbird's tongue is frayed and sponge-like, and if it can take the sugar water, it will at this point. If it takes the sugar water, it will very quickly be energized and be able to fly. If it does not, consider treating it in the warming box. Keep in mind that hummingbirds go into torpor and may do so as a reaction to shock, appearing dead, but delay treating as a potential specimen. Birds other than hummingbirds should never be given sugar water, as it can act as a diuretic.

2. *Wing Strain*.--Wing strain (described in NABC 2001a) can occur in the net before and during extraction and during processing. Banders can minimize this problem by following proper net check schedule procedure, using proper net extraction (especially the Body Grasp extraction method), and using proper Bander's Grip handling. Wing strain will usually be evident by one wing held noticeably lower than the other. If wing strain is suspected, the bird, prior to point of release, should be momentarily held in the Photographer's Hold and allowed to flap its wings. If the wings do not readily flap, move

the held bird up and down a few inches a few times (this will usually prompt a bird to flap its wings). If the bird has not yet flapped its wings, it should be placed into a bird bag and set in a safe, quiet place away from the banding table. Check on the bird after 20 minutes and attempt to release as above. Holding the bird for up to several hours may be necessary. The NABC manuals describe other, less common, injuries and treatments.

Priority of Data

The most important data are: species, band number, age (at least to the degree of hatching year vs. after hatching year), sex, capture time, and net location. If time permits, other data in the following order are important: breeding condition (if not noted in determining sex), wing molt, molt limits, primary wear, body molt, wing length, weight, and fat.

Recording How Aged and How Sexed

The codes for characters used in ageing and sexing birds are included in each banding kit (laminated reference sheet) and in Appendix D. As our knowledge of ageing and sexing birds develops, some characters may prove to be more or less useful than we now understand them to be. By recording at least two characters used in determining age and sex, we have found that age and/or sex ratios may be recalibrated by checking the data that have been recorded. Further, for data analyses, it may also be useful to note whether a spring bird was aged AHY based on inconclusive results after carefully examining the bird, or if it was not carefully examined and quickly processed due to a backlog of birds. The process of recording "how aged and how sexed" codes provides increased flexibility and greater resolution in describing age and sex determinations. It also provides lesser-experienced banders a simple and easily remembered basis for their data collection.

The most definitive characters should be used and recorded. Banders should especially pay attention to the detail of what plumage is observed in birds and use the most precise code possible. Banders should note that the use of several codes requires an accompanying note, e.g., "Q, Y, L, W, V, M, O, and Z."

Whenever molt limits are looked for, a code should be recorded in the "Molt Limit" fields (e.g., no molt limits found, record "0;" molt limit in greater coverts found, record "G"). Banders should record all molt limits found (e.g., if more than two limits are found, record in notes).

The use of the "0," "U," "Z," and "9" codes are very helpful in analyses examining whether characters are useful for ageing and/or sexing. The use of "Z" should include a note on what the suspected age/sex is and what the conflicting characters are.

Recording Wing and Tail Molt

Wing molt should be recorded as symmetrical or adventitious in the data fields on the front of the form. The presence of tail molt should be recorded only in the notes on the back of the form. The details of both wing and tail molt should be recorded using the standardized notion method. The letter "P" denotes primaries, "S" denotes secondaries, and "T" denotes tail. The letters "L" and "R" indicate left or right, respectively. The feathers are also numbered in the standard manner as in the introduction to Pyle (1997). The letter "G" indicates that the specified feather is growing and the letter "X" indicates that the feather is missing. If the feathers missing or growing are in sequence, e.g., numbers one through five are growing, the numbers are recorded

forwards (“15”) to include all the feathers. If the feathers are not in sequence, e.g., numbers one and five are growing or missing but not the feathers in between, then the numbers are recorded in reverse order (“51”). For example, you capture a bird that has primaries one through five, secondaries three and six, and the left tail feathers one through three are missing. This would be recorded in the notes in the following manner: “P15S63G, TL13X.” All molting or missing flight feathers should be recorded, including those that may have been dropped by the bird during capture or handling. Be sure to include a note indicating if you were aware that feathers were lost during capture or processing.

Recording Notes

Notes should be made about specific plumage characteristics and measurements taken in addition to the normal data recorded on the front of the form, for example the length of the crown patch of an Orange-crowned Warbler or other criteria used to make age and sex determinations (see Table 1). Make notes as concise as possible and use the standard abbreviations found in Pyle (1997) p 732. When referring to a figure in Pyle, record the note as “Pyle Fig ### = X.” If a feather sample was collected or a photo taken, record this in the notes. Note any injuries, malformations, or deformities, especially if a status code other than N (Normal) is used. All unbanded birds should have a note explaining why the bird was released unbanded.

Bands and Band Sizes

1. Birds should always be banded with the best-fitting size band. Refer to the band size reference for top 50 species captured (Appendix E). Band sizes for species not listed in this reference are listed in Pyle (1997) and the Tabular Pyle. The sizes listed are those recommended by the USGS Bird Banding Laboratory. If in doubt, and after measuring the tarsus, a bander determines that a size other than those recommended should be used, then a note that includes tarsus minimum and maximum width (to the nearest 0.1 mm) should be recorded.

2. Bands that are determined to be unreadable and replaced (Band Code C=Changed) must be taped to a sheet of paper with the readable digits, species, station, date, and replacement band number written and this information given to the field crew leader as soon as possible. It is very likely that the Bird Banding Laboratory will be able to discern the original number through an etching process.

3. Bands that are determined to be unsafe to the bird should be adjusted or replaced accordingly. When a band is changed, the OLD band is recorded on the recapture page with band code = “R.” The NEW band is recorded on the new band sheet with the band code = “C.” Notes referencing the matching band numbers should be recorded on both sheets. The new sheet should reference the OLD band number and the recap sheet should reference the NEW band number.

4. Bands should not be placed regularly on either the right or left legs, but on whichever is handy and available. Banders must be in the habit of inspecting both legs for an existing band.

Table 1. List of measurements to be recorded by genus or species.

Genus/Species	Data
Selasphorus	Special data form for *Selasphorus* Hummingbirds.
Empidonax	Special *Empidonax* form.
Barn Swallow	Tail formula; record as “Pyle Fig. 209 = ##mm.”
Bushtit	Iris color; record as “iris = light, iris = dark.”
Ruby-crowned Kinglet	Presence of red in crown; record as “C = red.”
Golden-crowned Kinglet	Presence of orange in crown; record as “C = org.”
Wrentit	Outer iris color; record as “outer iris = __.”
Orange-crowned Warbler	Length of concealed crown patch; record as “C = ## mm.”
Nashville Warbler	Length of concealed crown patch; record as “C = ## mm.”
Wilson’s Warbler	Length of crown patch and percent green of crown patch.
White-crowned Sparrow	Color of bill, underwing coverts, and thighs; percent black of crown stripes; width of central crown stripe.
Golden-crowned Sparrow	Crown plumage from Pyle Fig. 300; record as “cr = [A-D].”
Oregon Junco	Percent brown of nape.
Yellow-breasted Chat	Color of roof of mouth and lores; record as “mouth = __; lores = __.”

Rare Birds

All Primary Banders should be familiar with the diagnostic characteristics of the top 30-50 species commonly captured and they should be aware of any similar, less-common species. When you capture an unfamiliar, unusual, or uncommon bird, document it with a photograph, using a camera with a close focus function. The bird should be held in front of a uniform background with a label with the date, location, and the last three digits of the band number. Be sure to show diagnostic characters. At the very least, take a side view with the back wing flared up to show molt and upper coverts. A top and bottom view would be advantageous. If you do not have a camera, a thorough written description covering all the major plumage areas (e.g., upper parts, undertail coverts, etc.) and color of body parts (including bill and legs) should be taken. Birds that can’t be readily identified should be processed completely and photographed. The pictures should be noted in the notes section on the banding sheet and the film rapidly processed.

Mortalities

In the course of capturing birds, and despite of every precaution being taken, some mortalities may occur. Also, while working in the field, or at other times, you may encounter dead birds or be presented one by the public. While these birds’ demise is unfortunate, it presents an invaluable opportunity to contribute greatly needed study specimens to scientific collections and training programs. It is essential to take preliminary actions in order to preserve these specimens’ value; otherwise, a great life is lost a second time.

Specimens must be frozen as soon as possible. If you are more than an hour or so from a freezer, keep the wrapped and bagged specimen in an ice chest or cooler (or, at the minimum, in the

shade). **Please keep in mind that these specimens are not of study value without the information listed below recorded on the wrapping and also on the outside of the plastic bag.** In order to protect feather condition and shape, the bird must be rolled up in a piece of (appropriate-sized) clean paper with each end folded over toward the center of the bird, without disturbing the rectrices and head plumage. The carcass should be arranged with the wings at resting position and the legs directed towards the tail. If possible, fill the mouth with cotton (to absorb fluids). The wrapped specimen must then be placed into a plastic bag, preferably a sealed zip-lock freezer bag. Specimens derived of netting/banding activity should be recorded as Unbanded birds. Keep specimens in the field residence freezer and arrange for transport with the Project Lead.

Information that must be recorded for each specimen (on paper wrapping and on plastic bag): species (write out common name), age and sex (if known), date (day/month [three-letter abbr.]/year), location (include County), cause of death (probable if not known), and your name.

Closing the Nets and Leaving the Site

Personnel should be familiar with adverse conditions that may require early closing of nets as described in Ralph et al. (1993). These include rain, high winds, strong sun, or predator presence. Be sure to remove all twigs, leaves, feathers, etc. from the net before closing. This will greatly reduce the incidence of tearing nets while opening. Identify damaged nets with flagging marked with a permanent felt pen describing the extent and location of the damage (see Net Repairs section).

Be sure to disguise your presence as much as possible, by hiding ropes under rocks, using minimal flagging, and putting poles under brush. Wrapping and hiding the rope also keeps animals from becoming entangled. Place a stick into the PVC pipe to keep dirt and little critters out of the pipe. Count the bagged nets **BEFORE** stowing to ensure that all of the nets have been taken down. Be certain that this last step is followed, as it is the only way to be certain that no nets have been forgotten at the station before leaving (without walking the entire circuit again).

The poles should be hidden in a standardized location at each station. This is to ensure that people filling in for the regular crew can easily find the poles. They should be cached at the end of the net lane and on the side of the lane that is away from the trail that a visitor would be likely to see. If that location is not available for hiding the pole, choose the next least visible place. Be sure that all the hiding spots are well marked on the station map. Always bring a copy of the station map with you when opening and closing to ensure that the poles are stashed in the designated locations.

Visitors and External Relationships

Permits must be in each kit. If near a campground or where visitors are encountered, banders should introduce themselves and the ongoing netting work. If an adverse situation is perceived or anticipated, the Project Lead or support staff should be contacted and nets closed. Ninety-nine percent of encounters with the public will be very positive; banders should take advantage of the situation to educate the public as to the work we do and how it benefits birds.

Take visitors on net rounds with two banders so that if one bird is difficult to remove, the other bander can move on ahead with the visitors. Confine visits to nets to the last half of the morning,

and never when there are so many birds that you consider taking minimum data. Make appropriate apologies, but under no circumstances should visitors go on net rounds alone or when they may endanger the birds' safety.

Data Recording

Daily Mist Netting Journal

Record the following:

1. Station name: Record the name of the station (e.g., Oregon Caves).

2. Station code: Record the four-letter code for the station name (e.g., ORCA).

3. Day and date: Record the day of the week (e.g., Monday), as well as the date. Please spell out the month.

4. Time open: Record the time you commenced opening and the time opening was completed.

5. Time closed: Record the time you commenced closing and the time closing the nets was completed.

6. Nets run: Record each net opened, noting any individual net locations that were not opened. Record in the notes section the reason for any nets not opened or the times nets were opened or closed if different from the general open and close times for the array.

7. Total number of nets run: Record the total number of nets opened in the array on that date.

8. Net runs: Record the time each net round was started.

9. Banders: Record the complete names of all banders.

10. In each of the three time intervals (open, mid, close): Record (1) Percent cloud: Estimate the percent of cloud cover to the nearest 10% in each of the three intervals. (2) Precipitation: None (N), Fog (F), Mist (M), Drizzle (D), Rain (R) (Ralph et al. 1993). Include any descriptors such as light, heavy, steady, or intermittent. (3) Temperature: Record temperature in centigrade using the thermometer provided with your kit. (4) Wind: Record wind using the *Beaufort* scale (Appendix F).

11. Notes: Record any unusual or interesting occurrences, visitors' names, problems encountered, etc. Also record plants flowering or fruiting and all birds singing or seen carrying nesting material or food. Note when area searches were conducted and who did them.

12. Number of birds captured: Cross check totals on back of form with a second, approximate count from data forms.

13. Other species detected: Record additional bird species not captured or detected on area searches.

Banding Data Form

Refer to the sample completed form (Appendix G). Be sure to completely fill out the headings on the top of each form. Please only record bands from a single string on a banding form. When starting a new string, always start a new form. This will help ensure that band numbers are recorded and computerized correctly and will facilitate data filing, band inventory, and reporting. Lost or destroyed bands should be recorded in sequence on the new band sheets. Please record the code ("L" for lost and "D" for destroyed), band number, date, and location. Record "BALO" or "BADE" in the species code field and write "Band lost" or "Band destroyed" in the notes section. After the last band of a string is used, the form should be discontinued with "end of string" written following the last band record. Never record bands from more than one band string series on a single form, no matter if is the same size (but different strings) or different band sizes. This causes great confusion in data management and record keeping; another data form must be used.

Completed Forms

When a data form is completed, it should be immediately removed from the data book and filed in the binder in the section for completed forms. When the banding kit returns to the field residence, completed banding, journal, and area search forms must be removed from the kit. Completed forms must be proofed by the Primary Bander and two photocopies made. Photocopies should be double-sided with the notes on the back of the copy. Be certain that the copies are clearly legible (use a dark exposure setting). When the original form is copied, initial the "Copied by" space. The original forms should then be filed in a safe place until such time that they can be hand carried to the Project Lead. The journal forms should be organized by station, then by date. The banding forms should be filed in order by band size, then band number for new bands, and by date for hummingbirds, recaptures, and unbanded birds.

Literature Cited

Blackshaw, S. R. 1993. An improved method of net handling and storage. North American Bird Bander **18**(2):49-50.

DeSante, D. F., K. M. Burton, P. Velez, and D. Froehlich. 2001. MAPS manual: 2001 protocol. The Institute for Bird Populations, Point Reyes Station, CA.

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Ralph, C. J., G. R. Geupel, P. Pyle, T. E. Martin, and D. F. DeSante.1993. Handbook of field methods for monitoring landbirds. Gen. Tech. Rep. PSW-GTR-144. Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture, Albany, CA.

Ralph, C. J., K. R. Hollinger, and R. I. Frey. 2004. Redwood Sciences Laboratory and the Klamath Demographic Monitoring Network mist netting station management procedures. U.S. Department of Agriculture, Forest Service Pacific Southwest Research Station Redwood Sciences Laboratory, Arcata, California. Copies available from Klamath Bird Observatory, Ashland, OR.

Sakai, W., and C. J. Ralph, editors. 2003. The Tabular Pyle. Klamath Bird Observatory, Ashland, OR.

KBO Banding Kit Equipment and Materials Inventory Checklist
Kit ID ___ Checked By ___ Date __/__/__

___ TOOL BAG

___ Hedge Shears (1)
___ Hand Pruners (2)
___ Hammer, 3# (1)
___ Hand Saw (1)
___ Work Gloves (2)
___ Spare PVC (2)
___ Rope, 1/4" 8' lengths (6)
___ Ring Clamp Stand (1)
___ Ring Clamp (1)
___ Plastic Tarp (1)
___ Foghorn, handheld (1)
___ Flagging (2)
___ First Aid Kit (1)
___ Insect Repellant (1)
___ Tecnu (1)
___ Hand Sanitizer (1)
___ Orange Caps (2)
___ Orange Vests (2)
___ Duct Tape (1)
___ Wooden Band Can Holder (1)

___ Birdbags Meshbag

___ Birdbags 6" x 10" (60)
___ Birbags 10" x 14" (5)
___ Small Towel (1)

___ Banding Tool Bag

Bands

___ Size 0A (200)
___ Size 0 (300)
___ Size 1 (200)
___ Size 1B (200)
___ Size 1A (200)
___ Size 2 (100)
___ Size 3 (25)
___ Size 3A (10)
___ Size 3B (10)
___ Size 4 (10)
___ Size 4L (10)
___ Size 5 (10)
___ Size 5L (10)

Banding Tools

___ Band Pliers 0-1A (2)
___ Band Pliers 2-3 (1)
___ Band Pliers 3B-3A (1)
___ Leg Gauge (1)
___ Needle-nose Pliers (1)
___ Lineman's Pliers (1)
___ 4" End-nippers (1)
___ Calipers, dial (1)
___ Wing-rule 15cm (2)
___ Wing-rule 30cm (1)
___ Band-cutter Scissors (1)
___ Circlip Pliers (1)

___ Tupperware Container

___ Weighing Cups (1 set)
___ Mechanical Pencils, # 0.7 (2)
___ Refill leads tube, # 0.7 (1)
___ Eraser (1)
___ Regular Wood Pencils (2)
___ Pencil Sharpener (1)
___ Sharpie Pen (2)
___ Orange/Red Marker (1)
___ Folding Scissors (2)
___ Scotch Tape (1)
___ Feather Envelopes (25)
___ Super Glue (1)
___ Lighter (1)
___ Rubber Bands (20)
___ Plastic Baggies (25)
___ Cotton Balls (3)

___ Small Cooler Pack

___ Hand Warmer Packs (12)
___ Electronic Scale (1)
___ Flash Light (1)
___ Camera (1)
___ 2 way Radios (3)
___ Calculator (1)
___ AAA Batteries (6)
___ AA Batteries (16)
___ C Batteries (4)
___ 9V Batteries (2)

___ NET BAG

___ 36 Mm, 12m Nets (15)
___ 3/4" swivel-snaps (32)
___ Plastic Net Bags (25)
___ Clothes-pins (White), # 1- 13 (5 of each)
___ Clothes-pins (Red), # 1-13 (5 of each)
___ Clothes-pins, blank (5)
___ Net Repair Kit (1)

___DATA BAG

___ Thermometer (1)
___ Skull Water Bottle (1)
___ Eye Drop Bottle (2)
___ Sugar Packets (4)
___ Optivisors with Cloth Bag (2)
___ Pyle 1997 (1)
___ Sibley Guide to Birds (1)
___ Metal Clipboard (1)
___ Regular Clipboard (1)
___ Tabular Pyle Keybook (1)

___ Data Binder

Data Forms

___ Mist netting Journal (20)
___ Banding Data (20)
___ Empidonax Data (3)
___ Hummingbird Data (3)
___ Area Search, 2-sided (20)
___ KBO Species Checklist (20)
___ Veg/ Location Form, 2-sided (25)
___ Blank Paper (15)
___ Lined Paper (15)
___ Kit Inventory Forms (3)

Code Sheets, Laminated

___ Banding Code Reference Sheet
___ Bird Topography
___ Skull Ossification Chart
___ Sp. Code/ Band Size
___ Target Species List/
___ How Aged/Sexed Codes (1)
___ Skull Ossification dates and Number of Primaries Reference Sheet (1)

Maps and Directions

CABN	WOOD	REBA	TOPS
ORCA	INVA	ODES	WILL
SBRR	GERB	ANT1	HOCK
JOHN	SNCO	HAMI	7MIL
WIIM	SFRD	WIWI	

Permits (Current/Nonexpired)

Master (USGS)
Subpermit (USGS)
Scientific Taking Permit
Refuge Permit

___ Reference Binder

___ Current Banding Schedule
___ Sunrise Schedule
___ KBO Contact List
___ Red Book
___ Purple Book
___ Blue Book
___ The Handbook of Field Methods for Monitoring Landbirds (Ralph et al. 1993)
___ The North American Banders' Study Guide (North American Banding Council, 2001a)
___ The North American Banders' Manual for Banding Passerines and Near Passerines (North American Banding Council, 2001b)
___ The Instructor's Guide to Training Passerine Bird Banders in North America (North American Banding Council, 2001c)
___ The Trainer's Syllabus (Ralph et. al 1993)

___ FIELD VEHICLES

___ Poles (6)
___ Spare Stakes (6)
___ Oregon GazeteerSpare PVC (2)
___ BLM Forest Service Maps
___ Full Size Shovel
___ Axe
___ Fire Extinguisher

CHECKED BY:_____ DATE:____/____/____ COMPUTED BY:_____ DATE:____/____/____ BITID:

KLAMATH NETWORK EMPIDONAX BANDING SHEET State:[ ][ ] Year:[ ][ ][ ][ ] Bandsize:[ ][ ]

[redacted]				AGE:		After Second Year	O	SEX:		STATUS:	
New Band	N	Decreased	D	Local	L	Third Year	T	Male	M	Normal	N
Repeat	P	Band Lost	L	Hatch Year	H	After Third Year	V	Female	F	Color Band	C
Unbanded	U	Band Changed	C	After Hatch Year	A	Undetermined	U	Undetermined	U	Injured	I
				Second Year	S	Recaptured	X	Recaptured	X	Dead	D

EMPIDONAX

RECORD	BANDER	CODE	BAND NUMBER	SPECIES NAME ABBREVIATION	SPECIES CODE	AGE	HOW AGED	SEX	HOW SEXED	SKULL	CP	BP	FAT	B.M.L.T.	MOLT INTENSITY	PRIMARY MOLT LIMITS	WING	WEIGHT	STATUS	MO	DAY	CAP TIME	STATION	NET STR #	NOTE #
																		.							1
																		.							2
																		.							3
																		.							4
																		.							5
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																		.							7
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																		.							12
																		.							13
																		.							14
																		.							15
																		.							16
																		.							17
																		.							18
																		.							19
																		.							20

ENTERED BY:_____ DATE:____/____/____ DATABASE NAME:_____ SCHEDULED BY:_____ DATE:____/____/____ (Created on 5/7/03)

KLAMATH NETWORK EMPIDONAX NOTES

Colors

Black = K	Olive = O
Brown = N	Pink = P
Dusky = D	White = W
Green = R	Yellow = Y
Gray = G	

Eye-ring Shape (use 1-2 codes)

Absent = A	Complete = C
Indistinct = I	Broken = B
Distinct = D	Round = R
	Tear Drop = T

Yes = Y
No = N

Outer Web of [illegible]
No Contrast = N
Slight Contrast = S
Marked Contrast = M

Band #	Upper Jaw Color	Under Jaw Color	Throat Color	Chin Color	Leg Color	Eye Ring Shape	Eye Ring Color	Lower Mandible (Base)	Lower Mandible (Tip)	Bill (from nares)	Bill Width	Longest p – Longest s	Longest p – p6	+/- p6p10	p8p5	+/- p10p5	p10p4 (>, <, =)	p6 Emarginated?	Tail Length	Wing – Tail	r6 – r1	Outer Web of [illegible]	Notes:
1										.	.	.	.	.	.	.							
2										.	.	.	.	.	.	.							
3										.	.	.	.	.	.	.							
4										.	.	.	.	.	.	.							
5										.	.	.	.	.	.	.							
6										.	.	.	.	.	.	.							
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12										.	.	.	.	.	.	.							
13										.	.	.	.	.	.	.							
14										.	.	.	.	.	.	.							
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16										.	.	.	.	.	.	.							
17										.	.	.	.	.	.	.							
18										.	.	.	.	.	.	.							
19										.	.	.	.	.	.	.							
20										.	.	.	.	.	.	.							

Crosswalk 05/14/03

ENTERED BY:_____ DATE:____/____/____ DATABASE NAME:_____

KLAMATH NETWORK MIST NETTING JOURNAL

Station name: _____ Station Code: ☐☐☐☐

Month: ☐☐ Day: ☐☐ Year: ☐☐☐☐

Net site numbers: ____ - ____ Total # of nets: ____ Time open: ____ - ____ Time closed: _____ - _____

Net Rounds _____, _____, _____, _____, _____, _____, _____, _____, _____,
_____, _____, _____, _____, _____, _____, _____, _____, _____,

****

USE FOR NETS OPENED LATE OR CLOSED AND REOPENED DURING THE BANDING SESSION:

Net site #'s: _____ Time open: _____ Time closed: _____ Time open:_____ Time closed: _____

Net site #'s: _____ Time open: _____ Time closed: _____ Time open:_____ Time closed: _____

Net site #'s: _____ Time open: _____ Time closed: _____ Time open:_____ Time closed: _____

Net site #'s: _____ Time open: _____ Time closed: _____ Time open:_____ Time closed: _____

****

Area search letter ___@ _____ by :_____; Area search letter ___@ _____ by :_____;

Area search letter ___@ _____ by :_____; Area search letter ___@ _____ by :_____;

Area search letter ___@ _____ by :_____; Area search letter ___@ _____ by :_____;

****

Banders:

_____ _____

_____ _____

_____ _____

WEATHER	OPEN	MID	CLOSE
Cloud Cover %			
Precipitation			
Temperature ºC			
Wind/Beaufort			

Precipitation: **N** = None, **F** = Fog, **M** = Mist, **D** = Drizzle, **R** = Rain
Wind (Beaufort): **0** = calm, **1** = light air – rising smoke drifts,
2 =leaves start to rustle, **3** = twigs start to sway, **4** = moderate breeze – small branches move

BIRDS CAPTURED	
Recaptures	
New Birds	
Unbanded	
Total Captures	
Number of Species	
Number stressed	
Number Injured	
Number Mortalities	

NOTES: _____

_____

_____

_____

_____

_____

Month: ☐☐ **Day:** ☐☐ **Year:** ☐☐☐☐ **Station Code:** ☐☐☐☐

BIRDS CAPTURED:

Species Code	Recaptures	New Bands	Un-banded
Totals			

Species Code	Recaptures	New Bands	Un-banded
Totals			

NOTES (cont.): _____

CHECKED BY: _____ DATE: ____/____/____ CORRECTED BY: _____ DATE: ____/____/____ BIT ID: _____

KLAMATH NETWORK BANDING SHEET

State: ☐☐ **Year:** ☐☐☐☐ **Bandsize:** ☐☐

COOPERATOR:

☐☐☐☐

CODE:				AGE:		After Second Year	0	SEX:		STATUS:	
New Band	N	Deceased	D	Local	L	Third Year	T	Male	M	Normal	N
Repeat	R	Band Lost	L	Hatch Year	H	After Third Year	V	Female	F	Color Band	C
Unbanded	U	Band Changed	C	After Hatch Year	A	Undetermined	U	Undetermined	U	Injured	I
				Second Year	S	Not recapped	X	Not recapped	X	Dead	D

PROCEDURE	BANDER	CODE	BAND NUMBER	SPECIES NAME ABBREVIATION	SPECIES CODE	AGE	HOW AGED	SEX	HOW SEXED	LEVEL	CP	BP	FAT	BLT.	WING 1	WING 2	MOLT	LIMIT	WING	WEIGHT	STATUS	MO	DAY	CAP TIME	STATION	NET NUM #	# RECS
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BANDER'S AND RECORDER'S NAMES:

ENTERED BY: _____ DATE: ____/____/____ DATABASE NAME: _____ SCHEDULED BY: _____ DATE: ____/____/____ (Created on 5/7/03)

Note #	Notes:

Appendix A. Instructions for Repairing Mist Nets.

MIST NET REPAIR 101

(for smaller tears)

As banders, we all start out handling mist nets with extreme caution; over time we learn what stresses our nets will tolerate. Most of us have experienced the dismay of creating holes, either through our own carelessness or from having to cut out a badly tangled bird [or bat]. We can ignore a few smaller holes, but at some point the net must be either fixed or discarded. (Before you begin, consider the net's age and overall condition; a fragile, sunburned old net isn't worth the effort.) However, price and availability being what they are today, you may find that fixing mist nets isn't really that difficult.

I discovered a wonderful tool used by coastal fisherman to repair their cast nets. It's a small plastic shuttle that can be loaded with black, one-ounce nylon thread ("button" thread,) which works well for small tears in almost all mesh sizes and deniers. As you learn to use it, you'll find this tool indispensable. [Shuttle and thread are available from Avinet.]

Working on a calm, overcast day is easiest on the eyes and temperament. For your repair session, you'll need a loaded shuttle and scissors. The net should be tightly stretched and opened as wide as possible so the mesh pattern can be followed more accurately. If "bag" interferes with the repair spot, try pinning up the excess by weaving a long straw of grass into the sagging upper panel. When you're finished, the straw can be drawn out quickly and easily.

Trim small torn threads away from the edges of the holes. Start your work with a solid knot on sound thread at one side of the hole. If it's a simple hole following a straight line, you can simply whipstitch it shut (fig.1.) Be sure to pass your shuttle through original netting that hasn't been damaged by the force of the tear. Make a concluding knot, and you've fixed the hole! More complicated holes require following the tear pathways individually; fox one path at a time, knotting it off, until you've closed the entire hole. If the tear is longer than 5 or 6 inches, you'll need to stabilize your thread as you progress. Just use the shuttle to create a square knot that involves your thread and the net; this keeps the net from gaping along the length of your repair thread.

MIST NET REPAIR 102

(for larger holes in large-mesh nets)

So you say a DEER went through your mist net? (This really did happen to one of our 4" - mesh owl nets when I was working at Whitefish Point Bird Observatory in Michigan.) Whether made by a deer, hawk or the neighbor's dog, large holes are a nightmare.

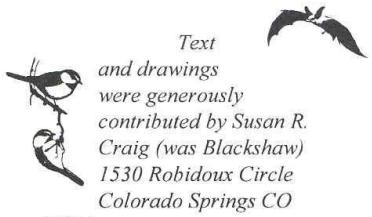
As before, trim away torn and damaged thread from the edges of the hole. If you decide that a hunk of net is actually missing, stand back and try to imagine how much net is involved. You're going to rebuild the missing net (fig. 2.)

First, from the spool of 1 ounce, black nylon thread, measure out a length of thread twice as deep as the hole, then double that before cutting. Cutting ample lengths of thread helps avoid unnecessary knots, which interfere with the net's performance. Double the thread, letting the two cut ends hang down. Secure the loop at the top into sound netting at the top of the hole. You should now have two threads, attached at one point only, hanging from the top of the hole. Repeat this process across the top of the hole, matching your knots to the mesh pattern.

Don't use the shuttle for this reweaving technique; just tie your knots, threading through mesh as you go along. Start reweaving from the top center; this allows you to judge more accurately the size of the repair patch needed. Starting from the side may be confusing, resulting in an awkward, baggy patch.

Select one thread from each of two adjacent hanging double threads; at their intersection, make a simple knot with sides matching the net's mesh (see knot detail, fig. 2.) Continue horizontally through one row of knots, matching mesh size and pattern of the net. Continue this to the second, third, etc., rows. If the hole is oval shaped, you can add more hanging threads as your work progresses downward. When your reweaving contacts the sides of the hole, simply knot into them as the mesh pattern dictates. The repair patch will slowly grow to fit the hole. Upon reaching the lower edge of the hole, tie thread ends into the edge, and trim long ends.

Although this task seems rather formidable, you'll find that large holes CAN be repaired.



Text and drawings were generously contributed by Susan R. Craig (was Blackshaw) 1530 Robidoux Circle Colorado Springs CO 80915

REP-KIT.WPD 1/98

Fig. 1

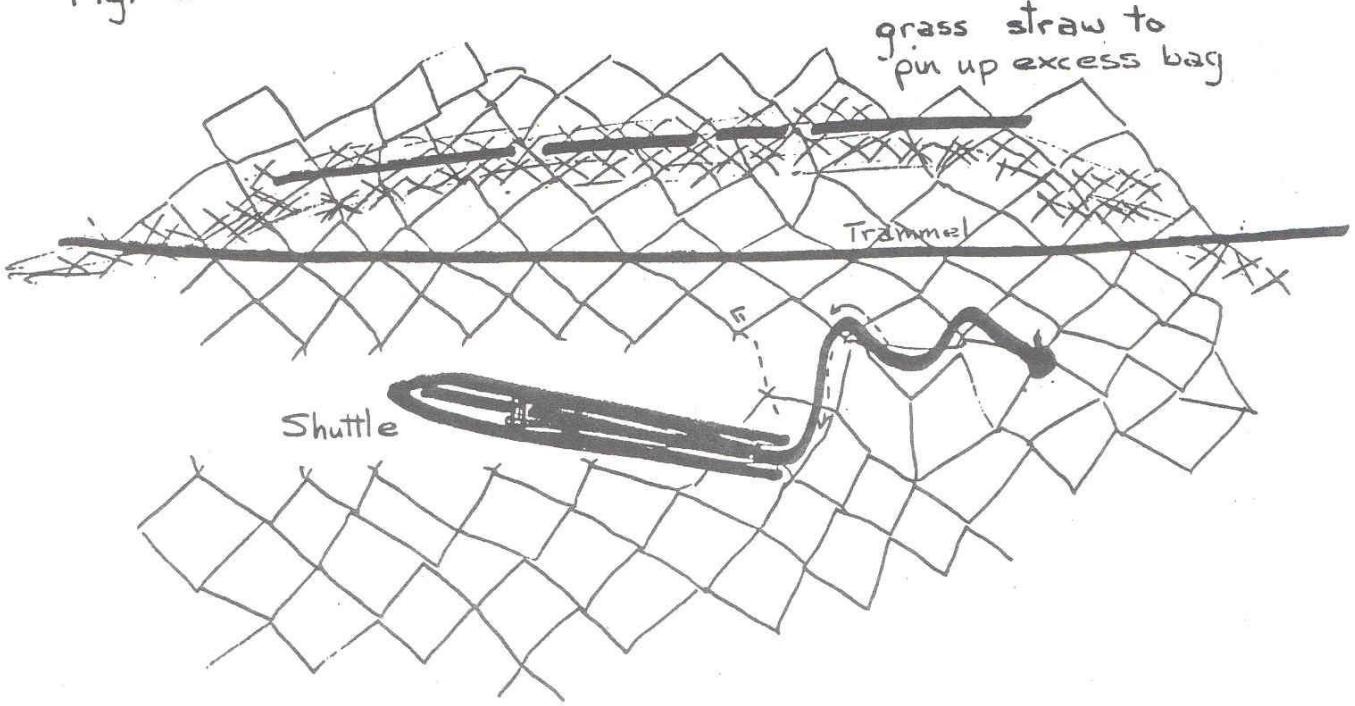
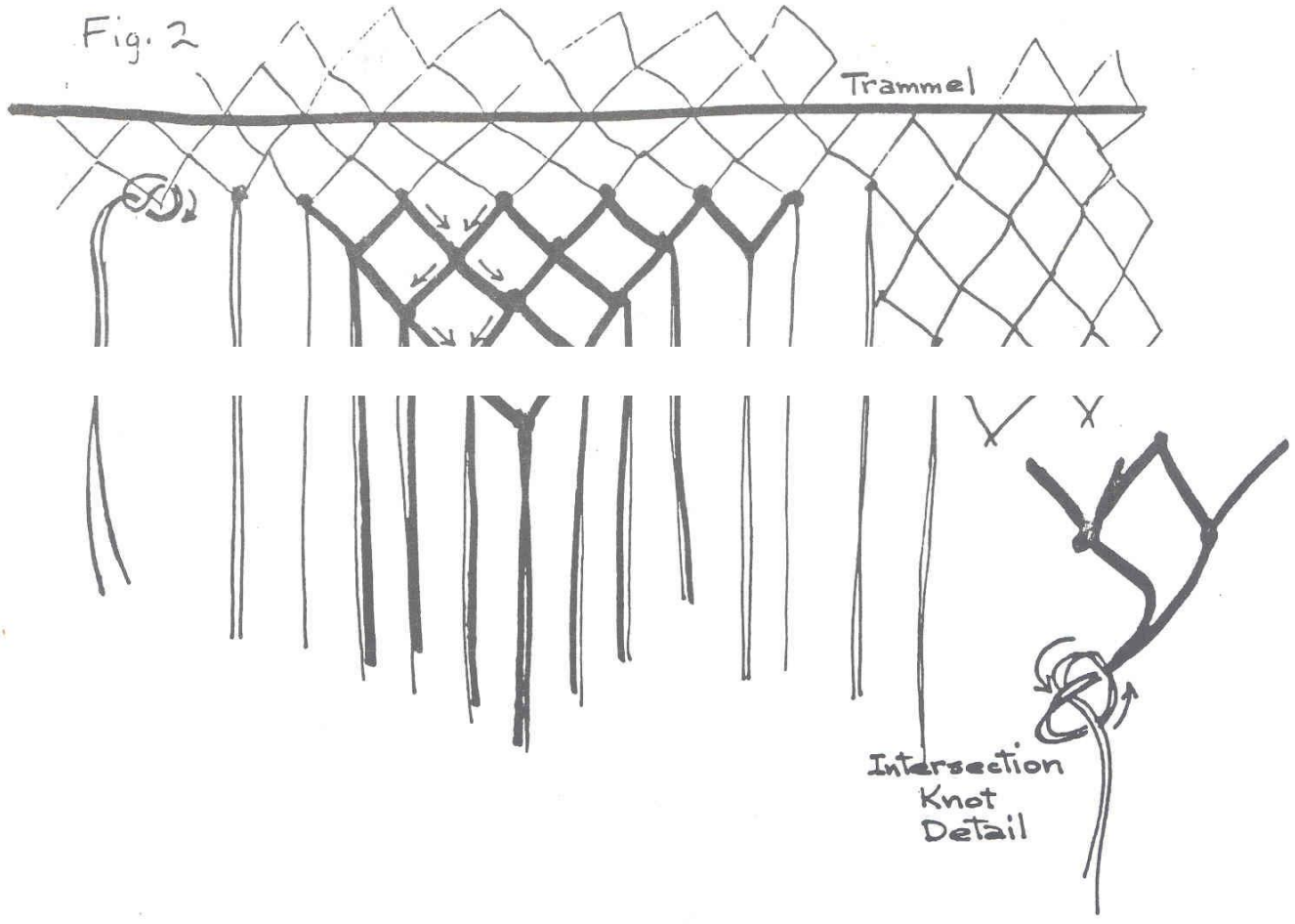

grass straw to
pin up excess bag
Trammel
Shuttle

Fig. 2


Trammel
Intersection
Knot
Detail

Loading the needle

The netting needle is a beautifully functional tool, designed to hold conveniently until required, and to serve easily when needed, as long a length of string as possible; for the fewer joining knots there are the better.

You will find it best to cut off a measured length of string before loading the needle, so that the twist produced as you load will run off at the free end. This will not be possible of course in the early stages when you do not know the capacity of the needles, so load direct from the ball in the first instance, cut off, unload the needle and measure the length of the string. Mark this by some permanent mark in the room and after this you can cut the required length of string to load the needle fully but without overloading and what is more the string can be laid out on the floor to untwist as you load.

The actual loading hardly needs any detailing as the needle is really simple.

1. Hold the needle in the left hand with the point upwards.

2. Hold the end of the string anywhere on the body of the needle with the left thumb.



a

Fig. 11

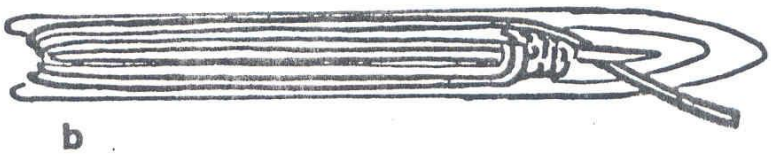
3. Run the string up the body, round the prong and down the same side of the body to trap the starting end of the string (Fig. 11a).

Note
The needle is flexible so by pressing on the point of the needle with the right hand the prong is left clear and the string can be run round it easily.

4. Take the string round the bottom or heel of the needle, between the two projections.

5. Turn the needle back to front, still with the point upwards, and continue loading by repeating the same processes:
(i) up the body, round the prong and down the same side
(ii) under the heel, turn the needle, and up the other side
(iii) round the prong again and down the same side, etc.

6. Continue until the needle is comfortably loaded. Neither the prong nor the heel should be completely filled or the string will spill off. It will be obvious that in use an extra working length of string will be released from the needle by pulling back on the needle so that the working string presses on the flexible point and clears the prong (Fig. 11b).



b

Appendix B. Instructions for Handling and Storing Mist Nets.

An Improved Method of Net Handling and Storage

Susan R. Blackshaw
2809 Hearthwood Lane
Colorado Springs CO 80917

Aside from taking birds out of mist nets, the toughest part of banding is handling the nets. Nets get tangled and twisted in their bags. Trammel lines become mixed and ends dropped as nets are put up.

Several years ago, I began using the plastic grocery bags from the supermarket checkout for my nets. I have been teaching this method of net handling whenever I can with good response. The method is learned quickly and is nearly foolproof.

TO BEGIN

You need one bag per net. Start with a net already mounted on poles, closed and rolled. Before removing the loops from the first pole, slip one bag handle through these loops, lift them off the pole, and pass your left arm through the handle above the loops. This secures trammel loops in sequence (Fig. 1). Hold the empty bag handle with a few fingers on your left hand, permitting some use of your left hand when bagging the net. Next walk slowly toward the other pole, using your left hand to gather and maintain tension on the net, while your right hand loads the net into the bag. (Left handers can reverse the procedure.) When you reach the end of the net, take the unused bag handle from left fingers, passing it through the loops, still on the pole (Fig. 2). Remove the bag handle from your left arm; then, BEFORE removing loops from poles, tie the two handles together in a gentle square knot. Finally, remove the loops from the second pole. The net is now securely bagged with trammel loops locked in sequence. It is ready for transport or, with a few mothballs, for storage.

PUTTING UP A NET

Using this method, putting up a net is done easily by one person. However, until you are comfortable with the method, an assistant may help avoid tangles and debris in the net.

Start by erecting one pole. Plan ahead for the other end of the net by placing the second pole in its approximate location, along with whatever tools you need to secure it. Untie the bag handles carefully, and without disturbing loop sequence, place one set of loops on the erected pole. For security, place both handles, one still holding loops, over your left arm. Feed the net from the bag as you go, backing slowly toward the other pole location. An assistant can help in locating the other pole site. At the end of the net, you should have the now empty bag with loops still on one handle hanging from your wrist. Carefully remove the bag handles from your wrist, place the loops over the pole, and slide the bag handle free. If all steps have been followed without twists, the net is ready to open.

Practice will enable you to take down and put up nets quickly, and even interdigitation, two nets attached to the same pole, can be done by solo banders. In time, you can perform this technique with unrolled nets, allowing even faster set up and take down.

ACKNOWLEDGMENTS

My thanks to Tony Leukering for suggestions and review.

Fig. 1 Securing trammel loops in sequence

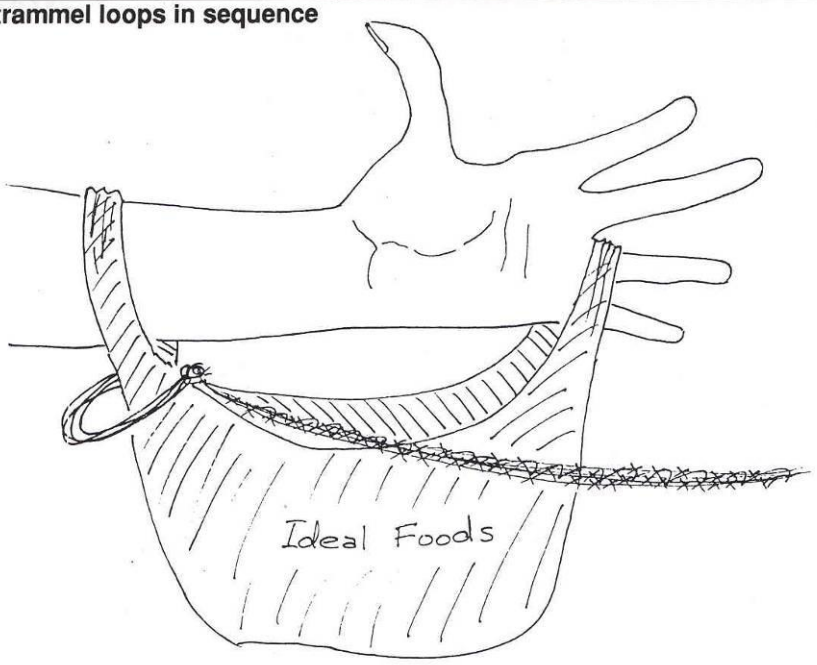
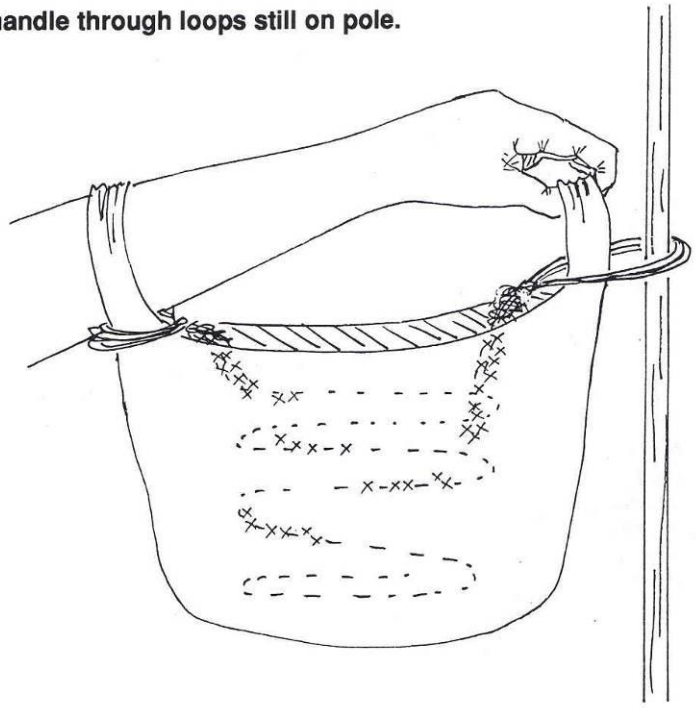


Fig. 2 Pass bag handle through loops still on pole.



Appendix C. The Target Species List. (Classifies species that can be precision-aged.)

Klamath Network SY/ASY Target Species List 2004																	
Rank	Species	pp	p10	ss	terts	pp covs	gr covs	pp vs gr covs	les covs	med covs	rects	plumage	eye color	mouth color	bill color	skull	note
A	RBSA			X		X						X	X				
A	DOWO			X	X	X	X		X	X		X	X				
A	HAWO			X	X	X	X		X	X		X					
A	WHWO			X	X	X	X		X	X		X	X				
A	NOFL			X	X	X	X		X	X			X				
B	WIFL	X		X		X					X					X	
B	HAFL				X	X	X			X	X	X				X	underparts
B	DUFL				X	X	X		X	X	X					X	
B	GRFL				X	X	X		X	X	X					X	
B	WEFL				X	X	X		X	X						X	
B	BLPH	X			X		X			X	X					X	
B	WEKI	X		X	X	X	X				X	X				X	crown
A	STJA				X	X	X			X	X			X			mouth color possible
A	WESJ			X	X	X	X				X	X		X			mouth color possible
B	BCCH				?	X	X				X			?			
B	MOCH					X	X				X			X			
B	CBCH					X	X				X			?			
A	AMDI				?	X	X										
B	SWTH	X	X			X	X			X	X					X	
B	HETH	X	X			X	X			X	X					X	
B	AMRO	X			?	X	X			X	X					X	
B	VATH	X				X	X			X	X	X					
B	OCWA	X			?	X		X			X						
B	NAWA	X			?	X	?				X	X					
B	YWAR					X	X	X			X	X			X		beware of PA molt
B	BTYW					X		X		X	X	X					
B	HEWA					X		X		X	X	X					
B	WIWA							X			X	X					
A	YBCH			X	X			X			X						
A	WETA	X		X	X	X	X		X	X		X				X	
B	GTTO					X		X			X	X				X	
A	SPTO	X		X	X	X		X			X	X	X			X	
A	CHSP										X	X					
A	BHGR	X		X		X					X	X					
B	LAZB	X		X		X											
A	RWBL								X			X					
A	BUOR	X				X	X	X		X	X	X					
B	PUFI					X	X				X	X					
B	CAFI					X	X				X	X				X	
B	LEGO	X				X					X	X					
Reminder: Refer to Sakai and Ralph 2002 & Pyle 1997 age keys **and** molts descriptions - especially for **Note:** in bold font for cautions.																	

Appendix D. The Codes for Characters Used in Ageing and Sexing Birds.

HOW AGED AND SEXED CODE REFERENCE SHEET

HOW AGED AND SEXED FIELDS

Physical differences

B Brood patch
C Cloacal protuberance
@ Egg in oviduct
E Eye color
I Mouth/bill color or striations on bill (in hummingbirds)
G Gape
F Feet or legs
S Skull ossification
Q Measurements (e.g. quantification of any part, tail length, culmen, bill depth, wing length : mass index; put specific measurement in Notes.
Y Symmetrical flight feather molt

Plumage characters

A Adult definitive (alternate) plumage
H First winter (basic) plumage (hatching year feathers)
J Juvenal plumage – retained juvenal feathers, by color and pattern, not texture.
P Plumage – try to avoid this general code, others are more specific.
L Plumage color patch length or extent - put in Notes the specific measurement of patch on; C = crown, W = wing feathers, T = tail feathers, and S = spot on center of feather, e.g. C = 15 mm 80% green (on WIWA), or gorget development in hummingbirds.

HOW AGED AND SEXED FIELDS

Feather characters

D Primary covert shape or wear
W Differential feather wear (note specific track under molt limits (e.g. primaries, tail, coverts, etc.)
V Feather shape (put in Notes the specific feathers involved, primaries, tail, coverts, etc., e.g. V prims")
T Feather texture
R Pre Juvenal molt
= Fault bar alignment
Growth bar alignment

Remaining or undetermined

O Other (such as behavior, copulation - put in Notes)
U Undetermined after examination
X Age or sex determination not attempted
Z Less precise age, but high certainty (e.g AHY vs SY)

Molt limits

M Aged by molt limits, specify feather track or no molt limit with up to 2 codes in Molt Limit field.

MOLT LIMIT FIELD

Ø No Molt limit found after examination
P Primaries
S Secondaries
C Primary coverts
G Greater coverts
V Primary vs. greater coverts
R Rectrices
L Lesser coverts
M Median coverts
B Body feathers

rev. 18-May-03

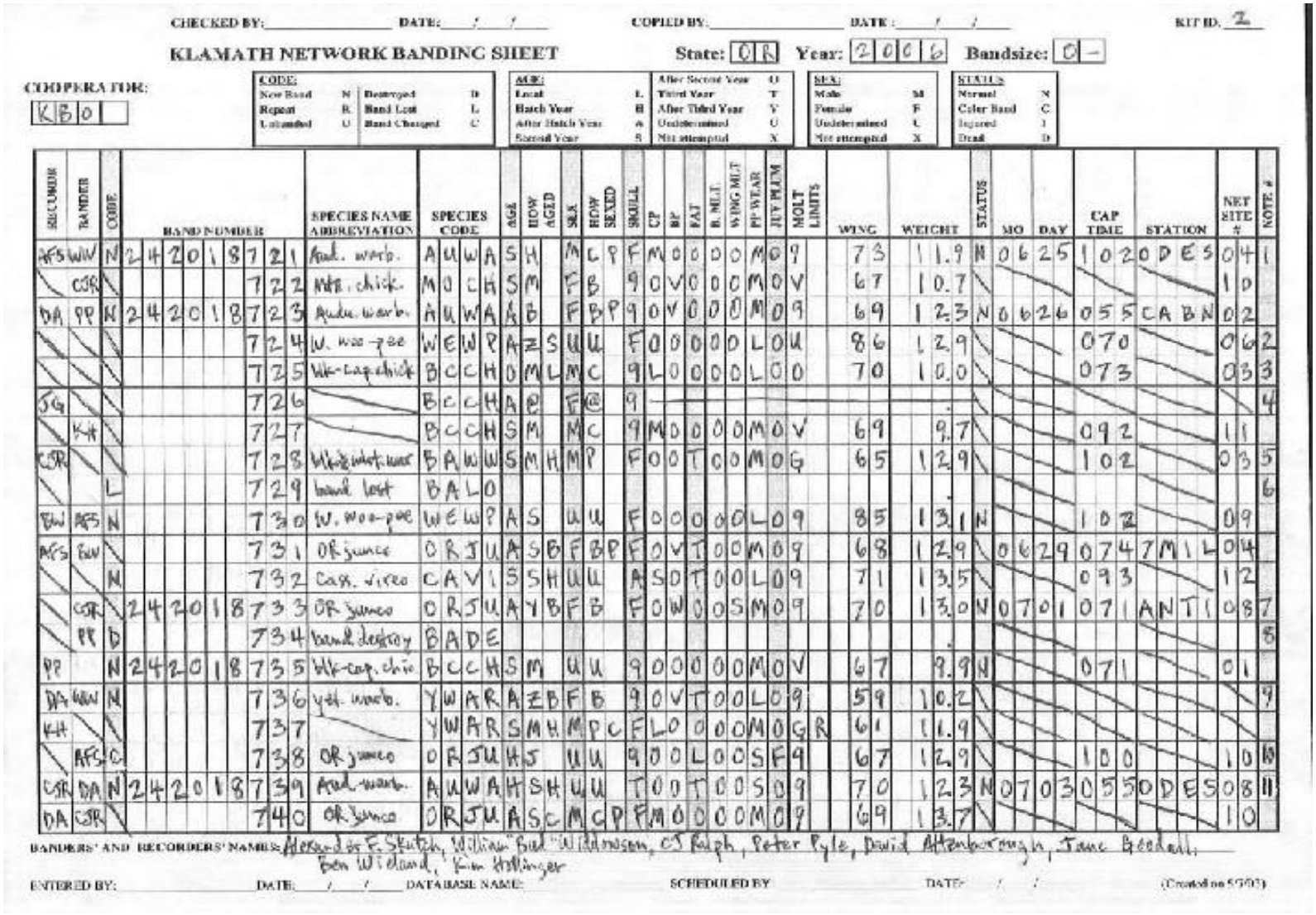
Appendix E. Reference of the Best-fitting Size Band for Commonly Captured Species.

Code	Common Name	# visible pp	p10	Early skull date	Band Size	Tab Page
RBSA	Red-breasted Sapsucker	10	reduced	n/a	1A - 1B	56
DOWO	Downy Woodpecker	10	reduced	n/a	1B	69
WEWP	Western Wood-Pewee	10	full length	1-Oct	0	95
WIFL	Willow Flycatcher	10	full length	15-Sep	0	105
HAFL	Hammonds Flycatcher	10	full length	15-Oct	0 - 0A	110
DUFL	Dusky Flycatcher	10	full length	15-Oct	0 - 0A	112
WEFL	Western Flycatcher	10	full length	15-Oct	0 - 0A	116
CAVI	Cassins Vireo	10	variable	15-Oct	1	156
WAVI	Warbling Vireo	10	variable	15-Oct	0	160
STJA	Stellers Jay	10	reduced	15-Oct	3 - 2	166
BCCH	Black-capped Chickadee	10	reduced	1-Oct	0	193
MOCH	Mountain Chickadee	10	reduced	1-Oct	0 - 0A	195
CBCH	Chestnut-backed Chickadee	10	reduced	1-Sep	0 - 0A	197
BUSH	Bushtit	10	minute	15-Aug	0A	203
RBNU	Red-breasted Nuthatch	10	reduced	15-Oct	0	205
WIWR	Winter Wren	10	reduced	1-Oct	0A - 0	222
GCKI	Golden-crowned Kinglet	10	reduced	1-Sep	0A	228
RCKI	Ruby-crowned Kinglet	10	reduced	1-Oct	0A	230
SWTH	Swainsons Thrush	10	reduced	1-Oct	1B	254
HETH	Hermit Thrush	10	reduced	1-Nov	1B	256
AMRO	American Robin	10	reduced	15-Oct	2	260
WREN	Wrentit	10	reduced	1-Sep	1	264
OCWA	Orange-crowned Warbler	9	invisible	15-Aug	0 - 0A	289
NAWA	Nashville Warbler	9	invisible	1-Oct	0A - 0	292
YWAR	Yellow Warbler	9	invisible	15-Sep	0 - 0A	299
AUWA	Audubons Warbler	9	invisible	15-Sep	0 - 0A	312
MYWA	Myrtle Warbler	9	invisible	15-Oct	0 - 0A	312
TOWA	Townsends Warbler	9	invisible	15-Oct	0A - 0	319
HEWA	Hermit Warbler	9	invisible	1-Oct	0A	322
MGWA	MacGillivrays Warbler	9	invisible	1-Oct	1 - 0	366
COYE	Common Yellowthroat	9	invisible	1-Sep	0 - 0A	368
WIWA	Wilsons Warbler	9	invisible	15-Sep	0A - 0	372
YBCH	Yellow-breasted Chat	9	invisible	1-Oct	1B - 1A	376
WETA	Western Tanager	9	invisible	1-Nov	1B	386
SPTO	Spotted Towhee	9	invisible	1-Nov	1A - 2	391
CHSP	Chipping Sparrow	9	invisible	1-Oct	0	405
FOSP	Fox Sparrow	9	invisible	1-Dec	1A	422
SOSP	Song Sparrow	9	invisible	1-Oct	1B	425
LISP	Lincolns Sparrow	9	invisible	15-Nov	0	427
WCSP	White-crowned Sparrow	9	invisible	15-Oct	1B	433
GCSP	Golden-crowned Sparrow	9	invisible	15-Nov	1B - 1A	436
ORJU	Oregon Junco	9	invisible	1-Oct	0 - 1	438
BHGR	Black-headed Grosbeak	9	invisible	1-Oct	1A	445
LAZB	Lazuli Bunting	9	invisible	1-Sep	1	450
RWBL	Red-winged Blackbird	9	invisible	15-Oct	? =2 - ? =1A	455
BHCO	Brown-headed Cowbird	9	invisible	1-Dec	? =1A - ? =1B	472
PUFI	Purple Finch	9	invisible	15-Nov	1 - 1B	491
PISI	Pine Siskin	9	invisible	15-Oct	0	499
LEGO	Lesser Goldfinch	9	invisible	15-Nov	0A - 0	502
AMGO	American Goldfinch	9	invisible	15-Dec	0 - 0A	506

Appendix F. Wind Should be Recorded According to the Beaufort Wind Scale.

Beaufort Wind Scale Wind Speed (MPH)	Wind Effects Observed on Land	Terms Used in NWS
0-1	Calm; smoke rises vertically.	Calm
1-3	Direction of wind shown by smoke drift, but not by wind vanes.	Light
4-7	Wind felt on face, leaves rustle, ordinary vane moved by wind.	Light
8-12	Leaves and small twigs in constant motion; wind extends light flag.	Gentle
13-18	Raises dust and loose paper; small branches are moved.	Moderate
19-24	Small trees in leaf begin to sway; crested wavelets form on inland waters.	Fresh
25-31	Large branches in motion; whistling heard in telephone wires; umbrellas used with difficulty.	Strong
32-38	Whole trees in motion; inconvenience felt walking against the wind.	Strong
39-46	Breaks twigs off trees; generally impedes progress.	Gale
47-54	Slight structural damage occurs; chimney pots and stales removed.	Gale
55-63	Seldom experienced inland; trees uprooted; considerable structural damage occurs.	Whole gale
64-72	Very rarely experienced inland; accompanied by widespread damage.	Whole gale
73 or more	Very rarely experienced; accompanied by widespread damage.	Hurricane

Appendix G. Banding Datasheet



CHECKED BY: _____ DATE: ___/___/___ COPIED BY: _____ DATE: ___/___/___ KIT ID: 2

KLAMATH NETWORK BANDING SHEET State: OR Year: 2006 Bandsize: 0-

COOPERATOR: KBO

CODE: New Band N; Recaptured R; Band Lost L; Unbanded U; Band Changed C; Destroyed D

AGE: Local L; Hatch Year H; After Hatch Year A; Second Year S; After Second Year O; Third Year T; After Third Year Y; Undetermined U; Not attempted X

SEX: Male M; Female F; Undetermined U; Not attempted X

STATUS: Normal N; Color Band C; Injured I; Dead D

RECORDER	TRANDER	CODE	BAND NUMBER	SPECIES NAME ABBREVIATION	SPECIES CODE	AGE	HOW AGED	SEX	HOW SEXED	SKULL	CP	BP	FAT	B. MLT.	WING MLT	FT WEAR	JUV PLUM	MOLT LIMITS	WING	WEIGHT	STATUS	MO	DAY	CAP TIME	STATION	NET SITE #	NOTE #
AFS	WW	N	2420187221	Aud. warb.	AUWA	S	H	M	C	P	F	M	0	0	0	0	M	0	9	73	11.9	N	06	25	1020	DES	04	1
	CSR		7222	Nttr. chick.	MOCH	S	M	F	B		9	0	V	0	0	0	M	0	V	67	10.7						10	
DA	PP	N	2420187223	Audu. warb.	AUWA	A	B	F	BP		9	0	V	0	0	0	M	0	9	69	12.3	N	06	26	0555	CABN	02	
			7224	W. woo-pee	WEWP	A	N	S	U	U	F	0	0	0	0	0	L	0	U	86	12.9				0700		06	2
			7225	Wh-cap chick	BCCH	O	M	L	M	C	9	L	0	0	0	0	L	0	0	70	10.0				0733		03	3
JG			7226		BCCH	A	P	F	@		9																	4
	KH		7227		BCCH	S	M	M	C		9	M	0	0	0	0	M	0	V	69	9.7				0922		11	
CSR			7228	Wht. whsk. wren	BAWW	S	M	H	M	P	F	0	0	T	0	0	M	0	G	65	12.9				1022		03	5
		L	7229	band lost	BALO																							6
BW	AFS	N	7230	W. woo-pee	WEW?	A	S		U	U	F	0	0	0	0	0	L	0	9	85	13.1	N			1022		09	
AFS	BW		7231	OR junco	ORJU	A	S	B	F	BP	F	0	V	T	0	0	M	0	9	68	12.9		06	29	0747	MIL	04	
		N	7232	Cass. vireo	CAVI	S	S	H	U	U	A	S	D	T	0	0	L	0	9	71	13.5				0933		12	
	CSR		2420187233	OR junco	ORJU	A	Y	B	F	B	F	0	W	0	0	S	M	0	9	70	13.0	N	07	01	0711	ANTI	08	7
	PP	D	7234	band destroy	BADE																							8
PP		N	2420187235	Wh-cap. chic	BCCH	S	M	U	U		9	0	0	0	0	0	M	0	V	67	8.9	N			0711		01	
DA	WW	N	7236	Yel. warb.	YWAR	A	E	B	F	B	9	0	V	T	0	0	L	0	9	59	10.2							9
KH			7237		YWAR	S	M	H	M	P	C	F	L	0	0	0	0	M	0	G	R	61	11.9						
	AFS	C	7238	OR junco	ORJU	H	J		U	U	9	0	0	L	0	0	S	F	9	67	12.9				1100		10	10
CSR	DA	N	2420187239	Aud. warb.	AUWA	H	S	H	U	U	T	0	0	T	0	0	S	0	9	70	12.3	N	07	03	0550	DES	08	11
DA	CSR		7240	OR junco	ORJU	A	S	C	M	C	P	F	M	0	0	0	0	M	0	9	69	13.7						10	

BANDERS' AND RECORDERS' NAMES: Alexander F. Skutch, William "Bill" Williamson, CJ Ralph, Peter Pyle, David Attenborough, Jane Goodall, Ben Wieland, Kim Hollinger

ENTERED BY: _____ DATE: ___/___/___ DATABASE NAME: _____ SCHEDULED BY _____ DATE: ___/___/___ (Created on 5/99)

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #7: Conducting Area Search Surveys

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP includes the methods for conducting area search surveys. The Area Search Data Form is provided at the end of this SOP.

Timing of the Survey

Area search surveys are conducted at least twice during each banding effort. If capture rates are slow, or extra persons are available at the station, multiple area searches should be completed. Surveys for the day should be done between sunrise and 5 hours after dawn. The order of search areas covered should vary from effort to effort. The first survey is done as the nets are set up. If the temperature and/or bird activity is low, wait until it warms up a bit to begin the first area search. One person starts setting up the nets and the other person completes the area survey. After 20 minutes, the surveyor (back at the start of the net round) begins to help set up nets (SOP #6: Mist Netting). Then, if possible, a second survey is conducted when bird captures have slowed down, often about 0930. Surveys should not be conducted in rain, strong winds, or extreme weather conditions.

Location of the Survey

A map of the area search survey plots for the Oregon Caves station is included in SOP #4: Locating and Marking Field Sites.

Conducting the Survey

One or more observers walk a 20-minute route, noting all birds seen or heard. The person who is the best birder should conduct the survey; the other surveyors should practice as time allows. The observer should be reasonably familiar with most (if not all) bird species likely to be encountered at the site. This method allows the observer to track down unfamiliar birds. Walking the site before a survey with a person familiar with the birds allows the less experienced observer to be more efficient.

Walk in an approximate circle or oval for exactly 20 minutes in each search area, stopping or moving to investigate sightings or calls when appropriate. Do not spend more than a minute

looking for a difficult bird. If there is an unknown bird that can not be identified, record it on your form as unknown (UNKN). Record numbers of birds of each species seen, heard, or both seen and heard in the search area during this time on the Area Search Data Form. Record birds outside the search area, as defined by the route you take, separately on your data sheet, but concentrate on finding as many birds as possible within the site. For birds heard calling, you may have to estimate whether they are inside your area or not. Note that this 20-minute time constraint is an extremely important component of the technique, as the data are to be used for monitoring.

Record data as follows:

Page: The page number of current page and the total pages for the survey route.

State: OR.

Project: NPLTM.

Station Code: ORCA.

Station Name: Oregon Caves.

Point: The area search letter (ORCAA or ORCAB).

Month-Day-Year: The date of the survey using two numbers for month and day and four numbers for year.

Observer Initials: The first, middle, and last name initials of the observer.

Secondary Observer Initials: The first, middle, and last name initials of secondary observers.

Temp.: The temperature at the beginning of the survey recorded in degrees Celsius.

Cloud Cover %: The estimated percent of cloud cover at the beginning of the survey.

Ppt: The type of precipitation at the beginning of the survey. N = None, F = Fog, M = Mist, D = Drizzle, R = Rain.

Wind: The wind at the beginning of the survey using the Beaufort Wind Scale class. 0 = calm, 0-1 mph, smoke rises vertically and the sea is mirror smooth. 1 = light air, smokes moves slightly with breeze and shows direction of wind. 2 = you can feel wind on your face and hear the leaves start to rustle. 3 = gentle breeze, small branches start to sway, wind extends a light flag. 4 = moderate breeze, loose dust or sand on the ground will move and larger branches will sway. >4 = Do not survey, too much wind.

Start Time: The time (using a 24-hour clock) that you started your 20-minute search.

Duration: Duration of survey in minutes, 20.

Species Code: The standard four letter species code.

Species Name Abr: The full common name or a clear abbreviation for the bird.

On Area: The numbers of each bird species counted on or within the search area. Birds seen, heard, or both should be counted.

Detection Type: Tally the birds detected during the survey by writing down the first detection type that the observer uses to identify the bird species. S = Song, C = Call, V = Visual, W = Wing (e.g., Mourning Dove or Hummingbird wing whir), D = Drumming, F = Fly over (e.g., SCC = one bird singing and two calling).

Off Area: The numbers of each bird species counted off or outside the search area. Birds heard, seen, or both should be tallied. Birds flying over the site (excluding those aerial foraging within the search area) should be counted here.

Total: The total number of the birds tallied in the ON or OFF AREA columns.

Breeding Status: Any breeding evidence observed during the count. N = current year's Nest found in the study area with eggs or young, in the process of being built, or already depredated or abandoned. M = adult seen gathering or carrying nesting Material to a likely nest site in the study area. F = adult seen carrying Food or Fecal sac to or from a likely nest site in the study area. D = Distraction display or injury feigning by an adult bird. L = a young bird incapable of sustained flight (a "Local") in the study area or very young (stub-tailed) fledglings being fed by parents in the study area. C = Copulation or Courtship observed of a species within its breeding range. T = other Territorial behavior observed. S = territorial Song or drumming heard.

Notes: Record any survey notes here (e.g., noise disturbance, location information, other sightings, etc.).

Page ____ of ____

Area Search Data Form

State ____ Project/Region ____ Site Code ____ Site Name ____ Point ____ Month ____ Day ____ Year ____

Obs. Initials ____ Secondary Obs. Initials ____ Temp. (C) ____ Cloud Cover (%) ____ Ppt ____ Wind ____ Start Time (24 hr) ____ Duration (minutes) ____

		On Area		Off Area		
Species Code	Species Name Abr.	Detection Type	Total	Detection Type	Total	Breeding Status

Notes:

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Precipitation (Ppt): **N = N**one, **F = F**og, **M = M**ist, **D = D**rizzle, **R = R**ain. Wind (Beaufort): **0** = calm, **1** = light air, **2** = leaves start to rustle, **3** = small branches start to sway, **4** = moderate breeze, >4 Do not survey

Detection Type: **S = S**ong, **C = C**all, **V = V**isual, **W = W**ing, **D = D**rumming, **F** = **F**ly over. Breeding Status: **N** = active **N**est, **M** = carrying nesting **M**aterial, **F** = carrying **F**ood or **F**ecal sac, **D** = **D**istraction display/feigning, **L** = **L**ocal young (limited flight or stub-tailed fed by parents), **C** = **C**opulation or **C**ourtship observed, **T** = **T**erritorial behavior, **S** = territorial **S**ong or drumming.

Observer's Full Names________________________________ Checked_________ Copied_________ Entered_______

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #8: Conducting Vegetation Surveys

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP consists of instructions for conducting the vegetation survey. The Vegetation Survey Form is provided at the end of this SOP.

Introduction

This is a system for assessing habitat characteristics in an efficient and timely fashion at landbird monitoring stations. Using the relevé methodology, the information collected will provide enough data to describe the vegetation formation, association, and structure. The data have some logical relationship with bird requirements for feeding or nesting. The method provides enough quantitative information for correlative analyses and ordinations. It is flexible so that it can be applied to any vegetation formation, including deserts, grasslands, and forests. This method follows recommendations put forth in Ralph and Bingham (2004).

Timing of the Survey

Typically, vegetation surveys should be conducted at stations along point count routes during the afternoon preceding the point count survey for that route. If an observer has completed the route in the past and is familiar with the locations of each station, he or she may opt to complete the vegetation survey after completing the point count survey if it is logistically advantageous. At the Oregon Caves banding station, the vegetation surveys should be completed once in June or July.

Location of the Survey

A 50 m plot is established, centered at a point count station or net location.

Conducting the Survey

Begin by walking around the point and identifying the species that make up the major structural components of the habitat. Determine the number of major layers of vegetation within your relevé by their dominant growth form: tree (T), shrub (S), herb (H), and moss (M). The classification of the T, S, H, and M layers does not limit the species which will be assigned to the

layers (e.g., only trees in the T layer). This process merely attempts to describe the structure of the vegetation.

In a forest with all layers, the tree layer is the uppermost stratum, dominated by mature trees. It may be a single layer or consist of two or more sublayers recognizable by marked changes in density and canopy status (see below). The shrub layer is dominated by shrubs or small trees. The herb layer is dominated by low growing plants, typically non-woody, although seedlings and other shorter trees and shrubs may be present. The moss layer is dominated by such plants as mosses, lichens, and liverworts. Bare ground and litter are ignored for this classification scheme.

For purposes of bird-habitat association, only species of trees and shrubs need be identified and recorded in the data below. For other plants, a generic name such as FERN, HERB, MOSS, LICH, will suffice. Moss (MOSS), lichen (LICH), and mistletoe (MIST) should be recorded in all layers in which they occur. If a plant cannot be identified in the field, bring it back to be keyed out later. Do this only if the plant makes up a significant part of the relevé(s). All snags within the plot are counted according to size class.

It is important that the total time spent taking information not exceed 15 minutes. In simple, one-layered, open vegetation sites, it can easily take less than 10 minutes per station. If you are taking longer than this, you are probably debating too much over minor details, especially layers of trees.

Completing the Field Form

Location

First complete the data under the location heading of the field form as follows:

Page: The page number of current page and the total pages for the survey route.

State: The two letter abbreviation for the state where the field site is located.

Project/Region: The code for the project, NPLTM.

Site Code: The code for the point count route or mist net site.

Site Name: The name of the survey route or mist net site.

Point: The station or point number where the relevé was conducted.

Split: Yes (Y) if plot was split, No (N) if plot was not split.

Observer: The first, middle, and last name initials of the observer.

Easting: The six number Universal Transverse Mercator (UTM) Easting value taken from a map or handheld Global Positioning System (GPS) unit.

Northing: The seven number UTM Northing value taken from a map or handheld GPS unit.

+/-: The accuracy, in meters, of the UTM coordinates taken from the GPS unit or estimated from a map.

Month-Day-Year: The date of the survey using two numbers for month and day and four numbers for year.

Plot Radius (m): The radius of the plot, which will always be 50 m.

B/U: B = Recently burned vegetation (e.g., scorched shrubs, trees with brown leaves still on branches, etc.) with greater than 10% cover within the plot. UB = Plot is unburned or with less than 10% burned vegetation.

R/U: R = Riparian plant species comprise a minimum of 5% of the plot radius. U = Plot radius is not composed of at least 5% riparian plant species.

Water: Recorded as '+' if water is present within the plot radius or ' - ' if there is no water in the plot. Permanent or semi-permanent sources of water are recorded (e.g., flowing creeks, seeps, or ponds).

TYPE: The type of water present within 100 m of the plot center; F = Flowing water (e.g., river, stream, or creek), P = Pond, W = Wetland, L = Lake.

AREA: The size of the entire riparian area (includes contiguous riparian outside of the plot); 1 = less than 0.5 hectares, 2 = between 0.5 and 4 ha, 3 = >4 ha.

Location Notes: Describe any unusual site characteristics, problems encountered, or changes related to the location.

Vegetation

Complete the data under the vegetation heading of the field form. We consider that there are up to four vegetative layers (tree, shrub, herb, and moss) within each relevé. In addition, there can be one or more sublayers that comprise each vegetative layer. The following is a set of height classes used to separate vegetative layers. Heights are relative to the ground or fallen logs and height classes are used only as a guide and are not taken as absolute values.

Tree Layer: Trees and shrubs usually taller than 5 m.

Shrub Layer: Shrubs, small trees, and tall herbs approximately between 50 cm to 5 m tall.

Herb Layer: Herbs, small shrubs, and very young trees 10 cm to 50 cm tall.

Moss Layer: Plants less than 10 cm high, on the ground or on fallen logs.

Total Cover (Tot. Cov.): For each of the four layers, estimate of all plants combined (i.e., up to 100% cover) using the Braun-Blanquet Cover Abundance Scale.
5 = >75 percent cover
4 = 51 - 75 percent cover
3 = 26 - 50 percent cover
2 = 5 - 25 percent cover
1 = numerous, but less than 5% cover or scattered with cover up to 5%
+ = few, with small cover
r = rare, solitary, with small cover

Height (Low and Upper): Recorded to the nearest meter for the tree layers and the nearest decimeter (0.1 m) for the shrub layers, the average height of the lower and upper bounds of each of the four primary layers.

Species (under height): Recorded as the species (use the four letter code - first two letters of the genus and the first two letters of the species) that is most common in the upper and lower limits of the layer.

DBH: For the tree layer, record the minimum and maximum diameter at breast height, to the nearest cm, of the smallest and largest tree in the layer.

Species (under DBH.): Recorded as the species of tree with maximum DBH and the species of tree with the minimum DBH.

Number of Sublayers (# SB): Recorded as the number of very obvious sublayers in each primary layer. Sublayers need not be recorded unless they are very obvious. Very rarely would there be more than two sublayers. The sublayers can be useful to the ecologist by providing a quick overview of the structure of a primary layer. They are primarily relevant to the tree layer, although sometimes are seen in the shrub layer. Sublayers are sometimes obvious when one species is shorter than the dominant species of the upper portion of the layer. In addition, sublayers are sometimes formed by two cohorts of one species, possibly related to some event. For example, a thick stand of young, 6 m Douglas-fir may include scattered, old, emergent individuals as well. Rarely, a third, lower layer of shade tolerant species is clear. If sublayers are present, they are obvious. Do not spend much time trying to see sublayers.

Composition

Next, complete the data under the composition heading of the field form as follows:

Species: Use the four letter code to record the plant species. It is important to use the standardized four letter code. If you are unsure of the species or proper code, please use the notes field to write an explanation and use a reference (e.g., http://plants.usda.gov/) to look up the correct code or species.

Sublayer: If no sublayers are present, only the primary layers (T, S, H) are used in the first row of the sublayer field. If sublayers are present, the primary layer letter on the top

is followed by a sublayer number (e.g., T1 [tallest trees], T2, S1, S2...) below it on the bottom in the same column.

Cover (under Sublayer): Use the Braun-Blanquet Cover Abundance Scale to record the percent cover that each species covers out of the entire circle. Since all the trees (or shrubs) in a primary layer can overlap, the total of all the species can add up to more than the total cover recorded above.

Vegetation Notes: Describe unknown or unique plant codes used. If you are unsure of a code or used a common name, please make a note of it here.

Snags: The number of snags according to size class (<14.9, 15-27.9, 28-63.9, 64-101.9, >102 cm DBH) should be recorded. They can be tallied while you are collecting data on the plot and then summed in the Count column.

References

Ralph, C. J., and B. Bingham. 2004. Instructions for completing the location and vegetation form: The releve technique. Redwood Sciences Laboratory, Arcata, CA.

LOCATION DATA

Page ____ of ____

STATE | PROJECT/REGION | SITE CODE | SITE NAME

POINT | SPLIT | OBSERVER | EASTING | NORTHING | +/- (m)

MONTH | DAY | YEAR | PLOT RADIUS (m) | WATER(+/-) | B/U | R/U | TYPE | AREA

LOCATION NOTES

LAYER	TOT. COV.	HEIGHT(m) LOW	SPECIES	UPPER	SPECIES	DBH(cm) MIN	SPECIES	MAX	SPECIES	# SB
~ >5m TREE										
~ .5-5m SHRUB										
~ .1-.5m HERB										
~ < .1m MOSS										

SPECIES COMPOSITION DATA

Cover Classes
5 = > 75%
4 = 50 - 75%
3 = 25 - 50%
2 = 5 -25%
1 = < 5%, numerous
+ = few
R = rare, solitary
0 = None

SPECIES	SUBLAYER	SPECIES	SUBLAYER

SNAGS

DBH (cm)	Tally	Count
< 14.9		
15-27.9		
28-63.9		
64-101.9		
> 102		

	INITIAL	DATE
PROOFED		
COPIED		
ENTERED		

VEGETATION NOTES

Observer's Full Name_____

Rev. 20070424JLS

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #9: Completing Species Checklists

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP includes instructions for completing the Species Checklist. A species checklist is included at the end of the SOP.

Introduction

A species checklist should be completed for each survey day, in conjunction with point count and mist netting surveys. This form is used to keep a tally of all species encountered throughout the day that were within the vicinity of the point count route or mist netting site. The species checklist adds value to survey data by accounting for all species encountered during an effort, whether detected during an actual point count, area search, or mist netting survey.

Comprehensive Species List

When arriving at a point count route or mist netting station, the Project Lead, technician, or intern should remain alert to all bird species observed in the area. Species identification of all birds that are encountered at any time during an effort should be attempted; species that have not been accounted for on point count, area search, or banding data forms should be noted on the Species Checklist Form. At the end of a survey effort, all species that were accounted for on the other data forms should also be added to the species checklist. If more than one individual is surveying the site, the team should keep one checklist that accounts for all species encountered by any individual in the group. Technicians who are conducting vegetation surveys during the afternoon (before a point count survey) should fill out two separate checklists, one during the afternoon effort and a second during the morning survey.

Completing the Form

The data form should be filled out as follows:

State: The two letter abbreviation for the state where the field site is located.

Project/Region: The code for the project, NPLTM.

Site Code: The code for the field site.

Site Name: The name of the field site.

Month-Day-Year: The date of the survey using two numbers for month and day and four numbers for year.

Primary Observer: The first, middle, and last name initials of the primary observer.

Secondary Observers: The first, middle, and last name initials of secondary observers.

Observers: The number of observers.

Start Time: Start time of survey on 24-hour clock.

End Time: End time of survey on 24-hour clock.

Survey Type: B for mist netting or PC for point count.

Breeding Code: The breeding code should be filled in to the left of each species code. Use the code that is the most definitive of breeding status, which is the following order:

N = active nest found
M = nest material being gathered or carried
F = food or fecal sack
D = distraction
L = local young being fed by adult
C = copulation or courtship
T = territorial behavior
S = territorial song or drumming heard
B = bird captured
E = encountered on study area
O = encountered flying over study area

Klamath Demographic Monitoring Network Species Checklist

State | Project/Region | Site Code | Site Name | Month | Day | Year

Primary Obs. | Secondary Obs. | # Obs. | Start Time | End Time | Survey Type*

*Surv. Type = AQ: Aquatic Surv., AS: Area Search, BT: Black Tern, BW: Bird Walk, CES: Constant Eff Surv, DEM: Band Demo, NS: Nest Search/S Map, O: Other, PC: Pt Cnt, ROI: Rapid Orn Inv, T:Travel

Breeding Codes ***(in hierarchial order, use single highest observed code)***

N = current year's nest found

M = nest material being gathered or carried

F = food or fecal sac carry

D = distraction

L = local young being fed by adult

C = copulation or courtship

T = territorial behavior (fights, chases, etc.)

S = territorial song or drumming heard

B = bird captured

E = encountered in study area

O = encountered flying over the study area

Grebes, Pelicans, Cormorants, Herons & Ducks

	EAGR	Eared Grebe
	CLGR	Clark's Grebe
	WEGR	Western Grebe
	UWCG	Unk. Western/Clark's Gr
	PBGR	Pied-billed Grebe
	DCCO	Double-cr. Cormorant
	AWPE	American Wh. Pelican
	AMBI	American Bittern
	LEBI	Least Bittern
	GREG	Great Egret
	GBHE	Great Blue Heron
	GRHE	Green Heron
	BCNH	Black-cr. Night Heron
	CAGO	Canada Goose
	COME	Common Merganser
	MALL	Mallard
	WODU	Wood Duck
	RNDU	Ring-necked Duck
	BUFF	Bufflehead
	NSHO	Northern Shoveler
	GADW	Gadwall
	CITE	Cinnamon Teal
	RUDU	Ruddy Duck
	CANV	Canvasback
	UNDU	Unknown Duck

Vultures

	TUVU	Turkey Vulture

Coots, Rails, & Cranes

	AMCO	American Coot
	SORA	Sora
	VIRA	Virginia Rail
	UNRA	Unidentified Rail
	SACR	Sandhill Crane

Shorebirds

	RNPH	Red-necked Phalarope
	AMAV	American Avocet
	BNST	Black-necked Stilt
	WILL	Willet
	SPSA	Spotted Sandpiper
	GRYE	Greater Yellowlegs
	KILL	Killdeer
	WISN	Wilson's Snipe
	USAN	Unidentified Sandpiper

Gulls & Terns

	CATE	Caspian Tern
	FOTE	Forster's Tern
	BLTE	Black Tern
	RBGU	Ring-billed Gull
	CAGU	California Gull
	UNGU	Unidentified Gull

Raptors

	GOEA	Golden Eagle
	BAEA	Bald Eagle
	PRFA	Prairie Falcon
	PEFA	Peregrine Falcon
	AMKE	American Kestrel
	NOHA	Northern Harrier
	SSHA	Sharp-shinned Hawk
	COHA	Cooper's Hawk
	NOGO	Northern Goshawk
	UNAC	Unidentified Accipiter
	RTHA	Red-tailed Hawk
	RSHA	Red-shoulder Hawk
	OSPR	Osprey
	WTKI	White-tailed Kite
	UNHA	Unidentified Hawk

Game Birds

	RUGR	Ruffed Grouse
	BGSE	Blue Grouse
	ASJU	Domestic Chicken
	CAQU	California Quail
	MOUQ	Mountain Quail
	WITU	Wild Turkey
	RPHE	Ring-necked Pheasant

Pigeons & Doves

	BTPI	Band-tailed Pigeon
	MODO	Mourning Dove
	ROPI	Rock Pidgeon

Owls

	NSWO	N. Saw-whet Owl
	WESO	Western Screech Owl
	FLOW	Flammulated Owl
	NOPO	Northern Pygmy Owl

Owls (cont'd)

	GHOW	Great-horned Owl
	BNOW	Barn Owl
	SPOW	Spotted Owl
	GGOW	Great Gray Owl
	UNOW	Unidentified Owl

Goatsuckers & Swifts

	COPO	Common Poorwill
	CONI	Common Nighthawk
	VASW	Vaux's Swift

Hummingbirds

	ANHU	Anna's Hummingbird
	RUHU	Rufous Hummingbird
	ALHU	Allen's Hummingbird
	UNSE	Unid. *Selasphorous* sp.
	CAHU	Calliope Hummingbird
	UNHU	Unidentified Hummingbird

Kingfishers

	BEKI	Belted Kingfisher

Woodpeckers

	HAWO	Hairy Woodpecker
	DOWO	Downy Woodpecker
	WHWO	White-headed Woodp.
	BBWO	Black-backed Woodp.
	PIWO	Pileated Woodpecker
	ACWO	Acorn Woodpecker
	LEWO	Lewis's Woodpecker
	UNWO	Unidentified Woodpecker
	NOFL	Northern Flicker
	RSFL	Red-shafted Flicker
	RNSA	Red-naped Sapsucker
	RBSA	Red-breasted Sapsucker
	WISA	Williamson's Sapsuck.
	UNSA	Unidentified Sapsucker

Flycatchers

	WEKI	Western Kingbird
	ATFL	Ash-throated Flycatch.
	SAPH	Say's Phoebe
	BLPH	Black Phoebe
	OSFL	Olive-sided Flycatcher
	WEWP	Western Wood Pewee
	PSFL	Pacific-slope Fly.
	WEFL	Western Flycatcher
	WIFL	Willow Flycatcher
	LEFL	Least Flycatcher
	HAFL	Hammond's Flycatcher
	DUFL	Dusky Flycatcher
	GRFL	Gray Flycatcher
	UNEM	Unid. *Empidonax* Fly.
	UNFL	Unidentified Flycatcher

Vireos

	CAVI	Cassin's Vireo
	WAVI	Warbling Vireo
	HUVI	Hutton's Vireo

Corvids

	BBMA	Black-billed Magpie
	STJA	Steller's Jay
	WESJ	Western Scrub Jay
	GRAJ	Gray Jay
	PIJA	Pinyon Jay
	CLNU	Clark's Nutcracker
	CORA	Common Raven
	AMCR	American Crow

Larks

	HOLA	Horned Lark

Swallows

	BARS	Barn Swallow
	CLSW	Cliff Swallow
	TRES	Tree Swallow
	VGSW	Violet-green Swallow
	NRWS	N. Rough-winged Swallow
	BANS	Bank Swallow
	UNSW	Unidentified Swallow
	PUMA	Purple Martin

Parids and Allies

	BUSH	Bushtit
	BCCH	Black-capped Chickadee
	MOCH	Mountain Chickadee
	CBCH	Chest.-backed Chickadee
	UNCH	Unidentified Chickadee
	OATI	Oak Titmouse
	JUTI	Juniper Titmouse
	OJTI	Unid. Oak/Juniper Titmouse

Nuthatches and Creepers

	BRCR	Brown Creeper
	WBNU	White-breasted Nuthatch
	RBNU	Red-breasted Nuthatch
	PYNU	Pygmy Nuthatch

Wrens

	ROWR	Rock Wren
	CANW	Canyon Wren
	BEWR	Bewick's Wren
	HOWR	House Wren
	WIWR	Winter Wren
	MAWR	Marsh Wren

Dippers, Kinglets & Gnatcatchers

	AMDI	American Dipper
	GCKI	Golden-crowned Kinglet
	RCKI	Ruby-crowned Kinglet
	BGGN	Blue-gray Gnatcatcher

Thrushes

	WEBL	Western Bluebird
	MOBL	Mountain Bluebird
	TOSO	Townsend's Solitaire
	SWTH	Swainson's Thrush
	HETH	Hermit Thrush
	AMRO	American Robin
	VATH	Varied Thrush

Babblers

	WREN	Wrentit

Starlings

	EUST	European Starling

Waxwings

	CEDW	Cedar Waxwing

Warblers

	NAWA	Nashville Warbler
	OCWA	Orange-crowned Warbler
	YWAR	Yellow Warbler
	MYWA	Myrtle Warbler
	AUWA	Audubon's Warbler
	UYRW	Yellow-rumped Warbler
	BTYW	Black-thr. Gray Warbler
	TOWA	Townsend's Warbler
	HEWA	Hermit Warbler
	MGWA	MacGillivray's Warbler
	COYE	Common Yellowthroat
	WIWA	Wilson's Warbler
	YBCH	Yellow-breasted Chat
	UNWA	Unidentified Warbler

Tanagers

	WETA	Western Tanager

Towhees & Sparrows

	SPTO	Spotted Towhee
	GTTO	Green-tailed Towhee
	CALT	California Towhee
	CHSP	Chipping Sparrow
	BRSP	Brewer's Sparrow
	VESP	Vesper Sparrow
	LASP	Lark Sparrow
	SAVS	Savannah Sparrow
	GRSP	Grasshopper Sparrow
	FOSP	Fox Sparrow

Sparrows (cont'd)

	SOSP	Song Sparrow
	LISP	Lincoln's Sparrow
	WTSP	White-throated Sparrow
	WCSP	White-crowned Sparrow
	GWCS	Gambel's WCSP
	PSWS	Puget Sound WCSP
	GCSP	Golden-crowned Sparrow
	ORJU	Oregon Junco
	UDEJ	Unid.Dark-eyed Junco

Grosbeaks and Buntings

	BHGR	Black-headed Grosbeak
	LAZB	Lazuli Bunting

Blackbirds and Orioles

	RWBL	Red-winged Blackbird
	TRBL	Tricolored Blackbird
	WEME	Western Meadowlark
	YHBL	Yellow-headed Blackbird
	BRBL	Brewer's Blackbird
	BHCO	Brown-headed Cowbird
	BUOR	Bullock's Oriole

Finches

	PUFI	Purple Finch
	CAFI	Cassin's Finch
	HOFI	House Finch
	RECR	Red Crossbill
	PISI	Pine Siskin
	LEGO	Lesser Goldfinch
	AMGO	American Goldfinch
	EVGR	Evening Grosbeak

Weavers

	HOSP	House Sparrow

Other Species Detected

Breeding Code	Species Code	Species Name

Notes (on observations, location, rarities, weather, etc.):

Rev. 20070424

Observer's Full Names_____ Checked_____ Copied_____ Entered_____

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #10: Post Field Season

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains procedures that will be completed after the field season, which include handling equipment, data forms, communication with NPS personnel, and reporting. Technicians and interns will assist the Project Lead in completing post season field tasks.

Clean, Inventory, and Store Field Equipment

1. All equipment should be inventoried.
2. All equipment should be cleaned, in working order, and stored in the proper storage location. Equipment should be prepared for winter storage, which will include removing batteries, emptying fluids, and winterizing trailers when applicable.
3. Record broken or missing equipment on the inventory sheet. Label the equipment with sufficient information so that someone else will understand the specific problem.
4. Report missing or faulty equipment and/or equipment needing repairs to the Project Lead so that equipment can be repaired or replaced before the following field season.
5. Vehicles, if provided, should be full of fuel and the inside and outside need to be thoroughly cleaned. Mileage reports and vehicle maintenance forms should be submitted to the Project Lead.

Data Forms

Data forms should be submitted to the Project Lead at the end of each sampling event. At the end of the field season, it is the Project Lead's responsibility to:

1. Ensure that all surveys have been completed.
2. Organize data forms as follows:
    a. For point count surveys, the forms will be organized by route. Forms include: species checklist, point count, and vegetation. They should be filed alphabetically by park and route name.
    b. For mist netting, the banding forms will be organized by band size and by date for all birds that received new bands. Unbanded birds and birds that were recaptured

(already banded) will be organized by date. Mist netting journal forms, species checklists, and area search surveys data forms will be organized chronologically.

3. Ensure that all data have been entered into the databases.
4. File extra field forms in the proper file cabinet for the following year.
5. Make copies of all data forms. Data forms will be filed in the proper format following the organizational structure listed above, with the copies stored at a separate location from the originals.

Close-out

The Project Leads should communicate with the Park and Network Contact to determine whether keys and/or other equipment need to be returned. Once keys and equipment have been returned, the Network Contact should be notified.

Field Season Reporting

The Project Lead should prepare a brief report (generally not more than three pages) due before November 1st that includes the following:

1. Clear enumeration of which transects were completed during the season.
2. Description of any logistic difficulties that arose and explanation of how they were addressed.
3. Clear documentation and explanation of any diversions from established protocols.
4. Discussion of any interesting or potentially important observations about the parks' bird communities that may have been noted during the field season (e.g., apparent changes in phenology from previous years or notable changes in apparent abundance of particular species).
5. Suggestions for improving the training session or field season logistics in the future.

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #11: Photo Management

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP includes instructions for managing photos taken for this monitoring protocol.

Introduction

This document covers photographic images collected by the Project Lead, technicians, and interns during the course of conducting project-related activities.

Care should be taken to distinguish data photos from incidental or opportunistic photos. Data photos are those taken for at least one of the following reasons:

1. To document a particular feature or perspective for the purpose of site relocation.
2. To capture site habitat characteristics and to indicate gross structural changes over time.
3. To document species detection.
4. To document field crew activities during surveys and site set-up.

It is the responsibility of the Project Lead to ensure images are properly named and stored in the correct location along with the image metadata as described below.

File Structure Set-up

Download and Processing Procedures

Any crew member who takes data photos should complete the following procedures for downloading and processing those photographs. A set of folders should be created in the My Pictures folder in My Documents on the technician's computer or on the computers at the field station where photos are downloaded. The Project Leads should keep documentation regarding the computers being used to download photos.

1. Download the raw, unedited images from the camera into the appropriate processing folder as described below.
2. Rename the images (refer to the image file naming standards section). If image file names were noted on the field data forms, be sure to update these forms to reflect the new

image file name prior to data entry. Using a red pen, draw a single line through the name on the field data form and record the new name.

3. Process images as follows:
    a. Copy the images to the "Originals" folder and set the contents as read-only by right clicking in Windows Explorer and checking the appropriate box. These originals are the image backup to be referred to in case of unintended file alteration or deletion.
    b. In the processing folder, delete any poor quality photos, repeats, or otherwise unnecessary photos. Low quality photos might be retained if the subject is highly unique or the photo is an irreplaceable data photo.
    c. Rotate the image to make the horizon level.
    d. Photos of people should have "red eye" glare removed.
    e. Photos should be cropped to remove edge areas that grossly distract from the subject.
    f. Complete a record in the Excel image metadata table for each processed image. An image metadata table can be obtained from the KLMN Internet web sites or by contacting the KLMN Data Manager. An example of the metadata table is included at the end of this SOP.
4. When finished, move the image files that are to be retained to the appropriate folder, as described below. To minimize the chance for accidental deletion or overwriting of needed files, no stray files should remain in the processing folder between downloads.

Image File Naming Standards

Names of the images will be dependent on which folder is used to store the image, as described below. The initials of people pictured (as a main subject) in photos should be included at the end of the image file name. Ensure that any initials you use in a photo file name are added to the document of names and initials located at on the KBO server at z:/Library/images/Initials Used in Photo Names. This document includes Initials, Full Name, Position, and Year sorted by initials.

Folder: Birds

All file names in this folder should include the month and year the photo was taken at the end of the name.

1. Sub Folder: Birds in the Hand
    a. Definition: Birds in the hand.
    b. File Name: Four Letter Species Code Age Sex Location Date.
    c. Example: HETH HY F WIWI 20061212
    d. Sub Sub Folder (in Birds in Hand): ID Characters
        - Definition: Pictures identifying specific parts of a bird such as a special molt limit.
        - File Name: Use same naming guidelines, except add a description after Species Code.
        - Example: HETH Juvenile Plumage HY F WIWI 20061212
2. Sub Folder: Birds in the Wild
    a. Definition: Birds that are flying, foraging, in habitat, etc. These photos are often donated, so it is important to include the photographer's name in the Properties and include the "C" for copyright.

b. File Name: Four Letter Species Code Age Sex (if age and sex is known) Location Date.
c. Example: HETH HY F WIWI 20061212

3. Sub Folder: Spread Wing
    a. Definition: Pictures of wings for molt study.
    b. File Name: Four Letter Species Code Age Sex Location Date.
    c. Example: HETH HY F WIWI 200612
4. Sub Folder: Nests/Fledglings
    a. Definition: Pictures of nests or fledglings in nest.
    b. File Name: Nest or Fledgling Species Code Location Date.
    c. Example: BCCH WIWI 20060406
5. Sub Folder: Disease and Malformations
    a. Definition: Pictures of birds with diseases or abnormalities.
    b. File Name: Four Letter Species Description of Disease Code Age Sex Location Date.
    c. Example: AMGO Albino A M WIWI 20060305

Folder: People

Include initials after year if there are photos highlighting one person. Refer to the document in the library with all initials.

1. Sub Folder: Field Work
    a. Definition: Photos of banding stations or other field work such as point counts. (Use four letter location code and include any more specific information, such as net number or point count station as necessary after "Place.")
    b. File Name: Place Activity Year.
    c. Example: NOMO06 Point Count 2006.
    d. Example: NOMO Banding IA 2006.
2. Sub Folder: Workshops/Meetings/Trainings
    a. Definition: Photos of workshops or meetings involving KBO staff, interns, board members, etc.
    b. File Name: Activity Year.
    c. Example: KBO Strategic Planning Meeting 2006

Folder: Places

1. Sub Folder: Study Sites
    a. Definition: Location where KBO conducts research, such as a banding station or specific study. (Use four letter location code when necessary.)
    b. File Name: Name Location Year.
    c. Example: Fire Study WIIM 2006
2. Sub Folder: Habitat Types
    a. Definition: Photos of habitat types such as riparian areas, forests, etc.
    b. File Name: Type of Habitat Location Year.
    c. Example: Riparian WIWI 2005

Folder: Project Data

1. Sub Folder: KLMN
    a. Definition: All Sub Folders should include the project name KLMN.
    b. File Name: Location Year Subject.

c. Include a text file in the Sub Folder with specifications on how you named your photos and a brief description of the project, location, lead personnel, years, and funding source or contract.

Folder: Originals

2. Sub Folder: Folder with date and photographer initials for complete set of original downloaded photos.
    a. Folder Name: Date in year, month, day format followed by initials.
    b. Example: 20071022 JDA

Deliver Image Files for Final Storage

It is the Project Lead's responsibility to compile all images into a common set of folders and to transfer processed images and metadata (Table 1) to the KLMN Data Manager (SOP #16: Data Transfer, Storage, and Archive).

To transfer images from computers and to transfer the compiled set of images to the KLMN Data Manager, copy the folder for the appropriate year and all associated sub folders and images onto a CD or DVD for delivery. These files will be stored in the Landbird_Image folder, a sub folder of the Landbird Monitoring folder located on the Klamath Network server. Copies of the images will be placed in the KLMN Image Library. Metadata for the images will be loaded into the KLMN Image Database, which is linked to the photographs in the KLMN Image Library. Images and metadata will be backed up and archived following the methodologies outlined in the Klamath Network Data Management Plan.

Table 1. Required metadata table for all images.

*Park Code	*Network Code	Project	*Photo Name	*Date	*Photographer	*Description	UTM East	UTM North	Datum	*Category Folder	*Ext.	*Rights	Collection	Publisher	Resource Type
	KLMN	Landbird							NAD 83 Zone 10		.jpg		KLMN	NPS	Image
	KLMN	Landbird							NAD 83 Zone 10		.jpg		KLMN	NPS	Image
	KLMN	Landbird							NAD 83 Zone 10		.jpg		KLMN	NPS	Image
	KLMN	Landbird							NAD 83 Zone 10		.jpg		KLMN	NPS	Image

1) * Required fields.
2) Populated fields are populated with their default values as shown above.
3) Fields include:

Park Code – CRLA, LABE, LAVO, ORCA, REDW, WHIS
Network Code – KLMN
Project – Name of the project you are working on
Photo Name – Name of the photograph, do NOT include the extension
Date – Date the photograph was taken in the format MM/DD/YYYY
Description – A DETAILED description of the photograph, including the name of the site, if applicable
UTM East and North – The UTM coordinates where the picture was taken, if applicable
Datum – The datum and zone for the UTM coordinates. The default is NAD 83 Zone 10
Category Folder – The name of the folder where the picture is being stored
Ext. – The extension; the KLMN requires photographs to be in jpeg format
Right – Generally, rights are “Public”
Publisher – Owner of the photograph, usually NPS
Resource Type – What is it? Image, PPT, Graphic; usually Image

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #12: Data Entry

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedures for entering point count, species checklist, area search, banding, and vegetation data into their respective databases.

Introduction

Data entry is a critical component of field studies that must be addressed to ensure the data collected are of good quality. This SOP provides details of how to complete data entry in the project databases, which include banding, area search, point count, species checklist, and vegetation data. Each database was developed in Access 2000 and utilizes lookup tables and electronic forms that mimic the hardcopy datasheets to reduce transcription errors and allow for easy data entry. Data dictionaries for each database are provided at the end of this SOP. Once data entry is completed, data are exported into flat .dbf files for further data verification and validation (SOP #13: Data Validation and Verification). Once quality control processes have been implemented, all field databases are uploaded into a master database that conforms to the NPS Natural Resource Database Template (NRDT).

Timelines and Responsibilities

Technicians and interns are responsible for completing the first two rounds of data validation (SOP #13: Data Validation and Verification) and data entry. Data should be entered as quickly as possible following data collection. Ideally, data are entered within 2 weeks of data collection and should be entered no later than 1 month after the field effort.

Organizing Your Data Entry System

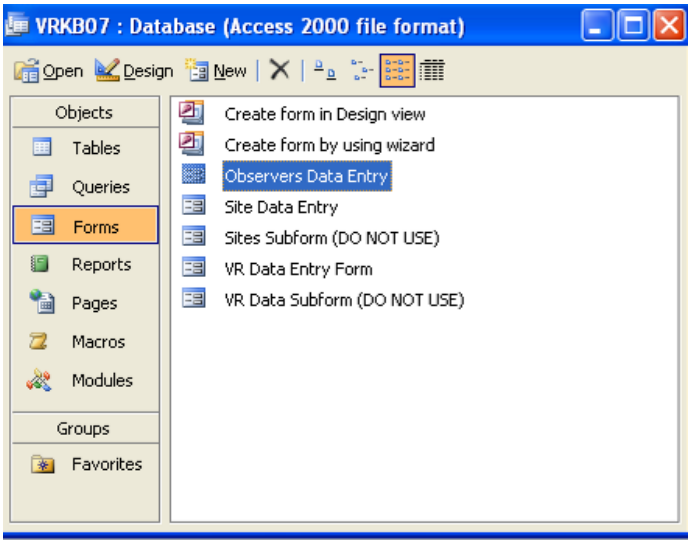
The first step is to get the data entry system organized on your computer. Create a folder called "Data Entry" on your C drive. Obtain a CD containing the five blank monitoring Access databases from the Project Lead. Each of the entry databases is named with six digits. The first two represent the type of survey (VR = variable radius point counts, VG = vegetation, AS = area search, SC = species checklist, BD = banding). The next two digits are for the initials of the person entering the data or initials representing your field station if more than one person will

enter data into the database. The last two digits represent the year during which data are collected. Each of these data sets is found within its own folder that is named using this same convention.

Data Entry

Procedures

1. To begin entering data, navigate to the proper database and double-click to open the Access file.
2. On the left side of the database window is an index column named “Objects.” Within this column, click on “Forms.” On the right side, at the bottom of the list, double-click on the Data Entry Form.



3. Begin to enter the data and be sure to use the “Enter” key to advance to the next field; continuing past the last field will advance you to the next form. You must complete the form and proceed to the next form so the data can be saved. The databases have been designed to not save data until the form is complete. Access will automatically save the data as each form is completed; you do not need to use the save function.
4. As you continue to enter data in the form, you can toggle back and forth from previous forms if necessary (e.g., if you have forgotten which record was last entered). On the bottom of the Data Entry Form, you will find the word "Record:" followed by buttons with arrows and a field containing a record number; click on the button with an arrow to toggle through the records and the arrow with the asterisk to get to the first blank record of the file.



5. As data are being entered, the person entering the data should visually review each data form to make sure that the data on screen match the field forms. This should be done by toggling through the records after the completion of each page.

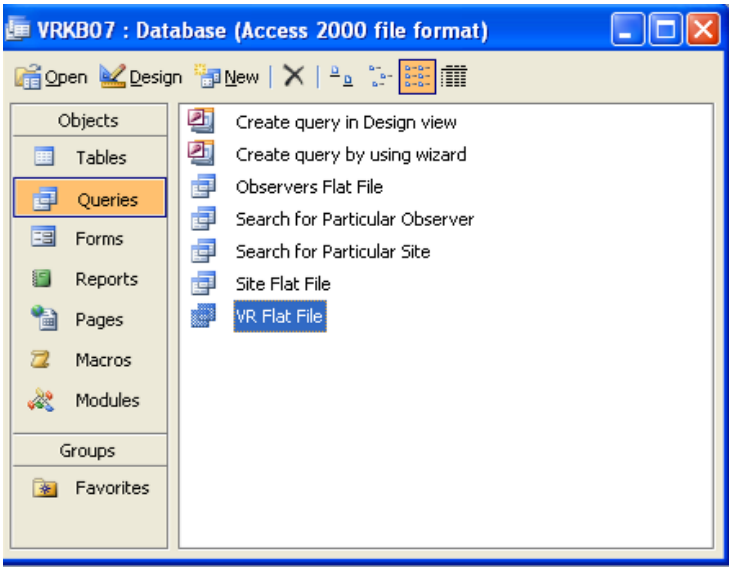
Basic Guidelines

1. Enter all data in capital letters, using the "Caps Lock" function on the keyboard. This is important because Access will automatically convert lowercase to uppercase, but when the data are exported, they revert to lowercase.
2. Enter all data exactly as they appear on the field form (for example, station numbers are two characters 01, 02, 03, and must be entered as such with the 0 proceeding single digits).
3. If data on a field form have been edited with a red pencil, enter the datum that is written in red.
4. You must be familiar enough with the Data Entry Form to know which fields are permitted to be blank. If you are not certain, review this with the Project Lead prior to data entry. Some fields are intentionally left blank and should be left blank during data entry. Alternately, when a field is left blank by the observer that actually required data, enter -9 in that entry field. This value is used because -9 would not be an acceptable data value for any field. An example of when to enter -9 is if a required field such as weight on the banding field form was left blank because the bird escaped before it could be weighed.
5. If there are data on the form that the database will not allow, then enter -8 and make a note on your data entry log, including the value that you tried to enter. This is a rare situation. An example would be if a new non-bird species is detected on a point count route and the species has not been incorporated into the validation program. The -8 will bring this to the attention of the Project Lead who will revise the validation text prior to the next field season.
6. When entering data, try to leave enough time to complete a block of data (e.g., a point count route or a page of banding data). Do not partially enter a point count route or banding data page.
7. Write your initials and the date on the bottom of the field form following the ENT field.
8. If you have any questions about how to enter data, ask the Project Lead for clarification immediately.

Exporting Data

Data backups should be completed every day that new data are entered. Backups are created to save time in case of mistakes or database file corruption. Pre-designed queries are used to create backups in a Dbase IV format to reduce the amount of space needed for storage. Follow these steps to create backups of the data at the end of the day:

1. Close the data entry form.
2. Change to the Query section of the database. On the left side of the window in the Access database is a column named "Objects;" click on "Query" in that column.
3. Select and double-click the pre-formatted query. The query title will include the first two letter code that indicates data type (e.g., VR in the point count database).



4. Export the data to a dBase file from the Query:
    a. Under the "File" drag-down menu, select "Export."
    b. The file should already be named appropriately (e.g., VRKB07). If it is not, change it. Under "save as type," select "dBase IV."
    c. Save it in your data folder. At the top, "Save in," select drive "C:," "Data Entry," and then your specific folder (e.g., VRKB07).
    d. If prompted, select "Yes" to replace the existing file.
5. Make a backup of this file on your hard drive:
    a. In File Manager, find the file.
    b. Click it once to select it and press Ctrl + C to copy it.
    c. Press Ctrl + V to paste it.
    d. Right click the "Copy of ....." and select "Rename."
    e. Delete the words "Copy of" and add the date to the end of the file name, so that it looks like "VRKB07 20071021." If you have made multiple saves in one day, you can number these alphabetically (i.e., VRKB07 20071021a and VRKB07 20071021b, etc.).
6. Transfer the complete database and all backup files to the Project Lead, using a CD or flash drive.

Maintaining the Data Entry Log

A data entry log must be maintained during data entry. A blank data entry log is included at the end of this SOP. Each data entry log should be specific to a single dataset. At the top of the data entry log, record the name of the data entry file and the names of all individuals entering data who are using the file. During each data entry session, record the date, your initials, what data was entered (e.g., point count route name and number of stations, band size and string number, total number of records at end of data entry session, number of hours spent entering data, and the name of the exported backup file). In addition, record any comments. Comments should include

the reason that -8 was entered for data that did not conform to the database or unresolved edit needs (SOP #13: Data Validation and Verification).

Data Entry Log

Data File:_____ Data Enterers' Names:_____

Init.	Date	Backup File	Project	Route and # of Stations or Band Size and Range of Band #s[1]	# of Pgs or Rec[2]	# of Hrs[3]	Comments (continue on next line if necessary)

1. For point count, area search, and vegetation data, record route name and number of stations; for species checklist, record only route name. For banding data, record the band size and the range of band numbers. If entering unbanded or hummingbird data, enter "unbanded" and the date of the first record on the page. If entering *Empidonax* data, enter the date and band number of the first record on the page.
2. Pages should be recorded for point counts, area search, and vegetation data. Number of records should be recorded for banding data.
3. Record the number of hours spent entering data at the end of a data entry session (not by route or page).

KBO Data Dictionaries

Dataset: ASXXYY
File Type: mdb
Relationship: Area Search Header (one) to Area Search Data (many)
Table: Area Search Header

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
RecNum	1	Y	Numeric	Integer	0	Auto Number based on order of entry; Key Field		Integer starting at 1, no limit
Project	2	Y	Character	20		Project or Region Code		
Site	3	Y	Character	20		Site name (often 4-letter code)	Each 4-letter code represents itself	
Point	4	Y	Character	2		Point (Search area)	Typically designated A or B	
Month	5	Y	Character	2		Month		01 to 12
Day	6	Y	Character	2		Day		01 to 31
Year	7	Y	Character	4		Year		
PrimObs	8	Y	Character	4		Primary observer's initials		
SecObs	9	N	Character	20		Secondary observer's initials, if multiple observers, initials separated by ","		
Temp	10	Y	Character	3		Temperature		Degrees Celsius, range=-10 to 40
CldCvr	11	Y	Character	3		Cloud Cover		Percentage, range=0 to 100%
Precip	12	Y	Character	2		Precipitation Type	N=None, F=Fog, M=Mist, D=Drizzle, R=Rain	
Wind	13	Y	Character	2		Wind Strength	Beaufort Scale, 0=calm, 1=light air, 2=leaves rustle, 3=small branches sway, 4=moderate breeze, >4 do not survey	

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
StrtTime	14	Y	Character	4		Start Time: 24-hour		0000 to 2359
Duration	15	Y	Numeric	Integer	0	Duration of survey		Minutes (default=20)
Notes	16	N	Character	255		Notes		

Table: Area Search Data

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
RecNum	1	Y	Numeric	Long Integer		Auto Number based on order of entry		Integer starting at 1, no limit
Species	2	Y	Character	4		AOU 4-letter bird species code	See Table: Bird List Lookup	
Detect	3	Y	Character	2		Detection Type	V=Visual, S=Song, C=Call, D=Drumming, W=Wing, F=Flyover	
Total	4	Y	Numeric	Long Integer	0	Total detections		>0
Area	5	Y	Character	3		Detection occurred on or off survey area	On, Off	
Breeding	6	Y	Character	2		Breeding Status	C=Courtship or copulation, D=distraction, F=carrying food or fecal sac, L=local young, M, Carrying nest material, N=Active nest, S=Song, T=Territorial behavior	

Dataset: VRXXYY
File Type: mdb
Relationship: VCP Header (one) to VCP Data (many)
Table: VCP Header

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
RecNum	1	Y	Numeric	Integer	0	Auto Number based on order of entry; Key Field		Integer starting at 1, no limit
Project	2	Y	Character	20		Project or Region Code		
Site	3	Y	Character	20		Site name (often 4-letter code)	Each 4-letter code represents itself	
Month	4	Y	Character	2		Month		01 to 12
Day	5	Y	Character	2		Day		01 to 31
Year	6	Y	Character	4		Year		
PrimObs	7	Y	Character	4		Primary observer's initials		
Temp	8	Y	Character	3		Temperature		Degrees Celsius, range=-10 to 40
CldCvr	9	Y	Character	3		Cloud Cover		Percentage, range=0 to 100%
Precip	10	Y	Character	2		Precipitation Type	N=None, F=Fog, M=Mist, D=Drizzle, R=Rain	
Wind	11	Y	Character	2		Wind Strength	Beaufort Scale, 0=calm, 1=light air, 2=leaves rustle, 3=small branches sway, 4=moderate breeze, >4 do not survey	
Notes	12	N	Character	255		Notes		

Table: VCP Data

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain

RecNum	1	Y	Numeric	Long Integer		Auto Number based on order of entry		Integer starting at 1, no limit
Point	2	Y	Character	3		Reference number for each point count point within a site (route)		
Noise	3	Y	Character	2		Noise level during point count census	1=No noise, 2=Moderate noise, 3=Too much noise, do not survey	
Time	4	Y	Character	4		Time of point count (24-hour)		0000 to 2359
Species	5	Y	Character	4		AOU 4-letter bird species code	See Table: Bird List Lookup	

Field Name	**Field**	**Required (Y/N)**	**Type**	**Length**	**Decimal**	**Definition**	**Enumerated Domain**	**Range Domain**
Distance	6	Y	Numeric	Long Integer	0	Distance to bird from point		Meters, to nearest meter, range=0 to 9999
Detect	7	Y	Character	2		Detection Type	V=Visual, S=Song, C=Call, D=Drumming, W=Wing, F=Flyover	
NumDet	8	Y	Numeric	Long Integer	0	Number of Detections		
DLoc	9	Y	Character	2	0	Detection Location	R=Riparian, U=Upland	
Previous	10	Y	Character	2		Previous detection	P=Previous	

Breeding	11	Y	Character	2	Breeding Status	C=Courtship or copulation, D=distraction, F=carrying food or fecal sac, L=local young, M, Carrying nest material, N=Active nest, S=Song, T=Territorial behavior

Dataset: SCXXYY
File Type: mdb
Relationship: Species Checklist Header (one) to Species Checklist Data (many)
Table: Species Checklist Header

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
RecNum	1	Y	Numeric	Integer	0	Auto Number based on order of entry; Key Field		Integer starting at 1, no limit
Project	2	Y	Character	20		Project or Region Code		
Site	3	Y	Character	20		Site name (often 4-letter code)	Each 4-letter code represents itself	
Month	4	Y	Character	2		Month		01 to 12
Day	5	Y	Character	2		Day		01 to 31
Year	6	Y	Character	4		Year		
PrimObs	7	Y	Character	4		Primary observer's initials		
SecObs	8	N	Character	20		Secondary observer's initials, if multiple observers, initials separated by ","		
NumObs	9	Y	Numeric	Integer		Number of observers		Integer
SurvType	10	Y	Character	3		Survey Type	AQ=Aquatic, AS=Area Search, BT=Black Tern, BW=Bird Walk, CES=Constant Effort Station, DEM=Banding Demo, NS=Nest Search, O=Other, PC=Point Count, ROI=Rapid Ornithological Inventory, T=Travel	
StrtTime	11	Y	Character	4		Start Time: 24-hour		0000 to 2359
EndTime	12	Y	Character	4		End Time: 24-hour		0000 to 2359
Notes	13	N	Character	255		Notes		

Table: Species Checklist Data

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
RecNum	1	Y	Numeric	Long Integer		Auto Number based on order of entry		Integer starting at 1, no limit
Species	2	Y	Character	4		AOU 4-letter bird species code	See Table: Bird List Lookup	
Breeding	3	Y	Character	2		Breeding Status	B=Bird captured C=Courtship or copulation, D=distraction, E=Encountered, F=carrying food or fecal sac, L=local young, M, Carrying nest material, N=Active nest, O=Flyover, S=Song, T=Territorial behavior	

Dataset: BDXXYY
File Type: mdb
Table: Banding Data

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
RecNum	2	Y	Numeric	Integer	0	Auto Number based on order of entry; Key Field		Integer starting at 1, no limit
Year	6	Y	Character	4		Year		
BandSize	2	Y	Character	2		Band Size	HH, 0A, 00, 1C, 01, 1B, 1A, 1P, 02, 03, 3A, 3B, 04, 4A, 05, 06, 7A, 7B, 7D, 08, 09, 9C, RR, UU	
Recorder	3	Y	Character	4		Recorder's initials		
Bander	4	Y	Character	4		Bander's initials		
BandCode	5	Y	Character	2		Band Status Code	C=Changed band, D=Destroyed band, L=Lost band, N=New band, R=Recapture, U=Unbanded	
BandNo	6	Y	Character	9		Band Number		
Species	7	Y	Character	4		AOU 4-letter bird species code	See Table: Bird List Lookup	
Age	8	Y	Character	2		Age	A=After hatch year, H=Hatch year, L=Local, O=After second year, S=Second year, T=Third year, U=Unknown, V=After third year	

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
HowAged1	9	Y	Character	2		How Aged	#=Growth bar alignment, @ Egg in oviduct, = Fault bar alignment, 0 = No molt limits, A=Definitive alternate plumage, B=Brood Patch, C=Cloacal protuberance, D=Primary covert shape or wear, E=Eye color, F=Feet or legs, G=Gape, H=First basic plumage, I=Mouth or bill, J=Juvenal plumage, K=Adult basic plumage, L=Plumage color length, M=Molt limits, N=First alternate plumage, O=Other, P=Plumage, Q=Measurements, R=Prejuvenal molt, S=Skull ossification, T=Feather texture, U=Undetermined, V=Feather shape, W=Differential feather wear, X=Age or sex undetermined, Y=Symmetrical flight feather molt, Z=Less precise age	
HowAged2	10	Y	Character	2		How Aged	Same as above	
Sex	11	Y	Character	2		Sex	M=Male, F=Female, U=Unknown	
HowSex1	12	Y	Character	2		How Sexed	@ Egg in oviduct, B=Brood Patch, C=Cloacal protuberance, E=Eye color, O=Other, P=Plumage, Q=Measurements	
HowSex1	12	Y	Character	2		How Sexed	Same as above	
Skull	13	Y	Character	2		Skull Ossification	A=Almost complete, F=Full, G=Greater than 2/3, H=Half, L=Less than 1/3, T=Trace, 0=None	

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
CP	14	Y	Character	2		Cloacal Protuberance	0=None, S=Small, M=Medium, L=Large	
BP	15	Y	Character	2		Brood Patch	0=None, S=Smooth, V=Vascularized, W=Wrinkled, M=Molting	
Fat	16	Y	Character	2		Fat	0=None, T=Trace, L=Thin layer, H=Half, F=Full, B=Bulging, G=Greatly bulging, V=Very extensive	
BodyMolt	17	Y	Character	2		Body Molt	0=None, T=Trace, L=Light, M=Medium, H=Heavy	
FFMolt	18	Y	Charatcter	2		Flight Feather Molt	N=None, S=Symmetrical, A=Adventitious	
FFWear	19	Y	Character	2		Flight Feather Wear	0=None, S=Slight, L=Light, M=Moderate, H=Heavy, X=Extreme	
JuvPlum	20	Y	Character	2		Juvenal Plumage	0=None, L=Less than ½, H=More than ½, F=Full	
MoltLim1	21	Y	Character	2		Molt Limit	0=None, A=Alula, B=Body, C=Primary Coverts, G=Greater Coverts, L=Lesser Coverts, M=Median Coverts, P=Primaries, R=Rectrices, S=Secondaries, T=Tertials, V=Primary vs. Greater Coverts	
MoltLim2	22	Y	Character	2		Molt Limit	Same as above	
Wing	23	Y	Numeric	Integer	0	Wing Chord		
Weight	24	Y	Numeric	Single	1	Weight		Integer
Status	25	Y	Character	2		Bird Status	N=Banded and released okay, C=Color banded, D=Dead, I=Injured	
Month	26	Y	Character	2		Month		01 to 12
Day	27	Y	Character	2		Day		01 to 31
CapTime	28	Y	Character	4		Capture Time (24-hour)		0000 to 2359

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
Site	29	Y	Character	4		Banding Station (4-letter code for each station)		
Point	30	Y	Character	2		Net Number		01 to 13
NoteNum	31	N	Character	2		Note Number		01 to 25
OldBand	32	Y	Character	9		Old Band Number		
UpColor	2	N	Character	2		Upper Part Color	D=Dusky, G=Gray, B=Black, N=Brown, O=Olive, P=Pink, R=Green, W=White, Y=Yellow	
UndColor	3	N	Character	2		Under Part Color	D=Dusky, G=Gray, B=Black, N=Brown, O=Olive, P=Pink, R=Green, W=White, Y=Yellow	
ThrColor	4	N	Character	2		Throat Color	D=Dusky, G=Gray, B=Black, N=Brown, O=Olive, P=Pink, R=Green, W=White, Y=Yellow	
ChnColor	5	N	Character	2		Chin Color	D=Dusky, G=Gray, B=Black, N=Brown, O=Olive, P=Pink, R=Green, W=White, Y=Yellow	
LgColor1	6	N	Character	2		Leg Color	D=Dusky, G=Gray, B=Black, N=Brown, O=Olive, P=Pink, R=Green, W=White, Y=Yellow	
LgColor2	7	N	Character	2		Leg Color	D=Dusky, G=Gray, B=Black, N=Brown, O=Olive, P=Pink, R=Green, W=White, Y=Yellow	
RngShp1	9	N	Character	2		Eye Ring Shape	A=Absent, B=Broken, C=Complete, D=Distinct, I=Indistinct, R=Round, T=Tear drop	
RngShp2	10	N	Character	2		Eye Ring Shape	A=Absent, B=Broken, C=Complete, D=Distinct, I=Indistinct, R=Round, T=Tear drop	

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
MandBase	11	N	Character	2		Mandible Base Color	D=Dusky, G=Gray, B=Black, N=Brown, O=Olive, P=Pink, R=Green, W=White, Y=Yellow	
MandTip	12	N	Character	2		Mandible Tip Color	D=Dusky, G=Gray, B=Black, N=Brown, O=Olive, P=Pink, R=Green, W=White, Y=Yellow	
Culmen	13	N	Numeric	Single	1	Length of culmen from nares (bill)		
BillWidt	14	N	Numeric	Single	1	Width of bill at nares		
LPPLSS	15	N	Numeric	Single	1	Longest primary - longest secondary		
LPP6	16	N	Numeric	Single	1	Longest primary - p6		
P6P10	17	N	Numeric	Single	1	P6 – p10		
P9P5	18	N	Numeric	Single	1	P9 – p5		
P10P5	19	N	Numeric	Single	1	P10 – p5		
P10P4	20	N	Character	2		P10 – p4	>, <, =	
P6Emarg	21	N	Character	2		P6 Emarginated?	Y=Yes, No=No	
Tail	22	N	Numeric	Integer	0	Tail length		
WingTail	23	N	Numeric	Integer	0	Wing Chord – Tail length		
R6R1	24	N	Numeric	Integer	0	Tip r6 – tip r1		
WebRect	25	N	Character	2		Outer web of rectrices	N=None, S=Slight=M=Moderate	
Clipped	2	N	Character	2		Clipped rectrix	R1, R2, R3, R4, R5, L1, L2, L3, L4, L5	
BillGrv	3	N	Numeric	Integer	0	Percent of bill length with grooves		Percent: 0 to 100
R2Emarg1	4	N	Character	2		R2 Emarginate: inner	0=None, S=Slight, M=Moderate	
R2Emarg2	5	N	Character	2		R2 Emarginate: outer	0=None, S=Slight, M=Moderate	
R5Width	6	N	Numeric	Single	1	R5 Width		

Dataset: VGXXYY
File Type: mdb
Relationships: Vegetation Data (one) to Species Composition Data (many)
Table: Vegetation Data

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
RecNum	1	Y	Numeric	Integer	0	Auto Number based on order of entry; Key Field		Integer starting at 1, no limit
Region	2	Y	Character	20		Project Code		
Site	3	Y	Character	20		Site name (often 4-letter code)	Each 4-letter code represents itself	
Point	4	Y	Character	3		Reference number for each point count point within a site (route)		
Split	5	N	Character	2		Split indicates multiple releve surveys conducted for single point and designates the survey	A, B, N=North, S=South, E=East, W=West	
PrimObs	6	Y	Character	4		Primary observer's initials		
Easting	7	Y	Numeric	Single	7	UTM Easting		
Northing	8	Y	Numeric	Single	7	UTM Northing		
Error	9	Y	Error	3	1	GPS Error		
Month	10	Y	Character	2		Month		
Day	11	Y	Character	2		Day		
Year	12	Y	Character	4		Year		
PltRad	13	Y	Numeric	Integer	0	Plot Radius		Integer, meters
Water	14	Y	Character	2		Water present	+=Yes, -=No	
Burned	15	Y	Character	2		Burned or Unburned	B=Burned, U=Unburned	
RipUp	16	Y	Character	2		Riparian or Upland	R=Riparian, U=Upland	
RipType	17	N	Character	2		Type of Riparian	W=Wetland, P=Pond, L=Lake, F=Flowing	
RipWidth	18	N	Character	2		Size of Riparian Area	1=less than 0.5 hectares, 2=between 0.5 and 4 ha 3=>4 ha	
SiteNotes	19	N	Character	255		Site Notes		

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
TRTOTCOV	2	Y	Character	2		Total Tree Cover	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	
TRLOWHT	3	Y	Numeric	Integer	0	Low Tree Height (meters)		
TRLOWSP	4	Y	Character	4		Low Tree Species	4-letter plant species codes	
TRUPPHT	5	Y	Numeric	Integer	0	Upper Tree Height (meters)		
TRUPPSP	6	Y	Character	4		Upper Tree Species	4-letter plant species codes	
TRMINDBH	7	Y	Numeric	Integer	0	Minimum Tree Diameter at breast height (centimeters)		
TRMINSP	8	Y	Character	4		Minimum Tree Species	4-letter plant species codes	
TRMAXDBH	9	Y	Numeric	Integer	0	Maximum Tree Diameter at breast height (centimeters)		
TRMAXSP	10	Y	Character	4		Maximum Tree Species	4-letter plant species codes	
TRNUMSUB	11	Y	Character	2		Number of Tree Sublayers		Range 0 to 3
SHTOTCOV	12	Y	Character	2		Total Shrub Cover	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	
SHLOWHT	13	Y	Numeric	Single	1	Low Shrub Height (meters)		
SHLOWSP	14	Y	Character	4		Low Shrub Species	4-letter plant species codes	

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
SHUPPHT	15	Y	Numeric	Single	1	Upper Shrub Height (meters)		
SHUPPSP	16	Y	Character	4		Upper Shrub Species	4-letter plant species codes	
SHNUMSU	17	Y	Character			Number of Shrub Sublayers		Range 0 to 3
HBTOTCOV	18	Y	Character			Total Herb Cover	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	
MSTOTCOV	19	Y	Character			Total Moss Cover	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	
Snag1	20	Y	Numeric	Integer	0	Total snags < 14.9 cm		
Snag2	21	Y	Numeric	Integer	0	Total snags 15-27.9 cm		
Snag3	22	Y	Numeric	Integer	0	Total snags 28-63.9 cm		
Snag4	23	Y	Numeric	Integer	0	Total snags 64-101.9 cm		
Snag5	24	Y	Numeric	Integer	0	Total snags >102 cm		
VegNotes	25	Y	Character	255		Vegetation Notes		

Table: Species Composition Data

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
RecNum	1	Y	Numeric	Integer	0	Auto Number based on order of entry; Key Field		Integer starting at 1, no limit
Species	3	N	Character	4		Plant Species	4-letter plant species codes	
T1	2	N	Character	2		Tree Sublayer 1	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	
T2	2	N	Character	2		Tree Sublayer 1	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
T3	2	N	Character	2		Tree Sublayer 1	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	
T4	2	N	Character	2		Tree Sublayer 1	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	
T5	2	N	Character	2		Tree Sublayer 1	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
T6	2	N	Character	2		Tree Sublayer 1	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	
S1	2	N	Character	2		Shrub Sublayer 1	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	
S2	2	N	Character	2		Shrub Sublayer 1	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
S3	2	N	Character	2		Shrub Sublayer 1	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	
S4	2	N	Character	2		Shrub Sublayer 1	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	
S5	2	N	Character	2		Shrub Sublayer 1	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
S6	2	N	Character	2		Shrub Sublayer 1	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	
H1	2	N	Character	2		Herb Sublayer 1	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	
H2	2	N	Character	2		Herb Sublayer 2	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
M1	2	N	Character	2		Moss Sublayer 1	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	
M2	2	N	Character	2		Moss Sublayer 1	0=None, 1=numerous, but less than 5 percent cover, or scattered with cover up to 5 percent, 2=5 - 25 percent cover, 3=25 - 50 percent cover, 4=50 - 75 percent cover, 5=> 75 percent cover, R=Rare, solitary, with small cover, +=Few, with small cover	

Note: Two codes can be used in all fields except RECNUM to indicate either an error on datasheet (-8) or no data collected (-9). All categorical.

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #13: Data Validation and Verification

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedures for verifying and validating data and includes information on handling field forms.

Field Forms

The field data forms are part of the permanent record; they should be handled in a way that preserves their future interpretability and information content. If changes to data on the forms need to be made after the day of data collection, the original values should not be erased or otherwise rendered illegible. Instead, changes should be made as follows:

1. Edits and revisions should be made in red pencil to make it easier for subsequent viewers to be able to retrace the edit history.
2. A horizontal line should be drawn through the original value and the new value written adjacent to the original value with the date and initials of the person making the change.
3. All corrections should be accompanied by a written explanation in the appropriate notes section on the field form. These notes should also be dated and initialed.
4. These procedures should be followed throughout data entry and data validation, until the final annual dataset is created. After that point, edits are made only in digital edit logs and not on the hardcopies of the data.

Data Validation and Verification

Technician and/or Intern

The data undergo two rounds of review by the technician and/or intern. The goal of data proofing and editing by the technician and/or intern is to ensure all data have been recorded and to make certain each record in the database matches its corresponding record on the datasheet. The first data review occurs in the field at the end of each survey, when the observer proofs and edits the data. This proofing and editing consists of looking for typos, obvious mistakes, and missing data. If additional data have been recorded in a field notebook, they are entered on the field forms at the end of the day. For example, during mist netting, birds are occasionally released or escape at

the net with capture information recorded in field notebooks. The minimal data gathered (i.e., species, sex, net number) are then recorded on datasheets at the end of the banding session. After each page of data is proofed and edited, the observer initials the bottom of the datasheet to indicate completion.

The second round of proofing is completed by the technician and/or intern when the data are entered into the Access databases (SOP #12: Data Entry). The Access data entry interface has domain values built in on all fields to increase the accuracy of data entry. For example, if the observer enters a bird code that is not in the bird list, an error message is displayed regarding the problem. The person entering the data is allowed to correct minor errors while entering data (e.g., misspelling a species code or improperly ageing or sexing a bird when the data unambiguously supports a different determination). When minor errors or typos on the datasheets are encountered during data entry, they are corrected with red pencil and noted in the "Error Notes" field. In addition, all corrections are logged in a data entry log that corresponds with each data file (SOP #12: Data Entry). After completion of data entry, all unresolved errors are forwarded to the Project Lead for further scrutiny.

Project Lead

Two additional rounds of review are completed by the Project Lead. The first occurs when datasheets and Access databases are forwarded by the technician and/or intern to the Project Lead. The Project Lead reviews the unresolved errors identified during the data entry process. When possible, these errors are corrected with red pencil and noted on the field forms. In addition, all corrections are made in the Access database, noted in the "Error Notes" field, and logged in the text-based log file that corresponds with each data file (SOP #12: Data Entry).

The second round of review, completed by the Project Lead, involves data validation. Data validation is the process of checking data for completeness, structural integrity, and logical consistency. The Project Lead compiles the data from all observers into a single dataset for each survey type (e.g., point count, mist net). Each of these files has a root name that includes two digits indicating the name of the survey method, two digits indicating the project, and two digits indicating the year the data were collected (e.g., VRKB06, BDKB06). The Project Lead then completes his/her second round of proofing and editing. During this process, the Access databases are backed up each time data validation and related editing occurs. The backup files are named with the root file name followed by the date (e.g., VRKB06 20060131).

A series of validation programs, written in SAS, R, and Visual Basic, produce outputs that allow the Project Lead to identify errors in the data. The programs produce a series of error reports, which are then checked by the Project Lead. All error reports are stored electronically with the databases and hardcopies printed and filed. For point count, area search, and vegetation data, error reports include:

1. Number of stations and visits per route – The Project Lead compares this output to the actual number of stations and visits that were to be completed. If the numbers do not match, he or she compares the database to the field forms to determine where the error occurred. This process identifies errors in route names, station numbers, or survey dates.
2. Routes and stations missing UTM coordinates – This output contains gaps where the UTM coordinates are missing. The Project Lead compares the dataset and the UTM database to identify errors in route names or missing location information.

3. Species codes and common name with number of detections – This output allows the Project Lead to identify incorrect codes that do not output with a common name and suspect codes of uncommon species. These questionable records are cross-referenced with field forms to determine appropriate edits. If necessary, observers are contacted to provide verification.

For banding data error reports, include:

1. Incorrect age and sex determinations that are both inappropriate for a particular time of year and/or for individual species and measurements that falls outside of known ranges for each species.
2. Duplicate records.
3. Incorrect band numbers.
4. Recaptures marked as newly banded or unbanded and recaptures of birds at different stations.
5. Data that do not correspond to previous years' data (e.g., duplicate band numbers, bands incorrectly recorded as new captures when they are actually recaptures, and band numbers recorded at different stations).

After all edits have been identified by validation programs, minor errors (e.g., route names, station numbers, improper species codes, minor ageing and sexing errors) are corrected, noted in the "Error Notes" field, and logged into the database log file for the database. This process results in a database that matches the datasheets, error reports, and log of database edits.

Once the validation and verification steps have been completed, the databases are uploaded into the KLMN Master Bird databases where they receive another round of data validation. At this stage, the datasets are archived and made ready for distribution and analyses.

Editing Archived Datasets

As datasets are analyzed, additional edits may be identified. Any further editing must follow the editing archived datasets procedure detailed below:

1. Ensure that the dataset is backed up correctly, as detailed above in the data verification section.
2. Maintain a digital data entry log with meticulous notes tracking all edits and the reason for needed changes.
3. Incorporate edits into the Access dataset with notes in the "Error Notes" field and output a revised dataset.
4. Resulting datasets should be checked for accuracy of edits and retention of all records.
5. The old dataset can be easily recovered if editing was incorrect by returning to the dataset backed up in step 1.
6. Transfer the revised dataset, along with the digital data management log, to the NPS Data Manager, to be incorporated into the KLMN Landbird database (SOP #17: Data Transfer, Storage, and Archiving).

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #14: Metadata Guidelines

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedures for completing metadata for products developed using this protocol. This includes, but is not limited to, databases, documents, GPS data, and GIS data. Details on metadata for photographs can be found in SOP #11: Photo Management. This SOP is based on metadata recommendations developed by the KLMN (Mohren 2007), the Natural Resource GIS Program (NR-GIS Data Store 2005a-i), and by the NPS, North Coast Cascade Network (NCCN 2006a, NCCN 2006b, NCCN 2006c).

Introduction

Documentation is a critical step towards ensuring products collected as part of this monitoring effort are usable for their intended purposes now and well into the future. This involves the development of metadata, which is defined as structured information about the content, quality, condition, and other characteristics of a product. In addition to spatial information, metadata include information about data format, collection and analysis methods, time of collection, originator, access/use constraints, and distribution. Metadata provide the means to catalog products, within Intranet and Internet systems, making them available to a broad range of potential users. While most frequently developed for geospatial data, metadata describing non-geospatial datasets are also important (NCCN 2006a).

Timelines

It is the responsibility of the Project Lead to submit metadata or metadata products (e.g., Metadata Interview Form, data dictionary) to the Klamath Network Data Manager, in the proper format, when he or she submits the product in which the metadata is associated. SOP #16: Data Transfer, Storage, and Archive provides detail on the products to be delivered to the Data Manager, the due dates for those products, and the person responsible for those products.

Responsibilities and Standards

Metadata is one of the most important pieces of documentation to help guarantee the long-term usability of data. The degree of documentation will vary depending on the product, but a few standards will always hold true.

1. Metadata for spatial data collected through I&M funded projects will meet FGDC, NBII, and NPS standards.
2. Project Leads will be expected to submit a data dictionary (for tabular and spatial data) and Metadata Interview Form (for spatial data) prior to the start of the first field season.
3. Project Leads will be expected to review and revise all data dictionaries and Metadata Interview Forms at the end of each field season and report changes following the timeline listed SOP #16: Data Transfer, Storage, and Archive.
4. It is the responsibility of the Data Manager to develop the official metadata based on the data dictionary and Metadata Interview Form provided by the Project Lead.
5. It is the Data Manager's responsibility to parse and transfer metadata to the NPS Data Store, if applicable.
6. The Data Manager will work with the Project Lead and park staff to determine the sensitivity level of any data (SOP# 15: Sensitive Data).

Reports

Three main types of reports are expected to be developed during this monitoring effort, including Annual Effort Reports, Analysis and Synthesis Reports, and Scientific Publications (SOP #17: Data Analysis and Reporting). It is the responsibility of the individual creating the reports to ensure the following guidelines are met.

1. First and last name of all authors are included on the reports.
2. Affiliation of the authors is included on the report.
3. Version numbers are used on all drafts of the report.
4. Date the report was completed is included on the report.
5. The date representing the information presented in the report is included in the report.
6. Series number is included in the report when applicable.
7. The NatureBib accession number has been added to the keywords field in the properties of the document in the format: NatureBib# 123456. This will be created by the Network Data Manager.

Spatial Data, Databases, and Spreadsheets

The Data Manager is responsible for creating and maintaining the official metadata for all GIS and GPS products, Relational Databases, and Spreadsheets. It is the responsibility of the Project Lead to provide Metadata Interview Forms and data dictionaries to the Data Manager prior to

implementing the field work as described in SOP #16: Data Transfer, Storage, and Archive. The Data Manager will use the Metadata Interview Form, data dictionary, and protocol to develop complete metadata for each product. Each year field work occurs, the Project Lead must submit a data dictionary (if changes to the product have occurred) and Metadata Interview Form following the timeline in SOP #16: Data Transfer, Storage, and Archive.

Steps for Metadata Creation

Step 1: Metadata Interview Form and Information Gathering (Figure 1)

A. The Project Lead should obtain and complete the KLMN Metadata Interview Form at project onset to facilitate compiling the information required to create compliant metadata.
    1. The KLMN Metadata Interview Form is posted on the KLMN Internet and Intranet web pages. In addition, the form can be obtained by contacting the Network Data Manager.
    2. Best attempts should be made to populate the Metadata Interview Form as completely as possible prior to starting field work. However, it is recognized that changes to the form will occur throughout the project.

B. A data dictionary must be created to provide information to help the Data Manager create or update the official metadata and in some cases, the project database. The data dictionary should include:
    1. The name and purpose of each table, shapefile, coverage, or feature class.
    2. A list of attribute names, type, size, and description by table. An example of a data dictionary in the proper format is provided at the end of this SOP.
    3. If the database was not designed by the Klamath Network, it is the responsibility of the Project Lead to provide the Data Manager with the data dictionary.

C. If a taxa list other then a current ITIS certified taxa list was used, the Project Lead will need to provide the list that was used at the end of each field season. Taxa lists should include:
    1. Taxon group (Bird, Mammal, Reptile, Invertebrate, etc.)
    2. Scientific name
    3. Common name
    4. Any special code that defines a species

D. The Project Lead should send a copy of any additional information that might be valuable for the development of metadata.

Step2: Sensitivity Review. Sensitive data (species locations, site locations, etc.) may not be subject for release to the public.

A. The current version of NPS Data Store does not screen for sensitive information. Therefore, any data with a sensitive status will not be posted on the Data Store.

B. The Network Data Manager will be responsible for posting data as sensitive. Status of the data will be based on comments provided by the Project Lead under the "Sensitivity" question in the Metadata Interview Form and certification form. In addition, the Klamath Network will consult with park staff if the sensitivity status of any data is questionable.

Step 3: Metadata Software Selection

A. The Klamath Network will utilize ArcCatalog, NPS Metadata Tool and Editor, and the Database Metadata Extractor to create metadata for all projects.
    1. ArcCatalog automatically harvests spatial organization and reference information, as well as entity and attribute information for GIS datasets.
    2. The NPS Metadata Tool and Editor is provided as a stand alone program or as an extension for ArcCatalog and is available at:

        http://science.nature.nps.gov/nrdata/tools/

        i. It can be used for metadata creation and editing.
        ii. It can import, export, and parse metadata.
        iii. It cannot harvest entity and attribute information; however, this is an anticipated feature for the next version.
    3. The NPS Database Metadata Extractor (MTE) is a custom software application for authoring, editing, and managing NPS metadata. The MTE operates either as an extension to ArcCatalog versions 8.3/9.x or as a standalone desktop application. Eventually, this tool will be incorporated into the NPS Metadata Tools and Editor. Features of this tool include:
        i. Automatically harvests entity (table) and attribute (field) metadata from Access databases, including domains.
        ii. Allows the user to edit and review the harvested metadata and make batch edits.
        iii. Allows the user to export metadata to a FGDC-compliant XML file.
        iv. Allows exported XML to be used in the Metadata Tools and Editor either by opening it to start a new metadata record or by updating it with a template to fill in Section 5 of an existing metadata record.

Step 5: Additional Requirements

A. Along with the required metadata, the Klamath Network requires the following information be included in the metadata document.
    1. The name and agreement code for the project. These references can be entered in the Related Key element in the Program Information section (NPS Section 0) on the NPS Profile.
    2. References to all products (GIS, GPS, Databases, Reports) generated by the projects. These references can be entered in the repeatable Cross Reference element of the Identification Information section.
    3. Standard language for NPS liability should be inserted into the Distribution Liability metadata element of the Distribution Information (FGDC Section 6).
        i. This can be found at: http://www.nps.gov/gis/liability.htm.

Step 6: Biological Data Profile

If a dataset includes biological information, the Biological Data Profile provides a set of extended metadata elements to document the species observed, taxonomic information, methods, and analytical tools.

A. The most direct, and KLMN preferred, means to populating the Biological Data Profile metadata elements are outlined in Biological Profile (National Biological Information Infrastructure - NBII) Metadata Guide (NR-GIS Data Store 2005a).
    i. This approach primarily utilizes the NPS Metadata Tools and Editor and may also require the entity and attribute harvesting capability of NPS Database Metadata Extractor for Access datasets.
B. The following two documents describe alternative approaches to completing the Biological Data profile for a metadata record. Note that the first requires the use of additional metadata creation software (Spatial Metadata Management System, or SMMS):
    i. Metadata Tools Used in the Creation of the FGDC Biological Data Profile (Callahan and Devine, 2004).
    ii. National Biological Information Infrastructure (NBII) Metadata Steps (McGuire 2004).

Step 7: Metadata Review

The Data Manager should review metadata for quality control (QC) prior to posting to NPS Data Store. A useful QC Checklist is available for download on the NPS Intermountain Region GIS web site at: http://imgis.nps.gov/tips_templates.html.

Step 8: Metadata Parsing and Exporting to XML Format

The NPS Data Store requires that metadata records be parsed into FGDC-structured metadata and then exported to XML format.

A. If using ArcCatalog, these steps can both be done directly with the NPS Metadata Tools and Editor. See Parsing Metadata with the NPS Metadata Tools and Editor (NR-GIS Data Store 2005i) for more information.
B. If using other applications, export the metadata first to ASCII text format and then parse with Metadata Parser (MP). MP can simultaneously output an XML format metadata file as well.
    i. MP must be customized to handle NPS, Biological Data, or ESRI Profile metadata elements. For specifics, refer to:
        a. The README.txt file included in the zipped NPS Metadata Profile configuration files, available from the NPS Data Store website at: http://science.nature.nps.gov/nrdata/docs/metahelp/metahelp.cfm.
        b. Parsing Metadata with the NPS Metadata Tools and Editor (NR-GIS Data Store 2005i).

Step 9: Metadata Posting

Post the metadata to the NPS Data Store.

A. Authorized NPS staff may request upload and edit access to the NPS Data Store through the NPS Natural Resource Universal Web Login (UWL), available at: https://science1.nature.nps.gov/nrdata/. This is also the portal for uploading data.
B. More information about metadata upload format requirements is available at: http://science.nature.nps.gov/nrdata/docs/metahelp/metainfo.cfm and in Metadata and Data Uploading Guidance (NR-GIS Data Store 2005g).

Step 10: Editing/Updating Metadata Already Posted to NPS Data Store

As of Version 1, the NPS Data Store application allows online editing of NPS Theme Category and ISO Theme Keyword information and the deletion of single metadata records and/or datasets only (see help documentation at: http://science.nature.nps.gov/nrdata/docs/metahelp/edithelp.cfm).

A. For metadata records simply needing edits to NPS Theme Category or ISO Theme Keyword elements, refer to Editing Category Information (NR-GIS Data Store 2005f).

B. If a metadata record posted to the NPS Data Store contains errors or requires edits to other elements, it will need to be deleted from the NPS Data Store, edited, and then reposted. Refer to Deleting Single Records (NR-GIS Data Store 2005e).

   i. The user should first download the metadata record (save in XML format) to the local system, then edit as needed in a text editor or metadata software program.

   ii. The edited metadata record can then be resubmitted to the NPS Data Store.

   iii. If the dataset documented by the metadata record requires no edits, it will not need to be reposted. Simply ascertain that the metadata file still specifies the correct pathway to the dataset on the NR-GIS Data Server before resubmitting the metadata file.

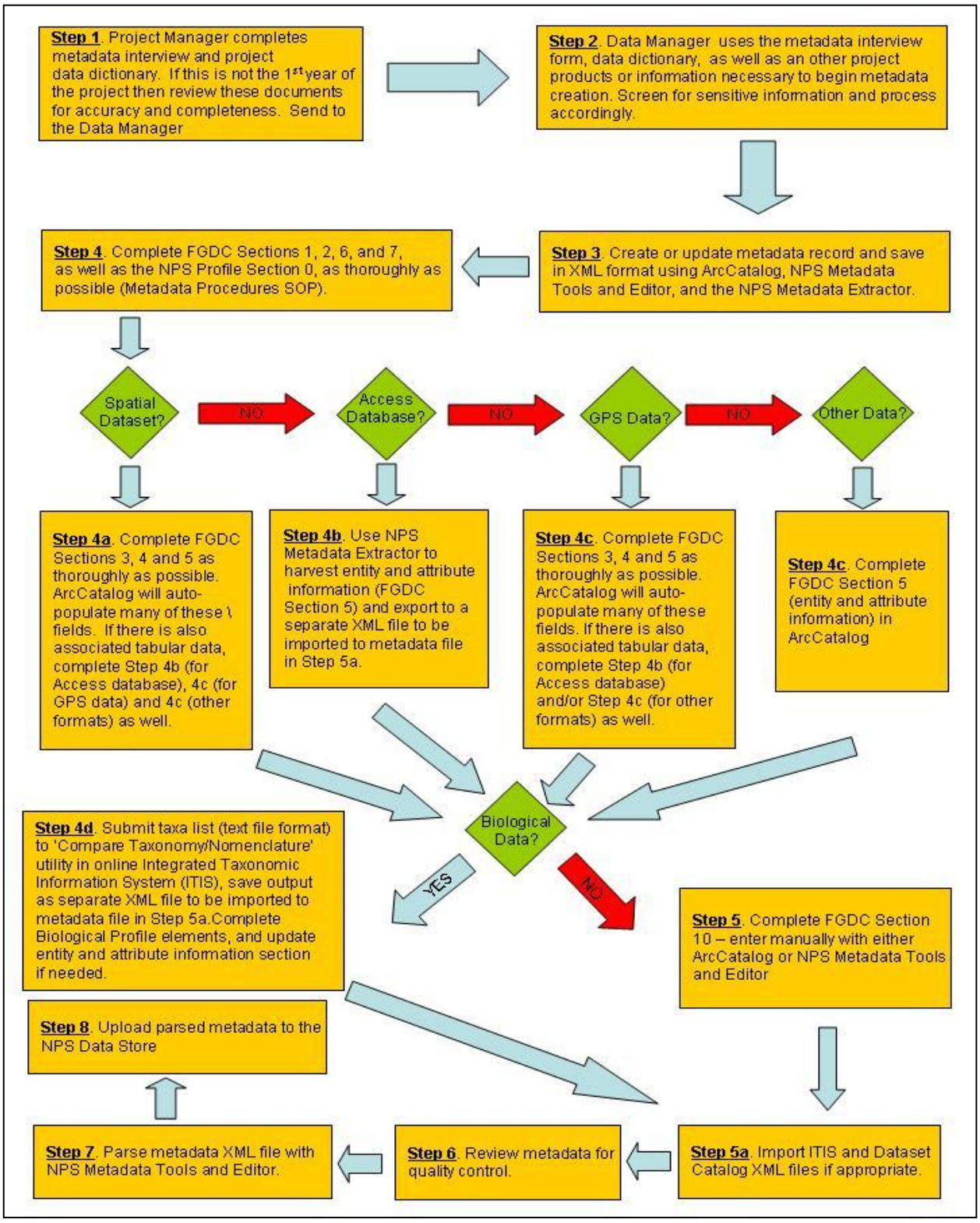


Figure 3. The following diagram shows the general workflow for metadata creation for spatial and tabular data.

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Electronic Metadata Interview

[**Note: Please make your responses directly within this word document in "Red" type**.]

1. Have you already prepared metadata for this dataset?
   a. If yes, please send a copy of the document or reference to where it can be found and skip to item **18**.

2. What is the title of the dataset?

3. Who is the originator(s)/owner of the dataset? (Include address and telephone number)?
   a. If someone else should answer question about the data, please list the name, address, and telephone number.

   b. Are there other organizations or individuals who should get credit for support, funding, or data collection and analysis?

4. Does the dataset contain any sensitive information that should not be released to the public? NPS?
   a. Explain why the data should not be released to the public.

   b. Explain why the data should not be released to non-park NPS staff.

5. Is the dataset published or part of a larger publication?
   a. If so, what is the reference?

6. Include a brief (no more than a few sentences) description of the dataset.

7. Why were the data collected in the first place?

8. What is the time period represented by the dataset?

9. Where the data developed primarily through:
   a. Field visits
   b. Remote instrumentation (i.e., Temperature recorders, etc.)
   c. Existing data sources

10. What is the status of the data you are documenting? – *complete, in progress, planned*
    a. Will the dataset be updated? If so, how frequently?

11. Where were the data collected? Include description and coordinates, if known.

12. List some keywords to help search for this dataset.
    a. Thematic, Place, Temporal, Strata, Taxonomy

    b. If a controlled vocabulary was used, what is the reference?

13. List any related datasets that could be documented for cross-reference.

14. The FGDC Biological Profile includes the means to document tabular datasets, taxonomy, field methods, and the use of analytical tools or models.
    a. Was your dataset developed using a model or other analytical tool?

        i. If so, what is the reference?

        ii. If the model or tool is available, include a contact and/or URL.

    b. Does the dataset contain biological information? If no, skip to item **15**.
        i. What species or communities were examined?

        ii. Did you use a taxonomic authority or field guide for identification? If so, what is the reference?

        iii. Briefly summarize your field methods (cut and paste from other documents!).
            1. If you used existing protocols or methods, list the references.

        iv. If you use a different taxonomic hierarchy than what is available in ITIS, then you need to supply the taxonomic hierarchy for all species within the dataset.

15. Is your dataset archived in a databank or data catalog? If yes, please include a reference to the documentation and skip to item 16. If No:
    a. What measures did you take to make certain that your dataset was as nearly correct as possible?

    b. Were there any things that you excluded from your data collection (e.g., stems less than a certain diameter or streams without surface flow)?

    c. What is the form of your dataset? - *spreadsheet, ASCII file, GIS layer, database, other*

    d. What is the filename for your dataset?

i. For each file or table, list the fields in the dataset and for each field list:

ii. The definition of the field**.**

iii. If the data are coded (Enumerated Domain), list the codes and the definitions.

iv. If the codes come from a published code set (Codeset Domain), list the reference**.**

v. If the data are measured (Range Domain), list the units and the minimum and maximum allowable values ("no limit" is acceptable).

vi. Otherwise, the domain is unrepresentable. Include a brief description of what is in the field**.**

16. Is this a GIS dataset? If no, skip to item 17.
    a. Include a path to where the data can be accessed over the network or send a copy of the ArcInfo export file, an ArcView shapefile, or an ArcCatalog exported metadata file (txt or xml).
        i. Include projection parameters, if necessary.

    b. List any source datasets you used. For each source, list:
        i. Source name, originator, and publication date.

        ii. Source time period and scale.

        iii. Source presentation form and media type.

        iv. Contribution of source to your analysis.

    c. List the processing steps you used to create your dataset, including the approximate date of processing.

17. Is the dataset available for distribution? If no, go to 18.
    a. Are there legal restrictions on who may use the data?

    b. Do you have any advice for potential users of the dataset?

    c. What are your distribution instructions?

18. You are done. Send this completed document with the relevant responses to this interview to your metadata coordinator (Sean Mohren, Klamath Network Data Manager. Sean_Mohren@nps.gov, 541-552-8576)

Example Data Dictionary

Dataset: ASXXYY
File Type: mdb
Relationship: Area Search Header (one) to Area Search Data (many)
Table: Area Search Header

Field Name	Field	Required (Y/N)	Type	Length	Decimal	Definition	Enumerated Domain	Range Domain
RecNum	1	Y	Numeric	Integer	0	Auto Number based on order of entry; Key Field		Integer starting at 1, no limit
Project	2	Y	Character	20		Project or Region Code		
Site	3	Y	Character	20		Site name (often 4-letter code)	Each 4-letter code represents itself	
Point	4	Y	Character	2		Point (Search area)	Typically designated A or B	
Month	5	Y	Character	2		Month		01 to 12
Day	6	Y	Character	2		Day		01 to 31
Year	7	Y	Character	4		Year		
PrimObs	8	Y	Character	4		Primary observer's initials		
SecObs	9	N	Character	20		Secondary observer's initials, if multiple observers, initials separated by ","		
Temp	10	Y	Character	3		Temperature		Degrees Celsius, range=-10 to 40
CldCvr	11	Y	Character	3		Cloud Cover		Percentage, range=0 to 100%

Definitions and Acronyms

ArcCatalog	Module in ESRI's ArcGIS software within which metadata for spatial datasets (coverages, shapefiles) can be created.
Biological Data Profile	Set of definitions for the documentation of biological data through the creation of extended elements to the FGDC Content Standard for Digital Geospatial Metadata (CSDGM).
CSDGM	Content Standard for Digital Geospatial Metadata. The FGDC-promulgated metadata standard established to provide a common set of terminology and definitions for documenting digital geospatial data.
Dataset Catalog	NPS Inventory and Monitoring Program tool for metadata creation, ideal for abbreviated dataset documentation but not for fully FGDC-compliant metadata creation.
ESRI®	Environmental Systems Research Institute. A GIS software company.
FGDC	Federal Geographic Data Committee. The interagency committee that promotes the coordinated development, use, sharing, and dissemination of geographic data.
GIS	Geographic Information System. A computer system for capturing, manipulating, analyzing, and displaying data related to positions on the Earth's surface.
ISO	International Organization for Standardization. A network of national standards institutes of 150 countries, responsible for the "ISO 19115" international metadata standard.
Metadata	Data about the content, quality, condition, and other characteristics of a dataset, documented in a standardized format.
MP	Metadata Parser. A command-line program developed by the USGS to locate syntax errors in metadata files, verify FGDC-compliance, and convert between file formats.
NBII	National Biological Information Infrastructure. Collaborative program instrumental in developing the Biological Data Profile of the FGDC's CSDGM.

NPS Profile	The NPS Natural Resource and GIS Metadata Profile extends the FGDC CSDGM to incorporate NPS-specific elements such as park and project details. The NPS Profile includes the Biological Data Profile and the ESRI Profile.
NPS Data Store	The NPS Natural Resource, GIS, and I&M Programs' web-based system (incorporating a database, data server, and secure web interface) to integrate data dissemination and metadata maintenance for Natural Resource, GIS, and other program data sets, digital documents, and digital photos.
SGML	Standard Generalized Markup Language. An ISO standard flexible markup language (predecessor to XML) used in many applications, including electronic publishing on the Web.
XML	Extensible Markup Language. A simple and flexible text format (a profile, or subset, of SGML) that facilitates large-scale electronic publishing and exchange of data on the Web.

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #15: Sensitive Data

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP includes instructions for handling sensitive data. This document was adapted from the National Park Service North Coast and Cascades Network Landbird Protocol (Boetsch et al. 2005).

Introduction

Although it is the general NPS policy to share information widely, the NPS also realizes that providing information about the location of park resources may sometimes place those resources at risk of harm, theft, or destruction. This can occur, for example, with regard to caves, archeological sites, tribal information, and rare plant and animal species. Therefore, information will be withheld when the NPS foresees that disclosure would be harmful to an interest protected by an exemption under the Freedom of Information Act (FOIA). The National Parks Omnibus Management Act, Section 207, 16 U.S.C. 5937, is interpreted to prohibit the release of information regarding the "nature or specific location" of certain cultural and natural resources in the national park system. Additional details and information about the legal basis for this policy can be found in the NPS Management Policies (National Park Service 2006), and in Director's Order #66. These guidelines apply to all KLMN staff, cooperators, contractors, and other partners who are likely to obtain or have access to information about protected NPS resources. The NPS Contact has primary responsibility for ensuring adequate protection of sensitive information related to this project.

The following are highlights of our strategy for protecting this information:

1. *Protected resources*, in the context of the KLMN Inventory and Monitoring Program, include species that have State- or Federally-listed status and other species deemed rare or sensitive by local park taxa experts.
2. *Sensitive information* is defined as information about protected resources which may reveal the "nature or specific location" of protected resources. Such information must not be shared outside the National Park Service, unless a signed confidentiality agreement is in place.

3. In general, if information is withheld from one non-NPS requesting party, it must be withheld from anyone else who requests it, and if information is provided to one requesting party without a confidentiality agreement, it must be provided to anyone else who requests it.
4. To share information as broadly as legally possible and to provide a consistent, tractable approach for handling sensitive information, the following shall apply if a project is likely to collect and store sensitive information:
    a. Random coordinate offsets of up to 2 km for data collection locations, and
    b. Removal of data fields from the released copy that is likely to contain sensitive information.

What Kinds of Information Can and Cannot Be Shared?

Do Not Share

Project staff and cooperators should not share any information outside NPS that reveals details about the "nature or specific location" of protected resources, unless a confidentiality agreement is in place. Specifically, the following information should be omitted from shared copies of all data, presentations, reports, or other published forms of information.

1. *Exact coordinates* – Instead, public coordinates are to be generated that include a random offset azimuth and distance. These offset coordinates can be shared freely.
2. *Other descriptive location data* – Examples may include travel descriptions, location descriptions, or other fields that contain information which may reveal the specific location of the protected resource(s).
3. *Protected resource observations at disclosed locations* – If specific location information has already been made publicly available, the occurrence of protected resources at that location cannot be shared outside NPS without a confidentiality agreement. For example, if the exact coordinates for a monitoring station location are posted to a web site or put into a publication, then at a later point in time a spotted owl nest is observed at that monitoring station, that nest cannot be mentioned or referred to in any report, presentation, dataset, or publication that will be shared outside NPS.

Do Share

All other information about the protected resource(s) may be freely shared, so long as the information does not reveal details about the "nature or specific location" of the protected resource(s) that are not already readily available to the general public in some form (e.g., other published material). Species tallies and other types of data presentations that do not disclose the precise locations of protected resources may be shared, unless by indicating the presence of the species the specific location is also revealed (i.e., in the case of a small park).

Details for Specific Products

Whenever products such as databases and reports are being generated, handled, and stored, they should be created explicitly for one of the following purposes:

1. *Public or general use* – Intended for general distribution, sharing with cooperators, or posting to public web sites. They may be derived from products that contain sensitive

information so long as the sensitive information is either removed or otherwise rendered in a manner consistent with other guidance in this document.

2. *Internal NPS use* – These are products that contain sensitive information and should be stored and distributed only in a manner that ensures their continued protection. These products should clearly indicate that they are solely for internal NPS use by containing the phrase: "Internal NPS Use Only – Not For Release." These products can only be shared within NPS or in cases where a confidentiality agreement is in place. They do not need to be revised in a way that conceals the location of protected resources.

When submitting products to the Network Data Manager, a Certification Form is required. If the submitted product was not meant for public use, it should be clearly noted on question 8 of the Certification Form (SOP #16: Data Transfer, Storage, and Archive) and / or question 4 of the Metadata Interview Form (SOP #14: Metadata Guidelines).

Datasets

To create a copy of a dataset that will be posted or shared outside NPS:

1. Make sure the public offset coordinates have been populated for each sample or observation location in tbl_Locations.
2. Remove tbl_Coordinates and tbl_GPS_Info.
3. Delete the following database objects to ensure consistent omission of fields that may contain specific, identifying information about locations of protected resources:
    a. tbl_Area_Search_Data.Area_Survey_Notes
    b. tbl_Locations.Loc_Directions
    c. tbl_Locations.Loc_Notes
    d. tbl_Event_Details.Event_Notes
    e. tbl_Locations_Coordinates.Y_Coordinate, Y_Coordinate
    f. tbl_Sites.Site_Desc
    g. tbl_Sites.Site_Notes

The local, master copy of the database contains the exact coordinates and all data fields. The Data Manager and/or GIS Specialist can provide technical assistance as needed to apply coordinate offsets or otherwise edit data products for sensitive information.

Maps and Other GIS Output

General use maps and other geographic representations of observation data that will be released or shared outside NPS should be rendered using offset coordinates and should only be rendered at a scale that does not reveal their exact position (e.g., 1:100,000 maximum scale).

If a large-scale, close-up map is to be created using exact coordinates (e.g., for field crew navigation, etc.), the map should be clearly marked with the following phrase: "Internal NPS Use Only – Not For Release."

The Network Data Manager and/or GIS Specialist can provide technical assistance as needed to apply coordinate offsets or otherwise edit data products for sensitive information.

Presentations and Reports

Public or general-use reports and presentations should adhere to the following guidelines:

1. Do not list exact coordinates or specific location information in any text, figure, table, or graphic in the report or presentation. If a list of coordinates is necessary, use only offset coordinates and clearly indicate that coordinates have been purposely offset to protect the resource(s) as required by law and NPS policy.
2. Use only general use maps, as specified in the section on maps and other GIS output.

If a report is intended for internal use only, these restrictions do not apply. However, each page of the report should be clearly marked with the following phrase: "Internal NPS Use Only – Not For Release."

Voucher Specimens

Specimens of protected taxa should only be collected as allowed by law. Labels for specimens should be clearly labeled as containing sensitive information by containing the following phrase: "Internal NPS Use Only – Not For Release." These specimens should be stored separately from other specimens to prevent unintended access by visitors. As with any sensitive information, a confidentiality agreement should be in place prior to sending these specimens to another non-NPS cooperator or collection.

Procedures for Coordinate Offsets

1. Process GPS data, upload into the database, and finalize coordinate data records. Update tbl_Coordinates.Is_best as appropriate, especially where there is more than one set of coordinates per sample location.
2. Set the minimum and maximum offset distances (project-specific, typically up to 2 km).
3. Apply a random offset and random azimuth to each unique set of coordinates.
4. Coordinates may then be either rounded or truncated so the UTM values end in zeros to give a visual cue that the values are not actual coordinates.
5. Do not apply independent offsets to clustered or otherwise linked sample locations (e.g., multiple sample points along a transect). Instead, either apply a single offset to the cluster so they all remain clustered after the offset is applied, or apply an offset to only one of the points in the cluster (e.g., the transect origin) and store the result in the public coordinates for each point in that cluster.
6. These "public" coordinates are then the only ones to be shared outside NPS – including all published maps, reports, publications, presentations, and distribution copies of the dataset – in the absence of a confidentiality agreement.

The following components can be used to create individual offsets rounded to the nearest 100 meters in Excel:

1. Angle = rand() * 359
2. Distance = ((Max_offset – Min_offset) * rand() + Min_offset)
3. Public_UTME = Round(UTME_final + (Distance * cos(Angle – 90)), -2)
4. Public_UTMN = Round(UTMN_final + (Distance * sin(Angle + 90)), -2)

Sharing Sensitive Information

No sensitive information (e.g., information about the specific nature or location of protected resources) may be posted to the NPS Data Store or another publicly-accessible web site, or otherwise shared or distributed outside NPS without a confidentiality agreement between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared.

Only products that are intended for public/general-use may be posted to public web sites and clearinghouses – these may not contain sensitive information.

Responding to Data Requests

If requests for distribution of products containing sensitive information are initiated by the NPS, by another federal agency, or by another partner organization (e.g., a research scientist at a university), the unedited product (e.g., the full dataset that includes sensitive information) may only be shared after a confidentiality agreement is established between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared.

Once a confidentiality agreement is in place, products containing sensitive information may be shared following these guidelines:

1. Prior to distribution, talk to the Project Manager and Park Resource Specialist to make sure they know the data are being distributed.
2. Always clearly indicate in accompanying correspondence that the products contain sensitive information and specify which products contain sensitive information.
3. Indicate in all correspondence that products containing sensitive information should be stored and maintained separately from non-sensitive information and protected from accidental release or re-distribution.
4. Indicate that NPS retains all distribution rights; copies of the data should not be redistributed by anyone but NPS.
5. Include the following standard disclaimer in a text file with all digital media upon distribution: "The following files contain protected information. This information was provided by the National Park Service under a confidentiality agreement. It is not to be published, handled, re-distributed, or used in a manner inconsistent with that agreement." The text file should also specify the file(s) containing sensitive information.
6. If the products are being sent on physical media (e.g., CD or DVD), the media should be marked in such a way that clearly indicates that media contains sensitive information provided by the National Park Service.

Confidentiality Agreements

Confidentiality agreements may be created between the NPS and another organization or individual to ensure that protected information is not inadvertently released. When contracts or other agreements with a non-federal partner do not include a specific provision to prevent the release of protected information, the written document must include the following standard Confidentiality Agreement:

> **Confidentiality Agreement** - I agree to keep confidential any protected information that I may develop or otherwise acquire as part of my work with the National Park Service. I understand that with regard to protected information, I am an agent of the National Park Service and must not release that information. I also understand that by law I may not share protected information with anyone through any means except as specifically authorized by the National Park Service. I understand that protected information concerns the nature and specific location of endangered, threatened, rare, commercially valuable, mineral, paleontological, or cultural patrimony resources such as threatened or endangered species, rare features, archeological sites, museum collections, caves, fossil sites, gemstones, and sacred ceremonial sites. Lastly, I

understand that protected information must not be inadvertently disclosed through any means, including web sites, maps, scientific articles, presentation, and speeches.

Note: Certain states, including the State of Washington, have sunshine laws that do not have exemptions for sensitive information. NPS should not create confidentiality agreements or share sensitive information with these states without first seeking the advice of an NPS solicitor.

Freedom of Information (FOIA) Requests

All official FOIA requests will be handled according to NPS policy. The NPS Contact will work with the Data Manager and the park FOIA representative(s) of the park(s) for which the request applies.

References

Boetsch, J. R., B. Christoe, and R. E. Holmes. 2005. Data management plan for the North Coast and Cascades Network Inventory and Monitoring Program. National Park Service. Port Angeles, WA. Online. (http://www1.nature.nps.gov/im/units/nccn/datamgmt.cfm).Accessed 6 February 2007.

National Park Service. 2006. Management policies. Online. (http://www.nps.gov/policy/mp/policies.htm). Accessed 6 February 2007.

Director's Order Number 66. Freedom of Information Act and the protection of exempted information. National Park Service.

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #16: Data Transfer, Storage, and Archive

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedures for data transfer to the Network Data Manager. In addition, data certification, storage, archiving, and a timeline for project deliverables are addressed.

Data Transfer

All project deliverables, including but not limited to raw data, processed data, Metadata Interview Forms, updated data dictionary (if necessary), images with metadata, training logs, datasheets, spatial files, and Certification Forms will be transferred to the KLMN Data Manager following the timeline listed in Table 1. It is the responsibility of the Project Lead to ensure all products and associated documentation are delivered following the outlined timeline.

Certification Form

The Klamath Network will utilize a Certification Form submitted by the Project Lead to ensure:

1. The data are complete for the period of time indicated on the form.
2. The data have undergone the quality assurance checks indicated in the Landbird Monitoring Protocol.
3. Metadata for all data has been provided (when applicable).
4. Project timelines are being followed and all products from the field season have been submitted.
5. The correct level of sensitivity is associated with the deliverables.

A new Certification Form should be submitted each time a product is submitted. If multiple products are submitted at the same time, only one Certification Form is needed for those products. Certification Forms can be obtained from the KLMN Internet and Intranet web sites or by contacting the KLMN Data Manager. An example of the Certification Form is included at the end of this SOP.

Field Forms

Hardcopies of the datasheets will be provided to the KLMN Data Manager following the timeline in Table 1. It is the responsibility of the Data Manager to scan the datasheets into PDF

documents within 1 month of receiving the hardcopies. The datasheets will be organized in the order in which they will be scanned when they are transferred to the Data Manager (SOP #10: Post Field Season).

a. For point count surveys, this will include four forms for each route: site description, species checklist, point count, and vegetation. They should be organized alphabetically by route name and by park. Each route will become a PDF document.
b. For mist netting, the banding data will be organized by band size and date for all birds that received new bands. Unbanded birds and birds that were recaptured (already banded) will be organized by date. All banding data will be scanned into a single PDF document.
c. For Banding Journal Forms, species checklists, and area search surveys (associated with mist netting), the data forms will be organized chronologically by site and filed alphabetically by site name and by park. Each site will become a single PDF document.

The scanned document will be named with the park code, site name, a description of the form, and the year the data represents. For example, the scanned document associated with point counts in Lava Beds National Monument would be named LAVO_LB20_PC_2008, where "LAVO" is the park code, "LB20" is the name of the route, "PC" is for point counts, and 2008 is the year the data were collected.

Electronic files will be stored in the data folder located in the landbird project folder on the KLMN server. Additional details on storage methods are described below. In addition, a copy of all PDF files will be sent to the Project Lead within 1 month of receiving the hardcopy datasheets.

Databases

Six Access databases are used to store data while in the field. They are associated with the four survey methods, vegetation sampling method, and the location information (SOP#12: Data Entry). Data in the databases will be provided to the Network Data Manager annually, along with reviewed and/or updated Metadata Interview Forms and data dictionaries (SOP #14: Metadata Guidelines). Prior to being transferred, the data will be subjected to all QA/QC process described in SOP #13: Data Validation and Verification. Hardcopies of the digital error logs and data entry logs will be provided with the databases. Data from the databases will be transferred as six .dbf files (see format below) and uploaded into the KLMN Landbird database. The KLMN Landbird database is a relational database that incorporates the six databases used to store field data and is designed following the NPS Natural Resource Database Template.

The flat files will be named using a six character code representing the survey type, the Network, and the year the data were collected. Formats are:
Area Search Surveys: ASKNXX where the XX represents the two digit year
Mist Netting: BDKNXX where the XX represents the two digit year
Point Count Surveys: VRKNXX where the XX represents the two digit year
Species Checklist: SCKNXX where the XX represents the two digit year
Vegetation Surveys: VGKNXX where the XX represents the two digit year

The location file will be transferred after the initial field season and will be transferred in subsequent years only if it has been updated (SOP #4: Locating and Marking Field Sites has

details about re-marking locations). The location file will be named according to the following convention: Location Data: WPKN.

The bird and vegetation species code lists will be transferred to KLMN annually to be incorporated into the KLMN database.

Photos

Images and associated metadata will be transferred to the Data Manager in the format explained in SOP #11: Photo Management.

GPS Waypoint Files

GPS waypoint files are created using Waypoint Express as described in SOP #3: Using the Global Positioning System. These text files and associated GIS layers will be transferred to the Network Data Manager, who will store them in the Landbird_GIS folder, a subfolder of the Landbird project folder as described below. Waypoint files will be transferred prior to starting the first field season and in subsequent years if new locations are added or if the spatial information of a location is adjusted.

Training and Contact Information

Prior to implementing field work, a list of contact information for each person involved in the Landbird project will need to be submitted to the KLMN Data Manager. Contact information will include:

- First Name
- Last Name
- Middle Initial
- Organization
- Position Title
- Mailing Address
- Email Address
- Work Phone Number

Each person conducting field work as part of this protocol will need to follow the training procedures outlined in SOP #2: Training Observers. Log books developed in a standardized Excel format will need to be delivered to the Network Data Manager following the timeline listed above.

Reports

There is the potential for a variety of reports to be developing utilizing data collected as part of this landbird monitoring project, including annual reports, three-year analysis and synthesis reports, scientific publications, one page summary reports, and comprehensive reports.

Annual effort reports and analysis reports will be the responsibility of the Project Lead and should be submitted in the NPS Technical Report Series format, unless utilizing another series format for publication.

The comprehensive report described in SOP #17: Analyses and Reporting and any scientific publications created by Network staff or by any staff member working on the landbird project should be submitted to the KLMN Data Manager upon completion.

Summary reports are one page reports completed by the Network staff that and are used to sum up information in the annual and analyses reports. These reports should be completed within 1 month of receiving the annual or analyses reports. These reports will be sent to all park employees and will provide links to the larger reports.

Data Storage

Project folders have been created for each monitoring protocol the KLMN plans to implement (Figure 1). Project folders contain five standard folders using a naming convention that includes the project title and one of the following: Documents, GIS, Data, Images, or Analysis. These five folders will contain all the data and information for a project as follows:

a) **Landbird_Documents.** This folder contains the reports, budgets, work plans, emails, protocols, contracts, datasheets, and agreements associated with a specific project.
b) **Landbird_GIS.** This folder contains shapefiles, coverages, layer files, geodatabases, GPS files, GIS/GPS associated metadata, and spatial imagery associated with a project.
c) **Landbird_Data.** This folder contains the KLMN Landbird database and .dbf files from the six field databases.
d) **Landbird_Images.** This folder contains any photographs related to the project and associated image metadata. In addition, copies of all photographs and metadata will be transferred into the KLMN Image database. Details on the KLMN Image database can be found in the KLMN Data Management Plan.
e) **Landbird_Analysis.** This folder will contain derived data and associated metadata created during analysis.

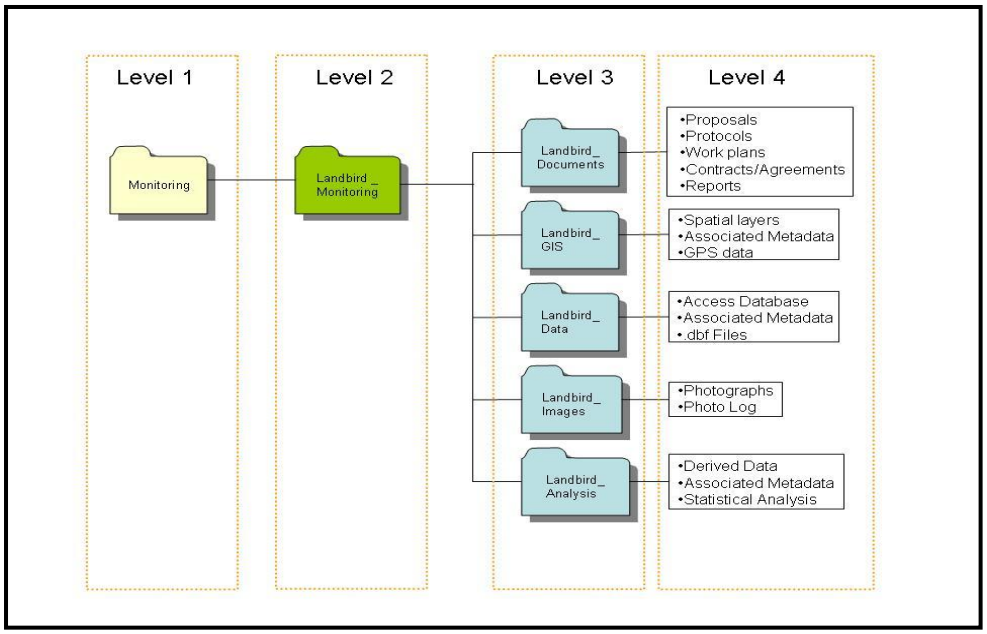


Figure 1. The landbird file structure the KLMN will use to store all landbird data and information.

Core Network staff will have read-only access to all products to prevent changes to the information. If write access is needed, you will need to contact the Network Data Manager. It is the responsibility of all KLMN staff to inform the Data Manager when they have added new material to the project folder.

Storage, Backup, and Archiving

A copy of the project folder will be stored in the KLMN Archive drive whenever any new information is added to the folder. The KLMN Archive and Network drives are subject to all backup and archiving process described in the KLMN Data Management Plan. The KLMN relies on Southern Oregon University (SOU) for the backup and long-term storage requirements. Nightly backups are done by SOU to store information that has been edited. This is not a full backup but is intended to protect products that have been manipulated. This information is stored for a 1 week period before it is recycled. SOU begins a weekly full backup of their servers on every Friday and stores the files on tape drives. Backups are stored for 60 days before the tapes are reused. SOU will run quarterly backups on March 31st, June 30th, October 31st, and December 31st of each year. Files stored on a quarterly basis are maintained for one year before being recycled (Mohren 2007).

Despite the QA/QC measures in place, finding errors in datasets in the future is inevitable. The process for documenting the correction of such errors is detailed in SOP #13: Data Validation and Verification. In such instances, archived data will not be corrected; however, an updated product will be placed into the archive drive along with the digital error and entry logs.

Table 1. Deliverable products, responsible individual, data due, and store location for all products developed while implementing the KLMN Landbird Monitoring Protocol.

Deliverable Product	Primary Responsibility	Target Date	Instructions for KLMN
Contact Information	Project Lead	two weeks prior to the start of the field season	KLMN Landbird Database Stored in the Landbird_Data Folder.
Processed GPS Data Files	Project Lead	Prior to beginning the first field season and by Mar 1st of the following year when updates occur	Store in Landbird_GIS[5]
Waypoint Tracking Form and Files	Project Lead	Prior to beginning the first field season and by Mar 1st of the following year when updates occur	Store in Landbird_GIS[5]
Metadata Interview Form	Project Lead	Prior to beginning the first field season and by Mar 1st of the following year when updates occur	Store in Landbird_Data[5], Use to create and revise full metadata.
Updated Data Dictionary	Project Lead	Prior to beginning the first field season and by Mar 1st of the following year when updates occur	Store in Landbird_Data[5], Use to create and revise full metadata.
Full Metadata (Parsed XML)	Network Data Manager	Prior to beginning the first field season and by March 1st of the following year	Store in Landbird_Data[5], Upload the Parsed XML Record to the NPS Data Store [2]
Protocol Changes (if made)	Principal Investigator and Network Contact	Mar 1st prior to implementing the change	Store in Landbird_Document5, Update Protocol on Web sites and NPS Data Store, Send Copy to Parks
Data Certification Report	Project Lead	every time a product(s) is submitted	Store in Landbird_Document5

Table 1. Deliverable products, responsible individual, due data, and store location for all products developed while implementing the KLMN Landbird Monitoring Protocol (continued).

Deliverable Product	Primary Responsibility	Target Date	Instructions for KLMN
Field Data Forms (Route, Marker, Point Count, Mist-Net, Area Search, Checklist, Banding, Vegetation, Site)	Project Lead	Mar 1st of the following year	Scan Original, Marked-up Field Forms as PDF Files and Store in Landbird_Document[5]
Digital Error Log	Project Lead	Mar 1st of the following year	Scan Original, Marked-up Field Forms as PDF Files and Store in Landbird_Document[5]
Databases	Project Lead	Mar 1st of the following year	Store in Landbird_Data[5], Send Copy to Parks
Training Excel Spreadsheet	Project Lead	Mar 1st of the following year	Scan Original, Marked-up Field Forms as PDF Files and Store in Landbird_Document[5]
Digital Photographs and Metadata	Project Lead	Mar 1st of the following year	Store in Landbird_Image[5], Copies of Photographs in KLMN Image Library, Copies of Image Metadata into KLMN Image Database linked to Photographs
Annual Report	Project Lead	Mar 1st of the following year	Store in Landbird_Document[5], Upload to NPS Data Store[2], Send Copy to Parks, Post on the KLMN Internet and Intranet Web sites
Three Year Analyses and Synthesis Report	Principal Investigator	Every three years on April 1st	
Other Publications	NPS Staff, Principal Investigator	as completed	
Regional Effort Report	Project Lead	Feb 1st of the following year	Store in Landbird_Document[5], Send Copy to Parks, Post on the KLMN Internet and Intranet Web sites
Other Records	Network Contact	review for retention every April 1st	Digital Files that are Slated for Permanent Retention Should be Uploaded to the KLMN Landbird Project Folder. Retain or Dispose of Records Following NPS Director's Order #19 [4].

[1] The KLMN Image Library is a hierarchical digital filing system stored on the KLMN file servers. The image library is linked to an image database that stores metadata on each image.
[2] NPS Data Store is a clearinghouse for natural resource data and metadata (http://science.nature.nps.gov/nrdata). Only non-sensitive information is posted to NPS Data Store. Refer to the protocol section on sensitive information for details.
[3] NatureBib is the NPS bibliographic database (http://www.nature.nps.gov/nrbib/index.htm). This application has the capability of storing and providing public access to image data (e.g., PDF files) associated with each record.
[4] NPS Director's Order 19 provides a schedule indicating the amount of time that the various kinds of records should be retained. Available at: http://data2.itc.nps.gov/npspolicy/DOrders.cfm.
[5] The KLMN Landbird project folder located on the shared file server at the KLMN office. The project folder contains five folders including: Landbird_Documents, Landbird_Data, Landbird_Analysis, Landbird_GIS, and Landbird_Image used to separate and store data and information collected as part of the landbird monitoring.

References

Mohren, S. R. 2007. Data management plan, Klamath Inventory and Monitoring Network. Natural Resource Report NPS/KLMN/NRR—2007/012. National Park Service, Fort Collins, Colorado.

KLMN Certification Form

1) Certification date: _____

2) Certified by: _____
Title: _____
Affiliation: _____

3) Agreement code: _____
Project title: _____

4) Range of dates for certified data: _____

5) Description of data being certified: _____
_____
_____
_____

6) List the parks covered in the certified data set, and provide any park-specific details about this certification.

Park	Details

7) This certification refers to data in accompanying files. Check all that apply and indicate file names (folder name for images) to the right:

_____ Hardcopy Datasheet(s): _____
_____ PDF Datasheet(s): _____
_____ Database(s): _____
_____ Spreadsheet(s): _____
_____ Spatial data theme(s): _____
_____ GPS file(s): _____
_____ Geodatabase file(s): _____
_____ Photograph(s): _____
_____ Data Logger(s) files: _____
_____ Other (specify): _____
_____ Certified data are already in the master version of a park, KLMN or NPS database.
Please indicate the database system(s): _____

8) Is there any sensitive information in the certified data which may put resources at greater risk if released to the public (e.g., spotted owl nest sites, cave locations, rare plant locations)?

_____ No _____ Yes Details:

_____
_____
_____

9) Were all data processing and quality assurance measures outlined in the protocol followed?

Yes / No

If No, Explain _____
_____
_____

10) Who reviewed the products?
_____

11) Results and summary of quality assurance reviews, including details on steps taken to rectify problems encountered during data processing and quality reviews.
_____
_____
_____

Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #17: Data Analysis and Reporting

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP provides details of the analyses and reporting elements of the monitoring plan to ensure that the data and results of the landbird monitoring program are consistent with the landbird monitoring objectives and are available to the KLMN parks, the scientific community, and the public. These include two reporting elements: (1) an annual effort report and (2) third year analysis and synthesis reports. These reports are intended to address the objectives of the KLMN landbird monitoring efforts and to inform the KLMN program's annual reporting and 5-year synthesis reporting processes.

Data analysis and reporting will be conducted to meet the primary landbird monitoring objectives:

1. Monitor breeding landbird richness, relative abundance, and density.
    - Determine the status of breeding landbird richness and relative abundance every 3 years within the sampling frame of each park.
    - Provide quantitative information about the distribution and composition of landbird assemblages within 3 years.
    - Determine long-term trends of species richness, relative abundance, and density for abundant breeding landbirds at year 15 and for every subsequent 3 year period.
    - Provide long-term trends in similarity of landbird assemblages within the sampling frame at each park by year 15 and for every subsequent 3 year period.

2. Co-sample habitat parameters and integrate bird and vegetation monitoring to aid in interpretation of landbird status and trends.
    - Co-sample habitat parameters every 3 years to provide information about potential causes of landbird trends.
    - Integrate landbird and vegetation monitoring data to aid in the development of the KLMN Comprehensive Synthesis Report.

3. Determine status and trends in demographic parameters (productivity, adult survival, and recruitment) for selected landbird species at a mixed-conifer and riparian habitat at ORCA.
   - Determine the breeding status of landbirds annually.
   - Determine long-term trends of relative abundance, productivity, survival, recruitment, and fitness in abundant breeding landbirds.

In consultation with scientific staff in the KLMN parks, we have developed a schedule for analysis and reporting that addresses these objectives over the first 15 years of the program (Table 1).

Table 1. Overview of general reporting tools with purpose/objectives and reporting year.

Report	Year	Purpose/Objective			
		1. Monitor breeding landbird richness and density	2. Co-sample habitat parameters	3. Using mist netting, determine status and trends in demographic information	4. Provide quantitative information about landbird assemblages
Annual Report	All sampling years	Provide description of each field season's efforts and key findings			
Analysis and Synthesis Report 1 Detectability Density Community structure	2010	X	X		X
Analysis and Synthesis Report 2 Analysis of status and trends of mist netting data at Oregon Caves	2013			X	
Analysis and Synthesis Report 3 Power analysis of point count data	2016	Provide information about statistical power of monitoring sampling design (point count data).			
Analysis and Synthesis Report 4 Topic to be determined	2019				
Analysis and Synthesis Report 5 Analysis of status and trends for all parks (point count data)	2022	X	X	X	X

Annual Report

The Annual Report will provide a summary of monitoring efforts for the year, due on March 1st of each year following a field season. The Annual Report will include:
(A) An executive summary;

(B) An introduction referencing the protocol;
(C) A summary of the current year's monitoring efforts including the number of VCP point count surveys conducted per transect for each park and the number of net hours, captures, and area search surveys by constant effort monitoring effort;
(D) A summary of past efforts;
(E) A summary of bird detections and associated Partners in Flight status;
(F) A list of additional birds detected only on species checklists;
(G) Public interest highlights;
(H) A summary of relevant outreach, reports, publications, and presentations; and
(J) Documentation of any changes made to the protocol.

In addition to the Klamath Network specific annual report, each year the Klamath Bird Observatory (KBO) completes comprehensive reports that summarize their bird monitoring efforts throughout the Klamath region. These reports provide regional bird monitoring cooperators with a picture of how discrete monitoring efforts and specific programs (e.g., the KLMN landbird monitoring effort) fit within the larger Klamath Bird Monitoring Network. KLMN landbird monitoring efforts will be integrated into these regional reports.

Analysis and Synthesis Reports

Analysis and Synthesis reports will be completed every third year, due on April 1st of the following year (e.g., final draft of 2010 Analysis and Synthesis report will be due April 1, 2011). We have collaborated with park staff to identify the scope of each analysis report and to articulate specific questions to be addressed by each report. In general, analyses of data collected through implementation of this Landbird Monitoring Protocol will provide information about bird-habitat relationships, population trends from point count and area search data, and trends in abundance and demographic indices derived from mist netting data. Analyses of single species will be focused on common species and conservation focal species in the Klamath region as identified by Partners in Flight (PIF) (Altman 1999, 2000; CalPIF 2002a, 2002b, 2004, 2005; RHJV 2004); community analyses will be inclusive of all species.

Analysis and Synthesis Report 1: Determining Status and Bird Community Structure

The first Analysis and Synthesis report, prepared in 2010, will focus on 3 years of data collected at the VCP point count stations during the 2008-2010 field seasons. The report will contain two related analyses that will inform us about the nature of bird communities in the parks of the Klamath Network, as well as the feasibility and efficiency of our sampling regime. The first analysis will explore *detectability* and spatial patterns of *species density* and the second will examine the *community structure* of our avifauna.

Detectability and Density Analysis

Bird species vary in detectability for a number of reasons related to differences in vocalization, visibility, and other behaviors. Moreover, the detectability of the same species varies from place to place because of differences in habitat structure (e.g., a bird species may be harder to detect in dense chaparral than in grassland). Although individuals are trained together, detection rates can also vary by surveyor. We will conduct an analysis of factors influencing the detectability of common species and PIF focal species in the five parks where extensive surveys will be conducted. We will develop detection functions to be used for estimating density of birds from

raw counts. We will use the most recently available version of the free software program *Distance* (Thomas et al. 2006), following procedures outlined by Buckland et al. (2001), which are similar to those outlined by Seigel et al. (2007).

Distance sampling data will be used to model a detection function. An understanding of the rate at which detection probability declines with distance from the observer allows for a better grasp of other factors that affect detectability (e.g., environment, observer, cue, and cluster). Data analysis will begin with visual evaluation of histograms that compare frequency and detection function with distance. Such histograms can highlight anomalies caused by outliers, evasive movement, or other factors. After such initial graphical analyses, we will fit competing models to the data (Buckland et al. 2001). First, we will select a key detection function by testing the uniform or half-normal function to start, then the hazard rate function. Next, we will select a series expander (cosine, simple polynomials, Hermite polynomials) if needed. Then, resulting models will be selected using Akaike's Information Criteria (AIC) (Burnham and Anderson 1998). Using distance to account for detection probability, annual density estimates for each species analyzed (by point, route, and park) will be generated, along with 95% confidence intervals.

Spatial Patterns of Species Density

To consider spatial patterns of species density within the parks, density estimates at the point scale will be analyzed with vegetation composition and structure variables collected at each point to determine the relationship of species density and specific habitat features. We will examine a correlation matrix to determine highly correlated variables (>60%) (Morrison et al. 1987). The most biologically significant of correlated variables will be retained in further analysis. We will then use principal components analysis to select a set of significant predictor variables. A set of general linear models (Crawley 1997, Seavy et al. 2005) that use these predictor variables to describe species density estimates by point will then be compared using AIC to determine which habitat features, and combination of habitat features, make up the best fitting models. This aspect of the analysis will be conducted in R Project for Statistical Computing (R Development Core Team 2008).

Analysis of Landbird Community Structure

A quantitative understanding of the species composition of landbird assemblages in space, and in relation to known environmental gradients, will provide context for interpreting all subsequent monitoring results. Delineation of recurring groups of birds will also be of interest to determine if habitat associations are clearly defined or if birds sort individualistically across the park landscapes. These analyses will also allow us to evaluate which uncommon birds tend to occur with the more common birds that may provide inference for status and trends.

Bird assemblages will be analyzed for each sampling frame using standardized ordination and classification techniques (Gauch 1982, McCune and Grace 2002) and related to variation in environmental variables such a elevation, vegetation cover, and aspect. Nonmetric Multidimensional Scaling (NMS) will be used to ordinate the routes using the species presence/absence data (McCune and Mefford 1999). Ecological distances in similarities in bird community composition will be displayed using the Sorenson distance metric. Monte Carlo tests will be used to determine whether the axes generated by NMS were stronger than those obtained by chance. To determine if variation in bird community composition is associated with

independent variables, we will perform indirect gradient analysis by determining Pearson's correlations between the variables and each ordination axis. These correlations will be plotted on the ordination bi-plot diagrams with arrows representing the direction and strength of the correlations (McCune and Mefford 1999).

We will use hierarchical clustering analyses (McGarigal et al. 2000) to evaluate the presence and significance of assemblages in the bird data. Delineation of these assemblages will allow us to evaluate the linkages between groups of birds and habitat features. Hierarchical cluster analyses will be performed with the Cluster Analysis option in PC-Ord using the Flexible beta linkage mechanism (with beta set at -0.25) and the relative Euclidean distance measure (McCune and Grace 2002).

Analysis and Synthesis Report 2: Population Trend Analysis of Banding Data

In year six, the analysis report will focus on 10 years of data collected between 2002 and 2012 at the Oregon Caves constant effort monitoring station. We will conduct trend analyses of relative abundance for both breeding and migrating species. We will compare and contrast these results with other trend information generated from Klamath Bird Monitoring Network and Breeding Bird Survey data. Productivity indices generated from the Oregon Caves data will be included as a covariate in the trend models to evaluate the relationships between breeding success, population abundance, and the condition of breeding birds.

For these analyses, we will compare annual capture rates of hatch year (juveniles) and after hatch year (adults) birds, to estimate trends of breeding and migratory populations. Age-specific annual capture rates will be calculated by season and when appropriate adjusted for missed banding effort using methods developed by the Institute for Bird Populations (Nott and DeSante 2002). In addition, the banding data will be analyzed to estimate annual indices associated with the condition of breeding individuals (e.g, breeding status as indicated by brood patch and cloacal protuberance scores, body condition, and indices relating to variation in breeding adult age structure).

Breeding Adult Metrics

Breeding metrics will be derived using a variety of after hatch year captures. We assume the majority of adult birds captured during the breeding season nest somewhere in the immediate vicinity of the station. Several authors have defined a breeding season using various approaches and considered birds captured within that time period as a measure of the breeding population (Benson and Winker 2005, Lloyd-Evans and Atwood 2004, Ballard et al. 2003, Ralph and Hollinger 2003, Dunn and Hussell 1995). Additionally, we will work with the Institute for Bird Populations to develop techniques that consider annual variation in body condition and age structures to help qualify annual measures of abundance (P. Nott, personal communication, November 3, 2009).

We will create the following breeding metrics using breeding season adult captures:

1. **Brood Patch Defined** - female captures with a brood patch scored as "vascular" or "wrinkled." Counts of female birds in the height of breeding condition are the most conservative representation of the breeding population and are therefore the most certain index for local breeding populations. By limiting counts to breeding females, this index avoids bias by eliminating non-breeding females and unpaired males. Although birds

captured with brood patches scored as "smooth" and "feathers growing" might legitimately be locally breeding females, the potential to erroneously score a hatching year bird with a "baby belly" or other molting individuals justifies conservatism. Species where males share incubation or brooding activities are excluded.

2. **Breeding Defined** - captures evaluated as either having a well developed brood patch (females) or enlarged cloacal protuberance (males).
3. **Breeding Resident** - birds captured and determined to be in breeding condition (well developed brood patch or enlarged cloacal protuberance) or recaptured greater than 6 days from original capture (including individuals captured across years).
4. **Breeding Window** - the beginning of the breeding window is the first 10 day period where the cumulative number of birds captured in breeding condition exceeds 5% of the cumulative capture rate. The close of the breeding window is the 10 day period where the cumulative capture rate of birds in breeding condition reaches 95% of all birds captured in breeding condition.
5. **Timing of Breeding** – first, second, and third day of HY capture.
6. **Body Condition** - weight to wing chord ratios.
7. **Seniority Indices** - based on position of age-specific wing chord as it relates to variation is size between second-year and after-second year, as estimated using a proportion of the individuals precisely aged.

These last three indices represent measures of fitness. For example, measures of productivity can be associated with migrants that arrive early and in good condition (Nott et al. 2002).

Productivity Metrics

Indices of reproductive success (HY:AHY) will be calculated as the ratio of effort adjusted HY individuals to AHY individuals (unique band numbers, not captures). To consider annual trends in productivity, we will derive a metric by dividing the number of hatch year birds captured by the various breeding adult counts described above. We will create up to two alternative counts that represent locally hatched birds:

1. **Hatch Year Juvenal Plumage** - all hatch year birds captured with greater than 50% juvenal plumage.
2. **Local Residents** - all hatch year birds captured at least once with greater than 50% juvenal plumage or recaptured greater than 6 days from original capture.

Migration Metrics

During fall migration, birds that likely breed throughout a larger geographic scale are captured, as compared to those captured during the breeding window, captured in breeding status, or captured in juvenal plumage. To represent these populations, we will create up to three post-breeding season metrics:

1. **After Hatch Year Fall Migration Window** - all after hatch year birds captured after the close of the breeding window (defined above).
2. **Hatch Year Fall Migration Window** - all hatch year birds captured after the close of the breeding window (defined above). This is an arbitrary starting point for counting hatch year birds, but we chose this comparable metric for comparisons with the After Hatch Year Fall Migration Window captures.

3. **Hatch Year Dispersers** - all hatch year captures during the entire season that were not captured at any time with greater than 50% juvenal plumage and were not recaptured at any time.

Population Dynamic Models

Using the breeding adult and migration metrics for the top 10 species captured at Oregon Caves, we will estimate trends. Instead of employing nonparametric statistics or data transformations, we will use generalized linear models (GLMs [Crawley 1997, Seavy et al. 2005]) that allow for non-normal random components and accommodate the distributional properties of count data. To estimate trends in captures, we will fit GLMs specifying a Poisson distribution and log-link, where the annual capture total for each species will be the response variable and year the explanatory variable. We will test to assure the data fit a Poison distribution. If they deviate, we will test other distributions for goodness of fit, such as Gaussian or negative binomial, which can perform better when distribution of count data deviate from Poison distribution (White and Bennetts 1996). The year parameter is a measure of the magnitude of the population trend. To estimate the influence of annual productivity on population trends, we will use the previous year's hatch year abundance as an additional explanatory variable of population size. By incorporating this measure in the trend model, we can assess the association between productivity and population abundance.

Analysis and Synthesis Report 3: Power Analysis of Point Count Data

Report three will focus on evaluating the power to detect a 50% decline in density and/or abundance over 20 years with a fixed sample size and significance level of 0.10. While a power analysis was completed to help design this protocol, the purpose of this report is to redo the power analysis using data collected following this protocol to 1) ensure the methods being used support the conclusions of the prior power analysis that was completed using what was assumed to be similar data, and 2) to determine which species we will have sufficient data on to provide trend estimates that will be developed in the fifth Analysis and Synthesis report, and 3) to determine the statistical model for trend that will be used for the trend analysis in report five. We will use a simulation approach implemented in R or SAS to evaluate power. In this report, we can address several questions, not just the observed power for the specified sampling design and sampling objectives. For example, how many routes and how many years of data are required to detect a 50% decline with power =0.80 and α =0.10?

We are interested in estimating trends in park-wide density and/or relative abundance for the most abundantly detected migratory and breeding species. For the rare species, we will explore using occupancy models to estimate trend (MacKenzie et al. 2006). Density is estimated using the DISTANCE package, which accounts for differences in detectability. Relative abundance is the number of birds counted per route.

We will explore two different types of mixed models for modeling trend in relative abundance and density: linear mixed models and generalized linear mixed models (GLMM). It is possible that density will adhere to the assumption of Gaussian errors; thus, a linear mixed model will be sufficient. However, relative abundance, essentially a count, may be better modeled using a Poisson error structure. For example, Purcell et al. (2005) used an overdispersed Poisson distribution for bird point count data. The overdispersion parameter allows for extra variability

common in ecological data; the route-to-route variability and observer-to-observer variability are accounted for by random effects. Another modeling approach used by Sims et al. (2006) modeled bird counts using a linear mixed model with log transformed counts. Their model also accounted for route-to-route variation via a random effect, but they furthermore accounted for year-to-year variation common to all plots (this would be confounded with observer-to-observer variability) and year-to-year variation specific to each plot that could be due to habitat or other local differences. Either approach may be suitable to model trend after 3 years of data have been collected within each park. The precision of the variance component (random effect) estimates will improve with more years of data. However, report three will explore which approach is best suited for the KLMN. The GLIMMIX procedure in SAS, or a similar package in R, will be used to fit linear and generalized linear mixed models to the monitoring data.

The Sierra Nevada Network lakes protocol has developed R scripts to simulate power for a linear mixed model (Heard et al. 2008). Their methods utilize those developed by VanLeeuwen et al. (1996), Urquhart and Kincaid (1999), and Piepho and Ogutu (2002) for analyzing trends in wildlife populations. They use a log transformation similar to the work by Sims et al. (2006); we will explore using their approach directly or adapt their approach in the generalized linear model framework. Their substantial efforts will inform our work and should help to expedite our development of usable R scripts.

Subsequent third year analysis reports will relate to the objectives outlined in the KLMN Landbird Monitoring Protocol. Analyses will include investigation of trends in species richness, habitat relationships, survivorship, and breeding phenology.

Analysis and Synthesis Report 4: to be Determined

After discussions with park staff, we determined that by 2019 there would not be enough data gathered at each park to determine trends in bird species using the VCP point count data (report five). We also recognized that park staff priorities and concerns may change over time. Since this report will be due 11 years after implementing the Landbird Protocol, we have decided not to designate what report and associated analysis will be completed for report four. Within one year of the 2019 field season, we will work with park staff, local avian experts, and statisticians to determine which report and associated analysis would be most valuable at this time based on the data we have collected. The constants to keep in mind when designated the topics of the report are that the report should relate back to the objectives of this protocol, be useful to park managers, and that the analysis should be feasible based on funding and available knowledge.

Analysis and Synthesis Report 5: Analysis of Status and Trends for all Parks (Point Count Data)

Status and Trends in PIF Focal Species Abundance

In year 15, we expect to have a sufficient time series to begin the detection of trends in densities for some of the species that have low year-to-year variability. The power analysis (report three) will inform us as to which species we will be able to detect a trend at year 15. Once complete, this trend analysis will be repeated periodically in future years to continue to monitor trends in both common and less common species. The timeframe for repeating the trend analysis will be determined in the third Analysis and Synthesis report. For trend analysis, we will use the modeling approaches described above for report three. In particular, linear mixed models or

generalized linear mixed models (GLMM) will be used. The GLIMMIX procedure in SAS, or a similar package in R, will be used to fit linear and generalized linear mixed models to the monitoring data. Some adjustments to the models used in report three may be needed due to the longer time series of data, such as in the correlation structure.

For trend analysis of density data, the focus is on detecting a nonzero slope coefficient, assuming a fixed linear effect of time in a mixed or generalized mixed model (VanLeeuwen et al. 1996; Piepho and Ogutu 2002). Once the null hypothesis of no linear effect of time is rejected, we will explore the nature of change over time. For example, does the change through time appear cyclical or is it quadratic? Once enough data are available, these higher order terms can be included in the model.

Geostatistical Analysis and Modeling

Kriging: Kriging is a statistical interpretation method that uses data from a single data type (parameter) to predict values of that data type at unsampled locations by examining the spatial autocorrelation between sites (Beers and Kleijnen 2003, Krivoruchko 2006). Using Kriging methodologies, we will incorporate detection probabilities and estimated abundance as parameters into several models and associated maps that will illustrate the areas of a park where PIF focal species are (1) most likely to be detected, (2) most abundant in any given year, and (3) changing in abundance over time. Ordinary Kriging, based on estimated abundance (described below) of PIF focal species, will be used to develop spatial models for each year a park is surveyed. When complete, this modeling effort will result in five maps that demonstrate the predicated abundance of individual species across the park at a given sampling period. Once abundance maps have been developed, we will conduct a change detection analysis using these maps to determine if PIF focal species distributions are stable or shifting in space over time. In addition, ordinary Kriging will be used to develop models that incorporate detection probabilities (described below) over the 15 year sampling frame. Spatial models based on detection probabilities will be used to develop a map that predicts the probability of observing a species in a given location at a park.

To complete the geostatistical analyses, we will utilize the latest software (currently ArcGIS, ArcGIS Geostatistical Analyst, and ArcGIS Spatial Analyst) to develop the models and associated maps. Prior to developing the maps, model assumptions and trends will be examined using variograms, histograms, and QQplots. Based on initial exploration of the data, detrending and transformations should be applied when necessary (Johnston et al. 2001, Beers and Kleijnen 2003) to ensure that data are in appropriate form for the models used.

Estimating Abundance: We will use the methods described above for report one, *Detectability and Density Analysis*, to develop estimates of abundance for PIF focal species. Abundance estimates will be calculated at each route for each year and models using ordinary Kriging and the change detection methods described above will be used to examine the change in abundance of PIF focal species over space and time.

Developing species occupancy models: We will combine the data collected at the 12 point count stations along each route to determine the occupancy status of a species at a given route in a given year. The occupancy data will be examined over the 15 year time frame to develop several single species multiple season models (MacKenzie et al. 2006) that incorporate local extinction

and colonization to predict detection probabilities when detection probabilities are less than one for each site (MacKenzie et al. 2003). Based on the results of the analysis of habitat data described in earlier sections of this SOP (*Detectability and Density Analysis*), we will examine occupancy models that incorporate statistically and biologically significant habitat variables for each species as covariates. Models will be ranked based on AIC (Burnham and Anderson 1998) and the model weights and standard errors will be used to estimate the contribution of the covariates to the model (Mackenzie et al. 2002). This will be accomplished using the most up-to-date version of the software PRESENCE (currently v2.1) to analyze the data. Once detection probabilities have been established for each site, we will use ordinary Kriging to model the detection probability of each PIF focal species within the park, as described above.

Determining Changes in Species Composition

Changes in species composition over time can provide a particularly valuable adjunct to population trends information. The entire assemblage of species not only provides a more robust indicator of environmental change than individual species, but major changes in the relative frequency or abundance of species can also provide important information to help evaluate changes in the abundance of PIF focal species. One of the most fundamental types of detectable change in multivariate or multispecies datasets is directional change in dissimilarity (i.e., the decline in shared species) at a site over repeated visits, or "progressive change" (Philippi et al. 1998) in communities over time. Comparisons of dissimilarity among sites over time can illustrate stability (no change) or instability. Unstable patterns include directional changes in species composition over time as dissimilarity increases or convergence over time as it decreases (Collins et al. 2000; Figure 1). Directional change is the most likely outcome for long-term monitoring of ecological change in bird communities in response to environmental change (e.g., climate change). Convergence could also present a management concern if it indicates a relative increase in generalists and a decline in the rarer bird species at a sample site over time. If dissimilarity among samples is constant over various time intervals, the system is compositionally stable. If dissimilarity increases over time, the system is changing. If dissimilarity decreases over time, the system is unstable and undergoing convergence.

To evaluate progressive change in composition of our monitoring sites over time, we will develop time-dependent dissimilarity indices to compare landbird composition at each site over the five sample intervals. Dissimilarity indices will be calculated between a site at the first sampling event (time one; t1) and each of the next four sampling events (t2-t5). Our dissimilarity index, D, will be created from presence-absence data as the complement of the widely-used Jaccard's Index of Similarity (Legendre and Legendre 1983).

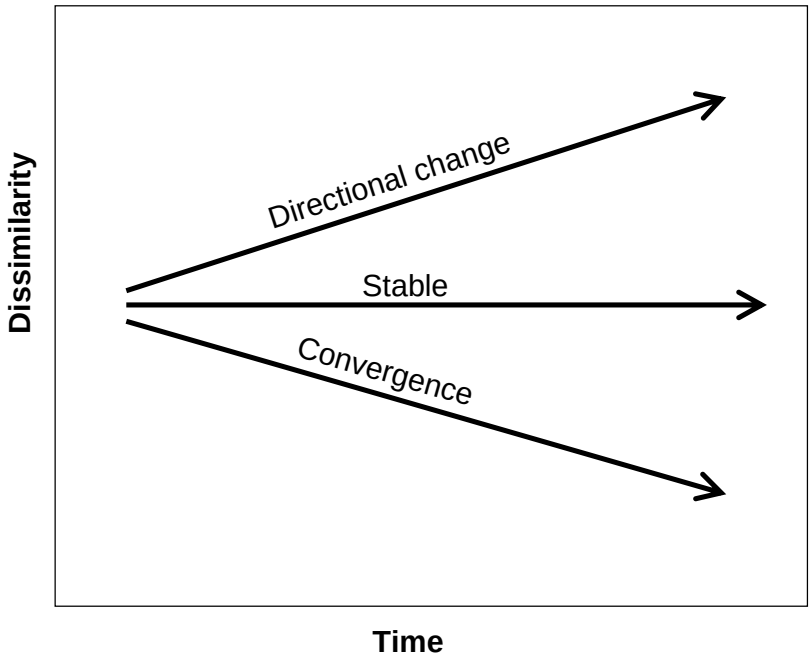


Figure 1. Three patterns of dissimilarity as a function of time with time series data (after Collins et al. 2000).

Jaccard's Index can be calculated as follows:

$$J = a/(a+b+c)$$

Where the number of species present in both samples is a, the number of species present in sample 1 but missing from sample 2 is b, the number of species missing in sample 1 but present in sample 2 is c.

And the dissimilarity index D is the remainder after subtracting J from unity:

$$D = 1- J.$$

This metric is well understood, easily calculated, and available in most standard multivariate statistical packages (Community Analysis Program, PC-Ord). Once a dissimilarity matrix is prepared that compares sampling event 1 with all subsequent sampling events, the null hypothesis of a zero slope in pairwise dissimilarity over time can be evaluated with general linear models for each sample site in the park. Although 25-35 analyses will be needed per park, these analyses should proceed quickly. In the event of determination of a significant, positive nonzero slope for a site, the standardized coefficient of the regression model should be recorded. Because there will be multiple comparisons (25-35 sites) per park, we will need to subject the findings to a suitable post hoc test for multiple comparisons, such as Tukey's test (Tukey 1953). A significant change will be reported only with determination of a significant result from the post hoc test.

If a significant change is detected, we will analyze the spatial pattern in the results by analyzing spatial autocorrelation patterns in the significant slope patterns detected. Within a GIS program, Kriging will be used to determine spatial patterns in change across the park in question. For

example, it is quite possible that different areas of the parks will show different degrees of compositional similarity or be changing at different rates. In such analyses, nonsignificant or negative linear models of dissimilarity over time will standardize to zero for a sampling site, with standardized slope coefficients for the significant site models presented.

In summary, the results to be reported from multi species analyses in this Analysis and Synthesis report will be: (1) the detection of significant positive evidence of environmental change at each of the sampling locations in the park, as indicated by significantly positive slopes in linear models of compositional distance over time; (2) a report of significant levels of change across the park sampling frame as verified by Tukey's test of multiple comparisons; and (3) a summary of the spatial patterns in compositional change within the park, as indexed by spatial Kriging models of the linear model slopes across the park sampling frame.

Report Format

Annual Reports and alternate year analysis reports will use the NPS Natural Resource Publications template, a pre-formatted Microsoft Word template document based on current NPS formatting standards. These templates and documentation of the NPS publication standards are available at: http://www.nature.nps.gov/publications/NRPM/index.cfm.

Procedures for Reporting

1. The Annual Report will be completed in a totally digital format. The Annual Report will be published as a *Data Report* for the park and therefore should follow the standard, accepted format for a regional report. If the report has pages generated as Microsoft Access reports, the report should be run in Access and **saved with a .snp file extension**.

2. Files should follow the naming structure outlined in the Klamath Network File_Naming_Convention_Guidelines. Standards all file names should follow include:

    a. File name will be no less than 10 characters in length.
    b. File names must never contain special characters (*&@%$) or spaces. When separating names, use an underscore (e.g., use_underscore).
    c. Dates will be in one of the following formats YYYYMMDD, YYYYMM, or YYYY. The most detailed date information should be used whenever possible.
    d. The date should correspond to the date the document or version of the document was created. Dates should be the last component in the naming convention.
    e. The title should be the first portion of the file name, be in mixed case format, and be as descriptive as possible (e.g., Landbird_Annual_Report_20070401).

3. Collate document together, with appendices (use of templates posted on the NRPM web site is highly recommended), and submit draft manuscript and the NRPM Manuscript Submittal Form and Checklist via email to one of the NPS Key Officials listed on the NRPM web site.

4. The NPS Key Official determines whether or not additional peer review is necessary based on the manuscript content and the quality of the initial reviews, and if deemed appropriate, arranges for and oversees additional peer review. The NPS Key Official

determines whether or not a Management Review is necessary. If so, he or she selects an appropriate reviewer who can verify consistency with NPS policy or clear an appropriate relation to NPS policy and that appropriate treatment is given to sensitive issues.

5. Once the Key Official is satisfied that reviewer comments have been adequately incorporated and the report meets the minimum standards for the series, the report is approved for publication in one of the series and the contributor obtains a report number, as well as a NPS Technical Information Center (TIC) identification number, following the guidance on the NRPM web site.

6. Once the report numbers are added, produce a PDF (portable document format) version of the publication and send it to the Klamath Network contact. In addition, submit the PDF and all documents used to create the PDF (.xls, .doc, .snp) to the Klamath Network Data Manager.

7. The Klamath Network Data Manager will be responsible for archiving and distributing the document following processes outlined in the KLMN Data Management Plan. Annual reports will be sent to the Resource Chiefs of each park, loaded to the NPS Data Store, and posted on the KLMN Internet and Intranet web sites. A record for the report will be created in NatureBib. Species listed in the annual report will be compared to park species lists in NPSpecies to ensure all species are included on the list. Discrepancies between species mentioned in the report but not on the park species list will be discussed between project researchers, park staff, and the Klamath Network, with adjustments made as necessary.

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Landbird Monitoring Protocol for Klamath Network Parks

Standard Operating Procedure (SOP) #18: Revising the Protocol

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedures for revising the protocol narrative and associated Standard Operating Procedures (SOPs).

Introduction

This document explains how to make and track changes to the KLMN Landbird Monitoring Protocol, including its accompanying SOPs. While this monitoring plan has been developed using current standardized methodology, all monitoring programs need to be flexible to adapt to changes. As new technologies, methods, and equipment become available, this protocol will be updated as appropriate, by balancing current best practices against the continuity of protocol information. Project staff should refer to this SOP whenever edits are necessary and should be familiar with the protocol versioning system in order to identify and use the most current versions of the protocol documents. All changes will be made in a timely manner with the appropriate level of review.

All edits require review for clarity and technical soundness. Small changes to existing documents (e.g., formatting, simple clarification of existing content, small changes in the task schedule or project budget, or general updates to information management handling SOPs) may be reviewed in-house by project cooperators and KLMN staff. However, major changes to data collection or analysis techniques, sampling design, or response design will trigger an outside review. The Project Lead should coordinate with the KLMN Contact to determine if outside review is needed.

Revision Procedures

The following procedures will ensure that both minor and major revisions to this document will align with the monitoring plan.

1. Discuss proposed changes with other project staff prior to making modifications. It is important to consult with the Data Manager prior to making changes because certain types of changes may jeopardize dataset integrity unless they are planned and executed with dataset integrity in mind. Also, because certain changes may require altering the

database structure or functionality, advance notice of changes is important to minimize disruptions to project operations. Consensus should be reached on who will be making the changes and in what timeframe.

2. Make the agreed-upon changes in the appropriate protocol document. Note that the protocol is split into separate documents for each appendix and SOP. Also note that a change in one document may necessitate other changes elsewhere in the protocol. For example, a change in the narrative may require changes to several SOPs; similarly, renumbering an SOP may mean changing document references in several other documents. Also, the project task list and other appendices may need to be updated to reflect changes in timing or responsibilities for the various project tasks.
3. Document all edits in the Revision History Log embedded in the protocol narrative and each SOP. Log changes only in the document being edited (i.e., if there is a change to an SOP, log those changes only in that document). Record the date of the changes (i.e., the date on which all changes were finalized), author of the revision, the change and the paragraph(s) and page(s) where changes are made, and briefly the reason for making the changes, and the new version number. Version numbers increase incrementally by hundredths (e.g., version 1.01, 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0). Record the previous version number, date of revision, and author of revision; identify paragraphs and pages where changes are made, rationale for revisions, and the new version number.
4. Circulate the changed document for internal review among project staff and cooperators. Minor changes and clarifications will be reviewed in-house. When significant changes in methodology are suggested, revisions will first undergo internal review by the project staff. Additional external review including, but not limited, to National Park Service staff with appropriate avian research and statistical expertise will be required.
5. Upon ratification and finalizing changes:
    a. Ensure that the version date (last saved date field code in the document header) and file name (field code in the document footer) are updated properly throughout the document.
    b. Make a copy of each changed file to the protocol archive folder (i.e., a subfolder under the Protocol folder in the project workspace).
    c. The copied files should be renamed by appending the revision date in YYYYMMDD format. In this manner, the revision date becomes the version number and this copy becomes the “versioned” copy to be archived and distributed.
    d. The current, primary version of the document (i.e., not the versioned document just copied and renamed) does not have a date stamp associated with it.
    e. To avoid unplanned edits to the document, reset the document to read-only by right-clicking on the document in Windows Explorer and checking the appropriate box in the Properties popup.
    f. Inform the Data Manager so the new version number(s) can be incorporated into the project metadata.

6. As appropriate, create PDF files of the versioned documents to post to the Internet and share with others. These PDF files should have the same name and be made from the versioned copy of the file.

7. Send a digital copy of the revised monitoring plan to the Network Contact and Network Data Manager. The revised monitoring plan will be forwarded to all individuals who had been using a previous version of the affected document. Ensure that surveyors in the field have a hardcopy of the new version.

8. The Network Data Manager will place a copy of the revised protocol in the proper folder on the Klamath Network shared drive. In addition, the Network Data Manager will archive the previous version in the Klamath Network archive drive.

9. The Network Data Manager will post the revised version and update the associated records in the proper I&M databases, including but not limited to NatureBib, NPS Data Store, KLMN Intranet and Internet web sites, and the Protocol database.

Appendix A. Species Detected during KBO 2002 and 2003 Inventory of Klamath Network Parks and Applicable Conservation Plans.

	OR/WA PIF			CalPIF				Continental PIF[8]		ODFW Conservation Strategy[9]			CDFG[10]
Common Name	Conifer[1]	Eastslope[2]	Riparian[3]	Oak[4]	Conifer[5]	Coastal Scrub[6]	Sagebrush[7]	Intermountain West	Pacific	West Cascades	Klamath Mts	East Cascades	CA wildlife: Cons. strategy
Acorn Woodpecker				X									
American Crow													
American Dipper													
American Goldfinch													
American Kestrel													
American Pipit	X												
American Robin													
Annas Hummingbird													
Ash-throated Flycatcher		X		X									
Audubons Warbler													
Band-tailed Pigeon	X			X					X	X			
Barn Swallow													
Belted Kingfisher													
Bewicks Wren				X		X							
Black Oystercatcher													
Black Phoebe													
Black-backed Woodpecker		X			X							X	
Black-billed Magpie													
Black-capped Chickadee													X
Black-headed Grosbeak			X										
Black-throated Gray Warbler	X				X				X				
Blue Grouse		X							X				

	OR/WA PIF			CalPIF				Continental PIF[8]		ODFW Conservation Strategy[9]			CDFG[10]
Common Name	Conifer[1]	Eastslope[2]	Riparian[3]	Oak[4]	Conifer[5]	Coastal Scrub[6]	Sagebrush[7]	Intermountain West	Pacific	West Cascades	Klamath Mts	East Cascades	CA wildlife: Cons. strategy
Blue-gray Gnatcatcher				X		X					X		
Brewers Blackbird													
Brewers Sparrow								X					X
Brown Creeper	X	X			X								
Brown Pelican													
Brown-headed Cowbird													
Bullocks Oriole													
Bushtit													
California Quail				X		X							
California Towhee				X		X			X				
Canada Goose													
Canyon Wren													
Cassins Finch					X			X					
Cassins Vireo													
Cedar Waxwing													
Chestnut-backed Chickadee									X				
Chipping Sparrow		X			X								X
Clarks Nutcracker		X			X			X					
Cliff Swallow													
Common Merganser													
Common Nighthawk													
Common Raven													
Common Yellowthroat			X			X							
Coopers Hawk													X
Downy Woodpecker													
Dusky Flycatcher								X					
Evening Grosbeak													

	OR/WA PIF				CalPIF			Continental PIF[8]		ODFW Conservation Strategy[9]			CDFG[10]
Common Name	Conifer[1]	Eastslope[2]	Riparian[3]	Oak[4]	Conifer[5]	Coastal Scrub[6]	Sagebrush[7]	Intermountain West	Pacific	West Cascades	Klamath Mts	East Cascades	CA wildlife: Cons. strategy
Fox Sparrow					X				X				
Golden-crowned Kinglet					X								
Golden-crowned Sparrow									X				
Grasshopper Sparrow											X		
Gray Flycatcher					X		X	X					
Gray Jay					X								
Great Blue Heron													
Great Horned Owl													
Green Heron													
Green-tailed Towhee							X	X					
Hairy Woodpecker													
Hammonds Flycatcher	X												
Hermit Thrush		X											
Hermit Warbler	X								X				X
Horned Lark													
House Finch													
House Wren													
Huttons Vireo	X			X									
Juniper Titmouse							X						
Killdeer													
Lark Sparrow				X			X						X
Lazuli Bunting													
Lesser Goldfinch													
Lewis Woodpecker		X		X				X	X		X	X	X
Lincolns Sparrow	X												
MacGillivrays Warbler					X								
Mallard													

	OR/WA PIF				CalPIF			Continental PIF[8]		ODFW Conservation Strategy[9]			CDFG[10]
Common Name	Conifer[1]	Eastslope[2]	Riparian[3]	Oak[4]	Conifer[5]	Coastal Scrub[6]	Sagebrush[7]	Intermountain West	Pacific	West Cascades	Klamath Mts	East Cascades	CA wildlife: Cons. strategy
Marbled Murrelet													
Marsh Wren													
Mountain Bluebird								X					
Mountain Chickadee													
Mountain Quail					X	X			X				
Mourning Dove													
Nashville Warbler		X											
Northern Goshawk										X		X	X
Northern Harrier													X
Northern Pygmy-Owl				X									
Northern Rough-winged Swallow													
Northern Shrike													
Oak Titmouse				X					X				X
Olive-sided Flycatcher	X	X			X			X	X	X		X	X
Orange-crowned Warbler	X												
Oregon Junco					X								
Osprey													X
Pacific-slope Flycatcher	X								X				
Pileated Woodpecker	X				X								
Pine Siskin													
Pinyon Jay								X					
Purple Finch					X								
Purple Martin											X		X
Pygmy Nuthatch													
Red Crossbill	X												
Red-breasted Nuthatch					X								

	OR/WA PIF			CalPIF				Continental PIF[8]		ODFW Conservation Strategy[9]			CDFG[10]
Common Name	Conifer[1]	Eastslope[2]	Riparian[3]	Oak[4]	Conifer[5]	Coastal Scrub[6]	Sagebrush[7]	Intermountain West	Pacific	West Cascades	Klamath Mts	East Cascades	CA wildlife: Cons. strategy
Red-breasted Sapsucker									X				X
Red-shafted Flicker													
Red-shouldered Hawk				X									
Red-tailed Hawk													
Ring-necked Pheasant													
Rock Wren													
Ruby-crowned Kinglet													
Ruffed Grouse													X
Rufous Hummingbird	X							X	X				X
Sage Thrasher													
Sandhill Crane		X										X	X
Savannah Sparrow													
Sharp-shinned Hawk													X
Song Sparrow			X			X							
Spotted Sandpiper			X										
Spotted Towhee						X							
Stellers Jay					X				X				
Swainsons Thrush			X										
Townsends Solitaire													
Townsends Warbler													
Tree Swallow			X										
Turkey Vulture						X							
Varied Thrush	X				X				X				
Vauxs Swift	X												X
Vesper Sparrow							X						
Violet-green Swallow													
Warbling Vireo			X										

	OR/WA PIF			CalPIF				Continental PIF[8]		ODFW Conservation Strategy[9]			CDFG[10]
Common Name	Conifer[1]	Eastslope[2]	Riparian[3]	Oak[4]	Conifer[5]	Coastal Scrub[6]	Sagebrush[7]	Intermountain West	Pacific	West Cascades	Klamath Mts	East Cascades	CA wildlife: Cons. strategy
Western Bluebird	X			X									
Western Gull													
Western Kingbird													
Western Meadowlark							X						
Western Scrub-Jay				X		X			X				
Western Tanager					X								
Western Wood-Pewee													
White-breasted Nuthatch				X									
White-crowned Sparrow													
White-headed Woodpecker		X						X	X		X	X	X
White-throated Sparrow													
Williamsons Sapsucker		X						X					
Wilsons Warbler	X		X										
Winter Wren	X								X				
Wrentit						X			X				
Yellow Warbler			X										X
Yellow-breasted Chat			X										X

[1]Altman, B. 1999. Conservation strategy for landbirds in coniferous forests of western Version 1.0. Oregon and Washington. Oregon-Washington Partners in Flight. Online. (http://www.orwapif.org/pdf/western_forest.pdf). Accessed 8 January 2008.

[2] Altman, B. 2000. Conservation strategy for landbirds of the east-slope of the Cascade Mountains in Oregon and Washington. Version 1.0. Oregon-Washington Partners in Flight. Online. (http://www.orwapif.org/pdf/east_slope.pdf). Accessed 8 January 2008.

[3] RHJV (Riparian Habitat Joint Venture). 2004. The riparian bird conservation plan: A strategy for reversing the decline of riparian associated birds in California. Version 2.0. California Partners in Flight. Online. (http://www.prbo.org/calpif/pdfs/riparian .v-2.pdf). Accessed 8 January 2008.

[4] California Partners in Flight (CalPIF). 2002a. The oak woodland bird conservation plan: A strategy for protecting and managing oak woodland habitats and associated birds in California (S. Zack, lead author). Version 2.0. Point Reyes Bird Observatory, Stinson Beach, CA. Online. (http://www.prbo.org/calpif/plans.html). Accessed 8 January 2008.

[5] California Partners in Flight (CalPIF). 2002b. The draft coniferous forest bird conservation plan: A strategy for protecting and managing coniferous forest habitats and associated birds in California (J. Robinson and J. Alexander, lead authors). Version 1.0. Point Reyes Bird Observatory, Stinson Beach, CA. Online. (http://www.prbo.org/calpif/plans.html). Accessed 8 January 2008.

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[7] California Partners in Flight (CalPIF). 2005. The sagebrush bird conservation plan: a strategy for protecting and managing sagebrush habitats and associated birds in California. Version 1.0. PRBO Conservation Science, Stinson Beach, CA. Online. (http://www.prbo.org/calpif/plans.html). Accessed 8 January 2008.

[8] Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. W. Bradstreet, G. S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Iñigo-Elias, and others. 2004. Partners in Flight North American landbird conservation plan. Cornell Lab of Ornithology, Ithaca, NY.

[9] Oregon Department of Fish and Wildlife (ODFW). 2005. Oregon conservation strategy. Oregon Department of Fish and Wildlife, Salem, OR.

[10] California Department of Fish and Game (CDFG). 2005. California wildlife: Conservation challenges. (California's Wildlife Action Plan). Wildlife Health Center, University of California, Davis.

Appendix B. Scientific Names of all Birds Encountered during Klamath Network Parks' Inventory (2002-2003).

Common Name	Scientific Name
Acorn Woodpecker	*Melanerpes formicivorus*
American Crow	*Corvus brachyrhynchos*
American Dipper	*Cinclus mexicanus*
American Goldfinch	*Carduelis tristis*
American Kestrel	*Falco sparverius*
American Pipit	*Anthus rubescens*
American Robin	*Turdus migratorius*
Annas Hummingbird	*Calypte anna*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Audubons Warbler	*Dendroica c. auduboni*
Band-tailed Pigeon	*Columba fasciata*
Barn Swallow	*Hirundo rustica*
Belted Kingfisher	*Ceryle alcyon*
Bewicks Wren	*Thryomanes bewickii*
Black Oystercatcher	*Haematopus bachmani*
Black Phoebe	*Sayornis nigricans*
Black-backed Woodpecker	*Picoides arcticus*
Black-billed Magpie	*Pica hudsonia*
Black-capped Chickadee	*Poecile atricapilla*
Black-headed Grosbeak	*Pheucticus melanocephalus*
Black-throated Gray Warbler	*Dendroica nigrescens*
Blue Grouse	*Dendragapus obscurus*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Brewers Blackbird	*Euphagus cyanocephalus*
Brewers Sparrow	*Spizella breweri*
Brown Creeper	*Certhia americana*
Brown Pelican	*Pelecanus occidentalis*
Brown-headed Cowbird	*Molothrus ater*
Bullocks Oriole	*Icterus bullockii*
Bushtit	*Psaltriparus minimus*
California Quail	*Callipepla californica*
California Towhee	*Pipilo crissalis*
Canada Goose	*Branta canadensis*
Canyon Wren	*Catherpes mexicanus*
Cassins Finch	*Carpodacus cassinii*
Cassins Vireo	*Vireo cassinii*
Cedar Waxwing	*Bombycilla cedrorum*
Chestnut-backed Chickadee	*Poecile rufescens*
Chipping Sparrow	*Spizella passerina*
Clarks Nutcracker	*Nucifraga columbiana*
Cliff Swallow	*Petrochelidon pyrrhonota*
Common Merganser	*Mergus merganser*
Common Nighthawk	*Chordeiles minor*
Common Raven	*Corvus corax*
Common Yellowthroat	*Geothlypis trichas*

Common Name	Scientific Name
Coopers Hawk	*Accipiter cooperii*
Downy Woodpecker	*Picoides pubescens*
Dusky Flycatcher	*Empidonax oberholseri*
Evening Grosbeak	*Coccothraustes vespertinus*
Fox Sparrow	*Passerella iliaca*
Golden-crowned Kinglet	*Regulus satrapa*
Golden-crowned Sparrow	*Zonotrichia atricapilla*
Grasshopper Sparrow	*Ammodramus savannarum*
Gray Flycatcher	*Empidonax wrightii*
Gray Jay	*Perisoreus canadensis*
Great Blue Heron	*Ardea herodias*
Great Horned Owl	*Bubo virginianus*
Green Heron	*Butorides virescens*
Green-tailed Towhee	*Pipilo chlorurus*
Hairy Woodpecker	*Picoides villosus*
Hammonds Flycatcher	*Empidonax hammondii*
Hermit Thrush	*Catharus guttatus*
Hermit Warbler	*Dendroica occidentalis*
Hermit x Black-throated Gray Warbler Hybrid	*Hermit x Black-throated Gray Warbler Hybrid*
Horned Lark	*Eremophila alpestris*
House Finch	*Carpodacus mexicanus*
House Wren	*Troglodytes aedon*
Huttons Vireo	*Vireo huttoni*
Juniper Titmouse	*Baeolophus ridgewayi*
Killdeer	*Charadrius vociferus*
Lark Sparrow	*Chondestes grammacus*
Lazuli Bunting	*Passerina amoena*
Lesser Goldfinch	*Carduelis psaltria*
Lewis Woodpecker	*Melanerpes lewis*
Lincolns Sparrow	*Melospiza lincolnii*
MacGillivrays Warbler	*Oporornis tolmiei*
Mallard	*Anas platyrhynchos*
Marbled Murrelet	*Brachyramphus marmoratus*
Marsh Wren	*Cistothorus palustris*
Mountain Bluebird	*Sialia currucoides*
Mountain Chickadee	*Poecile gambeli*
Mountain Quail	*Oreortyx pictus*
Mourning Dove	*Zenaida macroura*
Nashville Warbler	*Vermivora ruficapilla*
Northern Goshawk	*Accipiter gentilis*
Northern Harrier	*Circus cyaneus*
Northern Pygmy-Owl	*Glaucidium gnoma*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Northern Shrike	*Lanius excubitor*
Oak Titmouse	*Baeolophus inornatus*
Olive-sided Flycatcher	*Contopus cooperi*
Orange-crowned Warbler	*Vermivora celata*
Oregon Junco	*Junco h. oregonus*
Osprey	*Pandion haliaetus*

Common Name	Scientific Name
Pacific-slope Flycatcher	*Empidonax difficilis*
Pileated Woodpecker	*Dryocopus pileatus*
Pine Siskin	*Carduelis pinus*
Pinyon Jay	*Gymnorhinus cyanocephalus*
Purple Finch	*Carpodacus purpureus*
Purple Martin	*Progne subis*
Pygmy Nuthatch	*Sitta pygmaea*
Red Crossbill	*Loxia curvirostra*
Red-breasted Nuthatch	*Sitta canadensis*
Red-breasted Sapsucker	*Sphyrapicus ruber*
Red-shafted Flicker	*Colaptes a. cafer*
Red-shouldered Hawk	*Buteo lineatus*
Red-tailed Hawk	*Buteo jamaicensis*
Ring-necked Pheasant	*Phasianus colchicus*
Rock Wren	*Salpinctes obsoletus*
Ruby-crowned Kinglet	*Regulus calendula*
Ruffed Grouse	*Bonasa umbellus*
Rufous Hummingbird	*Selasphorus rufus*
Sage Thrasher	*Oreoscoptes montanus*
Sandhill Crane	*Grus canadensis*
Savannah Sparrow	*Passerculus sandwichensis*
Sharp-shinned Hawk	*Accipiter striatus*
Song Sparrow	*Melospiza melodia*
Spotted Sandpiper	*Actitis macularia*
Spotted Towhee	*Pipilo maculatus*
Stellers Jay	*Cyanocitta stelleri*
Swainsons Thrush	*Catharus ustulatus*
Townsends Solitaire	*Myadestes townsendi*
Townsends Warbler	*Dendroica townsendi*
Tree Swallow	*Tachycineta bicolor*
Turkey Vulture	*Cathartes aura*
Unidentified Oak/Juniper Titmouse	*Unidentified Titmouse*
Varied Thrush	*Ixoreus naevius*
Vauxs Swift	*Chaetura vauxi*
Vesper Sparrow	*Pooecetes gramineus*
Violet-green Swallow	*Tachycineta thalassina*
Warbling Vireo	*Vireo gilvus*
Western Bluebird	*Sialia mexicana*
Western Gull	*Larus occidentalis*
Western Kingbird	*Tyrannus verticalis*
Western Meadowlark	*Sturnella neglecta*
Western Scrub-Jay	*Aphelocoma californica*
Western Tanager	*Piranga ludoviciana*
Western Wood-Pewee	*Contopus sordidulus*
White-breasted Nuthatch	*Sitta carolinensis*
White-crowned Sparrow	*Zonotrichia leucophrys*
White-headed Woodpecker	*Picoides albolarvatus*
White-throated Sparrow	*Zonotrichia albicollis*
Williamsons Sapsucker	*Sphyrapicus thyroideus*

Common Name	Scientific Name
Wilsons Warbler	*Wilsonia pusilla*
Winter Wren	*Troglodytes troglodytes*
Wrentit	*Chamaea fasciata*
Yellow Warbler	*Dendroica petechia*
Yellow-breasted Chat	*Icteria virens*

Appendix C. Species Detected during the 2002 and 2003 Inventory of the Parks and Applicable Conservation Plans.

Crater Lake National Park

	OR/WA PIF		Continental PIF[3]		ODFW Conservation Strategy[4]	
Common Name	Conifer[1]	Eastslope[2]	Intermountain West	Pacific	West Cascades	East Cascades
American Goldfinch						
American Robin						
Audubons Warbler						
Black-backed Woodpecker		X				X
Black-headed Grosbeak						
Black-throated Gray Warbler	X			X		
Blue Grouse		X		X		
Brown Creeper	X	X				
Brown-headed Cowbird						
Cassins Finch			X			
Cassins Vireo						
Chestnut-backed Chickadee				X		
Chipping Sparrow		X				
Clarks Nutcracker		X	X			
Common Merganser						
Common Raven						
Coopers Hawk						
Dusky Flycatcher			X			
Evening Grosbeak						
Fox Sparrow				X		
Golden-crowned Kinglet						
Golden-crowned Sparrow				X		
Gray Jay						
Great Horned Owl						
Green-tailed Towhee			X			
Hairy Woodpecker						
Hammonds Flycatcher	X					
Hermit Thrush		X				
Hermit Warbler	X			X		
House Wren						
Lazuli Bunting						
Lincolns Sparrow	X					
MacGillivrays Warbler						
Mountain Bluebird			X			
Mountain Chickadee						

Common Name	OR/WA PIF		Continental PIF[3]		ODFW Conservation Strategy[4]	
	Conifer[1]	Eastslope[2]	Intermountain West	Pacific	West Cascades	East Cascades
Nashville Warbler		X				
Olive-sided Flycatcher	X	X	X	X	X	X
Orange-crowned Warbler	X					
Oregon Junco						
Pacific-slope Flycatcher	X			X		
Pileated Woodpecker	X					
Pine Siskin						
Pygmy Nuthatch						
Red Crossbill	X					
Red-breasted Nuthatch						
Red-breasted Sapsucker				X		
Red-shafted Flicker						
Red-tailed Hawk						
Ruby-crowned Kinglet						
Spotted Towhee						
Stellers Jay				X		
Swainsons Thrush						
Townsends Solitaire						
Turkey Vulture						
Varied Thrush	X			X		
Violet-green Swallow						
Western Tanager						
Western Wood-Pewee						
White-breasted Nuthatch						
White-headed Woodpecker		X	X	X		X
Williamsons Sapsucker		X	X			
Winter Wren	X			X		

[1] Altman, B. 1999. Conservation strategy for landbirds in coniferous forests of western Version 1.0. Oregon and Washington. Oregon-Washington Partners in Flight. Online. (http://www.orwapif.org/pdf/western_forest.pdf). Accessed 8 January 2008.

[2] Altman, B. 2000. Conservation strategy for landbirds of the east-slope of the Cascade Mountains in Oregon and Washington. Version 1.0. Oregon-Washington Partners in Flight. Online. (http://www.orwapif.org/pdf/east_slope.pdf). Accessed 8 January 2008.

[3] Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. W. Bradstreet, G. S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Iñigo-Elias, and others. 2004. Partners in Flight North American landbird conservation plan. Cornell Lab of Ornithology, Ithaca, NY.

[4] Oregon Department of Fish and Wildlife (ODFW). 2005. Oregon conservation strategy. Oregon Department of Fish and Wildlife, Salem, OR.

Lava Beds National Monument

Common Name	CalPIF		Continental PIF[3]	CDFG[4]
	Conifer[1]	Sagebrush[2]	Intermountain West	CA wildlife: Cons. strategy
American Goldfinch				
American Kestrel				
American Pipit				
American Robin				
Ash-throated Flycatcher				
Audubons Warbler				
Bewicks Wren				
Black-billed Magpie				
Black-headed Grosbeak				
Blue-gray Gnatcatcher				
Brewers Blackbird				
Brewers Sparrow			X	X
Brown-headed Cowbird				
Bullocks Oriole				
Bushtit				
California Quail				
California Towhee				
Canyon Wren				
Cassins Finch	X		X	
Cedar Waxwing				
Chipping Sparrow	X			X
Clarks Nutcracker	X		X	
Common Nighthawk				
Common Raven				
Coopers Hawk				X
Dusky Flycatcher			X	
Evening Grosbeak				
Golden-crowned Kinglet	X			
Golden-crowned Sparrow				
Gray Flycatcher	X	X	X	
Green-tailed Towhee		X	X	
Hairy Woodpecker				
Hermit Thrush				
Horned Lark				
House Finch				

Common Name	CalPIF		Continental PIF[3]	CDFG[4]
	Conifer[1]	Sagebrush[2]	Intermountain West	CA wildlife: Cons. strategy
House Wren				
Juniper Titmouse		X		
Lark Sparrow		X		X
Lazuli Bunting				
Lesser Goldfinch				
Lewis Woodpecker			X	X
Mountain Bluebird			X	
Mountain Chickadee				
Mountain Quail	X			
Mourning Dove				
Northern Shrike				
Olive-sided Flycatcher	X		X	X
Oregon Junco	X			
Pileated Woodpecker	X			
Pine Siskin				
Pinyon Jay			X	
Purple Finch	X			
Pygmy Nuthatch				
Red Crossbill				
Red-breasted Nuthatch	X			
Red-breasted Sapsucker				X
Red-shafted Flicker				
Red-tailed Hawk				
Ring-necked Pheasant				
Rock Wren				
Ruby-crowned Kinglet				
Rufous Hummingbird			X	X
Sage Thrasher				
Sandhill Crane				X
Savannah Sparrow				
Spotted Towhee				
Stellers Jay	X			
Townsends Solitaire				
Turkey Vulture				
Varied Thrush	X			
Vesper Sparrow		X		

Common Name	CalPIF		Continental PIF[3]	CDFG[4]
	Conifer[1]	Sagebrush[2]	Intermountain West	CA wildlife: Cons. strategy
Western Bluebird				
Western Kingbird				
Western Meadowlark		X		
Western Scrub-Jay				
Western Tanager	X			
Western Wood-Pewee				
White-breasted Nuthatch				
White-crowned Sparrow				
White-throated Sparrow				
Williamsons Sapsucker			X	
Wrentit				

[1]California Partners in Flight (CalPIF). 2002. The draft coniferous forest bird conservation plan: A strategy for protecting and managing coniferous forest habitats and associated birds in California (J. Robinson and J. Alexander, lead authors). Version 1.0. Point Reyes Bird Observatory, Stinson Beach, CA. Online. (http://www.prbo.org/calpif/plans.html). Accessed 8 January 2008.

[2]CalPIF (California Partners in Flight). 2005. Version 1.0. The sagebrush bird conservation plan: A strategy for protecting and managing sagebrush habitats and associated birds in California. PRBO Conservation Science, Stinson Beach, CA. Online. (http://www.prbo.org/calpif/plans.html). Accessed 8 January 2008.

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[4] California Department of Fish and Game (CDFG). 2005. California wildlife: Conservation challenges. (California's wildlife action plan). Wildlife Health Center, University of California, Davis.

Lassen Volcanic National Park

Common Name	CalPIF		Continental PIF[3]	CDFG[4]
	Riparian[1]	Conifer[2]	Pacific	CA wildlife: Cons. strategy
American Goldfinch				
American Robin				
Audubons Warbler				
Band-tailed Pigeon			X	
Black-backed Woodpecker		X		
Brown Creeper		X		
Canada Goose				
Cassins Finch		X		
Cedar Waxwing				
Chipping Sparrow		X		X
Clarks Nutcracker		X		
Common Raven				
Downy Woodpecker				
Evening Grosbeak				
Fox Sparrow		X	X	
Golden-crowned Kinglet		X		
Golden-crowned Sparrow			X	
Hairy Woodpecker				
Hammonds Flycatcher				
Hermit Thrush				
House Wren				
Lesser Goldfinch				
Lewis Woodpecker			X	X
Lincolns Sparrow				
Mallard				
Mountain Chickadee				
Mountain Quail		X	X	
Orange-crowned Warbler				
Oregon Junco		X		
Pileated Woodpecker		X		
Pine Siskin				
Pygmy Nuthatch				
Red Crossbill				
Red-breasted Nuthatch		X		

Common Name	CalPIF		Continental PIF[3]	CDFG[4]
	Riparian[1]	Conifer[2]	Pacific	CA wildlife: Cons. strategy
Red-shafted Flicker				
Red-tailed Hawk				
Ruby-crowned Kinglet				
Savannah Sparrow				
Sharp-shinned Hawk				X
Song Sparrow	X			
Spotted Sandpiper	X			
Spotted Towhee				
Stellers Jay		X	X	
Western Meadowlark				
Western Scrub-Jay			X	
White-breasted Nuthatch				
White-crowned Sparrow				
White-headed Woodpecker			X	X
Williamsons Sapsucker				
Wilsons Warbler	X			
Winter Wren			X	

[1]RHJV (Riparian Habitat Joint Venture). 2004. The riparian bird conservation plan: A strategy for reversing the decline of riparian associated birds in California. Version 2.0. California Partners in Flight. Online. (http://www.prbo.org/calpif/pdfs/riparian .v-2.pdf). Accessed 8 January 2008.

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[4]California Department of Fish and Game (CDFG). 2005. California wildlife: Conservation challenges. (California's wildlife action plan). Wildlife Health Center, University of California, Davis.

Oregon Caves National Monument

Common Name	OR/WA PIF	Continental PIF[2]	ODFW Conservation Strategy[3]
	Conifer[1]	Pacific	Klamath Mts
American Crow			
American Robin			
Audubons Warbler			
Black-capped Chickadee			
Black-headed Grosbeak			
Blue Grouse		X	
Brown Creeper	X		
Bushtit			
California Quail			
Canada Goose			
Cassins Vireo			
Cedar Waxwing			
Chestnut-backed Chickadee		X	
Chipping Sparrow			
Common Raven			
Downy Woodpecker			
Dusky Flycatcher			
Evening Grosbeak			
Fox Sparrow		X	
Golden-crowned Kinglet			
Golden-crowned Sparrow		X	
Gray Jay			
Hairy Woodpecker			
Hermit Thrush			
Hermit Warbler	X	X	
MacGillivrays Warbler			
Mountain Chickadee			
Mourning Dove			
Nashville Warbler			
Northern Pygmy-Owl			
Olive-sided Flycatcher	X	X	
Orange-crowned Warbler	X		
Oregon Junco			

Common Name	OR/WA PIF	Continental PIF[2]	ODFW Conservation Strategy[3]
	Conifer[1]	Pacific	Klamath Mts
Pacific-slope Flycatcher	X	X	
Pileated Woodpecker	X		
Purple Finch			
Red-breasted Nuthatch			
Red-breasted Sapsucker		X	
Red-shafted Flicker			
Ruby-crowned Kinglet			
Ruffed Grouse			
Sharp-shinned Hawk			
Song Sparrow			
Spotted Towhee			
Stellers Jay		X	
Swainsons Thrush			
Townsends Solitaire			
Varied Thrush	X	X	
Warbling Vireo			
Western Tanager			
Western Wood-Pewee			
Wilsons Warbler	X		
Winter Wren	X	X	
Yellow Warbler			

[1]Altman, B. 1999. Conservation strategy for landbirds in coniferous forests of western Version 1.0. Oregon and Washington. Oregon-Washington Partners in Flight. Online. (http://www.orwapif.org/pdf/western_forest.pdf). Accessed 8 January 2008.

[2] Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. W. Bradstreet, G. S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Iñigo-Elias, and others. 2004. Partners in Flight North American landbird conservation plan. Cornell Lab of Ornithology, Ithaca, NY.

[3]Oregon Department of Fish and Wildlife (ODFW). 2005. Oregon conservation strategy. Oregon Department of Fish and Wildlife, Salem, OR.

Redwood National and State Parks

Common Name	CalPIF				Continental PIF[5]	CDFG[6]
	Riparian[1]	Oak[2]	Conifer[3]	Coastal Scrub[4]	Pacific	CA wildlife: Cons. strategy
Acorn Woodpecker		X				
American Crow						
American Goldfinch						
American Kestrel						
American Pipit						
American Robin						
Annas Hummingbird						
Audubons Warbler						
Band-tailed Pigeon		X			X	
Barn Swallow						
Bewicks Wren		X		X		
Black Oystercatcher						
Black-capped Chickadee						X
Black-headed Grosbeak	X					
Black-throated Gray Warbler			X		X	
Blue Grouse					X	
Brown Creeper			X			
Brown Pelican						
Bushtit						
California Quail		X		X		
Cassins Vireo						
Cedar Waxwing						
Chestnut-backed Chickadee					X	
Chipping Sparrow			X			X
Cliff Swallow						
Common Raven						
Common Yellowthroat	X			X		
Coopers Hawk						X
Downy Woodpecker						
Fox Sparrow			X		X	
Golden-crowned Kinglet			X			
Golden-crowned Sparrow					X	
Grasshopper Sparrow						
Gray Jay			X			

	CalPIF				Continental PIF[5]	CDFG[6]
Common Name	Riparian[1]	Oak[2]	Conifer[3]	Coastal Scrub[4]	Pacific	CA wildlife: Cons. strategy
Hairy Woodpecker						
Hermit Thrush						
Hermit Warbler					X	X
Huttons Vireo		X				
Killdeer						
Lazuli Bunting						
Lesser Goldfinch						
Lewis Woodpecker		X			X	X
Lincolns Sparrow						
MacGillivrays Warbler			X			
Marbled Murrelet						
Marsh Wren						
Mountain Quail			X	X	X	
Mourning Dove						
Northern Harrier						X
Northern Pygmy-Owl		X				
Orange-crowned Warbler						
Oregon Junco			X			
Osprey						X
Pacific-slope Flycatcher					X	
Pileated Woodpecker			X			
Purple Finch			X			
Purple Martin						X
Red Crossbill						
Red-breasted Nuthatch			X			
Red-breasted Sapsucker					X	X
Red-shafted Flicker						
Red-shouldered Hawk		X				
Red-tailed Hawk						
Ruby-crowned Kinglet						
Savannah Sparrow						
Song Sparrow	X			X		
Spotted Towhee				X		
Stellers Jay			X		X	
Swainsons Thrush	X					
Townsends Solitaire						
Tree Swallow	X					
Turkey Vulture				X		

Common Name	CalPIF				Continental PIF[5]	CDFG[6]
	Riparian[1]	Oak[2]	Conifer[3]	Coastal Scrub[4]	Pacific	CA wildlife: Cons. strategy
Varied Thrush			X		X	
Vauxs Swift						X
Warbling Vireo	X					
Western Gull						
Western Meadowlark						
Western Scrub-Jay		X		X	X	
Western Tanager			X			
Western Wood-Pewee						
White-breasted Nuthatch		X				
White-crowned Sparrow						
Wilsons Warbler	X					
Winter Wren					X	
Wrentit				X	X	
Yellow Warbler	X					X

[1]RHJV (Riparian Habitat Joint Venture). 2004. The riparian bird conservation plan: A strategy for reversing the decline of riparian associated birds in California. Version 2.0. California Partners in Flight. Online. (http://www.prbo.org/calpif/pdfs/riparian .v-2.pdf). Accessed 8 January 2008.

[2]California Partners in Flight (CalPIF). 2002a. The oak woodland bird conservation plan: A strategy for protecting and managing oak woodland habitats and associated birds in California (S. Zack, lead author). Version 2.0. Point Reyes Bird Observatory, Stinson Beach, CA. Online. (http://www.prbo.org/calpif/plans.html). Accessed 8 January 2008.

[3]California Partners in Flight (CalPIF). 2002b. The draft coniferous forest bird conservation plan: A strategy for protecting and managing coniferous forest habitats and associated birds in California (J. Robinson, and J. Alexander, lead authors). Version 1.0. Point Reyes Bird Observatory, Stinson Beach, CA. Online. (http://www.prbo.org/calpif/plans.html). Accessed 8 January 2008.

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[5]Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. W. Bradstreet, G. S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Iñigo-Elias, and others. 2004. Partners in Flight North American landbird conservation plan. Cornell Lab of Ornithology, Ithaca, NY.

[6]California Department of Fish and Game (CDFG). 2005. California wildlife: Conservation challenges. (California's wildlife action plan). Wildlife Health Center, University of California, Davis.

Whiskeytown National Recreation Area

Common Name	CalPIF			Continental PIF[4]	CDFG[5]
	Riparian[1]	Oak[2]	Conifer[3]	Pacific	CA wildlife: Cons. strategy
Acorn Woodpecker		X			
American Crow					
American Dipper					
American Goldfinch					
American Kestrel					
American Robin					
Annas Hummingbird					
Ash-throated Flycatcher		X			
Audubons Warbler					
Band-tailed Pigeon		X		X	
Belted Kingfisher					
Bewicks Wren		X			
Black Phoebe					
Black-headed Grosbeak	X				
Black-throated Gray Warbler			X	X	
Blue-gray Gnatcatcher		X			
Brown Creeper			X		
Brown-headed Cowbird					
Bullocks Oriole					
Bushtit					
California Quail		X			
California Towhee		X		X	
Canada Goose					
Cassins Vireo					
Cedar Waxwing					
Chestnut-backed Chickadee				X	
Chipping Sparrow			X		X
Cliff Swallow					
Common Merganser					
Common Raven					
Downy Woodpecker					
Dusky Flycatcher					
Fox Sparrow			X	X	
Golden-crowned Kinglet			X		
Golden-crowned Sparrow				X	

	CalPIF			Continental PIF[4]	CDFG[5]
Common Name	Riparian[1]	Oak[2]	Conifer[3]	Pacific	CA wildlife: Cons. strategy
Great Blue Heron					
Green Heron					
Hairy Woodpecker					
Hermit Thrush					
House Finch					
House Wren					
Huttons Vireo		X			
Lazuli Bunting					
Lesser Goldfinch					
Lewis Woodpecker		X		X	X
Lincolns Sparrow					
MacGillivrays Warbler			X		
Mountain Quail			X	X	
Mourning Dove					
Nashville Warbler					
Northern Goshawk					X
Northern Pygmy-Owl		X			
Northern Rough-winged Swallow					
Oak Titmouse		X		X	X
Olive-sided Flycatcher			X	X	X
Orange-crowned Warbler					
Oregon Junco			X		
Pacific-slope Flycatcher				X	
Pileated Woodpecker			X		
Pine Siskin					
Purple Finch			X		
Red Crossbill					
Red-breasted Nuthatch			X		
Red-shafted Flicker					
Red-tailed Hawk					
Ruby-crowned Kinglet					
Song Sparrow	X				
Spotted Sandpiper	X				
Spotted Towhee					
Stellers Jay			X	X	
Townsends Solitaire					

	CalPIF			Continental PIF[4]	CDFG[5]
Common Name	Riparian[1]	Oak[2]	Conifer[3]	Pacific	CA wildlife: Cons. strategy
Tree Swallow	X				
Turkey Vulture					
Violet-green Swallow					
Warbling Vireo	X				
Western Scrub-Jay		X		X	
Western Tanager			X		
Western Wood-Pewee					
White-breasted Nuthatch		X			
White-crowned Sparrow					
Wilsons Warbler	X				
Winter Wren				X	
Wrentit				X	
Yellow Warbler	X				X
Yellow-breasted Chat	X				X

[1] RHJV (Riparian Habitat Joint Venture). 2004. The riparian bird conservation plan: A strategy for reversing the decline of riparian associated birds in California. Version 2.0. California Partners in Flight. Online. (http://www.prbo.org/calpif/pdfs/riparian .v-2.pdf). Accessed 8 January 2008.

[2]California Partners in Flight (CalPIF). 2002a. The oak woodland bird conservation plan: A strategy for protecting and managing oak woodland habitats and associated birds in California (S. Zack, lead author). Version 2.0. Point Reyes Bird Observatory, Stinson Beach, CA. Online. (http://www.prbo.org/calpif/plans.html). Accessed 8 January 2008.

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[5]California Department of Fish and Game (CDFG). 2005. California wildlife: Conservation challenges. (California's wildlife action plan). Wildlife Health Center, University of California, Davis.

Appendix D. Avian Species List Developed Using the NPS NPSpecies Database for the Six Parks within the Klamath Network.

Crater Lake National Park

Order	Family	Scientific Name	Common Names	Park-Status	Abundance	Residency
Anseriformes	Anatidae	Aix sponsa	Wood Duck	Probably Present	NA	NA
Anseriformes	Anatidae	Anas acuta	Northern Pintail	Probably Present	NA	NA
Anseriformes	Anatidae	Anas americana	American Wigeon	Probably Present	NA	NA
Anseriformes	Anatidae	Anas clypeata	Northern Shoveler	Probably Present	NA	NA
Anseriformes	Anatidae	Anas cyanoptera	Cinnamon Teal	Probably Present	NA	NA
Anseriformes	Anatidae	Anas discors	Blue-winged Teal	Probably Present	NA	NA
Anseriformes	Anatidae	Anas platyrhynchos	Mallard	Present in Park	Rare	Migratory
Anseriformes	Anatidae	Anas strepera	Gadwall	Probably Present	NA	NA
Anseriformes	Anatidae	Anser albifrons	Greater White-fronted Goose	Present in Park	Rare	Migratory
Anseriformes	Anatidae	Aristonetta valisneria, Aythya valisineria	Canvasback	Probably Present	NA	NA
Anseriformes	Anatidae	Aythya affinis	Lesser Scaup	Probably Present	NA	NA
Anseriformes	Anatidae	Aythya americana	Redhead	Probably Present	NA	NA
Anseriformes	Anatidae	Aythya collaris	Ring-necked Duck	Probably Present	NA	NA
Anseriformes	Anatidae	Branta canadensis	Canada Goose	Present in Park	Occasional	Migratory
Anseriformes	Anatidae	Bucephala albeola	Bufflehead	Probably Present	NA	NA
Anseriformes	Anatidae	Bucephala clangula	Common Goldeneye	Probably Present	NA	NA
Anseriformes	Anatidae	Bucephala islandica, Glaucionetta islandica	Barrow's Goldeneye	Unconfirmed	NA	NA
Anseriformes	Anatidae	Chen caerulescens	Blue Goose, Snow Goose	Unconfirmed	NA	NA
Anseriformes	Anatidae	Histrionicus histrionicus	Harlequin Duck	Unconfirmed	NA	NA
Anseriformes	Anatidae	Lophodytes cucullatus	Hooded Merganser	Present in Park	Unknown	Unknown
Anseriformes	Anatidae	Mergus merganser	Common Merganser	Present in Park	Unknown	Unknown
Anseriformes	Anatidae	Oxyura jamaicensis	Ruddy Duck	Present in Park	Unknown	Unknown
Apodiformes	Apodidae	Aeronautes saxatalis	White-throated Swift	Historic	NA	NA
Apodiformes	Apodidae	Chaetura vauxi	Vaux's Swift	Probably Present	NA	NA
Apodiformes	Trochilidae	Archilochus alexandri	Black-chinned Hummingbird	Unconfirmed	NA	NA
Apodiformes	Trochilidae	Calypte anna	Anna's Hummingbird	Probably Present	NA	NA
Apodiformes	Trochilidae	Selasphorus platycercus	Broad-tailed Hummingbird	Present in Park	Occasional	Vagrant
Apodiformes	Trochilidae	Selasphorus rufus	Rufous Hummingbird	Present in Park	Uncommon	Breeder
Apodiformes	Trochilidae	Selasphorus sasin	Allen's Hummingbird	Present in Park	Rare	Unknown
Apodiformes	Trochilidae	Stellula calliope	Calliope Hummingbird	Present in Park	Rare	Breeder

Order	Family	Scientific Name	Common Names	Park-Status	Abundance	Residency
Charadriiformes	Scolopacidae	Gallinago delicata, Gallinago gallinago	Wilson's snipe	Present in Park	Rare	Resident
Ciconiiformes	Accipitridae	Accipiter cooperii	Cooper's Hawk	Present in Park	Uncommon	Breeder
Ciconiiformes	Accipitridae	Accipiter gentilis	Northern Goshawk	Present in Park	Occasional	Breeder
Ciconiiformes	Accipitridae	Accipiter striatus, Accipiter velox velox	Sharp-shinned Hawk	Present in Park	Uncommon	Breeder
Ciconiiformes	Accipitridae	Aquila chrysaetos	Golden Eagle	Present in Park	Rare	Unknown
Ciconiiformes	Accipitridae	Buteo borealis calurus, Buteo jamaicensis	Red-tailed Hawk	Present in Park	Common	Breeder
Ciconiiformes	Accipitridae	Buteo lagopus	Rough-legged Hawk, Roughleg	Unconfirmed	NA	NA
Ciconiiformes	Accipitridae	Buteo regalis	Ferruginous Hawk	Unconfirmed	NA	NA
Ciconiiformes	Accipitridae	Buteo swainsoni	Swainson's Hawk	Unconfirmed	NA	NA
Ciconiiformes	Accipitridae	Circus cyaneus, Circus hudsonius	Northern Harrier	Probably Present	NA	NA
Ciconiiformes	Accipitridae	Haliaeetus leucocephalus	Bald Eagle	Present in Park	Uncommon	Resident
Ciconiiformes	Accipitridae	Pandion haliaetus	Osprey	Present in Park	Uncommon	Resident
Ciconiiformes	Ardeidae	Ardea alba, Casmerodius albus	Great Egret	Present in Park	Unknown	Resident
Ciconiiformes	Ardeidae	Ardea herodias	Great Blue Heron	Unconfirmed	NA	NA
Ciconiiformes	Ardeidae	Nycticorax nycticorax, Nycticorax nycticorax hoactli	Black-crowned Night Heron, Black-crowned Night-Heron	Present in Park	Unknown	Unknown
Ciconiiformes	Charadriidae	Charadrius montanus	Mountain Plover	Unconfirmed	NA	NA
Ciconiiformes	Charadriidae	Charadrius vociferus, Oxyechus vociferus vociferus	Killdeer	Probably Present	NA	NA
Ciconiiformes	Ciconiidae	Cathartes aura	Turkey Vulture	Present in Park	Uncommon	Unknown
Ciconiiformes	Falconidae	Falco columbarius, Falco columbarius bendirei	Merlin	Present in Park	Rare	Unknown
Ciconiiformes	Falconidae	Falco mexicanus	Prairie Falcon	Present in Park	Common	Unknown
Ciconiiformes	Falconidae	Falco peregrinus	Peregrine Falcon	Historic	NA	NA
Ciconiiformes	Falconidae	Falco peregrinus anatum	American Peregrine Falcon	Unconfirmed	NA	NA
Ciconiiformes	Falconidae	Falco sparverius, Falco sparverius sparverius		Present in Park	Uncommon	Unknown
Ciconiiformes	Gaviidae	Gavia immer	Common Loon, Great Northern Loon	Present in Park	Occasional	Vagrant
Ciconiiformes	Laridae	Larus californicus	California Gull	Present in Park	Common	Resident
Ciconiiformes	Laridae	Larus delawarensis	Ring-billed Gull	Present in Park	Rare	Resident
Ciconiiformes	Laridae	Sterna forsteri	Forster's Tern	Present in Park	Rare	Resident
Ciconiiformes	Pelecanidae	Pelecanus erythrorhynchos	American White Pelican	Present in Park	Uncommon	Resident
Ciconiiformes	Pelecanidae	Pelecanus occidentalis	Brown Pelican	Present in Park	Occasional	Vagrant
Ciconiiformes	Phalacrocoracidae	Phalacrocorax auritus	Double-crested Cormorant	Present in Park	Uncommon	Unknown
Ciconiiformes	Podicipedidae	Aechmophorus occidentalis	Western Grebe	Unconfirmed	NA	NA
Ciconiiformes	Podicipedidae	Podiceps nigricollis	Black-necked Grebe, Eared Grebe	Present in Park	Rare	Unknown
Ciconiiformes	Podicipedidae	Podilymbus podiceps	Pied-billed Grebe	Probably Present	NA	NA

Order	Family	Scientific Name	Common Names	Park-Status	Abundance	Residency
Ciconiiformes	Scolopacidae	Actitis macularia	Spotted Sandpiper	Present in Park	Rare	Resident
Ciconiiformes	Scolopacidae	Heteroscelus incanus	Wandering Tattler	Probably Present	NA	NA
Ciconiiformes	Scolopacidae	Numenius americanus	Long-billed Curlew	Probably Present	NA	NA
Ciconiiformes	Scolopacidae	Phalaropus tricolor	Wilson's Phalarope	Probably Present	NA	NA
Ciconiiformes	Scolopacidae	Tringa melanoleuca	Greater Yellowlegs	Probably Present	NA	NA
Ciconiiformes	Scolopacidae	Tringa solitaria	Solitary Sandpiper	Present in Park	Unknown	Unknown
Ciconiiformes	Scolopacidae	Tringa solitaria cinnamomea		Present in Park	Unknown	Unknown
Columbiformes	Columbidae	Columba fasciata	Band-tailed Pigeon	Probably Present	NA	NA
Columbiformes	Columbidae	Columba livia	Common Pigeon, Rock Dove, Rock Pigeon	Unconfirmed	NA	NA
Columbiformes	Columbidae	Zenaida macroura	Mourning Dove	Present in Park	Uncommon	Breeder
Coraciiformes	Alcedinidae	Ceryle alcyon, Megaceryle alcyon, Megaceryle alcyon caurina	Belted Kingfisher	Present in Park	Occasional	Unknown
Galliformes	Odontophoridae	Callipepla californica	California Quail, Californian Quail	Probably Present	NA	NA
Galliformes	Odontophoridae	Oreortyx pictus	Mountain Quail	Unconfirmed	NA	NA
Galliformes	Phasianidae	Bonasa umbellus	Ruffed Grouse	Present in Park	Uncommon	Breeder
Galliformes	Phasianidae	Bonasa umbellus sabini		Unconfirmed	NA	NA
Galliformes	Phasianidae	Dendragapus fuliginosus sierrae, Dendragapus obscurus	Blue Grouse	Present in Park	Uncommon	Breeder
Galliformes	Phasianidae	Dendragapus obscurus fuliginosus		Probably Present	NA	NA
Galliformes	Phasianidae	Phasianus colchicus	Common Pheasant, Ring-necked Pheasant	Probably Present	NA	NA
Gruiformes	Gruidae	Grus canadensis	Sandhill Crane	Probably Present	NA	NA
Gruiformes	Rallidae	Fulica americana	American Coot	Probably Present	NA	NA
Gruiformes	Rallidae	Fulica americana americana		Probably Present	NA	NA
Gruiformes	Rallidae	Porzana carolina	Sora	Unconfirmed	NA	NA
Passeriformes	Aegithalidae	Psaltriparus minimus	American Bushtit, Bushtit	Present in Park	Rare	Breeder
Passeriformes	Alaudidae	Eremophila alpestris, Eremophila alpestris merrilli		Present in Park	Uncommon	Breeder
Passeriformes	Bombycillidae	Bombycilla cedrorum	Cedar Waxwing	Unconfirmed	NA	NA
Passeriformes	Cardinalidae	Hedymeles melanocephalus melanocephalus, Pheucticus melanocephalus	Black-headed Grosbeak	Present in Park	Uncommon	Breeder
Passeriformes	Cardinalidae	Passerina amoena	Lazuli Bunting	Present in Park	Uncommon	Breeder
Passeriformes	Certhiidae	Certhia americana, Certhia familiaris, Certhia familiaris zelotes	Brown Creeper	Present in Park	Common	Breeder
Passeriformes	Certhiidae	Polioptila caerulea	Blue-gray Gnatcatcher, Blue-grey Gnatcatcher	Probably Present	NA	NA
Passeriformes	Cinclidae	Cinclus mexicanus	American Dipper	Present in Park	Uncommon	Breeder

Order	Family	Scientific Name	Common Names	Park-Status	Abundance	Residency
Passeriformes	Cinclidae	Cinclus mexicanus unicolor		Present in Park	Uncommon	Breeder
Passeriformes	Corvidae	Aphelocoma californica, Aphelocoma coerulescens	Western Scrub Jay, Western Scrub-Jay	Unconfirmed	NA	NA
Passeriformes	Corvidae	Corvus brachyrhynchos	American Crow	Unconfirmed	NA	NA
Passeriformes	Corvidae	Corvus corax	Common Raven, Northern Raven	Present in Park	Common	Breeder
Passeriformes	Corvidae	Corvus corax sinuatus		Probably Present	NA	NA
Passeriformes	Corvidae	Cyanocitta stelleri	Steller's Jay	Present in Park	Common	Breeder
Passeriformes	Corvidae	Cyanocitta stelleri frontalis		Probably Present	NA	NA
Passeriformes	Corvidae	Nucifraga columbiana	Clark's Nutcracker	Present in Park	Common	Breeder
Passeriformes	Corvidae	Perisoreus canadensis, Perisoreus canadensis griseus, Perisoreus obscurus obscurus	Gray Jay, Grey Jay	Present in Park	Common	Breeder
Passeriformes	Corvidae	Pica pica	Black-billed Magpie, Eurasian Magpie	Present in Park	Rare	Resident
Passeriformes	Emberizidae	Chlorura chlorura, Chlorura chlorura, Oberholseria chlorura, Pipilo chlorurus	Green-tailed Towhee	Present in Park	Uncommon	Breeder
Passeriformes	Emberizidae	Chondestes grammacus	Lark Sparrow	Unconfirmed	NA	NA
Passeriformes	Emberizidae	Junco hyemalis	Dark-eyed Junco	Present in Park	Abundant	Breeder
Passeriformes	Emberizidae	Junco hyemalis oreganus, Junco oreganus		Present in Park	Abundant	Breeder
Passeriformes	Emberizidae	Melospiza lincolnii	Lincoln's Sparrow	Present in Park	Uncommon	Breeder
Passeriformes	Emberizidae	Melospiza lincolnii alticola		Present in Park	Uncommon	Breeder
Passeriformes	Emberizidae	Melospiza lincolnii lincolnii		Present in Park	Uncommon	Resident
Passeriformes	Emberizidae	Melospiza melodia morphna		Present in Park	Common	Breeder
Passeriformes	Emberizidae	Melospiza melodia, Melospiza melodia fisherella	Song Sparrow	Present in Park	Common	Breeder
Passeriformes	Emberizidae	Passerculus sandwichensis	Savannah Sparrow	Present in Park	Rare	Breeder
Passeriformes	Emberizidae	Passerella iliaca sinuosa		Present in Park	Uncommon	Resident
Passeriformes	Emberizidae	Passerella iliaca, Passerella iliaca fulva	Fox Sparrow	Present in Park	Uncommon	Breeder
Passeriformes	Emberizidae	Pipilo erythrophthalmus, Pipilo maculatus	Spotted Towhee	Present in Park	Uncommon	Breeder
Passeriformes	Emberizidae	Pooecetes gramineus	Vesper Sparrow	Probably Present	NA	NA
Passeriformes	Emberizidae	Spizella breweri	Brewer's Sparrow	Present in Park	Rare	Migratory
Passeriformes	Emberizidae	Spizella passerina, Spizella passerina arizonae	Chipping Sparrow	Present in Park	Uncommon	Breeder
Passeriformes	Emberizidae	Zonotrichia atricapilla	Golden-crowned Sparrow	Present in Park	Uncommon	Migratory
Passeriformes	Emberizidae	Zonotrichia leucophrys gambelii		Present in Park	Uncommon	Migratory
Passeriformes	Emberizidae	Zonotrichia leucophrys oriantha		Probably Present	NA	NA
Passeriformes	Emberizidae	Zonotrichia leucophrys pugetensis		Present in Park	Uncommon	Migratory

Order	Family	Scientific Name	Common Names	Park-Status	Abundance	Residency
Passeriformes	Emberizidae	Zonotrichia leucophrys, Zonotrichia leucophrys leucophrys	White-crowned Sparrow	Present in Park	Uncommon	Migratory
Passeriformes	Fringillidae	Acanthis flammea, Carduelis flammea	Common Redpoll	Unconfirmed	NA	NA
Passeriformes	Fringillidae	Carduelis pinus, Carduelis pinus pinus, Spinus pinus, Spinus pinus pinus	Pine Siskin	Present in Park	Common	Breeder
Passeriformes	Fringillidae	Carduelis psaltria	Lesser Goldfinch	Present in Park	Uncommon	Breeder
Passeriformes	Fringillidae	Carduelis tristis	American Goldfinch	Present in Park	Common	Breeder
Passeriformes	Fringillidae	Carpodacus cassinii	Cassin's Finch	Present in Park	Common	Breeder
Passeriformes	Fringillidae	Carpodacus mexicanus	House Finch	Unconfirmed	NA	NA
Passeriformes	Fringillidae	Carpodacus purpureus	Purple Finch	Present in Park	Uncommon	Breeder
Passeriformes	Fringillidae	Coccothraustes vespertinus brooksi, Hesperiphona vespertina brooksi	evening grosbeak	Unconfirmed	NA	NA
Passeriformes	Fringillidae	Coccothraustes vespertinus, Hesperiphona vespertina	Evening Grosbeak	Present in Park	Uncommon	Breeder
Passeriformes	Fringillidae	Junco oreganus thurberi	Sierra junco	Present in Park	Common	Breeder
Passeriformes	Fringillidae	Leucosticte arctoa, Leucosticte tephrocotis	Gray-crowned Rosy-Finch, Grey-crowned Rosy Finch	Probably Present	NA	NA
Passeriformes	Fringillidae	Leucosticte tephrocotis littoralis		Probably Present	NA	NA
Passeriformes	Fringillidae	Loxia curvirostra	Red Crossbill	Present in Park	Common	Breeder
Passeriformes	Fringillidae	Loxia curvirostra bendirei		Present in Park	Common	Breeder
Passeriformes	Fringillidae	Loxia curvirostra minor		Probably Present	NA	NA
Passeriformes	Fringillidae	Loxia leucoptera	Two-barred Crossbill, White-winged Crossbill	Probably Present	NA	NA
Passeriformes	Fringillidae	Pinicola enucleator	Pine Grosbeak	Unconfirmed	NA	NA
Passeriformes	Hirundinidae	Hirundo pyrrhonota, Petrochelidon pyrrhonota	American Cliff Swallow, Cliff Swallow	Present in Park	Uncommon	Unknown
Passeriformes	Hirundinidae	Hirundo rustica	Barn Swallow	Present in Park	Rare	Breeder
Passeriformes	Hirundinidae	Iridoprocne bicolor, Tachycineta bicolor	Tree Swallow	Present in Park	Uncommon	Breeder
Passeriformes	Hirundinidae	Stelgidopteryx ruficollis, Stelgidopteryx serripennis	Northern Rough-winged Swallow	Probably Present	NA	NA
Passeriformes	Hirundinidae	Tachycineta thalassina, Tachycineta thalassina lepida	Violet-green Swallow	Probably Present	NA	NA
Passeriformes	Icteridae	Agelaius phoeniceus	Red-winged Blackbird	Probably Present	NA	NA
Passeriformes	Icteridae	Agelaius phoeniceus caurinus		Probably Present	NA	NA
Passeriformes	Icteridae	Euphagus cyanocephalus	Brewer's Blackbird	Unconfirmed	NA	NA
Passeriformes	Icteridae	Icterus bullockii	Bullock's Oriole	Unconfirmed	NA	NA
Passeriformes	Icteridae	Molothrus ater	Brown-headed Cowbird	Present in Park	Unknown	Breeder
Passeriformes	Icteridae	Sturnella neglecta	Western Meadowlark	Probably Present	NA	NA
Passeriformes	Motacillidae	Anthus rubescens, Anthus spinoletta	American Pipit, Buff-bellied Pipit	Probably Present	NA	NA

Order	Family	Scientific Name	Common Names	Park-Status	Abundance	Residency
Passeriformes	Paridae	Baeolophus inornatus, Parus inornatus	Oak Titmouse	Unconfirmed	NA	NA
Passeriformes	Paridae	Parus atricapillus, Poecile atricapillus	Black-capped Chickadee	Present in Park	Uncommon	Breeder
Passeriformes	Paridae	Parus gambeli, Parus gambeli abbreviatus, Penthestes gambeli baileyi, Poecile gambeli	Mountain Chickadee	Present in Park	Common	Breeder
Passeriformes	Paridae	Parus rufescens, Parus rufescens rufescens, Poecile rufescens	Chestnut-backed Chickadee	Present in Park	Uncommon	Unknown
Passeriformes	Parulidae	Dendroica auduboni, Dendroica auduboni auduboni, Dendroica coronata auduboni		Present in Park	Common	Breeder
Passeriformes	Parulidae	Dendroica coronata	Yellow-rumped Warbler	Present in Park	Common	Breeder
Passeriformes	Parulidae	Dendroica nigrescens	Black-throated Gray Warbler, Black-throated Grey Warbler	Present in Park	Uncommon	Breeder
Passeriformes	Parulidae	Dendroica occidentalis	Hermit Warbler	Present in Park	Common	Breeder
Passeriformes	Parulidae	Dendroica petechia	American Yellow Warbler, Yellow Warbler	Probably Present	NA	NA
Passeriformes	Parulidae	Dendroica townsendi	Townsend's Warbler	Present in Park	Uncommon	Breeder
Passeriformes	Parulidae	Geothlypis trichas	Common Yellowthroat	Probably Present	NA	NA
Passeriformes	Parulidae	Icteria virens	Yellow-breasted Chat	Unconfirmed	NA	NA
Passeriformes	Parulidae	Oporornis tolmiei	MacGillivray's Warbler	Present in Park	Uncommon	Breeder
Passeriformes	Parulidae	Vermivora celata	Orange-crowned Warbler	Present in Park	Rare	Breeder
Passeriformes	Parulidae	Vermivora celata lutescens		Present in Park	Rare	Breeder
Passeriformes	Parulidae	Vermivora ruficapilla	Nashville Warbler	Present in Park	Rare	Breeder
Passeriformes	Parulidae	Vermivora ruficapilla ridgwayi		Present in Park	Rare	Breeder
Passeriformes	Parulidae	Wilsonia pusilla chryseola		Probably Present	NA	NA
Passeriformes	Parulidae	Wilsonia pusilla, Wilsonia pusilla pileolata	Wilson's Warbler	Present in Park	Uncommon	Breeder
Passeriformes	Passeridae	Passer domesticus	House Sparrow	Probably Present	NA	NA
Passeriformes	Regulidae	Corthylio calendula cineraceus, Regulus calendula, Regulus calendula cineraceus	Ruby-crowned Kinglet	Present in Park	Uncommon	Resident
Passeriformes	Regulidae	Regulus satrapa, Regulus satrapa olivaceus	Golden-crowned Kinglet	Present in Park	Uncommon	Breeder
Passeriformes	Sittidae	Sitta canadensis	Red-breasted Nuthatch	Present in Park	Abundant	Breeder
Passeriformes	Sittidae	Sitta carolinensis, Sitta carolinensis aculeata	White-breasted Nuthatch	Present in Park	Uncommon	Resident
Passeriformes	Sittidae	Sitta pygmaea	Pygmy Nuthatch	Present in Park	Rare	Unknown
Passeriformes	Sittidae	Sitta pygmaea melanotis		Present in Park	Unknown	Unknown
Passeriformes	Sturnidae	Sturnus vulgaris	Common Starling, European Starling	Probably Present	NA	NA
Passeriformes	Thraupidae	Piranga ludoviciana	Western Tanager	Present in Park	Uncommon	Breeder
Passeriformes	Troglodytidae	Catherpes mexicanus	Canyon Wren	Unconfirmed	NA	NA

Order	Family	Scientific Name	Common Names	Park-Status	Abundance	Residency
Passeriformes	Troglodytidae	Cistothorus palustris	Marsh Wren	Probably Present	NA	NA
Passeriformes	Troglodytidae	Nannus hiemalis pacificus, Troglodytes troglodytes	Winter Wren	Present in Park	Uncommon	Breeder
Passeriformes	Troglodytidae	Salpinctes obsoletus	Rock Wren	Probably Present	NA	NA
Passeriformes	Troglodytidae	Salpinctes obsoletus obsoletus		Probably Present	NA	NA
Passeriformes	Troglodytidae	Thryomanes bewickii, Thryomanes bewickii calophonus	Bewick's Wren	Probably Present	NA	NA
Passeriformes	Troglodytidae	Troglodytes aedon	House Wren	Present in Park	Rare	Breeder
Passeriformes	Troglodytidae	Troglodytes aedon parkmanii		Present in Park	Rare	Breeder
Passeriformes	Troglodytidae	Troglodytes troglodytes pacificus		Present in Park	Uncommon	Breeder
Passeriformes	Turdidae	Catharus guttatus, Hylocichla guttata, Hylocichla guttata guttata, Hylocichla guttata sequoiensis, Hylocichla guttata slevini	Hermit Thrush	Present in Park	Common	Breeder
Passeriformes	Turdidae	Catharus ustulatus, Hylocichla guttata slevini, Hylocichla ustulata, Hylocichla ustulata ustulata	Swainson's Thrush	Present in Park	Uncommon	Breeder
Passeriformes	Turdidae	Ixoreus naevius	Varied Thrush	Present in Park	Common	Breeder
Passeriformes	Turdidae	Myadestes townsendi	Townsend's Solitaire	Present in Park	Uncommon	Breeder
Passeriformes	Turdidae	Myadestes townsendi townsendi		Present in Park	Uncommon	Breeder
Passeriformes	Turdidae	Sialia currucoides	Mountain Bluebird	Present in Park	Common	Breeder
Passeriformes	Turdidae	Sialia mexicana	Western Bluebird	Present in Park	Rare	Breeder
Passeriformes	Turdidae	Turdus migratorius, Turdus migratorius propinquus	American Robin	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Contopus borealis, Contopus cooperi, Nuttallornis borealis	Olive-sided Flycatcher	Present in Park	Uncommon	Breeder
Passeriformes	Tyrannidae	Contopus richardsonii richardsonii, Contopus sordidulus, Contopus sordidulus veliei, Myiochanes richardsoni richardsoni	Western Wood Pewee, Western Wood-Pewee	Present in Park	Uncommon	Breeder
Passeriformes	Tyrannidae	Empidonax difficilis, Empidonax difficilis difficilis, Empidonax occidentalis	Pacific-slope Flycatcher, Western Flycatcher	Present in Park	Uncommon	Breeder
Passeriformes	Tyrannidae	Empidonax hammondii	Hammond's Flycatcher	Present in Park	Uncommon	Breeder
Passeriformes	Tyrannidae	Empidonax oberholseri	Dusky Flycatcher	Present in Park	Uncommon	Breeder
Passeriformes	Tyrannidae	Empidonax traillii	Willow Flycatcher	Probably Present	NA	NA
Passeriformes	Tyrannidae	Empidonax wrightii	Gray Flycatcher, Grey Flycatcher	Present in Park	Rare	Migratory
Passeriformes	Tyrannidae	Sayornis nigricans	Black Phoebe	Unconfirmed	NA	NA
Passeriformes	Tyrannidae	Sayornis saya	Say's Phoebe	Probably Present	NA	NA

Order	Family	Scientific Name	Common Names	Park-Status	Abundance	Residency
Passeriformes	Vireonidae	Vireo cassinii, Vireo cassinii cassinii, Vireo solitarius, Vireo solitarius cassinii	Cassin's Vireo	Present in Park	Rare	Breeder
Passeriformes	Vireonidae	Vireo gilvus swainsoni		Present in Park	Rare	Breeder
Passeriformes	Vireonidae	Vireo gilvus, Vireo gilvus leucopolius	Warbling Vireo	Present in Park	Rare	Breeder
Passeriformes	Vireonidae	Vireo huttoni	Hutton's Vireo	Probably Present	NA	NA
Passeriformes	Vireonidae	Vireo olivaceus	Red-eyed Vireo	Unconfirmed	NA	NA
Piciformes	Picidae	Asyndesmus lewis, Melanerpes lewis	Lewis' Woodpecker, Lewis's Woodpecker	Probably Present	NA	NA
Piciformes	Picidae	Ceophloeus pileatus picinus, Dryocopus pileatus, Dryocopus pileatus picinus	Pileated Woodpecker	Present in Park	Uncommon	Breeder
Piciformes	Picidae	Colaptes auratus	Northern Flicker	Present in Park	Common	Breeder
Piciformes	Picidae	Colaptes auratus collaris, Colaptes cafer, Colaptes cafer collaris		Present in Park	Common	Breeder
Piciformes	Picidae	Dendrocopos albolarvatus, Dryobates albolarvatus albolarvatus, Picoides albolarvatus	White-headed Woodpecker	Present in Park	Uncommon	Breeder
Piciformes	Picidae	Dendrocopos villosus, Dendrocopos villosus orius, Dryobates villosus orius, Picoides villosus	Hairy Woodpecker	Present in Park	Common	Breeder
Piciformes	Picidae	Melanerpes erythrocephalus, Melanerpes formicivorus	Acorn Woodpecker	Unconfirmed	NA	NA
Piciformes	Picidae	Picoides arcticus	Black-backed Woodpecker	Present in Park	Uncommon	Breeder
Piciformes	Picidae	Picoides pubescens	Downy Woodpecker	Present in Park	Common	Breeder
Piciformes	Picidae	Picoides tridactylus	Eurasian Three-toed Woodpecker, Three-toed Woodpecker	Present in Park	Uncommon	Breeder
Piciformes	Picidae	Picoides tridactylus fasciatus		Present in Park	Uncommon	Breeder
Piciformes	Picidae	Sphyrapicus ruber	Red-breasted Sapsucker	Present in Park	Rare	Breeder
Piciformes	Picidae	Sphyrapicus thyroideus, Sphyrapicus thyroideus thyroideus	Williamson's Sapsucker	Present in Park	Uncommon	Breeder
Piciformes	Picidae	Sphyrapicus varius daggetti		Probably Present	NA	NA
Piciformes	Picidae	Sphyrapicus varius, Sphyrapicus varius nuchalis, Sphyrapicus varius ruber	Yellow-bellied Sapsucker	Probably Present	NA	NA
Strigiformes	Caprimulgidae	Chordeiles minor	Common Nighthawk	Present in Park	Uncommon	Breeder
Strigiformes	Caprimulgidae	Chordeiles minor hesperis, Chordeiles virginianus hesperis		Present in Park	Uncommon	Breeder
Strigiformes	Caprimulgidae	Phalaenoptilus nuttallii	Common Poorwill	Probably Present	NA	NA
Strigiformes	Caprimulgidae	Phalaenoptilus nuttallii californicus		Unconfirmed	NA	NA
Strigiformes	Caprimulgidae	Phalaenoptilus nuttallii nuttallii		Unconfirmed	NA	NA

Order	Family	Scientific Name	Common Names	Park-Status	Abundance	Residency
Strigiformes	Strigidae	Aegolius acadicus	Northern Saw-whet Owl	Present in Park	Uncommon	Resident
Strigiformes	Strigidae	Asio otus	Long-eared Owl	Unconfirmed	NA	NA
Strigiformes	Strigidae	Athene cunicularia	Burrowing Owl	Present in Park	Occasional	Vagrant
Strigiformes	Strigidae	Bubo scandiacus, Nyctea scandiaca	Snowy Owl	Unconfirmed	NA	NA
Strigiformes	Strigidae	Bubo virginianus	Great Horned Owl	Present in Park	Common	Breeder
Strigiformes	Strigidae	Glaucidium gnoma	Mountain Pygmy Owl, Northern Pygmy-Owl	Present in Park	Uncommon	Breeder
Strigiformes	Strigidae	Megascops kennicottii, Otus asio, Otus kennicottii	Tecolote occidental, Western Screech Owl, Western Screech-Owl	Present in Park	Uncommon	Breeder
Strigiformes	Strigidae	Otus flammeolus	Flammulated Owl	Probably Present	NA	NA
Strigiformes	Strigidae	Strix nebulosa	Great Gray Owl, Great Grey Owl	Present in Park	Rare	Unknown
Strigiformes	Strigidae	Strix nebulosa nebulosa		Present in Park	Rare	Unknown
Strigiformes	Strigidae	Strix occidentalis caurina	Northern Spotted Owl	Present in Park	Common	Breeder
Strigiformes	Strigidae	Strix occidentalis, Strix occidentalis occidentalis	Spotted Owl	Present in Park	Common	Breeder
Strigiformes	Strigidae	Strix varia	Barred Owl	Present in Park	Common	Breeder
Strigiformes	Tytonidae	Tyto alba	Barn Owl, Common Barn-Owl	Unconfirmed	NA	NA

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Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Anseriformes	Anatidae	Aix sponsa	Wood Duck	Present in Park	Occasional	Migratory
Anseriformes	Anatidae	Anas acuta	Northern Pintail	Present in Park	Common	Resident
Anseriformes	Anatidae	Anas americana	American Wigeon	Present in Park	Common	Resident
Anseriformes	Anatidae	Anas clypeata	Northern Shoveler	Present in Park	Common	Breeder
Anseriformes	Anatidae	Anas crecca	Eurasian Teal, Green-winged Teal	Present in Park	Common	Migratory
Anseriformes	Anatidae	Anas cyanoptera	Cinnamon Teal	Present in Park	Common	Breeder
Anseriformes	Anatidae	Anas discors	Blue-winged Teal	Present in Park	Uncommon	Breeder
Anseriformes	Anatidae	Anas penelope	Eurasian Wigeon	Present in Park	Occasional	Migratory
Anseriformes	Anatidae	Anas platyrhynchos	Mallard	Present in Park	Common	Breeder
Anseriformes	Anatidae	Anas strepera	Gadwall	Present in Park	Common	Breeder
Anseriformes	Anatidae	Anser albifrons	Greater White-fronted Goose	Present in Park	Abundant	Resident
Anseriformes	Anatidae	Aythya affinis	Lesser Scaup	Present in Park	Common	Resident
Anseriformes	Anatidae	Aythya americana	Redhead	Present in Park	Uncommon	Resident
Anseriformes	Anatidae	Aythya collaris	Ring-necked Duck	Present in Park	Uncommon	Resident
Anseriformes	Anatidae	Aythya marila	Greater Scaup	Present in Park	Occasional	Vagrant
Anseriformes	Anatidae	Aythya valisineria	Canvasback	Present in Park	Common	Resident
Anseriformes	Anatidae	Branta canadensis	Canada Goose	Present in Park	Common	Breeder
Anseriformes	Anatidae	Bucephala albeola	Bufflehead	Present in Park	Common	Resident
Anseriformes	Anatidae	Bucephala clangula	Common Goldeneye	Present in Park	Common	Resident
Anseriformes	Anatidae	Bucephala islandica	Barrow's Goldeneye	Present in Park	Rare	Migratory
Anseriformes	Anatidae	Chen caerulescens	Blue Goose, Snow Goose	Present in Park	Common	Resident
Anseriformes	Anatidae	Chen canagica	Emperor Goose	Present in Park	Occasional	Vagrant
Anseriformes	Anatidae	Chen rossii	Ross' Goose, Ross's Goose	Present in Park	Common	Resident
Anseriformes	Anatidae	Cygnus columbianus	Tundra Swan	Present in Park	Common	Resident
Anseriformes	Anatidae	Lophodytes cucullatus	Hooded Merganser	Present in Park	Uncommon	Resident
Anseriformes	Anatidae	Melanitta fusca	Velvet Scoter, White-winged Scoter	Present in Park	Occasional	Vagrant
Anseriformes	Anatidae	Mergus merganser	Common Merganser	Present in Park	Uncommon	Resident
Anseriformes	Anatidae	Mergus serrator	Red-breasted Merganser	Present in Park	Uncommon	Migratory
Anseriformes	Anatidae	Oxyura jamaicensis	Ruddy Duck	Present in Park	Common	Resident
Apodiformes	Apodidae	Aeronautes saxatalis	White-throated Swift	Present in Park	Rare	Resident
Apodiformes	Apodidae	Chaetura vauxi	Vaux's Swift	Present in Park	Uncommon	Migratory

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Apodiformes	Trochilidae	Archilochus alexandri	Black-chinned Hummingbird	Present in Park	Uncommon	Migratory
Apodiformes	Trochilidae	Calypte anna	Anna's Hummingbird	Present in Park	Common	Breeder
Apodiformes	Trochilidae	Selasphorus platycercus	Broad-tailed Hummingbird	Present in Park	Rare	Migratory
Apodiformes	Trochilidae	Selasphorus rufus	Rufous Hummingbird	Present in Park	Abundant	Migratory
Apodiformes	Trochilidae	Stellula calliope	Calliope Hummingbird	Present in Park	Uncommon	Resident
Ciconiiformes	Accipitridae	Accipiter cooperii	Cooper's Hawk	Present in Park	Uncommon	Resident
Ciconiiformes	Accipitridae	Accipiter gentilis	Northern Goshawk	Present in Park	Rare	Resident
Ciconiiformes	Accipitridae	Accipiter striatus	Sharp-shinned Hawk	Present in Park	Uncommon	Migratory
Ciconiiformes	Accipitridae	Aquila chrysaetos	Golden Eagle	Present in Park	Uncommon	Resident
Ciconiiformes	Accipitridae	Buteo jamaicensis	Red-tailed Hawk	Present in Park	Common	Breeder
Ciconiiformes	Accipitridae	Buteo lagopus	Rough-legged Hawk, Roughleg	Present in Park	Common	Resident
Ciconiiformes	Accipitridae	Buteo regalis	Ferruginous Hawk	Present in Park	Uncommon	Resident
Ciconiiformes	Accipitridae	Buteo swainsoni	Swainson's Hawk	Present in Park	Uncommon	Migratory
Ciconiiformes	Accipitridae	Circus cyaneus	Northern Harrier	Present in Park	Common	Breeder
Ciconiiformes	Accipitridae	Haliaeetus leucocephalus	Bald Eagle	Present in Park	Common	Resident
Ciconiiformes	Accipitridae	Pandion haliaetus	Osprey	Present in Park	Uncommon	Migratory
Ciconiiformes	Ardeidae	Ardea herodias	Great Blue Heron	Present in Park	Common	Resident
Ciconiiformes	Ardeidae	Botaurus lentiginosus	American Bittern	Present in Park	Occasional	Resident
Ciconiiformes	Ardeidae	Butorides virescens	Green Heron	Present in Park	Uncommon	Resident
Ciconiiformes	Ardeidae	Casmerodius albus	Great Egret	Present in Park	Common	Resident
Ciconiiformes	Ardeidae	Egretta thula	Snowy Egret	Present in Park	Uncommon	Resident
Ciconiiformes	Ardeidae	Ixobrychus exilis	Least Bittern	Unconfirmed	NA	NA
Ciconiiformes	Ardeidae	Nycticorax nycticorax	Black-crowned Night Heron, Black-crowned Night-Heron	Present in Park	Uncommon	Resident
Ciconiiformes	Charadriidae	Charadrius alexandrinus	Kentish Plover, Snowy Plover	Present in Park	Occasional	Migratory
Ciconiiformes	Charadriidae	Charadrius vociferus	Killdeer	Present in Park	Common	Resident
Ciconiiformes	Charadriidae	Himantopus mexicanus	Ae'o, Black-necked Stilt, Hawaiian Stilt	Present in Park	Uncommon	Resident
Ciconiiformes	Charadriidae	Pluvialis squatarola	Black-bellied Plover, Grey Plover	Present in Park	Rare	Migratory
Ciconiiformes	Charadriidae	Recurvirostra americana	American Avocet	Present in Park	Common	Resident
Ciconiiformes	Ciconiidae	Cathartes aura	Turkey Vulture	Present in Park	Common	Resident
Ciconiiformes	Falconidae	Falco columbarius	Merlin	Present in Park	Uncommon	Migratory
Ciconiiformes	Falconidae	Falco mexicanus	Prairie Falcon	Present in Park	Common	Breeder
Ciconiiformes	Falconidae	Falco peregrinus	Peregrine Falcon	Present in Park	Rare	Migratory
Ciconiiformes	Falconidae	Falco sparverius	American Kestrel	Present in Park	Common	Breeder

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Ciconiiformes	Gaviidae	Gavia immer	Common Loon, Great Northern Loon	Present in Park	Rare	Migratory
Ciconiiformes	Laridae	Chlidonias niger	Black Tern	Present in Park	Common	Migratory
Ciconiiformes	Laridae	Larus argentatus	Herring Gull	Present in Park	Uncommon	Resident
Ciconiiformes	Laridae	Larus californicus	California Gull	Present in Park	Uncommon	Resident
Ciconiiformes	Laridae	Larus delawarensis	Ring-billed Gull	Present in Park	Common	Resident
Ciconiiformes	Laridae	Larus philadelphia	Bonaparte's Gull	Present in Park	Uncommon	Migratory
Ciconiiformes	Laridae	Sterna caspia	Caspian Tern	Present in Park	Uncommon	Resident
Ciconiiformes	Laridae	Sterna forsteri	Forster's Tern	Present in Park	Common	Resident
Ciconiiformes	Pelecanidae	Pelecanus erythrorhynchos	American White Pelican	Present in Park	Common	Resident
Ciconiiformes	Phalacrocoracidae	Phalacrocorax auritus	Double-crested Cormorant	Present in Park	Common	Resident
Ciconiiformes	Podicipedidae	Aechmophorus occidentalis	Western Grebe	Present in Park	Common	Resident
Ciconiiformes	Podicipedidae	Podiceps auritus	Horned Grebe	Present in Park	Rare	Migratory
Ciconiiformes	Podicipedidae	Podiceps grisegena	Red-necked Grebe	Unconfirmed	NA	NA
Ciconiiformes	Podicipedidae	Podiceps nigricollis	Black-necked Grebe, Eared Grebe	Present in Park	Uncommon	Resident
Ciconiiformes	Podicipedidae	Podilymbus podiceps	Pied-billed Grebe	Present in Park	Uncommon	Resident
Ciconiiformes	Scolopacidae	Actitis macularia	Spotted Sandpiper	Present in Park	Occasional	Migratory
Ciconiiformes	Scolopacidae	Calidris alpina	Dunlin	Present in Park	Uncommon	Migratory
Ciconiiformes	Scolopacidae	Calidris bairdii	Baird's Sandpiper	Present in Park	Occasional	Migratory
Ciconiiformes	Scolopacidae	Calidris mauri	Western Sandpiper	Present in Park	Uncommon	Migratory
Ciconiiformes	Scolopacidae	Calidris minutilla	Least Sandpiper	Present in Park	Uncommon	Migratory
Ciconiiformes	Scolopacidae	Catoptrophorus semipalmatus	Willet	Present in Park	Rare	Migratory
Ciconiiformes	Scolopacidae	Gallinago gallinago	Common Snipe	Present in Park	Uncommon	Resident
Ciconiiformes	Scolopacidae	Limnodromus scolopaceus	Long-billed Dowitcher	Present in Park	Uncommon	Migratory
Ciconiiformes	Scolopacidae	Limosa fedoa	Marbled Godwit	Present in Park	Uncommon	Migratory
Ciconiiformes	Scolopacidae	Numenius americanus	Long-billed Curlew	Present in Park	Rare	Migratory
Ciconiiformes	Scolopacidae	Phalaropus lobatus	Red-necked Phalarope	Present in Park	Occasional	Migratory
Ciconiiformes	Scolopacidae	Phalaropus tricolor	Wilson's Phalarope	Present in Park	Uncommon	Migratory
Ciconiiformes	Scolopacidae	Tringa flavipes	Lesser Yellowlegs	Present in Park	Uncommon	Migratory
Ciconiiformes	Scolopacidae	Tringa melanoleuca	Greater Yellowlegs	Present in Park	Uncommon	Migratory
Ciconiiformes	Scolopacidae	Tringa solitaria	Solitary Sandpiper	Unconfirmed	NA	NA
Ciconiiformes	Threskiornithidae	Plegadis chihi	White-faced Ibis	Present in Park	Common	Resident
Columbiformes	Columbidae	Columba fasciata	Band-tailed Pigeon	Present in Park	Rare	Resident
Columbiformes	Columbidae	Columba livia	Common Pigeon, Rock Dove, Rock Pigeon	Present in Park	Rare	Resident

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Columbiformes	Columbidae	Zenaida macroura	Mourning Dove	Present in Park	Common	Breeder
Coraciiformes	Alcedinidae	Ceryle alcyon	Belted Kingfisher	Present in Park	Uncommon	Resident
Galliformes	Odontophoridae	Callipepla californica	California Quail, Californian Quail	Present in Park	Abundant	Breeder
Galliformes	Odontophoridae	Oreortyx pictus	Mountain Quail	Present in Park	Uncommon	Breeder
Galliformes	Phasianidae	Alectoris chukar	Chukar, Chukar Partridge	Present in Park	Rare	Resident
Galliformes	Phasianidae	Bonasa umbellus	Ruffed Grouse	Present in Park	Unknown	Resident
Galliformes	Phasianidae	Centrocercus urophasianus	Greater Sage Grouse, Greater Sage-Grouse, Sage Grouse	Present in Park	Unknown	Breeder
Galliformes	Phasianidae	Dendragapus obscurus	Blue Grouse	Present in Park	Uncommon	Resident
Galliformes	Phasianidae	Phasianus colchicus	Common Pheasant, Ring-necked Pheasant	Present in Park	Common	Breeder
Gruiformes	Gruidae	Grus canadensis	Sandhill Crane	Present in Park	Uncommon	Migratory
Gruiformes	Rallidae	Fulica americana	American Coot	Present in Park	Common	Resident
Gruiformes	Rallidae	Porzana carolina	Sora	Present in Park	Rare	Resident
Gruiformes	Rallidae	Rallus limicola	Virginia Rail	Present in Park	Uncommon	Resident
Passeriformes	Aegithalidae	Psaltriparus minimus	American Bushtit, Bushtit	Present in Park	Common	Breeder
Passeriformes	Alaudidae	Eremophila alpestris, Eremophila alpestris merrilli	Horned Lark	Present in Park	Common	Breeder
Passeriformes	Bombycillidae	Bombycilla cedrorum	Cedar Waxwing	Present in Park	Common	Resident
Passeriformes	Bombycillidae	Bombycilla garrulus	Bohemian Waxwing	Present in Park	Occasional	Vagrant
Passeriformes	Cardinalidae	Passerina amoena	Lazuli Bunting	Present in Park	Uncommon	Resident
Passeriformes	Cardinalidae	Pheucticus melanocephalus	Black-headed Grosbeak	Present in Park	Uncommon	Breeder
Passeriformes	Certhiidae	Certhia americana	Brown Creeper	Present in Park	Common	Breeder
Passeriformes	Certhiidae	Polioptila caerulea	Blue-gray Gnatcatcher, Blue-grey Gnatcatcher	Present in Park	Uncommon	Breeder
Passeriformes	Corvidae	Aphelocoma californica, Aphelocoma californica superciliosa, Aphelocoma coerulescens	Western Scrub Jay, Western Scrub-Jay	Present in Park	Common	Breeder
Passeriformes	Corvidae	Corvus corax	Common Raven, Northern Raven	Present in Park	Common	Breeder
Passeriformes	Corvidae	Cyanocitta stelleri	Steller's Jay	Present in Park	Common	Breeder
Passeriformes	Corvidae	Gymnorhinus cyanocephalus	Pinyon Jay	Present in Park	Uncommon	Resident
Passeriformes	Corvidae	Nucifraga columbiana	Clark's Nutcracker	Present in Park	Common	Resident
Passeriformes	Corvidae	Pica pica	Black-billed Magpie, Eurasian Magpie	Present in Park	Common	Resident
Passeriformes	Emberizidae	Amphispiza belli	Sage Sparrow	Unconfirmed	NA	NA
Passeriformes	Emberizidae	Amphispiza bilineata	Black-throated Sparrow	Present in Park	Rare	Breeder
Passeriformes	Emberizidae	Calcarius lapponicus	Lapland Longspur	Present in Park	Rare	Migratory
Passeriformes	Emberizidae	Chondestes grammacus	Lark Sparrow	Present in Park	Uncommon	Breeder

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Passeriformes	Emberizidae	Junco hyemalis	Dark-eyed Junco	Present in Park	Common	Breeder
Passeriformes	Emberizidae	Melospiza lincolnii	Lincoln's Sparrow	Present in Park	Uncommon	Resident
Passeriformes	Emberizidae	Melospiza melodia	Song Sparrow	Present in Park	Common	Breeder
Passeriformes	Emberizidae	Passerculus sandwichensis	Savannah Sparrow	Present in Park	Uncommon	Resident
Passeriformes	Emberizidae	Passerella iliaca	Fox Sparrow	Present in Park	Common	Migratory
Passeriformes	Emberizidae	Pipilo chlorurus	Green-tailed Towhee	Present in Park	Uncommon	Resident
Passeriformes	Emberizidae	Pipilo crissalis	California Towhee	Present in Park	Uncommon	Breeder
Passeriformes	Emberizidae	Pipilo erythrophthalmus, Pipilo maculatus	Spotted Towhee	Present in Park	Common	Breeder
Passeriformes	Emberizidae	Pooecetes gramineus	Vesper Sparrow	Present in Park	Uncommon	Resident
Passeriformes	Emberizidae	Spizella arborea	American Tree Sparrow	Present in Park	Rare	Resident
Passeriformes	Emberizidae	Spizella breweri	Brewer's Sparrow	Present in Park	Common	Breeder
Passeriformes	Emberizidae	Spizella passerina	Chipping Sparrow	Present in Park	Common	Resident
Passeriformes	Emberizidae	Zonotrichia albicollis	White-throated Sparrow	Present in Park	Rare	Resident
Passeriformes	Emberizidae	Zonotrichia atricapilla	Golden-crowned Sparrow	Present in Park	Common	Resident
Passeriformes	Emberizidae	Zonotrichia leucophrys	White-crowned Sparrow	Present in Park	Common	Resident
Passeriformes	Fringillidae	Carduelis pinus	Pine Siskin	Present in Park	Uncommon	Resident
Passeriformes	Fringillidae	Carduelis psaltria	Lesser Goldfinch	Present in Park	Uncommon	Resident
Passeriformes	Fringillidae	Carduelis tristis	American Goldfinch	Present in Park	Rare	Resident
Passeriformes	Fringillidae	Carpodacus cassinii	Cassin's Finch	Present in Park	Common	Breeder
Passeriformes	Fringillidae	Carpodacus mexicanus	House Finch	Present in Park	Common	Breeder
Passeriformes	Fringillidae	Carpodacus purpureus	Purple Finch	Present in Park	Uncommon	Resident
Passeriformes	Fringillidae	Coccothraustes vespertinus	Evening Grosbeak	Present in Park	Uncommon	Resident
Passeriformes	Fringillidae	Loxia curvirostra	Red Crossbill	Present in Park	Uncommon	Resident
Passeriformes	Hirundinidae	Hirundo pyrrhonota	Cliff Swallow	Present in Park	Common	Breeder
Passeriformes	Hirundinidae	Hirundo rustica	Barn Swallow	Present in Park	Common	Resident
Passeriformes	Hirundinidae	Progne subis	Purple Martin	Present in Park	Common	Breeder
Passeriformes	Hirundinidae	Riparia riparia	Bank Swallow, Sand Martin	Present in Park	Common	Resident
Passeriformes	Hirundinidae	Stelgidopteryx serripennis	Northern Rough-winged Swallow	Present in Park	Rare	Resident
Passeriformes	Hirundinidae	Tachycineta bicolor	Tree Swallow	Present in Park	Common	Migratory
Passeriformes	Hirundinidae	Tachycineta thalassina	Violet-green Swallow	Present in Park	Common	Breeder
Passeriformes	Icteridae	Agelaius phoeniceus	Red-winged Blackbird	Present in Park	Common	Breeder
Passeriformes	Icteridae	Agelaius tricolor	Tricolored Blackbird	Present in Park	Uncommon	Breeder
Passeriformes	Icteridae	Euphagus cyanocephalus	Brewer's Blackbird	Present in Park	Common	Breeder

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Passeriformes	Icteridae	Icterus bullockii, Icterus bullockii bullockii, Icterus galbula	Bullock's Oriole	Present in Park	Common	Breeder
Passeriformes	Icteridae	Molothrus ater	Brown-headed Cowbird	Present in Park	Common	Resident
Passeriformes	Icteridae	Sturnella neglecta	Western Meadowlark	Present in Park	Common	Breeder
Passeriformes	Icteridae	Xanthocephalus xanthocephalus	Yellow-headed Blackbird	Present in Park	Uncommon	Migratory
Passeriformes	Laniidae	Lanius excubitor	Great Grey Shrike, Northern Shrike	Present in Park	Rare	Resident
Passeriformes	Laniidae	Lanius ludovicianus, Lanius ludovicianus gambeli	Loggerhead Shrike	Present in Park	Uncommon	Resident
Passeriformes	Mimidae	Oreoscoptes montanus	Sage Thrasher	Present in Park	Uncommon	Breeder
Passeriformes	Motacillidae	Anthus rubescens, Anthus rubescens pacificus	American Pipit, Buff-bellied Pipit	Present in Park	Rare	Resident
Passeriformes	Paridae	Baeolophus inornatus inornatus, Baeolophus ridgwayi, Baeolophus ridgwayi zaleptus, Parus inornatus	juniper titmouse	Present in Park	Uncommon	Breeder
Passeriformes	Paridae	Parus gambeli	Mountain Chickadee	Present in Park	Common	Breeder
Passeriformes	Parulidae	Dendroica coronata, Dendroica coronata auduboni	Yellow-rumped Warbler	Present in Park	Common	Migratory
Passeriformes	Parulidae	Dendroica nigrescens	Black-throated Gray Warbler, Black-throated Grey Warbler	Present in Park	Uncommon	Migratory
Passeriformes	Parulidae	Dendroica occidentalis	Hermit Warbler	Present in Park	Uncommon	Migratory
Passeriformes	Parulidae	Dendroica petechia	American Yellow Warbler, Yellow Warbler	Present in Park	Common	Migratory
Passeriformes	Parulidae	Dendroica townsendi	Townsend's Warbler	Present in Park	Common	Migratory
Passeriformes	Parulidae	Geothlypis trichas	Common Yellowthroat	Present in Park	Common	Resident
Passeriformes	Parulidae	Oporornis tolmiei	MacGillivray's Warbler	Present in Park	Rare	Resident
Passeriformes	Parulidae	Vermivora celata	Orange-crowned Warbler	Present in Park	Common	Migratory
Passeriformes	Parulidae	Vermivora ruficapilla	Nashville Warbler	Present in Park	Common	Migratory
Passeriformes	Parulidae	Wilsonia pusilla	Wilson's Warbler	Present in Park	Common	Migratory
Passeriformes	Passeridae	Passer domesticus	House Sparrow	Present in Park	Uncommon	Resident
Passeriformes	Regulidae	Regulus calendula	Ruby-crowned Kinglet	Present in Park	Common	Resident
Passeriformes	Regulidae	Regulus satrapa	Golden-crowned Kinglet	Present in Park	Common	Resident
Passeriformes	Sittidae	Sitta canadensis	Red-breasted Nuthatch	Present in Park	Common	Breeder
Passeriformes	Sittidae	Sitta carolinensis	White-breasted Nuthatch	Present in Park	Common	Breeder
Passeriformes	Sittidae	Sitta pygmaea	Pygmy Nuthatch	Present in Park	Abundant	Breeder
Passeriformes	Sturnidae	Sturnus vulgaris	Common Starling, European Starling	Present in Park	Uncommon	Resident
Passeriformes	Sylviidae	Chamaea fasciata	Wrentit	Unconfirmed	NA	NA
Passeriformes	Thraupidae	Piranga ludoviciana	Western Tanager	Present in Park	Common	Breeder

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Passeriformes	Troglodytidae	Catherpes mexicanus	Canyon Wren	Present in Park	Common	Breeder
Passeriformes	Troglodytidae	Cistothorus palustris	Marsh Wren	Present in Park	Uncommon	Breeder
Passeriformes	Troglodytidae	Salpinctes obsoletus	Rock Wren	Present in Park	Common	Breeder
Passeriformes	Troglodytidae	Thryomanes bewickii	Bewick's Wren	Present in Park	Common	Breeder
Passeriformes	Troglodytidae	Troglodytes aedon	House Wren	Present in Park	Common	Breeder
Passeriformes	Troglodytidae	Troglodytes troglodytes	Winter Wren	Present in Park	Uncommon	Resident
Passeriformes	Turdidae	Catharus guttatus	Hermit Thrush	Present in Park	Uncommon	Resident
Passeriformes	Turdidae	Ixoreus naevius	Varied Thrush	Present in Park	Uncommon	Resident
Passeriformes	Turdidae	Myadestes townsendi	Townsend's Solitaire	Present in Park	Common	Breeder
Passeriformes	Turdidae	Sialia currucoides	Mountain Bluebird	Present in Park	Common	Breeder
Passeriformes	Turdidae	Sialia mexicana	Western Bluebird	Present in Park	Common	Breeder
Passeriformes	Turdidae	Turdus migratorius	American Robin	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Contopus borealis	Olive-sided Flycatcher	Present in Park	Uncommon	Breeder
Passeriformes	Tyrannidae	Contopus sordidulus	Western Wood Pewee, Western Wood-Pewee	Present in Park	Uncommon	Breeder
Passeriformes	Tyrannidae	Empidonax hammondii	Hammond's Flycatcher	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Empidonax oberholseri	Dusky Flycatcher	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Empidonax wrightii	Gray Flycatcher, Grey Flycatcher	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Myiarchus cinerascens	Ash-throated Flycatcher	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Sayornis saya	Say's Phoebe	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Tyrannus verticalis	Western Kingbird	Present in Park	Common	Breeder
Passeriformes	Vireonidae	Vireo cassinii	Cassin's Vireo	Present in Park	Common	Breeder
Passeriformes	Vireonidae	Vireo gilvus	Warbling Vireo	Present in Park	Common	Migratory
Piciformes	Picidae	Colaptes auratus	Northern Flicker	Present in Park	Common	Resident
Piciformes	Picidae	Dryocopus pileatus	Pileated Woodpecker	Probably Present	NA	NA
Piciformes	Picidae	Melanerpes lewis	Lewis' Woodpecker, Lewis's Woodpecker	Present in Park	Uncommon	Resident
Piciformes	Picidae	Picoides albolarvatus	White-headed Woodpecker	Present in Park	Uncommon	Resident
Piciformes	Picidae	Picoides arcticus	Black-backed Woodpecker	Present in Park	Uncommon	Resident
Piciformes	Picidae	Picoides pubescens	Downy Woodpecker	Present in Park	Uncommon	Resident
Piciformes	Picidae	Picoides villosus	Hairy Woodpecker	Present in Park	Common	Resident
Piciformes	Picidae	Sphyrapicus ruber	Red-breasted Sapsucker	Present in Park	Common	Breeder
Piciformes	Picidae	Sphyrapicus thyroideus	Williamson's Sapsucker	Present in Park	Uncommon	Resident
Piciformes	Picidae	Sphyrapicus varius	Yellow-bellied Sapsucker	Unconfirmed	NA	NA
Strigiformes	Caprimulgidae	Chordeiles minor	Common Nighthawk	Present in Park	Common	Breeder

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Strigiformes	Caprimulgidae	Phalaenoptilus nuttallii	Common Poorwill	Present in Park	Uncommon	Breeder
Strigiformes	Strigidae	Aegolius acadicus	Northern Saw-whet Owl	Present in Park	Uncommon	Breeder
Strigiformes	Strigidae	Asio flammeus	Short-eared Owl	Present in Park	Rare	Resident
Strigiformes	Strigidae	Asio otus	Long-eared Owl	Present in Park	Occasional	Resident
Strigiformes	Strigidae	Athene cunicularia	Burrowing Owl	Present in Park	Occasional	Resident
Strigiformes	Strigidae	Bubo virginianus	Great Horned Owl	Present in Park	Common	Breeder
Strigiformes	Strigidae	Glaucidium gnoma	Mountain Pygmy Owl, Northern Pygmy-Owl	Present in Park	Uncommon	Resident
Strigiformes	Strigidae	Otus flammeolus	Flammulated Owl	Present in Park	Uncommon	Breeder
Strigiformes	Strigidae	Otus kennicottii	Western Screech-Owl	Present in Park	Rare	Resident
Strigiformes	Strigidae	Strix nebulosa	Great Gray Owl, Great Grey Owl	Present in Park	Occasional	Vagrant
Strigiformes	Tytonidae	Tyto alba	Barn Owl, Common Barn-Owl	Present in Park	Common	Breeder

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Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Anseriformes	Anatidae	Aix sponsa	Wood Duck	Present in Park	Uncommon	Migratory
Anseriformes	Anatidae	Anas acuta, Dafila acuta	Northern Pintail	Present in Park	Occasional	Migratory
Anseriformes	Anatidae	Anas americana	American Wigeon	Present in Park	Occasional	Migratory
Anseriformes	Anatidae	Anas clypeata	Northern Shoveler	Present in Park	Uncommon	Migratory
Anseriformes	Anatidae	Anas crecca	Eurasian Teal, Green-winged Teal	Present in Park	Occasional	Migratory
Anseriformes	Anatidae	Anas cyanoptera	Cinnamon Teal	Probably Present	NA	NA
Anseriformes	Anatidae	Anas discors	Blue-winged Teal	Probably Present	NA	NA
Anseriformes	Anatidae	Anas platyrhynchos	Mallard	Present in Park	Common	Breeder
Anseriformes	Anatidae	Anas strepera	Gadwall	Probably Present	NA	NA
Anseriformes	Anatidae	Anser albifrons	Greater White-fronted Goose	Probably Present	NA	NA
Anseriformes	Anatidae	Aythya affinis	Lesser Scaup	Present in Park	Occasional	Migratory
Anseriformes	Anatidae	Aythya americana	Redhead	Historic	NA	NA
Anseriformes	Anatidae	Aythya collaris	Ring-necked Duck	Present in Park	Rare	Breeder
Anseriformes	Anatidae	Aythya valisineria	Canvasback	Present in Park	Occasional	Migratory
Anseriformes	Anatidae	Branta canadensis	Canada Goose	Present in Park	Uncommon	Breeder
Anseriformes	Anatidae	Branta canadensis leucopareia	Aleutian Canada Goose	Historic	NA	NA
Anseriformes	Anatidae	Bucephala albeola	Bufflehead	Present in Park	Common	Breeder
Anseriformes	Anatidae	Bucephala clangula	Common Goldeneye	Present in Park	Occasional	Migratory
Anseriformes	Anatidae	Bucephala islandica	Barrow's Goldeneye	Probably Present	NA	NA
Anseriformes	Anatidae	Chen caerulescens	Blue Goose, Snow Goose	Probably Present	NA	NA
Anseriformes	Anatidae	Cygnus columbianus	Tundra Swan	Present in Park	Rare	Migratory
Anseriformes	Anatidae	Erismatura jamaicensis, Oxyura jamaicensis	Ruddy Duck	Present in Park	Rare	Migratory
Anseriformes	Anatidae	Histrionicus histrionicus	Harlequin Duck	Unconfirmed	NA	NA
Anseriformes	Anatidae	Melanitta perspicillata	Surf Scoter	Historic	NA	NA
Anseriformes	Anatidae	Mergus merganser	Common Merganser	Present in Park	Common	Breeder
Apodiformes	Apodidae	Aeronautes saxatalis	White-throated Swift	Present in Park	Rare	Vagrant
Apodiformes	Apodidae	Chaetura vauxi	Vaux's Swift	Probably Present	NA	NA
Apodiformes	Apodidae	Cypseloides niger	American Black Swift, Black Swift	Probably Present	NA	NA
Apodiformes	Trochilidae	Calypte anna	Anna's Hummingbird	Present in Park	Common	Migratory
Apodiformes	Trochilidae	Selasphorus rufus	Rufous Hummingbird	Present in Park	Common	Migratory
Apodiformes	Trochilidae	Selasphorus sasin	Allen's Hummingbird	Present in Park	Occasional	Migratory
Apodiformes	Trochilidae	Stellula calliope	Calliope Hummingbird	Present in Park	Uncommon	Breeder
Ciconiiformes	Accipitridae	Accipiter cooperii	Cooper's Hawk	Present in Park	Uncommon	Breeder

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Ciconiiformes	Accipitridae	Accipiter gentilis	Northern Goshawk	Present in Park	Uncommon	Breeder
Ciconiiformes	Accipitridae	Accipiter striatus	Sharp-shinned Hawk	Present in Park	Uncommon	Breeder
Ciconiiformes	Accipitridae	Aquila chrysaetos	Golden Eagle	Present in Park	Uncommon	Breeder
Ciconiiformes	Accipitridae	Buteo jamaicensis	Red-tailed Hawk	Present in Park	Uncommon	Breeder
Ciconiiformes	Accipitridae	Buteo lagopus	Rough-legged Hawk, Roughleg	Probably Present	NA	NA
Ciconiiformes	Accipitridae	Buteo lineatus	Red-shouldered Hawk	Probably Present	NA	NA
Ciconiiformes	Accipitridae	Buteo platypterus	Broad-winged Hawk	Historic	NA	NA
Ciconiiformes	Accipitridae	Buteo regalis	Ferruginous Hawk	Probably Present	NA	NA
Ciconiiformes	Accipitridae	Buteo swainsoni	Swainson's Hawk	Probably Present	NA	NA
Ciconiiformes	Accipitridae	Circus cyaneus	Northern Harrier	Probably Present	NA	NA
Ciconiiformes	Accipitridae	Elanus leucurus	White-tailed Kite	Historic	NA	NA
Ciconiiformes	Accipitridae	Haliaeetus leucocephalus, Haliaeetus leucocephalus leucocephalus	Bald Eagle	Present in Park	Uncommon	Breeder
Ciconiiformes	Accipitridae	Pandion haliaetus	Osprey	Present in Park	Uncommon	Breeder
Ciconiiformes	Ardeidae	Ardea alba	Great Egret	Probably Present	NA	NA
Ciconiiformes	Ardeidae	Ardea herodias	Great Blue Heron	Present in Park	Rare	Migratory
Ciconiiformes	Ardeidae	Botaurus lentiginosus	American Bittern	Probably Present	NA	NA
Ciconiiformes	Ardeidae	Butorides virescens	Green Heron	Probably Present	NA	NA
Ciconiiformes	Ardeidae	Casmerodius albus	Great Egret	Probably Present	NA	NA
Ciconiiformes	Ardeidae	Egretta thula	Snowy Egret	Historic	NA	NA
Ciconiiformes	Ardeidae	Nycticorax nycticorax	Black-crowned Night Heron, Black-crowned Night-Heron	Present in Park	Rare	Resident
Ciconiiformes	Charadriidae	Charadrius semipalmatus	Semipalmated Plover	Probably Present	NA	NA
Ciconiiformes	Charadriidae	Charadrius vociferus	Killdeer	Present in Park	Common	Breeder
Ciconiiformes	Ciconiidae	Cathartes aura	Turkey Vulture	Present in Park	Uncommon	Resident
Ciconiiformes	Ciconiidae	Gymnogyps californianus	California Condor	Historic	NA	NA
Ciconiiformes	Falconidae	Falco columbarius	Merlin	Present in Park	Occasional	Migratory
Ciconiiformes	Falconidae	Falco mexicanus	Prairie Falcon	Present in Park	Occasional	Migratory
Ciconiiformes	Falconidae	Falco peregrinus, Falco peregrinus anatum	Peregrine Falcon	Present in Park	Uncommon	Breeder
Ciconiiformes	Falconidae	Falco sparverius	American Kestrel	Present in Park	Rare	Migratory
Ciconiiformes	Gaviidae	Gavia immer	Common Loon, Great Northern Loon	Present in Park	Rare	Migratory
Ciconiiformes	Gaviidae	Gavia pacifica	Pacific Loon	Present in Park	Occasional	Migratory
Ciconiiformes	Laridae	Chlidonias niger	Black Tern	Historic	NA	NA
Ciconiiformes	Laridae	Larus californicus	California Gull	Present in Park	Common	Migratory
Ciconiiformes	Laridae	Larus delawarensis	Ring-billed Gull	Present in Park	Rare	Migratory

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Ciconiiformes	Laridae	Larus philadelphia	Bonaparte's Gull	Probably Present	NA	NA
Ciconiiformes	Laridae	Sterna caspia	Caspian Tern	Present in Park	Rare	Migratory
Ciconiiformes	Laridae	Sterna forsteri	Forster's Tern	Present in Park	Occasional	Unknown
Ciconiiformes	Laridae	Xema sabini	Sabine's Gull	Present in Park	Occasional	Migratory
Ciconiiformes	Pelecanidae	Pelecanus erythrorhynchos	American White Pelican	Present in Park	Uncommon	Migratory
Ciconiiformes	Phalacrocoracidae	Phalacrocorax auritus	Double-crested Cormorant	Present in Park	Uncommon	Resident
Ciconiiformes	Podicipedidae	Aechmophorus clarkii	Clark's Grebe	Present in Park	Rare	Migratory
Ciconiiformes	Podicipedidae	Aechmophorus occidentalis	Western Grebe	Present in Park	Rare	Vagrant
Ciconiiformes	Podicipedidae	Podiceps nigricollis	Black-necked Grebe, Eared Grebe	Present in Park	Rare	Breeder
Ciconiiformes	Podicipedidae	Podilymbus podiceps	Pied-billed Grebe	Present in Park	Common	Breeder
Ciconiiformes	Scolopacidae	Actitis macularia	Spotted Sandpiper	Present in Park	Uncommon	Breeder
Ciconiiformes	Scolopacidae	Calidris mauri	Western Sandpiper	Present in Park	Occasional	Migratory
Ciconiiformes	Scolopacidae	Calidris melanotos	Pectoral Sandpiper	Probably Present	NA	NA
Ciconiiformes	Scolopacidae	Calidris minutilla	Least Sandpiper	Probably Present	NA	NA
Ciconiiformes	Scolopacidae	Catoptrophorus semipalmatus	Willet	Historic	NA	NA
Ciconiiformes	Scolopacidae	Gallinago delicata, Gallinago gallinago		Present in Park	Common	Breeder
Ciconiiformes	Scolopacidae	Limnodromus scolopaceus	Long-billed Dowitcher	Probably Present	NA	NA
Ciconiiformes	Scolopacidae	Limosa fedoa	Marbled Godwit	Probably Present	NA	NA
Ciconiiformes	Scolopacidae	Phalaropus lobatus	Red-necked Phalarope	Present in Park	Occasional	Migratory
Ciconiiformes	Scolopacidae	Phalaropus tricolor	Wilson's Phalarope	Present in Park	Occasional	Migratory
Ciconiiformes	Scolopacidae	Tringa melanoleuca	Greater Yellowlegs	Present in Park	Occasional	Vagrant
Ciconiiformes	Scolopacidae	Tringa solitaria	Solitary Sandpiper	Unconfirmed	NA	NA
Columbiformes	Columbidae	Columba fasciata	Band-tailed Pigeon	Present in Park	Uncommon	Resident
Columbiformes	Columbidae	Columba livia	Common Pigeon, Rock Dove, Rock Pigeon	Present in Park	Occasional	Migratory
Columbiformes	Columbidae	Zenaida macroura	Mourning Dove	Present in Park	Rare	Migratory
Coraciiformes	Alcedinidae	Ceryle alcyon, Megaceryle alcyon	Belted Kingfisher	Present in Park	Common	Resident
Galliformes	Odontophoridae	Callipepla californica	California Quail, Californian Quail	Present in Park	Rare	Vagrant
Galliformes	Odontophoridae	Oreortyx pictus	Mountain Quail	Present in Park	Common	Breeder
Galliformes	Phasianidae	Bonasa umbellus	Ruffed Grouse	Probably Present	NA	NA
Galliformes	Phasianidae	Dendragapus obscurus	Blue Grouse	Present in Park	Common	Breeder
Galliformes	Phasianidae	Meleagris gallopavo	Wild Turkey	Present in Park	Rare	Vagrant
Galliformes	Phasianidae	Pavo cristatus	Common Peafowl, Indian Peafowl	Historic	NA	NA
Galliformes	Phasianidae	Phasianus colchicus	Common Pheasant, Ring-necked Pheasant	Historic	NA	NA
Gruiformes	Gruidae	Grus canadensis	Sandhill Crane	Present in Park	Rare	Migratory

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Gruiformes	Rallidae	Fulica americana	American Coot	Present in Park	Common	Breeder
Gruiformes	Rallidae	Porzana carolina	Sora	Present in Park	Occasional	Breeder
Gruiformes	Rallidae	Rallus limicola	Virginia Rail	Present in Park	Occasional	Unknown
Passeriformes	Aegithalidae	Psaltriparus minimus	American Bushtit, Bushtit	Present in Park	Occasional	Migratory
Passeriformes	Alaudidae	Eremophila alpestris	Horned Lark	Present in Park	Occasional	Migratory
Passeriformes	Bombycillidae	Bombycilla cedrorum	Cedar Waxwing	Probably Present	NA	NA
Passeriformes	Cardinalidae	Passerina amoena	Lazuli Bunting	Present in Park	Common	Breeder
Passeriformes	Cardinalidae	Pheucticus melanocephalus	Black-headed Grosbeak	Present in Park	Rare	Breeder
Passeriformes	Certhiidae	Certhia americana, Certhia familiaris zelotes	Brown Creeper	Present in Park	Common	Breeder
Passeriformes	Certhiidae	Polioptila caerulea	Blue-gray Gnatcatcher, Blue-grey Gnatcatcher	Probably Present	NA	NA
Passeriformes	Cinclidae	Cinclus mexicanus	American Dipper	Present in Park	Uncommon	Breeder
Passeriformes	Corvidae	Aphelocoma californica, Aphelocoma coerulescens	Western Scrub Jay, Western Scrub-Jay	Probably Present	NA	NA
Passeriformes	Corvidae	Corvus brachyrhynchos	American Crow	Present in Park	Occasional	Vagrant
Passeriformes	Corvidae	Corvus corax	Common Raven, Northern Raven	Present in Park	Common	Breeder
Passeriformes	Corvidae	Cyanocitta stelleri	Steller's Jay	Present in Park	Common	Breeder
Passeriformes	Corvidae	Nucifraga columbiana	Clark's Nutcracker	Present in Park	Common	Breeder
Passeriformes	Corvidae	Perisoreus canadensis	Gray Jay, Grey Jay	Present in Park	Common	Breeder
Passeriformes	Emberizidae	Aimophila ruficeps	Rufous-crowned Sparrow	Historic	NA	NA
Passeriformes	Emberizidae	Amphispiza belli	Sage Sparrow	Historic	NA	NA
Passeriformes	Emberizidae	Chondestes grammacus	Lark Sparrow	Historic	NA	NA
Passeriformes	Emberizidae	Junco hyemalis, Junco oreganus	Dark-eyed Junco	Present in Park	Common	Breeder
Passeriformes	Emberizidae	Melospiza lincolnii	Lincoln's Sparrow	Present in Park	Common	Breeder
Passeriformes	Emberizidae	Melospiza melodia	Song Sparrow	Present in Park	Common	Breeder
Passeriformes	Emberizidae	Passerculus sandwichensis	Savannah Sparrow	Present in Park	Occasional	Migratory
Passeriformes	Emberizidae	Passerella iliaca, Passerella iliaca fulva, Passerella iliaca megarhyncha, Passerella iliaca schistacea	Fox Sparrow	Present in Park	Common	Breeder
Passeriformes	Emberizidae	Pipilo chlorurus	Green-tailed Towhee	Present in Park	Occasional	Breeder
Passeriformes	Emberizidae	Pipilo crissalis	California Towhee	Unconfirmed	NA	NA
Passeriformes	Emberizidae	Pipilo erythrophthalmus, Pipilo maculatus	Spotted Towhee	Present in Park	Uncommon	Migratory
Passeriformes	Emberizidae	Pipilo fuscus	Brown Towhee, Canyon Towhee	Unconfirmed	NA	NA
Passeriformes	Emberizidae	Pooecetes gramineus	Vesper Sparrow	Present in Park	Occasional	Migratory
Passeriformes	Emberizidae	Spizella breweri	Brewer's Sparrow	Present in Park	Occasional	Breeder
Passeriformes	Emberizidae	Spizella passerina	Chipping Sparrow	Present in Park	Common	Breeder
Passeriformes	Emberizidae	Zonotrichia atricapilla	Golden-crowned Sparrow	Present in Park	Occasional	Migratory

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Passeriformes	Emberizidae	Zonotrichia leucophrys	White-crowned Sparrow	Present in Park	Uncommon	Breeder
Passeriformes	Fringillidae	Carduelis flammea	Common Redpoll	Unconfirmed	NA	NA
Passeriformes	Fringillidae	Carduelis pinus	Pine Siskin	Present in Park	Common	Breeder
Passeriformes	Fringillidae	Carduelis psaltria	Lesser Goldfinch	Probably Present	NA	NA
Passeriformes	Fringillidae	Carduelis tristis	American Goldfinch	Probably Present	NA	NA
Passeriformes	Fringillidae	Carpodacus cassinii	Cassin's Finch	Present in Park	Common	Breeder
Passeriformes	Fringillidae	Carpodacus mexicanus	House Finch	Probably Present	NA	NA
Passeriformes	Fringillidae	Carpodacus purpureus	Purple Finch	Probably Present	NA	NA
Passeriformes	Fringillidae	Coccothraustes vespertinus, Hesperiphona vespertina, Hesperiphona vespertina brooksi	Evening Grosbeak	Present in Park	Abundant	Breeder
Passeriformes	Fringillidae	Dendroica aestiva brewsteri		Present in Park	Common	Breeder
Passeriformes	Fringillidae	Leucosticte arctoa, Leucosticte tephrocotis, Leucosticte tephrocotis dawsoni, Leucosticte tephrocotis littoralis	Gray-crowned Rosy-Finch, Grey-crowned Rosy Finch	Present in Park	Rare	Breeder
Passeriformes	Fringillidae	Loxia curvirostra	Red Crossbill	Present in Park	Common	Breeder
Passeriformes	Fringillidae	Pinicola enucleator	Pine Grosbeak	Present in Park	Occasional	Unknown
Passeriformes	Hirundinidae	Hirundo pyrrhonota	Cliff Swallow	Present in Park	Rare	Migratory
Passeriformes	Hirundinidae	Hirundo rustica	Barn Swallow	Present in Park	Common	Breeder
Passeriformes	Hirundinidae	Iridoprocne bicolor		Present in Park	Common	Breeder
Passeriformes	Hirundinidae	Petrochelidon pyrrhonota	American Cliff Swallow, Cliff Swallow	Probably Present	NA	NA
Passeriformes	Hirundinidae	Progne subis	Purple Martin	Present in Park	Occasional	Unknown
Passeriformes	Hirundinidae	Stelgidopteryx serripennis	Northern Rough-winged Swallow	Present in Park	Rare	Migratory
Passeriformes	Hirundinidae	Tachycineta bicolor	Tree Swallow	Present in Park	Common	Breeder
Passeriformes	Hirundinidae	Tachycineta thalassina	Violet-green Swallow	Present in Park	Rare	Migratory
Passeriformes	Icteridae	Agelaius phoeniceus	Red-winged Blackbird	Present in Park	Common	Breeder
Passeriformes	Icteridae	Agelaius tricolor	Tricolored Blackbird	Historic	NA	NA
Passeriformes	Icteridae	Dolichonyx oryzivorus	Bobolink	Historic	NA	NA
Passeriformes	Icteridae	Euphagus cyanocephalus	Brewer's Blackbird	Present in Park	Common	Breeder
Passeriformes	Icteridae	Icterus bullockii, Icterus galbula	Bullock's Oriole	Present in Park	Occasional	Migratory
Passeriformes	Icteridae	Molothrus ater	Brown-headed Cowbird	Present in Park	Common	Breeder
Passeriformes	Icteridae	Quiscalus mexicanus	Great-tailed Grackle	Probably Present	NA	NA
Passeriformes	Icteridae	Sturnella neglecta	Western Meadowlark	Present in Park	Rare	Migratory
Passeriformes	Icteridae	Xanthocephalus xanthocephalus	Yellow-headed Blackbird	Present in Park	Occasional	Vagrant
Passeriformes	Laniidae	Lanius excubitor	Great Grey Shrike, Northern Shrike	Unconfirmed	NA	NA
Passeriformes	Motacillidae	Anthus rubescens, Anthus spinoletta	American Pipit, Buff-bellied Pipit	Present in Park	Rare	Migratory
Passeriformes	Paridae	Parus gambeli	Mountain Chickadee	Present in Park	Common	Breeder

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Passeriformes	Paridae	Poecile gambeli	Mountain Chickadee	Present in Park	Common	Breeder
Passeriformes	Parulidae	Dendroica coronata	Yellow-rumped Warbler	Present in Park	Common	Breeder
Passeriformes	Parulidae	Dendroica nigrescens	Black-throated Gray Warbler, Black-throated Grey Warbler	Present in Park	Uncommon	Migratory
Passeriformes	Parulidae	Dendroica occidentalis	Hermit Warbler	Present in Park	Common	Breeder
Passeriformes	Parulidae	Dendroica petechia	American Yellow Warbler, Yellow Warbler	Present in Park	Common	Breeder
Passeriformes	Parulidae	Dendroica townsendi	Townsend's Warbler	Present in Park	Uncommon	Migratory
Passeriformes	Parulidae	Geothlypis trichas	Common Yellowthroat	Present in Park	Rare	Migratory
Passeriformes	Parulidae	Icteria virens	Yellow-breasted Chat	Unconfirmed	NA	NA
Passeriformes	Parulidae	Oporornis tolmiei	MacGillivray's Warbler	Present in Park	Common	Breeder
Passeriformes	Parulidae	Seiurus noveboracensis	Northern Waterthrush	Probably Present	NA	NA
Passeriformes	Parulidae	Vermivora celata	Orange-crowned Warbler	Present in Park	Common	Migratory
Passeriformes	Parulidae	Vermivora ruficapilla	Nashville Warbler	Present in Park	Common	Breeder
Passeriformes	Parulidae	Wilsonia pusilla	Wilson's Warbler	Present in Park	Common	Breeder
Passeriformes	Ptilogonatidae	Phainopepla nitens	Phainopepla	Unconfirmed	NA	NA
Passeriformes	Regulidae	Regulus calendula	Ruby-crowned Kinglet	Present in Park	Rare	Migratory
Passeriformes	Regulidae	Regulus satrapa	Golden-crowned Kinglet	Present in Park	Common	Breeder
Passeriformes	Sittidae	Sitta canadensis	Red-breasted Nuthatch	Present in Park	Common	Breeder
Passeriformes	Sittidae	Sitta carolinensis	White-breasted Nuthatch	Present in Park	Common	Breeder
Passeriformes	Sittidae	Sitta pygmaea	Pygmy Nuthatch	Present in Park	Common	Breeder
Passeriformes	Sturnidae	Sturnus vulgaris	Common Starling, European Starling	Present in Park	Rare	Unknown
Passeriformes	Sylviidae	Chamaea fasciata	Wrentit	Encroaching	NA	NA
Passeriformes	Thraupidae	Piranga ludoviciana	Western Tanager	Present in Park	Common	Breeder
Passeriformes	Troglodytidae	Catherpes mexicanus	Canyon Wren	Present in Park	Occasional	Resident
Passeriformes	Troglodytidae	Cistothorus palustris	Marsh Wren	Probably Present	NA	NA
Passeriformes	Troglodytidae	Salpinctes obsoletus	Rock Wren	Present in Park	Uncommon	Breeder
Passeriformes	Troglodytidae	Thryomanes bewickii	Bewick's Wren	Present in Park	Occasional	Vagrant
Passeriformes	Troglodytidae	Troglodytes aedon	House Wren	Present in Park	Uncommon	Migratory
Passeriformes	Troglodytidae	Troglodytes troglodytes	Winter Wren	Present in Park	Uncommon	Breeder
Passeriformes	Turdidae	Catharus guttatus	Hermit Thrush	Present in Park	Common	Breeder
Passeriformes	Turdidae	Catharus ustulatus	Swainson's Thrush	Probably Present	NA	NA
Passeriformes	Turdidae	Ixoreus naevius	Varied Thrush	Present in Park	Occasional	Migratory
Passeriformes	Turdidae	Myadestes townsendi	Townsend's Solitaire	Present in Park	Common	Breeder
Passeriformes	Turdidae	Sialia currucoides	Mountain Bluebird	Present in Park	Uncommon	Breeder
Passeriformes	Turdidae	Sialia mexicana	Western Bluebird	Present in Park	Uncommon	Breeder

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Passeriformes	Turdidae	Turdus migratorius	American Robin	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Contopus borealis, Contopus cooperi	Olive-sided Flycatcher	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Contopus sordidulus	Western Wood Pewee, Western Wood-Pewee	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Empidonax difficilis	Pacific-slope Flycatcher, Western Flycatcher	Present in Park	Rare	Migratory
Passeriformes	Tyrannidae	Empidonax hammondii	Hammond's Flycatcher	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Empidonax oberholseri	Dusky Flycatcher	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Empidonax traillii, Empidonax traillii brewsteri	Willow Flycatcher	Present in Park	Uncommon	Breeder
Passeriformes	Tyrannidae	Empidonax wrightii	Gray Flycatcher, Grey Flycatcher	Present in Park	Rare	Migratory
Passeriformes	Tyrannidae	Myiarchus cinerascens	Ash-throated Flycatcher	Present in Park	Occasional	Vagrant
Passeriformes	Tyrannidae	Sayornis nigricans	Black Phoebe	Present in Park	Occasional	Vagrant
Passeriformes	Tyrannidae	Sayornis saya	Say's Phoebe	Probably Present	NA	NA
Passeriformes	Tyrannidae	Tyrannus verticalis	Western Kingbird	Unconfirmed	NA	NA
Passeriformes	Vireonidae	Vireo cassinii, Vireo solitarius, Vireo solitarius cassinii	Cassin's Vireo	Present in Park	Common	Breeder
Passeriformes	Vireonidae	Vireo gilvus	Warbling Vireo	Present in Park	Common	Breeder
Passeriformes	Vireonidae	Vireo huttoni	Hutton's Vireo	Unconfirmed	NA	NA
Piciformes	Picidae	Asyndesmus lewis, Melanerpes lewis	Lewis' Woodpecker, Lewis's Woodpecker	Present in Park	Rare	Migratory
Piciformes	Picidae	Colaptes auratus	Northern Flicker	Present in Park	Common	Breeder
Piciformes	Picidae	Dryocopus pileatus	Pileated Woodpecker	Present in Park	Uncommon	Breeder
Piciformes	Picidae	Melanerpes formicivorus	Acorn Woodpecker	Present in Park	Occasional	Vagrant
Piciformes	Picidae	Picoides albolarvatus	White-headed Woodpecker	Present in Park	Common	Breeder
Piciformes	Picidae	Picoides arcticus	Black-backed Woodpecker	Present in Park	Uncommon	Breeder
Piciformes	Picidae	Picoides pubescens	Downy Woodpecker	Present in Park	Uncommon	Breeder
Piciformes	Picidae	Picoides villosus	Hairy Woodpecker	Present in Park	Uncommon	Breeder
Piciformes	Picidae	Sphyrapicus nuchalis	Red-naped Sapsucker	Unconfirmed	NA	NA
Piciformes	Picidae	Sphyrapicus ruber	Red-breasted Sapsucker	Present in Park	Common	Breeder
Piciformes	Picidae	Sphyrapicus thyroideus	Williamson's Sapsucker	Present in Park	Uncommon	Breeder
Piciformes	Picidae	Sphyrapicus varius daggetti		Present in Park	Common	Breeder
Strigiformes	Caprimulgidae	Chordeiles minor	Common Nighthawk	Present in Park	Common	Breeder
Strigiformes	Caprimulgidae	Phalaenoptilus nuttallii	Common Poorwill	Present in Park	Rare	Unknown
Strigiformes	Strigidae	Aegolius acadicus, Cryptoglaux acadica	Northern Saw-whet Owl	Present in Park	Uncommon	Breeder
Strigiformes	Strigidae	Asio flammeus	Short-eared Owl	Historic	NA	NA
Strigiformes	Strigidae	Asio otus	Long-eared Owl	Historic	NA	NA

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Strigiformes	Strigidae	Bubo virginianus	Great Horned Owl	Present in Park	Uncommon	Breeder
Strigiformes	Strigidae	Glaucidium gnoma	Mountain Pygmy Owl, Northern Pygmy-Owl	Present in Park	Rare	Breeder
Strigiformes	Strigidae	Megascops kennicottii, Otus kennicottii	Western Screech-Owl	Historic	NA	NA
Strigiformes	Strigidae	Otus flammeolus	Flammulated Owl	Unconfirmed	NA	NA
Strigiformes	Strigidae	Strix nebulosa	Great Gray Owl, Great Grey Owl	Historic	NA	NA
Strigiformes	Strigidae	Strix occidentalis, Strix occidentalis occidentalis		Uncommon	Breeder	
Strigiformes	Tytonidae	Tyto alba	Barn Owl, Common Barn-Owl	Probably Present	NA	NA

Oregon Caves National Park

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Apodiformes	Apodidae	Chaetura vauxi	Vaux's Swift	Present in Park	Rare	Migratory
Apodiformes	Trochilidae	Calypte anna	Anna's Hummingbird	Present in Park	Occasional	Migratory
Apodiformes	Trochilidae	Selasphorus rufus	Rufous Hummingbird	Present in Park	Occasional	Migratory
Apodiformes	Trochilidae	Stellula calliope	Calliope Hummingbird	Present in Park	Rare	Migratory
Ciconiiformes	Accipitridae	Accipiter cooperii	Cooper's Hawk	Present in Park	Occasional	Migratory
Ciconiiformes	Accipitridae	Accipiter gentilis	Northern Goshawk	Present in Park	Rare	Resident
Ciconiiformes	Accipitridae	Accipiter striatus	Sharp-shinned Hawk	Present in Park	Occasional	Migratory
Ciconiiformes	Accipitridae	Aquila chrysaetos	Golden Eagle	Present in Park	Occasional	Migratory
Ciconiiformes	Accipitridae	Buteo jamaicensis	Red-tailed Hawk	Present in Park	Common	Resident
Ciconiiformes	Accipitridae	Haliaeetus leucocephalus	Bald Eagle	Present in Park	Occasional	Resident
Ciconiiformes	Ciconiidae	Cathartes aura	Turkey Vulture	Present in Park	Rare	Migratory
Ciconiiformes	Falconidae	Falco sparverius	American Kestrel	Present in Park	Occasional	Migratory
Ciconiiformes	Scolopacidae	Calidris himantopus	Stilt Sandpiper	Present in Park	Occasional	Vagrant
Columbiformes	Columbidae	Columba fasciata	Band-tailed Pigeon	Present in Park	Occasional	Migratory
Columbiformes	Columbidae	Columba livia	Common Pigeon, Rock Dove, Rock Pigeon	Present in Park	Occasional	Migratory
Columbiformes	Columbidae	Zenaida macroura	Mourning Dove	Present in Park	Rare	Resident
Galliformes	Odontophoridae	Callipepla californica	California Quail, Californian Quail	Present in Park	Occasional	Migratory
Galliformes	Odontophoridae	Oreortyx pictus	Mountain Quail	Present in Park	Occasional	Resident
Galliformes	Phasianidae	Bonasa umbellus	Ruffed Grouse	Present in Park	Rare	Resident
Galliformes	Phasianidae	Dendragapus obscurus	Blue Grouse	Present in Park	Abundant	Resident
Passeriformes	Aegithalidae	Psaltriparus minimus	American Bushtit, Bushtit	Present in Park	Rare	Resident
Passeriformes	Bombycillidae	Bombycilla cedrorum	Cedar Waxwing	Present in Park	Rare	Migratory
Passeriformes	Cardinalidae	Passerina amoena	Lazuli Bunting	Present in Park	Occasional	Migratory
Passeriformes	Cardinalidae	Pheucticus melanocephalus	Black-headed Grosbeak	Present in Park	Uncommon	Migratory
Passeriformes	Certhiidae	Certhia americana	Brown Creeper	Present in Park	Uncommon	Resident
Passeriformes	Cinclidae	Cinclus mexicanus	American Dipper	Present in Park	Common	Resident
Passeriformes	Corvidae	Corvus brachyrhynchos	American Crow	Present in Park	Uncommon	Resident
Passeriformes	Corvidae	Corvus corax	Common Raven, Northern Raven	Present in Park	Common	Resident
Passeriformes	Corvidae	Cyanocitta stelleri	Steller's Jay	Present in Park	Abundant	Resident
Passeriformes	Corvidae	Nucifraga columbiana	Clark's Nutcracker	Present in Park	Occasional	Vagrant
Passeriformes	Corvidae	Perisoreus canadensis	Gray Jay, Grey Jay	Present in Park	Rare	Migratory
Passeriformes	Emberizidae	Ammodramus bairdii	Baird's Sparrow	Present in Park	Occasional	Resident

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Passeriformes	Emberizidae	Junco hyemalis	Dark-eyed Junco	Present in Park	Common	Resident
Passeriformes	Emberizidae	Melospiza melodia	Song Sparrow	Present in Park	Uncommon	Migratory
Passeriformes	Emberizidae	Passerculus sandwichensis	Savannah Sparrow	Present in Park	Occasional	Migratory
Passeriformes	Emberizidae	Passerella iliaca	Fox Sparrow	Present in Park	Common	Migratory
Passeriformes	Emberizidae	Pipilo chlorurus	Green-tailed Towhee	Present in Park	Rare	Migratory
Passeriformes	Emberizidae	Pipilo maculatus	Spotted Towhee	Present in Park	Rare	Resident
Passeriformes	Emberizidae	Spizella passerina	Chipping Sparrow	Present in Park	Rare	Migratory
Passeriformes	Emberizidae	Zonotrichia atricapilla	Golden-crowned Sparrow	Probably Present	NA	NA
Passeriformes	Emberizidae	Zonotrichia leucophrys	White-crowned Sparrow	Present in Park	Occasional	Migratory
Passeriformes	Fringillidae	Carduelis pinus	Pine Siskin	Probably Present	NA	NA
Passeriformes	Fringillidae	Carduelis psaltria	Lesser Goldfinch	Present in Park	Occasional	Migratory
Passeriformes	Fringillidae	Carduelis tristis	American Goldfinch	Present in Park	Common	Migratory
Passeriformes	Fringillidae	Carpodacus cassinii	Cassin's Finch	Present in Park	Uncommon	Resident
Passeriformes	Fringillidae	Carpodacus purpureus	Purple Finch	Present in Park	Occasional	Migratory
Passeriformes	Fringillidae	Coccothraustes vespertinus	Evening Grosbeak	Present in Park	Rare	Migratory
Passeriformes	Fringillidae	Loxia curvirostra	Red Crossbill	Present in Park	Rare	Resident
Passeriformes	Hirundinidae	Tachycineta thalassina	Violet-green Swallow	Present in Park	Occasional	Migratory
Passeriformes	Icteridae	Euphagus cyanocephalus	Brewer's Blackbird	Present in Park	Rare	Resident
Passeriformes	Icteridae	Icterus bullockii	Bullock's Oriole	Present in Park	Rare	Migratory
Passeriformes	Paridae	Parus atricapillus	Black-capped Chickadee	Present in Park	Rare	Migratory
Passeriformes	Paridae	Parus gambeli	Mountain Chickadee	Present in Park	Common	Resident
Passeriformes	Paridae	Parus rufescens	Chestnut-backed Chickadee	Present in Park	Uncommon	Resident
Passeriformes	Paridae	Poecile gambeli	Mountain Chickadee	Present in Park	Uncommon	Resident
Passeriformes	Paridae	Poecile rufescens	Chestnut-backed Chickadee	Present in Park	Rare	Resident
Passeriformes	Parulidae	Dendroica coronata auduboni		Present in Park	Common	Migratory
Passeriformes	Parulidae	Dendroica coronata coronata		Present in Park	Occasional	Migratory
Passeriformes	Parulidae	Dendroica nigrescens	Black-throated Gray Warbler, Black-throated Grey Warbler	Present in Park	Rare	Migratory
Passeriformes	Parulidae	Dendroica occidentalis	Hermit Warbler	Present in Park	Uncommon	Migratory
Passeriformes	Parulidae	Dendroica petechia	American Yellow Warbler, Yellow Warbler	Present in Park	Rare	Migratory
Passeriformes	Parulidae	Dendroica townsendi	Townsend's Warbler	Present in Park	Occasional	Migratory
Passeriformes	Parulidae	Oporornis tolmiei	MacGillivray's Warbler	Present in Park	Uncommon	Migratory
Passeriformes	Parulidae	Vermivora celata	Orange-crowned Warbler	Present in Park	Occasional	Migratory
Passeriformes	Parulidae	Vermivora ruficapilla	Nashville Warbler	Present in Park	Rare	Migratory

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Passeriformes	Parulidae	Wilsonia pusilla	Wilson's Warbler	Present in Park	Rare	Migratory
Passeriformes	Passeridae	Passer domesticus	House Sparrow	Present in Park	Uncommon	Migratory
Passeriformes	Regulidae	Regulus calendula	Ruby-crowned Kinglet	Present in Park	Rare	Resident
Passeriformes	Regulidae	Regulus satrapa	Golden-crowned Kinglet	Present in Park	Uncommon	Resident
Passeriformes	Sittidae	Sitta canadensis	Red-breasted Nuthatch	Present in Park	Uncommon	Resident
Passeriformes	Sittidae	Sitta carolinensis	White-breasted Nuthatch	Present in Park	Rare	Resident
Passeriformes	Sturnidae	Sturnus vulgaris	Common Starling, European Starling	Present in Park	Uncommon	Resident
Passeriformes	Thraupidae	Piranga ludoviciana	Western Tanager	Present in Park	Uncommon	Migratory
Passeriformes	Troglodytidae	Troglodytes aedon	House Wren	Present in Park	Rare	Resident
Passeriformes	Troglodytidae	Troglodytes troglodytes	Winter Wren	Present in Park	Common	Resident
Passeriformes	Turdidae	Catharus guttatus	Hermit Thrush	Present in Park	Abundant	Resident
Passeriformes	Turdidae	Catharus ustulatus	Swainson's Thrush	Present in Park	Common	Resident
Passeriformes	Turdidae	Ixoreus naevius	Varied Thrush	Present in Park	Rare	Resident
Passeriformes	Turdidae	Myadestes townsendi	Townsend's Solitaire	Present in Park	Rare	Resident
Passeriformes	Turdidae	Sialia currucoides	Mountain Bluebird	Present in Park	Rare	Resident
Passeriformes	Turdidae	Sialia mexicana	Western Bluebird	Present in Park	Rare	Migratory
Passeriformes	Turdidae	Turdus migratorius	American Robin	Present in Park	Common	Resident
Passeriformes	Tyrannidae	Contopus borealis	Olive-sided Flycatcher	Present in Park	Uncommon	Migratory
Passeriformes	Tyrannidae	Contopus cooperi	Olive-sided Flycatcher	Present in Park	Uncommon	Migratory
Passeriformes	Tyrannidae	Contopus sordidulus	Western Wood Pewee, Western Wood-Pewee	Present in Park	Common	Migratory
Passeriformes	Tyrannidae	Empidonax difficilis	Pacific-slope Flycatcher, Western Flycatcher	Present in Park	Uncommon	Migratory
Passeriformes	Tyrannidae	Empidonax hammondii	Hammond's Flycatcher	Present in Park	Rare	Migratory
Passeriformes	Tyrannidae	Empidonax oberholseri	Dusky Flycatcher	Present in Park	Uncommon	Resident
Passeriformes	Tyrannidae	Empidonax occidentalis	Cordilleran Flycatcher	Present in Park	Uncommon	Resident
Passeriformes	Tyrannidae	Empidonax traillii	Willow Flycatcher	Present in Park	Rare	Resident
Passeriformes	Vireonidae	Vireo cassinii	Cassin's Vireo	Present in Park	Rare	Migratory
Passeriformes	Vireonidae	Vireo gilvus	Warbling Vireo	Present in Park	Rare	Migratory
Passeriformes	Vireonidae	Vireo huttoni	Hutton's Vireo	Present in Park	Occasional	Resident
Passeriformes	Vireonidae	Vireo solitarius	Blue-headed Vireo, Solitary Vireo	Present in Park	Occasional	Migratory
Piciformes	Picidae	Colaptes auratus	Northern Flicker	Present in Park	Uncommon	Resident
Piciformes	Picidae	Dryocopus pileatus	Pileated Woodpecker	Present in Park	Common	Resident
Piciformes	Picidae	Melanerpes lewis	Lewis' Woodpecker, Lewis's Woodpecker	Present in Park	Rare	Migratory
Piciformes	Picidae	Picoides albolarvatus	White-headed Woodpecker	Present in Park	Rare	Migratory

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Piciformes	Picidae	Picoides pubescens	Downy Woodpecker	Present in Park	Occasional	Migratory
Piciformes	Picidae	Picoides villosus	Hairy Woodpecker	Present in Park	Uncommon	Resident
Piciformes	Picidae	Sphyrapicus nuchalis	Red-naped Sapsucker	Present in Park	Occasional	Vagrant
Piciformes	Picidae	Sphyrapicus ruber	Red-breasted Sapsucker	Present in Park	Uncommon	Resident
Piciformes	Picidae	Sphyrapicus thyroideus	Williamson's Sapsucker	Present in Park	Occasional	Vagrant
Strigiformes	Caprimulgidae	Chordeiles minor	Common Nighthawk	Present in Park	Occasional	Migratory
Strigiformes	Caprimulgidae	Phalaenoptilus nuttallii	Common Poorwill	Present in Park	Uncommon	Migratory
Strigiformes	Strigidae	Aegolius acadicus	Northern Saw-whet Owl	Present in Park	Rare	Resident
Strigiformes	Strigidae	Asio otus	Long-eared Owl	Present in Park	Uncommon	Resident
Strigiformes	Strigidae	Bubo virginianus	Great Horned Owl	Present in Park	Rare	Resident
Strigiformes	Strigidae	Glaucidium gnoma	Mountain Pygmy Owl, Northern Pygmy-Owl	Present in Park	Rare	Resident
Strigiformes	Strigidae	Otus flammeolus	Flammulated Owl	Present in Park	Rare	Resident
Strigiformes	Strigidae	Otus kennicottii	Western Screech-Owl	Present in Park	Rare	Resident
Strigiformes	Strigidae	Strix occidentalis	Spotted Owl	Present in Park	Rare	Resident
Strigiformes	Strigidae	Strix varia	Barred Owl	Encroaching	NA	NA

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Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Anseriformes	Anatidae	Aix sponsa	Wood Duck	Present	Uncommon	Breeder
Anseriformes	Anatidae	Anas acuta	Northern Pintail	Present	Occasional	Resident
Anseriformes	Anatidae	Anas americana	American Wigeon	Present	Uncommon	Resident
Anseriformes	Anatidae	Anas clypeata	Northern Shoveler	Present	Rare	Resident
Anseriformes	Anatidae	Anas crecca	Green-winged Teal	Present	Occasional	Resident
Anseriformes	Anatidae	Anas cyanoptera	Cinnamon Teal	Present	Occasional	Resident
Anseriformes	Anatidae	Anas discors	Blue-winged Teal	Present	Occasional	Unknown
Anseriformes	Anatidae	Anas penelope	Eurasian Wigeon	Present	Occasional	Vagrant
Anseriformes	Anatidae	Anas platyrhynchos	Mallard	Present	Common	Breeder
Anseriformes	Anatidae	Anas strepera	Gadwall	Present	Rare	Resident
Anseriformes	Anatidae	Anser albifrons	Greater White-fronted Goose	Present	Occasional	Migratory
Anseriformes	Anatidae	Aythya affinis	Lesser Scaup	Present	Occasional	Resident
Anseriformes	Anatidae	Aythya collaris	Ring-necked Duck	Present	Common	Resident
Anseriformes	Anatidae	Aythya marila	Greater Scaup	Present	Occasional	Resident
Anseriformes	Anatidae	Aythya valisineria	Canvasback	Present	Occasional	Resident
Anseriformes	Anatidae	Branta bernicla	Brant	Present	Occasional	Migratory
Anseriformes	Anatidae	Branta canadensis leucopareia	Aleutian Canada Goose	Present	Rare	Migratory
Anseriformes	Anatidae	Branta canadensis moffitti	Western Canada Goose	Present	Common	Breeder
Anseriformes	Anatidae	Bucephala albeola	Bufflehead	Present	Abundant	Resident
Anseriformes	Anatidae	Bucephala clangula	Common Goldeneye	Unconfirmed	NA	NA
Anseriformes	Anatidae	Bucephala islandica	Barrow's Goldeneye	Unconfirmed	NA	NA
Anseriformes	Anatidae	Chen caerulescens	Snow Goose	Present	Occasional	Migratory
Anseriformes	Anatidae	Chen canagica	Emporer Goose	Unconfirmed	NA	NA
Anseriformes	Anatidae	Chen rossii	Ross' Goose	Unconfirmed	NA	NA
Anseriformes	Anatidae	Clangula hyemalis	Oldsquaw	Present	Occasional	Vagrant
Anseriformes	Anatidae	Cygnus columbianus	Tundra Swan	Present	Occasional	Resident
Anseriformes	Anatidae	Cygnus olor	Mute Swan	Present	Occasional	Vagrant
Anseriformes	Anatidae	Histrionicus histrionicus	Harlequin Duck	Present	Occasional	Resident
Anseriformes	Anatidae	Lophodytes cucullatus	Hooded Merganser	Present	Rare	Resident
Anseriformes	Anatidae	Melanitta fusca	White-winged Scoter	Present	Uncommon	Resident
Anseriformes	Anatidae	Anas acuta	Northern Pintail	Present	Occasional	Resident
Anseriformes	Anatidae	Anas americana	American Wigeon	Present	Uncommon	Resident

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Anseriformes	Anatidae	Anas clypeata	Northern Shoveler	Present	Rare	Resident
Anseriformes	Anatidae	Anas crecca	Green-winged Teal	Present	Occasional	Resident
Anseriformes	Anatidae	Anas cyanoptera	Cinnamon Teal	Present	Occasional	Resident
Anseriformes	Anatidae	Anas discors	Blue-winged Teal	Present	Occasional	Unknown
Anseriformes	Anatidae	Anas penelope	Eurasian Wigeon	Present	Occasional	Vagrant
Anseriformes	Anatidae	Anas platyrhynchos	Mallard	Present	Common	Breeder
Anseriformes	Anatidae	Anas strepera	Gadwall	Present	Rare	Resident
Anseriformes	Anatidae	Anser albifrons	Greater White-fronted Goose	Present	Occasional	Migratory
Anseriformes	Anatidae	Aythya affinis	Lesser Scaup	Present	Occasional	Resident
Anseriformes	Anatidae	Aythya collaris	Ring-necked Duck	Present	Common	Resident
Anseriformes	Anatidae	Aythya marila	Greater Scaup	Present	Occasional	Resident
Anseriformes	Anatidae	Aythya valisineria	Canvasback	Present	Occasional	Resident
Anseriformes	Anatidae	Branta bernicla	Brant	Present	Occasional	Migratory
Anseriformes	Anatidae	Branta canadensis leucopareia	Aleutian Canada Goose	Present	Rare	Migratory
Anseriformes	Anatidae	Branta canadensis moffitti	Western Canada Goose	Present	Common	Breeder
Anseriformes	Anatidae	Bucephala albeola	Bufflehead	Present	Abundant	Resident
Anseriformes	Anatidae	Bucephala clangula	Common Goldeneye	Unconfirmed	NA	NA
Anseriformes	Anatidae	Bucephala islandica	Barrow's Goldeneye	Unconfirmed	NA	NA
Anseriformes	Anatidae	Chen caerulescens	Snow Goose	Present	Occasional	Migratory
Anseriformes	Anatidae	Chen canagica	Emporer Goose	Unconfirmed	NA	NA
Anseriformes	Anatidae	Chen rossii	Ross' Goose	Unconfirmed	NA	NA
Anseriformes	Anatidae	Clangula hyemalis	Oldsquaw	Present	Occasional	Vagrant
Anseriformes	Anatidae	Cygnus columbianus	Tundra Swan	Present	Occasional	Resident
Anseriformes	Anatidae	Cygnus olor	Mute Swan	Present	Occasional	Vagrant
Anseriformes	Anatidae	Histrionicus histrionicus	Harlequin Duck	Present	Occasional	Resident
Anseriformes	Anatidae	Lophodytes cucullatus	Hooded Merganser	Present	Rare	Resident
Anseriformes	Anatidae	Melanitta fusca	White-winged Scoter	Present	Uncommon	Resident
Anseriformes	Anatidae	Melanitta nigra	Black Scoter	Present	Occasional	Resident
Anseriformes	Anatidae	Melanitta perspicillata	Surf Scoter	Present	Abundant	Resident
Anseriformes	Anatidae	Mergus merganser	Common Merganser	Present	Common	Breeder
Anseriformes	Anatidae	Mergus serrator	Red-breasted Merganser	Present	Rare	Resident
Anseriformes	Anatidae	Oxyura jamaicensis	Ruddy Duck	Present	Occasional	Resident
Apodiformes	Apodidae	Chaetura vauxi	Vaux's Swift	Present	Common	Breeder

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Apodiformes	Apodidae	Cypseloides niger	Black Swift	Present	Occasional	Migratory
Apodiformes	Trochilidae	Calypte anna	Anna's Hummingbird	Present	Common	Breeder
Apodiformes	Trochilidae	Selasphorus rufus	Rufous Hummingbird	Present	Uncommon	Migratory
Apodiformes	Trochilidae	Selasphorus sasin	Allen's Hummingbird	Present	Common	Breeder
Apodiformes	Trochilidae	Stellula calliope	Calliope Hummingbird	Unconfirmed		
Ciconiiformes	Accipitridae	Accipiter cooperii	Cooper's Hawk	Present	Uncommon	Breeder
Ciconiiformes	Accipitridae	Accipiter gentilis	Northern Goshawk	Present	Occasional	Vagrant
Ciconiiformes	Accipitridae	Accipiter striatus	Sharp-shinned Hawk	Present	Uncommon	Resident
Ciconiiformes	Accipitridae	Aquila chrysaetos	Golden Eagle	Present	Rare	Unknown
Ciconiiformes	Accipitridae	Buteo jamaicensis	Red-tailed Hawk	Present	Common	Breeder
Ciconiiformes	Accipitridae	Buteo lagopus	Rough-legged Hawk	Present	Rare	Resident
Ciconiiformes	Accipitridae	Buteo lineatus	Red-shouldered Hawk	Present	Common	Breeder
Ciconiiformes	Accipitridae	Circus cyaneus	Northern Harrier	Present	Common	Resident
Ciconiiformes	Accipitridae	Elanus caeruleus	White-tailed Kite	Present	Uncommon	Breeder
Ciconiiformes	Accipitridae	Haliaeetus leucocephalus	Bald Eagle	Present	Uncommon	Breeder
Ciconiiformes	Accipitridae	Pandion haliaetus	Osprey	Present	Common	Breeder
Ciconiiformes	Ardeidae	Ardea alba	Great Egret	Present	Uncommon	Resident
Ciconiiformes	Ardeidae	Ardea herodias	Great Blue Heron	Present	Common	Breeder
Ciconiiformes	Ardeidae	Botaurus lentiginosus	American Bittern	Present	Occasional	Unknown
Ciconiiformes	Ardeidae	Bubulcus ibis	Cattle Egret	Present	Occasional	Resident
Ciconiiformes	Ardeidae	Butorides striatus	Green-backed Heron	Unconfirmed	NA	NA
Ciconiiformes	Ardeidae	Butorides virescens	Green Heron	Present	Uncommon	Breeder
Ciconiiformes	Ardeidae	Casmerodius albus	Great Egret	Present	Uncommon	Resident
Ciconiiformes	Ardeidae	Egretta thula	Snowy Egret	Present	Occasional	Resident
Ciconiiformes	Ardeidae	Nycticorax nycticorax	Black-crowned Night-Heron	Present	Occasional	Unknown
Ciconiiformes	Charadriidae	Charadrius alexandrinus	Snowy Plover	Present	Rare	Breeder
Ciconiiformes	Charadriidae	Charadrius montanus	Mountain Plover	Unconfirmed	NA	NA
Ciconiiformes	Charadriidae	Charadrius semipalmatus	Semipalmated Plover	Present	Common	Resident
Ciconiiformes	Charadriidae	Charadrius vociferus	Killdeer	Present	Common	Breeder
Ciconiiformes	Charadriidae	Haematopus bachmani	Black Oystercatcher	Present	Common	Breeder
Ciconiiformes	Charadriidae	Himantopus mexicanus	Black-necked Stilt	Unconfirmed	NA	NA
Ciconiiformes	Charadriidae	Pluvialis dominica	American Golden-Plover	Probably Present	NA	NA
Ciconiiformes	Charadriidae	Pluvialis fulva	Pacific Golden-Plover	Probably Present	NA	NA

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Ciconiiformes	Charadriidae	Pluvialis squatarola	Black-bellied Plover	Present	Occasional	Resident
Ciconiiformes	Charadriidae	Recurvirostra americana	American Avocet	Unconfirmed	NA	NA
Ciconiiformes	Ciconiidae	Cathartes aura	Turkey Vulture	Present	Common	Breeder
Ciconiiformes	Falconidae	Falco columbarius	Merlin	Present	Rare	Resident
Ciconiiformes	Falconidae	Falco mexicanus	Prairie Falcon	Unconfirmed	NA	NA
Ciconiiformes	Falconidae	Falco peregrinus	Peregrine Falcon	Present	Uncommon	Breeder
Ciconiiformes	Falconidae	Falco sparverius	American Kestrel	Present	Uncommon	Breeder
Ciconiiformes	Fregatidae	Fregata magnificens	Magnificent Frigatebird	Present	Occasional	Vagrant
Ciconiiformes	Gaviidae	Gavia arctica	Arctic Loon	Unconfirmed	NA	NA
Ciconiiformes	Gaviidae	Gavia immer	Common Loon	Present	Rare	Resident
Ciconiiformes	Gaviidae	Gavia pacifica	Pacific Loon	Present	Rare	Resident
Ciconiiformes	Gaviidae	Gavia stellata	Red-throated Loon	Present	Rare	Resident
Ciconiiformes	Laridae	Brachyramphus marmoratus	Marbled Murrelet	Present	Common	Breeder
Ciconiiformes	Laridae	Cepphus columba	Pigeon Guillemot	Present	Uncommon	Resident
Ciconiiformes	Laridae	Cerorhinca monocerata	Rhinoceros Auklet	Present	Occasional	Resident
Ciconiiformes	Laridae	Chlidonias niger	Black Tern	Present	Occasional	Migratory
Ciconiiformes	Laridae	Fratercula cirrhata	Tufted Puffin	Present	Occasional	Resident
Ciconiiformes	Laridae	Larus argentatus	Herring Gull	Present	Occasional	Resident
Ciconiiformes	Laridae	Larus californicus	California Gull	Present	Abundant	Resident
Ciconiiformes	Laridae	Larus canus	Mew Gull	Present	Occasional	Resident
Ciconiiformes	Laridae	Larus delawarensis	Ring-billed Gull	Present	Occasional	Resident
Ciconiiformes	Laridae	Larus glaucescens	Glaucous-winged Gull	Present	Uncommon	Resident
Ciconiiformes	Laridae	Larus heermanni	Heermann's Gull	Present	Common	Resident
Ciconiiformes	Laridae	Larus hyperboreus	Glaucous Gull	Present	Uncommon	Resident
Ciconiiformes	Laridae	Larus occidentalis	Western Gull	Present	Abundant	Breeder
Ciconiiformes	Laridae	Larus philadelphia	Bonaparte's Gull	Present	Occasional	Resident
Ciconiiformes	Laridae	Larus pipixcan	Franklin's Gull	Unconfirmed	NA	NA
Ciconiiformes	Laridae	Larus thayeri	Thayer's Gull	Present	Occasional	Resident
Ciconiiformes	Laridae	Ptychoramphus aleuticus	Cassin's Auklet	Present	Common	Breeder
Ciconiiformes	Laridae	Rissa tridactyla	Black-legged Kittiwake	Present	Uncommon	Resident
Ciconiiformes	Laridae	Stercorarius parasiticus	Parasitic Jaeger	Unconfirmed	NA	NA
Ciconiiformes	Laridae	Stercorarius pomarinus	Pomarine Jaeger	Unconfirmed	NA	NA
Ciconiiformes	Laridae	Sterna antillarum	Least Tern	False Report		
Ciconiiformes	Laridae	Sterna caspia	Caspian Tern	Present	Uncommon	Resident

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Ciconiiformes	Laridae	Sterna elegans	Elegant Tern	Present	Occasional	Resident
Ciconiiformes	Laridae	Sterna forsteri	Forster's Tern	Unconfirmed	NA	NA
Ciconiiformes	Laridae	Sterna hirundo	Common Tern	Probably Present	Unknown	Migratory
Ciconiiformes	Laridae	Sterna paradisaea	Arctic Tern	Unconfirmed	NA	NA
Ciconiiformes	Laridae	Synthliboramphus antiquus	Ancient Murrelet	Present	Uncommon	Resident
Ciconiiformes	Laridae	Uria aalge	Common Murre	Present	Abundant	Breeder
Ciconiiformes	Laridae	Xema sabini	Sabine's Gull	Unconfirmed	NA	NA
Ciconiiformes	Pelecanidae	Pelecanus erythrorhynchos	American White Pelican	Present	Occasional	Vagrant
Ciconiiformes	Pelecanidae	Pelecanus occidentalis	Brown Pelican	Present	Abundant	Resident
Ciconiiformes	Phalacrocoracidae	Phalacrocorax auritus	Double-crested Cormorant	Present	Abundant	Breeder
Ciconiiformes	Phalacrocoracidae	Phalacrocorax pelagicus	Pelagic Cormorant	Present	Common	Breeder
Ciconiiformes	Phalacrocoracidae	Phalacrocorax penicillatus	Brandt's Cormorant	Present	Common	Breeder
Ciconiiformes	Podicipedidae	Aechmophorus clarkii	Clark's Grebe	Present	Occasional	Resident
Ciconiiformes	Podicipedidae	Aechmophorus occidentalis	Western Grebe	Present	Common	Resident
Ciconiiformes	Podicipedidae	Podiceps auritus	Horned Grebe	Present	Occasional	Resident
Ciconiiformes	Podicipedidae	Podiceps grisegena	Red-necked Grebe	Present	Occasional	Resident
Ciconiiformes	Podicipedidae	Podiceps nigricollis	Eared Grebe	Unconfirmed	NA	Resident
Ciconiiformes	Podicipedidae	Podilymbus podiceps	Pied-billed Grebe	Present	Rare	Resident
Ciconiiformes	Procellariidae	Diomedea nigripes	Black-footed Albatross	Unconfirmed	NA	NA
Ciconiiformes	Procellariidae	Fulmarus glacialis	Northern Fulmar	Unconfirmed	NA	NA
Ciconiiformes	Procellariidae	Oceanodroma furcata	Fork-tailed Storm-Petrel	Unconfirmed	NA	NA
Ciconiiformes	Procellariidae	Oceanodroma leucorhoa	Leach's Storm-Petrel	Unconfirmed	NA	NA
Ciconiiformes	Procellariidae	Puffinus griseus	Sooty Shearwater	Unconfirmed	NA	NA
Ciconiiformes	Procellariidae	Puffinus tenuirostris	Short-tailed Shearwater	Unconfirmed	NA	NA
Ciconiiformes	Scolopacidae	Actitis macularia	Spotted Sandpiper	Present	Uncommon	Breeder
Ciconiiformes	Scolopacidae	Aphriza virgata	Surfbird	Probably Present	NA	Resident
Ciconiiformes	Scolopacidae	Arenaria interpres	Ruddy Turnstone	Present	Occasional	Resident
Ciconiiformes	Scolopacidae	Arenaria melanocephala	Black Turnstone	Present	Rare	Resident
Ciconiiformes	Scolopacidae	Bartramia longicauda	Upland Sandpiper	Unconfirmed	NA	NA
Ciconiiformes	Scolopacidae	Calidris acuminata	Sharp-tailed Sandpiper	Unconfirmed	NA	NA
Ciconiiformes	Scolopacidae	Calidris alba	Sanderling	Present	Common	Resident
Ciconiiformes	Scolopacidae	Calidris alpina	Dunlin	Present	Occasional	Resident
Ciconiiformes	Scolopacidae	Calidris bairdii	Baird's Sandpiper	Present	Occasional	Vagrant

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Ciconiiformes	Scolopacidae	Calidris canutus	Red Knot	Unconfirmed	NA	NA
Ciconiiformes	Scolopacidae	Calidris himantopus	Stilt Sandpiper	Unconfirmed	NA	NA
Ciconiiformes	Scolopacidae	Calidris mauri	Western Sandpiper	Present	Rare	Resident
Ciconiiformes	Scolopacidae	Calidris melanotos	Pectoral Sandpiper	Present	Occasional	Migratory
Ciconiiformes	Scolopacidae	Calidris minutilla	Least Sandpiper	Present	Occasional	Resident
Ciconiiformes	Scolopacidae	Calidris ptilocnemis	Rock Sandpiper	Unconfirmed	NA	NA
Ciconiiformes	Scolopacidae	Calidris ruficollis	Red-necked Stint	Unconfirmed	NA	NA
Ciconiiformes	Scolopacidae	Catoptrophorus semipalmatus	Willet	Present	Occasional	Resident
Ciconiiformes	Scolopacidae	Gallinago gallinago	Common Snipe	Present	Occasional	Unknown
Ciconiiformes	Scolopacidae	Heteroscelus incanus	Wandering Tattler	Present	Occasional	Migratory
Ciconiiformes	Scolopacidae	Limnodromus griseus	Short-billed Dowitcher	Unconfirmed	NA	Resident
Ciconiiformes	Scolopacidae	Limnodromus scolopaceus	Long-billed Dowitcher	Unconfirmed	NA	Resident
Ciconiiformes	Scolopacidae	Limosa fedoa	Marbled Godwit	Present	Occasional	Resident
Ciconiiformes	Scolopacidae	Limosa haemastica	Hudsonian Godwit	Present	Occasional	Vagrant
Ciconiiformes	Scolopacidae	Limosa lapponica	Bar-tailed Godwit	Unconfirmed	NA	NA
Ciconiiformes	Scolopacidae	Numenius americanus	Long-billed Curlew	Present	Occasional	Resident
Ciconiiformes	Scolopacidae	Numenius phaeopus	Whimbrel	Present	Uncommon	Resident
Ciconiiformes	Scolopacidae	Phalaropus fulicaria	Red Phalarope	Present	Occasional	Migratory
Ciconiiformes	Scolopacidae	Phalaropus lobatus	Red-necked Phalarope	Present	Rare	Migratory
Ciconiiformes	Scolopacidae	Phalaropus tricolor	Wilson's Phalarope	Unconfirmed	NA	NA
Ciconiiformes	Scolopacidae	Philomachus pugnax	Ruff	Unconfirmed	NA	NA
Ciconiiformes	Scolopacidae	Tringa flavipes	Lesser Yellowlegs	Present	Occasional	Migratory
Ciconiiformes	Scolopacidae	Tringa melanoleuca	Greater Yellowlegs	Present	Occasional	Migratory
Ciconiiformes	Scolopacidae	Tringa solitaria	Solitairy Sandpiper	Present	Rare	Migratory
Ciconiiformes	Threskiornithidae	Plegadis chihi	White-faced Ibis	Present	Occasional	Migratory
Columbiformes	Columbidae	Columba fasciata	Band-tailed Pigeon	Present	Common	Breeder
Columbiformes	Columbidae	Columba livia	Rock Dove	Present	Common	Breeder
Columbiformes	Columbidae	Zenaida macroura	Mourning Dove	Present	Rare	Breeder
Coraciiformes	Alcedinidae	Ceryle alcyon	Belted Kingfisher	Present	Common	Breeder
Cuculiformes	Cuculidae	Coccyzus americanus	Yellow-billed Cuckoo	Present	Occasional	Vagrant
Galliformes	Odontophoridae	Callipepla californica	California Quail	Present	Abundant	Breeder
Galliformes	Odontophoridae	Oreortyx pictus	Mountain Quail	Present	Uncommon	Breeder
Galliformes	Phasianidae	Bonasa umbellus	Ruffed Grouse	Present	Uncommon	Breeder

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Galliformes	Phasianidae	Dendragapus obscurus	Blue Grouse	Present	Uncommon	Breeder
Galliformes	Phasianidae	Meleagris gallopavo	Wild Turkey	Present	Occasional	Resident
Galliformes	Phasianidae	Phasianus colchicus	Ring-necked Pheasant	Present	Occasional	Resident
Gruiformes	Rallidae	Fulica americana	American Coot	Present	Abundant	Resident
Gruiformes	Rallidae	Gallinula chloropus	Common Moorhen	Present	Occasional	Vagrant
Gruiformes	Rallidae	Porzana carolina	Sora	Present	Occasional	Resident
Gruiformes	Rallidae	Rallus limicola	Virginia Rail	Present	Occasional	Breeder
Passeriformes	Aegithalidae	Psaltriparus minimus	Bushtit	Present	Occasional	Breeder
Passeriformes	Alaudidae	Eremophila alpestris	Horned Lark	Unconfirmed	NA	NA
Passeriformes	Bombycillidae	Bombycilla cedrorum	Cedar Waxwing	Present	Uncommon	Breeder
Passeriformes	Bombycillidae	Bombycilla garrulus	Bohemian Waxwing	Present	Occasional	Vagrant
Passeriformes	Certhiidae	Catherpes mexicanus	Canyon Wren	Present	Occasional	Vagrant
Passeriformes	Certhiidae	Certhia americana	Brown Creeper	Present	Common	Breeder
Passeriformes	Certhiidae	Cistothorus palustris	Marsh Wren	Present	Abundant	Breeder
Passeriformes	Certhiidae	Salpinctes obsoletus	Rock Wren	Present	Occasional	Migratory
Passeriformes	Certhiidae	Thryomanes bewickii	Bewick's Wren	Present	Occasional	Breeder
Passeriformes	Certhiidae	Troglodytes aedon	House Wren	Present	Occasional	Unknown
Passeriformes	Certhiidae	Troglodytes troglodytes	Winter Wren	Present	Abundant	Breeder
Passeriformes	Cinclidae	Cinclus mexicanus	American Dipper	Present	Uncommon	Breeder
Passeriformes	Corvidae	Aphelocoma coerulescens	Scrub Jay	Present	Rare	Breeder
Passeriformes	Corvidae	Corvus brachyrhynchos	American Crow	Present	Abundant	Breeder
Passeriformes	Corvidae	Corvus corax	Common Raven	Present	Common	Breeder
Passeriformes	Corvidae	Cyanocitta cristata	Blue Jay	Present	False Report	
Passeriformes	Corvidae	Cyanocitta stelleri	Steller's Jay	Present	Common	Breeder
Passeriformes	Corvidae	Nucifraga columbiana	Clark's Nutcracker	Present	Occasional	Vagrant
Passeriformes	Corvidae	Perisoreus canadensis	Gray Jay	Present	Uncommon	Breeder
Passeriformes	Fringillidae	Agelaius phoeniceus	Red-winged Blackbird	Present	Common	Breeder
Passeriformes	Fringillidae	Ammodramus savannarum	Grasshopper Sparrow	Present	Occasional	Resident
Passeriformes	Fringillidae	Amphispiza belli	Sage Sparrow	Present	Occasional	Vagrant
Passeriformes	Fringillidae	Amphispiza bilineata	Black-throated Sparrow	Present	Occasional	Vagrant
Passeriformes	Fringillidae	Aythya americana	Redhead	Present	Occasional	Resident
Passeriformes	Fringillidae	Calamospiza melanocorys	Lark Bunting	Present	Occasional	Migratory
Passeriformes	Fringillidae	Calcarius lapponicus	Lapland Longspur	Present	Occasional	Vagrant

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Passeriformes	Fringillidae	Calcarius ornatus	Chestnut-collared Longspur	Unconfirmed	NA	NA
Passeriformes	Fringillidae	Carduelis lawrencei	Lawrence's Goldfinch	Present	Occasional	Migratory
Passeriformes	Fringillidae	Carduelis pinus	Pine Siskin	Present	Rare	Breeder
Passeriformes	Fringillidae	Carduelis psaltria	Lesser Goldfinch	Present	Uncommon	Breeder
Passeriformes	Fringillidae	Carduelis tristis	American Goldfinch	Present	Common	Breeder
Passeriformes	Fringillidae	Carpodacus cassinii	Cassin's Finch	Present	Occasional	Breeder
Passeriformes	Fringillidae	Carpodacus mexicanus	House Finch	Present	Common	Breeder
Passeriformes	Fringillidae	Carpodacus purpureus	Purple Finch	Present	Uncommon	Breeder
Passeriformes	Fringillidae	Coccothraustes vespertinus	Evening Grosbeak	Present	Occasional	Resident
Passeriformes	Fringillidae	Dendroica coronata	Yellow-rumped Warbler	Present	Rare	Resident
Passeriformes	Fringillidae	Dendroica nigrescens	Black-throated Gray Warbler	Present	Uncommon	Breeder
Passeriformes	Fringillidae	Dendroica occidentalis	Hermit Warbler	Present	Uncommon	Breeder
Passeriformes	Fringillidae	Dendroica palmarum	Palm Warbler	Present	Rare	Vagrant
Passeriformes	Fringillidae	Dendroica petechia	Yellow Warbler	Present	Rare	Breeder
Passeriformes	Fringillidae	Dendroica townsendi	Townsend's Warbler	Present	Rare	Resident
Passeriformes	Fringillidae	Dendroica virens	Black-throated Green Warbler	Unconfirmed	NA	NA
Passeriformes	Fringillidae	Dolichonyx oryzivorus	Bobolink	Present	Occasional	Vagrant
Passeriformes	Fringillidae	Euphagus carolinus	Rusty Blackbird	Present	Occasional	Vagrant
Passeriformes	Fringillidae	Euphagus cyanocephalus	Brewer's Blackbird	Present	Abundant	Breeder
Passeriformes	Fringillidae	Geothlypis trichas	Common Yellowthroat	Present	Common	Breeder
Passeriformes	Fringillidae	Guiraca caerulea	Blue Grosbeak	Present	Occasional	Vagrant
Passeriformes	Fringillidae	Icteria virens	Yellow-breasted Chat	Present	Occasional	Unknown
Passeriformes	Fringillidae	Icterus bullockii	Bullock's Oriole	Present	Occasional	Breeder
Passeriformes	Fringillidae	Icterus cucullatus	Hooded Oriole	Unconfirmed	NA	NA
Passeriformes	Fringillidae	Icterus spurius	Orchard Oriole	Present	Occasional	Vagrant
Passeriformes	Fringillidae	Junco hyemalis	Dark-eyed Junco	Present	Common	Breeder
Passeriformes	Fringillidae	Loxia curvirostra	Red Crossbill	Present	Uncommon	Breeder
Passeriformes	Fringillidae	Melospiza georgiana	Swamp Sparrow	Present	Occasional	Vagrant
Passeriformes	Fringillidae	Melospiza lincolnii	Lincoln's Sparrow	Present	Occasional	Resident
Passeriformes	Fringillidae	Melospiza melodia	Song Sparrow	Present	Common	Breeder
Passeriformes	Fringillidae	Mniotilta varia	Black-and-white Warbler	Unconfirmed	NA	NA
Passeriformes	Fringillidae	Molothrus ater	Brown-headed Cowbird	Present	Uncommon	Breeder
Passeriformes	Fringillidae	Oporornis tolmiei	MacGillivray's Warbler	Present	Occasional	Unknown

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Passeriformes	Fringillidae	Parula americana	Northern Parula Warbler	Present	Occasional	Vagrant
Passeriformes	Fringillidae	Passerculus sandwichensis	Savannah Sparrow	Present	Rare	Breeder
Passeriformes	Fringillidae	Passerella iliaca	Fox Sparrow	Present	Rare	Resident
Passeriformes	Fringillidae	Passerina amoena	Lazuli Bunting	Present	Common	Breeder
Passeriformes	Fringillidae	Pheucticus melanocephalus	Black-headed Grosbeak	Present	Common	Breeder
Passeriformes	Fringillidae	Pinicola enucleator	Pine Grosbeak	Unconfirmed		
Passeriformes	Fringillidae	Pipilo crissalis	California Towhee	Unconfirmed	NA	NA
Passeriformes	Fringillidae	Pipilo maculatus	Spotted Towhee	Present	Common	Breeder
Passeriformes	Fringillidae	Piranga ludoviciana	Western Tanager	Present	Uncommon	Breeder
Passeriformes	Fringillidae	Plectrophenax nivalis	Snow Bunting	Present	Occasional	Migratory
Passeriformes	Fringillidae	Pooecetes gramineus	Vesper Sparrow	Present	Occasional	Migratory
Passeriformes	Fringillidae	Protonotaria citrea	Prothonotary Warbler	Present	Occasional	Vagrant
Passeriformes	Fringillidae	Seiurus aurocapillus	Ovenbird	Unconfirmed	NA	NA
Passeriformes	Fringillidae	Setophaga ruticilla	American Redstart	Present	Occasional	Unknown
Passeriformes	Fringillidae	Spizella arborea	American Tree Sparrow	Present	Occasional	Migratory
Passeriformes	Fringillidae	Spizella breweri	Brewer's Sparrow	Present	Occasional	Migratory
Passeriformes	Fringillidae	Spizella passerina	Chipping Sparrow	Present	Rare	Breeder
Passeriformes	Fringillidae	Sturnella neglecta	Western Meadowlark	Present	Common	Breeder
Passeriformes	Fringillidae	Vermivora celata	Orange-crowned Warbler	Present	Common	Breeder
Passeriformes	Fringillidae	Vermivora ruficapilla	Nashville Warbler	Present	Occasional	Resident
Passeriformes	Fringillidae	Wilsonia pusilla	Wilson's Warbler	Present	Abundant	Breeder
Passeriformes	Fringillidae	Xanthocephalus xanthocephalus	Yellow-headed Blackbird	Present	Occasional	Migratory
Passeriformes	Fringillidae	Zonotrichia albicollis	White-throated Sparrow	Unconfirmed	NA	NA
Passeriformes	Fringillidae	Zonotrichia atricapilla	Golden-crowned Sparrow	Present	Rare	Resident
Passeriformes	Fringillidae	Zonotrichia leucophrys	White-crowned Sparrow	Present	Abundant	Breeder
Passeriformes	Fringillidae	Zonotrichia querula	Harris' Sparrow	Present	Occasional	Migratory
Passeriformes	Hirundinidae	Hirundo pyrrhonota	Cliff Swallow	Present	Abundant	Breeder
Passeriformes	Hirundinidae	Hirundo rustica	Barn Swallow	Present	Abundant	Breeder
Passeriformes	Hirundinidae	Progne subis	Purple Martin	Present	Rare	Breeder
Passeriformes	Hirundinidae	Riparia riparia	Bank Swallow	Unconfirmed	NA	NA
Passeriformes	Hirundinidae	Stelgidopteryx serripennis	Northern Rough-winged Swallow	Present	Abundant	Breeder
Passeriformes	Hirundinidae	Tachycineta bicolor	Tree Swallow	Present	Common	Breeder
Passeriformes	Hirundinidae	Tachycineta thalassina	Violet-green Swallow	Present	Common	Breeder

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Passeriformes	Icteridae	Quiscalus quiscula	Common Grackle	Present	Occasional	Vagrant
Passeriformes	Laniidae	Lanius excubitor	Northern Shrike	Present	Occasional	Migratory
Passeriformes	Laniidae	Lanius ludovicianus	Loggerhead Shrike	Unconfirmed	NA	NA
Passeriformes	Muscicapidae	Catharus guttatus	Hermit Thrush	Present	Common	Breeder
Passeriformes	Muscicapidae	Catharus ustulatus	Swainson's Thrush	Present	Abundant	Breeder
Passeriformes	Muscicapidae	Myadestes townsendi	Townsend's Solitaire	Present	Occasional	Breeder
Passeriformes	Muscicapidae	Sialia currucoides	Mountain Bluebird	Present	Occasional	Migratory
Passeriformes	Muscicapidae	Sialia mexicana	Western Bluebird	Present	Uncommon	Breeder
Passeriformes	Muscicapidae	Turdus migratorius	American Robin	Present	Abundant	Breeder
Passeriformes	Paridae	Parus atricapillus	Black-capped Chickadee	Present	Uncommon	Breeder
Passeriformes	Paridae	Parus gambeli	Mountain Chickadee	Present	Occasional	Resident
Passeriformes	Paridae	Parus rufescens	Chestnut-backed Chickadee	Present	Abundant	Breeder
Passeriformes	Passeridae	Anthus rubescens	American Pipit	Present	Rare	Resident
Passeriformes	Passeridae	Passer domesticus	House Sparrow	Present	Common	Breeder
Passeriformes	Regulidae	Regulus calendula	Ruby-crowned Kinglet	Present	Abundant	Resident
Passeriformes	Regulidae	Regulus satrapa	Golden-crowned Kinglet	Present	Abundant	Breeder
Passeriformes	Sittidae	Sitta canadensis	Red-breasted Nuthatch	Present	Uncommon	Breeder
Passeriformes	Sittidae	Sitta carolinensis	White-breasted Nuthatch	Present	Occasional	Migratory
Passeriformes	Sturnidae	Dumetella carolinensis	Gray Catbird	Present	Occasional	Vagrant
Passeriformes	Sturnidae	Mimus polyglottos	Northern Mockingbird	Present	Occasional	Resident
Passeriformes	Sturnidae	Sturnus vulgaris	European Starling	Present	Abundant	Breeeder
Passeriformes	Sylviidae	Chamaea fasciata	Wrentit	Present	Abundant	Breeder
Passeriformes	Turdidae	Ixoreus naevius	Varied Thrush	Present	Abundant	Breeder
Passeriformes	Tyrannidae	Contopus cooperi	Olive-sided Flycatcher	Present	Occasional	Unknown
Passeriformes	Tyrannidae	Contopus sordidulus	Western Wood-pewee	Present	Uncommon	Breeder
Passeriformes	Tyrannidae	Empidonax difficilis	Pacific-slope Flycatcher	Present	Abundant	Breeder
Passeriformes	Tyrannidae	Empidonax hammondii	Hammond's Flycatcher	Present	Unconfirmed	NA
Passeriformes	Tyrannidae	Empidonax oberholseri	Dusky Flycatcher	Present	Unconfirmed	NA
Passeriformes	Tyrannidae	Empidonax traillii	Willow Flycatcher	Present	Occasional	Resident
Passeriformes	Tyrannidae	Myiarchus cinerascens	Ash-throated Flycatcher	Present	Occasional	Migratory
Passeriformes	Tyrannidae	Sayornis nigricans	Black Phoebe	Present	Common	Breeder
Passeriformes	Tyrannidae	Sayornis saya	Say's Phoebe	Present	Occasional	Resident
Passeriformes	Tyrannidae	Tyrannus melancholicus	Tropical Kingbird	Present	Occasional	Vagrant

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Passeriformes	Tyrannidae	Tyrannus tyrannus	Eastern Kingbird	Present	Occasional	Vagrant
Passeriformes	Tyrannidae	Tyrannus verticalis	Western Kingbird	Present	Occasional	Migratory
Passeriformes	Vireonidae	Vireo cassinii	Cassin's Vireo	Present	Rare	Breeder
Passeriformes	Vireonidae	Vireo gilvus	Warbling Vireo	Present	Uncommon	Breeder
Passeriformes	Vireonidae	Vireo huttoni	Hutton's Vireo	Present	Common	Breeder
Piciformes	Picidae	Colaptes auratus	Northern Flicker	Present	Common	Breeder
Piciformes	Picidae	Dryocopus pileatus	Pileated Woodpecker	Present	Uncommon	Breeder
Piciformes	Picidae	Melanerpes erythrocephalus	Red-headed Woodpecker	Unconfirmed		
Piciformes	Picidae	Melanerpes formicivorus	Acorn Woodpecker	Present	Common	Breeder
Piciformes	Picidae	Melanerpes lewis	Lewis' Woodpecker	Present	Occasional	Migratory
Piciformes	Picidae	Picoides pubescens	Downy Woodpecker	Present	Uncommon	Breeder
Piciformes	Picidae	Picoides villosus	Hairy Woodpecker	Present	Uncommon	Breeder
Piciformes	Picidae	Sphyrapicus ruber	Red-breasted Sapsucker	Present	Uncommon	Breeder
Piciformes	Picidae	Sphyrapicus varius	Yellow-bellied Sapsucker	Present	Occasional	Vagrant
Strigiformes	Caprimulgidae	Chordeiles minor	Common Nighthawk	Present	Rare	Resident
Strigiformes	Caprimulgidae	Phalaenoptilus nuttallii	Common Poorwill	Unconfirmed	NA	NA
Strigiformes	Strigidae	Aegolius acadicus	Northern Saw-whet Owl	Present	Uncommon	Breeder
Strigiformes	Strigidae	Asio flammeus	Short-eared Owl	Present	Occasional	Resident
Strigiformes	Strigidae	Athene cunicularia	Burrowing Owl	Present	Occasional	Migratory
Strigiformes	Strigidae	Bubo virginianus	Great Horned Owl	Present	Uncommon	Breeder
Strigiformes	Strigidae	Glaucidium gnoma	Northern Pygmy Owl	Present	Uncommon	Breeder
Strigiformes	Strigidae	Nyctea scandiaca	Snowy Owl	Present	Occasional	Vagrant
Strigiformes	Strigidae	Otus flammeolus	Flammulated Owl	Unconfirmed		
Strigiformes	Strigidae	Otus kennicottii	Western Screech Owl	Present	Uncommon	Breeder
Strigiformes	Strigidae	Strix nebulosa	Great Gray Owl	Present	Occasional	Vagrant
Strigiformes	Strigidae	Strix occidentalis	Spotted Owl	Present	Uncommon	Breeder
Strigiformes	Strigidae	Strix varia	Barred Owl	Present	Common	Breeder
Strigiformes	Tytonidae	Tyto alba	Barn Owl	Present	Rare	Breeder
Passeriformes	Tyrannidae	Empidonax traillii	Willow Flycatcher	Present	Occasional	Resident
Passeriformes	Tyrannidae	Myiarchus cinerascens	Ash-throated Flycatcher	Present	Occasional	Migratory
Passeriformes	Tyrannidae	Sayornis nigricans	Black Phoebe	Present	Common	Breeder
Passeriformes	Tyrannidae	Sayornis saya	Say's Phoebe	Present	Occasional	Resident
Passeriformes	Tyrannidae	Tyrannus melancholicus	Tropical Kingbird	Present	Occasional	Vagrant

Whiskeytown National Recreation Area

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Anseriformes	Anatidae	Aix sponsa	Wood Duck	Present in Park	Uncommon	Breeder
Anseriformes	Anatidae	Anas acuta	Northern Pintail	Present in Park	Uncommon	Migratory
Anseriformes	Anatidae	Anas americana	American Wigeon	Present in Park	Uncommon	Migratory
Anseriformes	Anatidae	Anas clypeata	Northern Shoveler	Present in Park	Uncommon	Migratory
Anseriformes	Anatidae	Anas crecca	Eurasian Teal, Green-winged Teal	Present in Park	Uncommon	Migratory
Anseriformes	Anatidae	Anas cyanoptera	Cinnamon Teal	Probably Present	NA	NA
Anseriformes	Anatidae	Anas platyrhynchos	Mallard	Present in Park	Common	Breeder
Anseriformes	Anatidae	Anas strepera	Gadwall	Present in Park	Uncommon	Migratory
Anseriformes	Anatidae	Anser albifrons	Greater White-fronted Goose	Present in Park	Rare	Migratory
Anseriformes	Anatidae	Aythya affinis	Lesser Scaup	Present in Park	Uncommon	Migratory
Anseriformes	Anatidae	Aythya americana	Redhead	Present in Park	Rare	Migratory
Anseriformes	Anatidae	Aythya collaris	Ring-necked Duck	Present in Park	Common	Resident
Anseriformes	Anatidae	Aythya marila	Greater Scaup	Present in Park	Rare	Migratory
Anseriformes	Anatidae	Aythya valisineria	Canvasback	Present in Park	Uncommon	Migratory
Anseriformes	Anatidae	Branta canadensis	Canada Goose	Present in Park	Abundant	Breeder
Anseriformes	Anatidae	Bucephala albeola	Bufflehead	Present in Park	Abundant	Resident
Anseriformes	Anatidae	Bucephala clangula	Common Goldeneye	Present in Park	Uncommon	Migratory
Anseriformes	Anatidae	Bucephala islandica	Barrow's Goldeneye	Probably Present	NA	NA
Anseriformes	Anatidae	Chen caerulescens	Blue Goose, Snow Goose	Present in Park	Rare	Migratory
Anseriformes	Anatidae	Chen rossii	Ross' Goose, Ross's Goose	Probably Present	NA	NA
Anseriformes	Anatidae	Cygnus columbianus	Tundra Swan	Present in Park	Rare	Migratory
Anseriformes	Anatidae	Lophodytes cucullatus	Hooded Merganser	Present in Park	Common	Resident
Anseriformes	Anatidae	Melanitta perspicillata	Surf Scoter	Unconfirmed	NA	NA
Anseriformes	Anatidae	Mergus merganser	Common Merganser	Present in Park	Common	Breeder
Anseriformes	Anatidae	Mergus serrator	Red-breasted Merganser	Present in Park	Rare	Migratory
Anseriformes	Anatidae	Oxyura jamaicensis	Ruddy Duck	Present in Park	Common	Resident
Apodiformes	Apodidae	Chaetura vauxi	Vaux's Swift	Probably Present	NA	NA
Apodiformes	Apodidae	Cypseloides niger	American Black Swift, Black Swift	Unconfirmed	NA	NA
Apodiformes	Trochilidae	Archilochus alexandri	Black-chinned Hummingbird	Probably Present	NA	NA
Apodiformes	Trochilidae	Calypte anna	Anna's Hummingbird	Present in Park	Common	Breeder
Apodiformes	Trochilidae	Selasphorus rufus	Rufous Hummingbird	Present in Park	Uncommon	Breeder
Apodiformes	Trochilidae	Selasphorus sasin	Allen's Hummingbird	Unconfirmed	NA	NA

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Apodiformes	Trochilidae	Stellula calliope	Calliope Hummingbird	Probably Present	NA	NA
Ciconiiformes	Accipitridae	Accipiter cooperii	Cooper's Hawk	Present in Park	Uncommon	Breeder
Ciconiiformes	Accipitridae	Accipiter gentilis	Northern Goshawk	Present in Park	Occasional	Resident
Ciconiiformes	Accipitridae	Accipiter striatus	Sharp-shinned Hawk	Present in Park	Uncommon	Resident
Ciconiiformes	Accipitridae	Aquila chrysaetos	Golden Eagle	Present in Park	Rare	Migratory
Ciconiiformes	Accipitridae	Buteo jamaicensis	Red-tailed Hawk	Present in Park	Common	Breeder
Ciconiiformes	Accipitridae	Haliaeetus leucocephalus	Bald Eagle	Present in Park	Common	Breeder
Ciconiiformes	Accipitridae	Pandion haliaetus	Osprey	Present in Park	Common	Breeder
Ciconiiformes	Ardeidae	Ardea herodias	Great Blue Heron	Present in Park	Common	Breeder
Ciconiiformes	Ardeidae	Botaurus lentiginosus	American Bittern	Encroaching	NA	NA
Ciconiiformes	Ardeidae	Butorides striatus	Green-backed Heron	Present in Park	Uncommon	Resident
Ciconiiformes	Ardeidae	Butorides virescens	Green Heron	Present in Park	Uncommon	Resident
Ciconiiformes	Ardeidae	Casmerodius albus	Great Egret	Present in Park	Rare	Resident
Ciconiiformes	Charadriidae	Charadrius vociferus	Killdeer	Present in Park	Common	Breeder
Ciconiiformes	Ciconiidae	Cathartes aura	Turkey Vulture	Present in Park	Abundant	Breeder
Ciconiiformes	Falconidae	Falco columbarius	Merlin	Present in Park	Rare	Migratory
Ciconiiformes	Falconidae	Falco mexicanus	Prairie Falcon	Probably Present	NA	NA
Ciconiiformes	Falconidae	Falco peregrinus, Falco peregrinus anatum	Peregrine Falcon	Present in Park	Rare	Migratory
Ciconiiformes	Falconidae	Falco sparverius	American Kestrel	Present in Park	Rare	Resident
Ciconiiformes	Gaviidae	Gavia immer	Common Loon, Great Northern Loon	Present in Park	Uncommon	Migratory
Ciconiiformes	Laridae	Larus argentatus	Herring Gull	Present in Park	Uncommon	Resident
Ciconiiformes	Laridae	Larus californicus	California Gull	Present in Park	Common	Resident
Ciconiiformes	Laridae	Larus delawarensis	Ring-billed Gull	Present in Park	Common	Resident
Ciconiiformes	Laridae	Larus glaucescens	Glaucous-winged Gull	Present in Park	Rare	Migratory
Ciconiiformes	Laridae	Larus philadelphia	Bonaparte's Gull	Unconfirmed	NA	NA
Ciconiiformes	Laridae	Larus thayeri	Thayer's Gull	Present in Park	Occasional	Migratory
Ciconiiformes	Laridae	Sterna caspia	Caspian Tern	Probably Present	NA	NA
Ciconiiformes	Laridae	Sterna forsteri	Forster's Tern	Encroaching	NA	NA
Ciconiiformes	Pelecanidae	Pelecanus erythrorhynchos	American White Pelican	Present in Park	Occasional	Migratory
Ciconiiformes	Phalacrocoracidae	Phalacrocorax auritus	Double-crested Cormorant	Present in Park	Common	Resident
Ciconiiformes	Podicipedidae	Aechmophorus occidentalis	Western Grebe	Present in Park	Common	Resident
Ciconiiformes	Podicipedidae	Podiceps auritus	Horned Grebe	Present in Park	Common	Resident
Ciconiiformes	Podicipedidae	Podiceps grisegena	Red-necked Grebe	Present in Park	Occasional	Migratory

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Ciconiiformes	Podicipedidae	Podiceps nigricollis	Black-necked Grebe, Eared Grebe	Present in Park	Abundant	Resident
Ciconiiformes	Podicipedidae	Podilymbus podiceps	Pied-billed Grebe	Present in Park	Abundant	Resident
Ciconiiformes	Scolopacidae	Actitis macularia	Spotted Sandpiper	Present in Park	Uncommon	Breeder
Ciconiiformes	Scolopacidae	Calidris bairdii	Baird's Sandpiper	Unconfirmed	NA	NA
Ciconiiformes	Scolopacidae	Calidris minutilla	Least Sandpiper	Probably Present	NA	NA
Ciconiiformes	Scolopacidae	Gallinago gallinago	Common Snipe	Present in Park	Rare	Migratory
Ciconiiformes	Scolopacidae	Phalaropus lobatus	Red-necked Phalarope	Historic	NA	NA
Ciconiiformes	Scolopacidae	Phalaropus tricolor	Wilson's Phalarope	Encroaching	NA	NA
Ciconiiformes	Scolopacidae	Tringa melanoleuca	Greater Yellowlegs	Encroaching	NA	NA
Columbiformes	Columbidae	Columba fasciata	Band-tailed Pigeon	Present in Park	Abundant	Breeder
Columbiformes	Columbidae	Columba livia	Common Pigeon, Rock Dove, Rock Pigeon	Present in Park	Uncommon	Resident
Columbiformes	Columbidae	Zenaida macroura	Mourning Dove	Present in Park	Common	Breeder
Coraciiformes	Alcedinidae	Ceryle alcyon	Belted Kingfisher	Present in Park	Common	Breeder
Cuculiformes	Cuculidae	Geococcyx californianus	Greater Roadrunner	Present in Park	Rare	Breeder
Galliformes	Odontophoridae	Callipepla californica	California Quail, Californian Quail	Present in Park	Abundant	Breeder
Galliformes	Odontophoridae	Oreortyx pictus	Mountain Quail	Present in Park	Abundant	Breeder
Galliformes	Phasianidae	Bonasa umbellus	Ruffed Grouse	Probably Present	NA	NA
Galliformes	Phasianidae	Dendragapus obscurus	Blue Grouse	Present in Park	Rare	Breeder
Galliformes	Phasianidae	Meleagris gallopavo	Wild Turkey	Present in Park	Uncommon	Breeder
Gruiformes	Rallidae	Fulica americana	American Coot	Present in Park	Abundant	Resident
Gruiformes	Rallidae	Porzana carolina	Sora	Probably Present	NA	NA
Gruiformes	Rallidae	Rallus limicola	Virginia Rail	Probably Present	NA	NA
Passeriformes	Aegithalidae	Psaltriparus minimus	American Bushtit, Bushtit	Present in Park	Common	Breeder
Passeriformes	Aegithalidae	Psaltriparus minimus minimus		Present in Park	Common	Breeder
Passeriformes	Bombycillidae	Bombycilla cedrorum	Cedar Waxwing	Present in Park	Uncommon	Resident
Passeriformes	Bombycillidae	Bombycilla garrulus pallidiceps		Historic	NA	NA
Passeriformes	Cardinalidae	Passerina amoena	Lazuli Bunting	Present in Park	Common	Breeder
Passeriformes	Cardinalidae	Pheucticus melanocephalus	Black-headed Grosbeak	Present in Park	Abundant	Breeder
Passeriformes	Certhiidae	Certhia americana	Brown Creeper	Present in Park	Common	Breeder
Passeriformes	Certhiidae	Polioptila caerulea	Blue-gray Gnatcatcher, Blue-grey Gnatcatcher	Present in Park	Uncommon	Breeder
Passeriformes	Cinclidae	Cinclus mexicanus	American Dipper	Present in Park	Common	Breeder
Passeriformes	Corvidae	Aphelocoma californica, Aphelocoma coerulescens	Western Scrub Jay, Western Scrub-Jay	Present in Park	Abundant	Breeder

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Passeriformes	Corvidae	Corvus brachyrhynchos	American Crow	Present in Park	Uncommon	Resident
Passeriformes	Corvidae	Corvus corax	Common Raven, Northern Raven	Present in Park	Abundant	Breeder
Passeriformes	Corvidae	Cyanocitta stelleri	Steller's Jay	Present in Park	Abundant	Breeder
Passeriformes	Corvidae	Nucifraga columbiana	Clark's Nutcracker	Present in Park	Uncommon	Resident
Passeriformes	Emberizidae	Amphispiza belli	Sage Sparrow	Probably Present	NA	NA
Passeriformes	Emberizidae	Chondestes grammacus	Lark Sparrow	Present in Park	Uncommon	Breeder
Passeriformes	Emberizidae	Junco hyemalis	Dark-eyed Junco	Present in Park	Abundant	Breeder
Passeriformes	Emberizidae	Melospiza lincolnii	Lincoln's Sparrow	Present in Park	Uncommon	Resident
Passeriformes	Emberizidae	Melospiza melodia	Song Sparrow	Present in Park	Common	Breeder
Passeriformes	Emberizidae	Passerella iliaca	Fox Sparrow	Present in Park	Common	Breeder
Passeriformes	Emberizidae	Pipilo chlorurus	Green-tailed Towhee	Encroaching	NA	NA
Passeriformes	Emberizidae	Pipilo crissalis, Pipilo fuscus	California Towhee	Present in Park	Uncommon	Breeder
Passeriformes	Emberizidae	Pipilo erythrophthalmus, Pipilo maculatus	Spotted Towhee	Present in Park	Abundant	Breeder
Passeriformes	Emberizidae	Spizella passerina	Chipping Sparrow	Present in Park	Uncommon	Resident
Passeriformes	Emberizidae	Zonotrichia albicollis	White-throated Sparrow	Unconfirmed	NA	NA
Passeriformes	Emberizidae	Zonotrichia atricapilla	Golden-crowned Sparrow	Present in Park	Uncommon	Resident
Passeriformes	Emberizidae	Zonotrichia leucophrys	White-crowned Sparrow	Present in Park	Abundant	Resident
Passeriformes	Fringillidae	Carduelis lawrencei	Lawrence's Goldfinch	Probably Present	NA	NA
Passeriformes	Fringillidae	Carduelis pinus	Pine Siskin	Present in Park	Uncommon	Resident
Passeriformes	Fringillidae	Carduelis psaltria	Lesser Goldfinch	Present in Park	Abundant	Breeder
Passeriformes	Fringillidae	Carduelis tristis	American Goldfinch	Present in Park	Common	Resident
Passeriformes	Fringillidae	Carpodacus cassinii	Cassin's Finch	Probably Present	NA	NA
Passeriformes	Fringillidae	Carpodacus mexicanus	House Finch	Present in Park	Common	Breeder
Passeriformes	Fringillidae	Carpodacus purpureus	Purple Finch	Present in Park	Common	Breeder
Passeriformes	Fringillidae	Coccothraustes vespertinus	Evening Grosbeak	Present in Park	Uncommon	Breeder
Passeriformes	Fringillidae	Loxia curvirostra	Red Crossbill	Present in Park	Rare	Resident
Passeriformes	Hirundinidae	Hirundo pyrrhonota, Petrochelidon pyrrhonota	American Cliff Swallow, Cliff Swallow	Present in Park	Common	Breeder
Passeriformes	Hirundinidae	Hirundo rustica	Barn Swallow	Present in Park	Common	Breeder
Passeriformes	Hirundinidae	Progne subis	Purple Martin	Probably Present	NA	NA
Passeriformes	Hirundinidae	Riparia riparia	Bank Swallow, Sand Martin	Present in Park	Occasional	Migratory
Passeriformes	Hirundinidae	Stelgidopteryx serripennis	Northern Rough-winged Swallow	Present in Park	Common	Breeder
Passeriformes	Hirundinidae	Tachycineta bicolor	Tree Swallow	Present in Park	Common	Breeder
Passeriformes	Hirundinidae	Tachycineta thalassina	Violet-green Swallow	Present in Park	Uncommon	Breeder

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Passeriformes	Icteridae	Agelaius phoeniceus	Red-winged Blackbird	Present in Park	Common	Breeder
Passeriformes	Icteridae	Euphagus cyanocephalus	Brewer's Blackbird	Present in Park	Abundant	Breeder
Passeriformes	Icteridae	Icterus bullockii, Icterus galbula	Baltimore Oriole, Northern Oriole	Present in Park	Common	Breeder
Passeriformes	Icteridae	Molothrus ater	Brown-headed Cowbird	Present in Park	Common	Breeder
Passeriformes	Icteridae	Sturnella neglecta	Western Meadowlark	Present in Park	Uncommon	Resident
Passeriformes	Laniidae	Lanius ludovicianus	Loggerhead Shrike	Encroaching	NA	NA
Passeriformes	Mimidae	Mimus polyglottos	Northern Mockingbird	Present in Park	Uncommon	Resident
Passeriformes	Mimidae	Toxostoma redivivum	California Thrasher	Present in Park	Uncommon	Breeder
Passeriformes	Motacillidae	Anthus rubescens	American Pipit, Buff-bellied Pipit	Present in Park	Rare	Resident
Passeriformes	Paridae	Baeolophus inornatus, Parus inornatus	Oak Titmouse	Present in Park	Common	Breeder
Passeriformes	Paridae	Parus gambeli, Poecile gambeli	Mountain Chickadee	Present in Park	Common	Breeder
Passeriformes	Paridae	Parus rufescens, Poecile rufescens	Chestnut-backed Chickadee	Present in Park	Uncommon	Resident
Passeriformes	Parulidae	Dendroica auduboni, Dendroica coronata auduboni		Present in Park	Common	Breeder
Passeriformes	Parulidae	Dendroica coronata	Yellow-rumped Warbler	Present in Park	Common	Breeder
Passeriformes	Parulidae	Dendroica nigrescens	Black-throated Gray Warbler, Black-throated Grey Warbler	Present in Park	Common	Breeder
Passeriformes	Parulidae	Dendroica occidentalis	Hermit Warbler	Probably Present	NA	NA
Passeriformes	Parulidae	Dendroica petechia	American Yellow Warbler, Yellow Warbler	Present in Park	Uncommon	Breeder
Passeriformes	Parulidae	Dendroica townsendi	Townsend's Warbler	Unconfirmed	NA	NA
Passeriformes	Parulidae	Geothlypis trichas	Common Yellowthroat	Probably Present	NA	NA
Passeriformes	Parulidae	Icteria virens	Yellow-breasted Chat	Present in Park	Common	Breeder
Passeriformes	Parulidae	Oporornis tolmiei	MacGillivray's Warbler	Present in Park	Common	Breeder
Passeriformes	Parulidae	Vermivora celata	Orange-crowned Warbler	Present in Park	Common	Breeder
Passeriformes	Parulidae	Vermivora ruficapilla	Nashville Warbler	Present in Park	Common	Breeder
Passeriformes	Parulidae	Wilsonia pusilla	Wilson's Warbler	Present in Park	Uncommon	Migratory
Passeriformes	Passeridae	Passer domesticus	House Sparrow	Present in Park	Common	Breeder
Passeriformes	Regulidae	Regulus calendula	Ruby-crowned Kinglet	Present in Park	Common	Resident
Passeriformes	Regulidae	Regulus satrapa	Golden-crowned Kinglet	Present in Park	Common	Breeder
Passeriformes	Sittidae	Sitta canadensis	Red-breasted Nuthatch	Present in Park	Common	Breeder
Passeriformes	Sittidae	Sitta carolinensis	White-breasted Nuthatch	Present in Park	Common	Breeder
Passeriformes	Sittidae	Sitta pygmaea	Pygmy Nuthatch	Present in Park	Uncommon	Breeder
Passeriformes	Sturnidae	Sturnus vulgaris	Common Starling, European Starling	Present in Park	Common	Breeder

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Passeriformes	Sylviidae	Chamaea fasciata	Wrentit	Present in Park	Common	Breeder
Passeriformes	Thraupidae	Piranga ludoviciana	Western Tanager	Present in Park	Common	Breeder
Passeriformes	Troglodytidae	Catherpes mexicanus	Canyon Wren	Present in Park	Rare	Breeder
Passeriformes	Troglodytidae	Cistothorus palustris	Marsh Wren	Encroaching	NA	NA
Passeriformes	Troglodytidae	Salpinctes obsoletus	Rock Wren	Probably Present	NA	NA
Passeriformes	Troglodytidae	Thryomanes bewickii	Bewick's Wren	Present in Park	Common	Breeder
Passeriformes	Troglodytidae	Troglodytes aedon	House Wren	Present in Park	Common	Breeder
Passeriformes	Troglodytidae	Troglodytes troglodytes	Winter Wren	Present in Park	Common	Breeder
Passeriformes	Turdidae	Catharus guttatus	Hermit Thrush	Present in Park	Uncommon	Resident
Passeriformes	Turdidae	Catharus ustulatus	Swainson's Thrush	Probably Present	NA	NA
Passeriformes	Turdidae	Ixoreus naevius	Varied Thrush	Present in Park	Uncommon	Resident
Passeriformes	Turdidae	Myadestes townsendi	Townsend's Solitaire	Present in Park	Uncommon	Breeder
Passeriformes	Turdidae	Sialia currucoides	Mountain Bluebird	Encroaching	NA	NA
Passeriformes	Turdidae	Sialia mexicana	Western Bluebird	Present in Park	Common	Breeder
Passeriformes	Turdidae	Turdus migratorius	American Robin	Present in Park	Abundant	Breeder
Passeriformes	Tyrannidae	Contopus borealis, Contopus cooperi	Olive-sided Flycatcher	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Contopus sordidulus	Western Wood Pewee, Western Wood-Pewee	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Empidonax difficilis	Pacific-slope Flycatcher, Western Flycatcher	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Empidonax hammondii	Hammond's Flycatcher	Probably Present	NA	NA
Passeriformes	Tyrannidae	Empidonax oberholseri	Dusky Flycatcher	Present in Park	Uncommon	Breeder
Passeriformes	Tyrannidae	Empidonax traillii	Willow Flycatcher	Probably Present	NA	NA
Passeriformes	Tyrannidae	Empidonax traillii brewsteri		Probably Present	NA	NA
Passeriformes	Tyrannidae	Myiarchus cinerascens	Ash-throated Flycatcher	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Sayornis nigricans	Black Phoebe	Present in Park	Common	Breeder
Passeriformes	Tyrannidae	Tyrannus verticalis	Western Kingbird	Probably Present	NA	NA
Passeriformes	Vireonidae	Vireo cassinii, Vireo solitarius	Cassin's Vireo	Present in Park	Common	Breeder
Passeriformes	Vireonidae	Vireo gilvus	Warbling Vireo	Present in Park	Uncommon	Breeder
Passeriformes	Vireonidae	Vireo huttoni	Hutton's Vireo	Present in Park	Common	Breeder
Piciformes	Picidae	Colaptes auratus	Northern Flicker	Present in Park	Abundant	Breeder
Piciformes	Picidae	Dryocopus pileatus	Pileated Woodpecker	Present in Park	Rare	Breeder
Piciformes	Picidae	Melanerpes formicivorus	Acorn Woodpecker	Present in Park	Abundant	Breeder
Piciformes	Picidae	Melanerpes lewis	Lewis' Woodpecker, Lewis's Woodpecker	Present in Park	Occasional	Migratory

Order	Family	Scientific Names	Common Names	Park-Status	Abundance	Residency
Piciformes	Picidae	Picoides albolarvatus	White-headed Woodpecker	Probably Present	NA	NA
Piciformes	Picidae	Picoides nuttallii	Nuttall's Woodpecker	Present in Park	Uncommon	Breeder
Piciformes	Picidae	Picoides pubescens	Downy Woodpecker	Present in Park	Common	Breeder
Piciformes	Picidae	Picoides villosus	Hairy Woodpecker	Present in Park	Common	Breeder
Piciformes	Picidae	Sphyrapicus nuchalis	Red-naped Sapsucker	Unconfirmed	NA	NA
Piciformes	Picidae	Sphyrapicus ruber	Red-breasted Sapsucker	Present in Park	Uncommon	Breeder
Piciformes	Picidae	Sphyrapicus thyroideus	Williamson's Sapsucker	Unconfirmed	NA	NA
Strigiformes	Caprimulgidae	Chordeiles minor	Common Nighthawk	Present in Park	Rare	Breeder
Strigiformes	Caprimulgidae	Phalaenoptilus nuttallii	Common Poorwill	Present in Park	Rare	Breeder
Strigiformes	Strigidae	Aegolius acadicus	Northern Saw-whet Owl	Present in Park	Rare	Breeder
Strigiformes	Strigidae	Asio otus	Long-eared Owl	Unconfirmed	NA	NA
Strigiformes	Strigidae	Bubo virginianus	Great Horned Owl	Present in Park	Common	Breeder
Strigiformes	Strigidae	Glaucidium gnoma	Mountain Pygmy Owl, Northern Pygmy-Owl	Present in Park	Common	Breeder
Strigiformes	Strigidae	Otus flammeolus	Flammulated Owl	Probably Present	NA	NA
Strigiformes	Strigidae	Otus kennicottii	Western Screech-Owl	Present in Park	Common	Breeder
Strigiformes	Strigidae	Strix occidentalis, Strix occidentalis caurina	Northern Spotted Owl	Present in Park	Rare	Breeder
Strigiformes	Tytonidae	Tyto alba	Barn Owl, Common Barn-Owl	Encroaching	NA	NA

Appendix E. Recommendations for the Bird Community Vital Sign within KLMN.

Andrew A. Merton, PhD[1]

Executive Summary of Recommendations

What follows is a summary of the recommendations for the Landbird Monitoring Protocol:

1. To ensure spatial balance of the sampling locations, a generalized random-tessellation stratified (GRTS) survey design should be employed to select the start locations for each route (transect).
    a. Prior to selection of the start locations, the target population should be explicitly defined. For example, if bird communities are to be inventoried in the "matrix" habitat (non-riparian), then it must be evaluated a priori whether or not that habitat is unique at the park level or at the Network level (e.g., are the "matrix" habitats of Whiskeytown and Crater Lake considered to be two realizations of single habitat or are they significantly different and should be considered separate habitats [stratification]?).
    b. Once the target habitat(s) is/are selected, GRTS samples should be drawn; the rules for selecting start locations should be explicitly outlined in the protocol (e.g., within 100 meters of an established road or trail).
    c. The minimum number of routes to be surveyed during a field season should not fall below 25, to ensure a sufficient sample size for making inference concerning status.
        i. Current resources suggest that approximately 60 routes can be surveyed per field season. Hence, KBO should plan on sampling from no more than two habitats per field season.
    d. The number of sites (nodes) along a route should be no fewer than 10, to allow for adequate opportunity to observe a large enough number of birds for making inference about the total number of birds, number of species present, and the dominant species. Optimally, the number of sites to be visited should be 15 or more (if time and terrain allow).
2. The long-term sampling schedule should allow for re-visitation of a (randomly selected) subset of the routes (approximately half of the sites). This presents the best opportunity for making inference about change.
    a. Current resources allow for sampling in two of three consecutive field seasons. Optimally, this allows for between four and six different populations to be surveyed every three years. This implies a panel design of [1-2] for each population of interest.

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b. For a particular field season, approximately 50% of the routes should be revisited from the previous sampling season (three years prior) and the remaining starting locations are to be (randomly) selected from a GRTS generated list.
c. The entire GRTS sample should be revisited over the course of three or four 3-year cycles. For example, suppose 30 transects are to be visited in a single field season and four 3-year cycles are to elapse before recycling through the start of the GRTS sample. Then a list of 60 locations must be selected using GRTS for the complete survey. The table below lists the schedule of site visitation over the course of 14 years:

Year	1	4	7	11	14
Sites	1-30	16-45	30-60	1-15, 46-60	1-30

3. Planned analyses should assume that the sampling unit is the entire route and *not* the individual sites making up each route. This underscores the importance of obtaining a sufficiently large number of routes per target population. Immediately available analyses include ANOVA, general linear models, and point process and geostatistical models. Future modeling efforts will likely be available at the finer site level scale (by introducing random Poisson and gamma field theory).

Outline of the remaining document contents

The following analysis is based on data provided by the Klamath Bird Observatory (KBO) and is being used to establish both general and specific guidelines for the protocol to be submitted to the National Park Service (NPS) main office, with respect to the Inventory and Monitoring Program (I&M).

1. Sampling design
2. Description of the database provided by KBO
    a. General information including span of database, type of data collected, etc.
    b. Definition of parameters of interest used throughout the analysis
    c. Summary statistics
3. Sampling design
    a. Constraints with respect to the collection of data and its influence on the sampling design

Sampling Design

The key question being addressed by this exposition is what sample design to employ for monitoring with respect to the bird community vital sign. We are fortunate to have data that is believed to be representative of the communities found with KLMN with which to analyze design decisions. Unfortunately, the design is not solely dependent on the type of data to be collected. Other factors include the availability of resources, including but not limited to, funding of fieldwork (personnel, logistics, travel, etc.) and sampling constraints (accessibility, available field days, etc.). Thus the overall design must incorporate these additional constraints.

- What sample design should be employed to monitor the current status and trend (over time) of bird communities within the KLMN?
    a. Identify the target populations and the parameters of interest.
    b. Justify the sampling design using statistical methods.

Database description and summary statistics

The database was constructed by KBO using observations collected throughout the Upper Klamath Region, located in southern Oregon and northern California. All of the observations were made between the years 1997 and 2001 along as many as 14 fixed routes. Each route is a collection of between 15 to 25 sites, separated by approximately 250 m (transect sampling). There are more than 7200 records in the complete database with fields that describe the date (time/date stamp) and location (easting, northing) of the observations, species and number observed, and approximate distance from the reference site to the bird(s) in question, (i.e., less than or greater than 50 m).

Of the 14 routes available, nine were designated to be representative of three habitats found within KLMN, reducing the total number of available records to 5300. The three habitats are defined as (1) oak/woodland/riparian, (2) juniper shrub step, and (3) mixed conifer. All subsequent discussion is based on these 5300 records. Table 1 below summarizes the route characteristics by habitat. Furthermore, route is assumed to be the sampling unit and not the individual sites within each route. As will be discussed below, this was deemed necessary in order to maintain sufficient counts for individual species. Note that 167 species were observed over the five years of the study, but only a small minority of the species was observed at relatively high numbers. Future analyses will attempt to incorporate the spatial relationship of the sites *within* the routes using geostatistical modeling techniques (see below).

For each route, there is a lot of information available for analysis. Consequently, it was necessary to narrow the analysis scope to a tractable number of parameters to be analyzed. The following parameters were deemed representative of future analyses to be done within the I&M program: total birds observed per route, number of unique species encountered per route, and most abundant species within each route. A brief description of why each of these measures was selected for analysis follows, along with summary statistics and plots for the current database. Tables 2 through 4 summarize the observed values of these parameters for each combination of route and year for the three habitat types.

Table 5. Description of the routes used for the analysis

Habitat	Route	No. of Sites	Years Sampled
Oak/woodland/riparian	CHKB	15	1998 – 2001
	CHKC	25	1999 – 2001
	TPSY	15	1999 – 2001
Juniper shrub step	PEBA	23	1997, 1999 – 2001
	SOBU	15	1998 – 2001

	SURD	20	1998 – 2001
	SURE	20	1998 – 2001
Mixed conifer	GERB	25	1998 – 2001
	STMT	25	1999 – 2001

Total Number of Birds

This parameter is meant to be a surrogate for population density for the entire bird community. It is assumed that each habitat can support a finite number of birds. Probable sources of variability, such as territoriality, food abundance, predator/prey ratios, etc., are assumed to contribute to the overall variance observed at the route level. Density can be approximated by dividing the number of birds observed by the coverage area associated with the route. Future analyses should be able to incorporate the individual site information using geostatistical modeling methods.

Number of Unique Species

This parameter is a proxy for species richness and is meant to approximate the biodiversity of the habitat or region under study. As shown below, the number of observed unique species is strongly correlated with the number of sites within a route. Furthermore, the concept of guilds (collections of bird species) should be well represented by this response variable.

Most Abundant Species

It is assumed that there are several species that will be identified as critical indicators of the bird community health. Therefore, it is important to evaluate which, if any, species can be used for this purpose. One measure of the status of a particular species is the proportion of the total community that belongs to the species under study. In the current database, there were 167 different species observed over the five years and nine routes. The most abundant species for each route typically do not represent more than 20% of the population. In fact, many species make up less than 1% of the total observed population. In order to estimate population proportions with sufficiently high precision (small standard error), one requires large sample sizes that are currently beyond the available resources. (This issue will be discussed at greater length when the sample design is outlined.)

Table 6. Summary statistics for the routes defined to have an oak/woodland/riparian habitat. The total number of birds aggregates over all of the species observed along the route. The magnitude of the total count is strongly (positively) correlated with the number of sites within the route. Unique species totals the number of unique species observed along the route for that year. Although some species were observed every year, many species were observed in only one or two years. The number of unique species for *all years* was evaluated by aggregating over all observed years.

Route	Year(s)	Total No. of Birds	Unique Species	Three Most Abundant Species (percent)		
CHKB	1998	150	25	WETA (22.7)	WEWP (20.0)	YRMA (11.3)
	1999	119	29	WEWP (21.8)	BHGR (12.6)	WETA (11.7)
	2000	228	33	WETA (20.6)	WEWP (14.9)	ARMO (10.0)
	2001	179	25	WETA (18.9)	WEWP (18.4)	BHGR (7.2)
	All	676	56	WETA (18.2)	WEWP (18.2)	AMRO (8.5)
CHKC	1999	267	40	WETA (15.7)	WEWP (15.7)	AMRO (7.4)
	2000	301	44	AMRO (13.2)	WETA (12.2)	WEWP (10.2)
	2001	283	41	WETA (16.2)	WEWP (12.7)	AMRO (10.6)
	All	851	60	WETA (14.6)	WEWP (11.6)	AMRO (10.5)
TPSY	1999	137	26	WETA (16.5)	ORJU (14.5)	YRWA (8.7)
	2000	211	31	WETA (16.1)	CRJU (10.9)	YRWA (10.4)
	2001	233	26	PUFI (10.7)	ORJU (10.7)	WETA (10.3)
	All	581	45	WETA (13.7)	ORJU (9.4)	ORJU (7.7)

Table 7. Summary statistics for the routes defined to have a juniper shrub step habitat.

Route	Year(s)	Total No. of Birds	Unique Species	Three Most Abundant Species (percent)		
PEBA	1997	390	50	WEWP (9.2)	RWBL (8.7)	SOSP (5.8)
	1999	272	46	BHCO (9.5)	WEWP (8.8)	WETA (8.8)
	2000	376	47	WEWP (11.4)	ORJU (9.0)	BHCO (6.6)
	2001	259	48	WETA (9.2)	WEWP (5.7)	CHSP (5.7)
	All	1297	90	WEWP (9.0)	WETA (6.6)	BHCO (5.4)
SOBU	1998	175	37	GTTO (9.1)	STJA (9.1)	BHGR (8.0)
	1999	117	31	GTTO (14.5)	WETA (11.9)	CHSP (10.2)
	2000	170	32	RECR (11.7)	MOCH (9.4)	OSFL (8.8)
	2001	78	22	OSFL (10.2)	FOSP (10.2)	YRWA (10.2)
	All	540	55	GTTO (8.5)	OSFL (7.4)	RECR (7.0)
SURD	1998	67	17	YWRA (22.3)	THRU (13.4)	ORJU (8.8)
	1999	161	30	YRWA (13.6)	HETH (13.0)	ORJU (11.8)
	2000	494	31	WETA (18.2)	YWRA (10.9)	RBNU (9.1)
	2001	222	33	YWRA (16.2)	WETA (9.4)	MOCH (8.1)
	All	944	50	YWRA (13.4)	WETA (13.4)	RBNU (8.4)
SURE	1998	199	30	ORJU (15.0)	YRWA (15.0)	WETA (13.0)
	1999	135	31	YRWA (15.5)	RBNU (12.5)	WETA (8.8)
	2000	231	26	WETA (16.8)	DUFL (8.6)	RBNU (8.2)
	2001	177	30	HEWA (12.9)	DUFL (9.6)	ORJU (9.6)
	All	742	63	WETA (12.5)	YRWA (9.5)	RBNU (8.2)

Table 8. Summary statistics for the routes defined to have a mixed conifer habitat.

Route	Year(s)	Total No. of Birds	Unique Species	Three Most Abundant Species (percent)		
GERB	1998	283	35	CHSP (11.6)	BHCO (11.3)	SOSP (10.2)
	1999	151	37	VESP (17.2)	NOFL (11.3)	WETA (7.9)
	2000	308	48	AMRO (11.6)	VESP (9.0)	WEME (7.1)
	2001	317	36	AMRO (11.0)	MOCH (9.4)	WEME (8.5)
	All	1059	80	AMRO (7.5)	VESP (7.5)	MOCH (7.2)
STMT	1999	233	38	SPTO (20.1)	CHSP (10.7)	AMRO (7.7)
	2000	354	35	SPTO (11.8)	WEME (11.2)	CHSP (7.9)
	2001	214	34	SPTO (14.9)	BBMA (9.3)	WEME (6.5)
	All	801	58	SPTO (15.1)	WEME (8.7)	CHSP (7.9)

Data Analysis

In order to make practical recommendations for the Landbird Monitoring Protocol, it was necessary to evaluate the "signal strength" within the data with respect to the three parameters of interest described above. These analyses are meant to provide statistical support for the recommendations for the Landbird Monitoring Protocol. Note that the subsequent results focus on the data within the oak woodland/riparian habitat. The presentation here is representative of the analysis for the remaining two habitats, juniper shrub step and mixed conifer.

Total Number of Birds

The first measure of interest is the total number of birds observed per sampling route. Figure 1 below traces the path of each sampling route found in the oak woodland/riparian habitat. The area of the circle is directly proportional to the total number of birds observed at each site, aggregated over all sampling years. Figure 2 illustrates the within route variability for each route/year. Both plots suggest that the within route variability is quite large; therefore, it is recommended that the sampling unit for the bird protocol survey be defined as the route. This implies that the total number of routes per field season needs to be large (within a particular habitat) in order to make inference to the current status of the bird population.

The outstanding question is to determine the minimum length of each route (i.e., the number of sites per route) to adequately minimize the within route variability. To assess the variability in the number of birds expected to be encountered per route, the observed data were re-sampled using a bootstrap method to generate approximate distributions for the total counts. In brief, the bootstrap method assumes that the current data represent the population from which one can draw samples, with replacement, numerous times to generate an approximating distribution for the target statistic. For example, Figure 3 plots the results for simulated CHKB routes of lengths $n = \{5,6,\ldots,25\}$. Each boxplot of Figure 3 summarizes the distribution of 1000 independently drawn samples of the mean number of birds per site. Note that each boxplot is centered at approximately 11 birds per site but that the variability decreases as the number of sites increases. Figure 3 illustrates the importance of visiting a sufficiently large number of sites per route, say no fewer than 10, to adequately control for variability.

Number of Unique Species

To assess the biodiversity of the habitat (with respect to birds), the second parameter of interest is the number of unique species encountered along the route. Figure 4 illustrates the cumulative number of unique species encountered by sampling year over the first 15 sites for the three routes within the oak/woodland/riparian habitat. (The dotted line is for the aggregation of the data over all sampling years.) Note that each of the curves are monotonically increasing and do not "plateau" for $n = 15$. A large part of this behavior stems from the fact that several species are quite rare; that is to say that many species were observed only once over the course of the survey. This suggests that longer routes are necessary to ensure encountering a majority of the species present. It is important to note, however, that the trajectories of the plots (by route) are similar; although the *number* of unique species encountered is similar for various route lengths, the species do not necessarily align.

Distributions for the number of unique species encountered for various route lengths were computed using the bootstrap re-samples for route CHKB in the oak/woodland/riparian from the previous section (see Figure 5). Note that significant gains in the number of species encountered

are made between n = 5 and n = 15, with minimal gains thereafter. This confirms the need that the routes must be sufficiently long to ensure observation of a majority of the species.

Most Abundant Species

The analysis of the number of unique species encountered suggests that one or several species should be identified as sentinel for monitoring both status and trend. Tables 2 through 4 above list the top three species by route/year and the sample proportion (percentage) of the total number of birds observed. The bootstrap samples for route CHKB provide an opportunity to evaluate the variability associated with each sample proportion. Figures 6, 7, and 8 plot the distribution of the sample proportions for the top 10 species observed for routes of length 5, 15, and 25, respectively. First, note that the top nine of 10 species in all three plots are the same. Second, note the significant reduction in variability as the route length increases from 5 to 15 (with smaller gains for 15 to 25). Figure 9 plots the results for the top five species for each of the routes in the oak woodland/riparian habitat using a route length of 15. The species WETA and YRWA are common to all three figures; the top two panels suggest that species make-up of routes CHKB and CHKC are very similar (as expected). The ensemble of dominant species for route TPSY appear to differ from the other two illustrating the importance of sampling many routes within a defined habitat to overcome within variability.

Conclusions Pertaining to the Sampling Design

Based on the analysis of the KBO data, it is recommended that the length of the routes needs to include at least 10 sites in order to ensure that a sufficient number of encounters occur. Optimally, the ideal length is approximately 15 sites with little overall gain from longer routes. Each route is to be considered as a sampling unit; this implies that approximately 25 routes per habitat should be visited during a field season in order to obtain a sufficient sample size for making inference.

The biologists are tasked with identifying between two and five species per habitat for monitoring current status and trends. It is recommended that the species selected be from the list of most abundant species, so that sample populations are unlikely to be too close to zero (i.e., a sample size of 25 routes impedes precision for estimating proportions for rare birds).

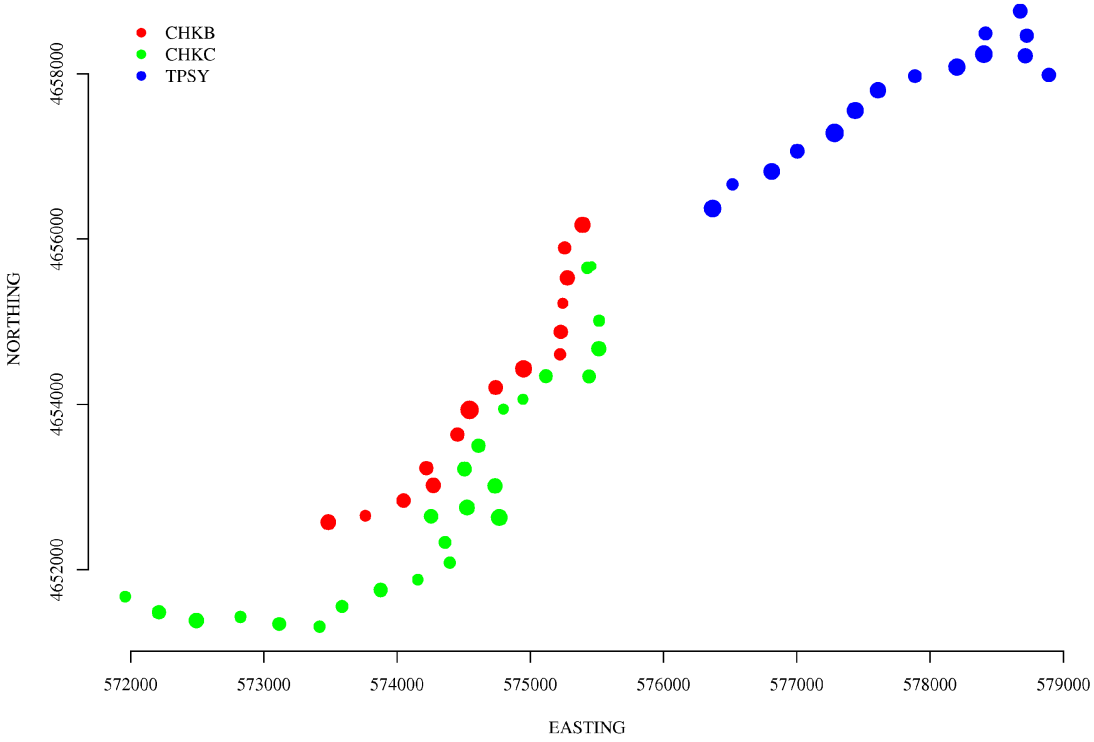


Figure 4. Sampling routes in the oak woodland/riparian habitat. The area of the circle is directly proportional to the total number of birds observed per site, aggregated over all sampling years.

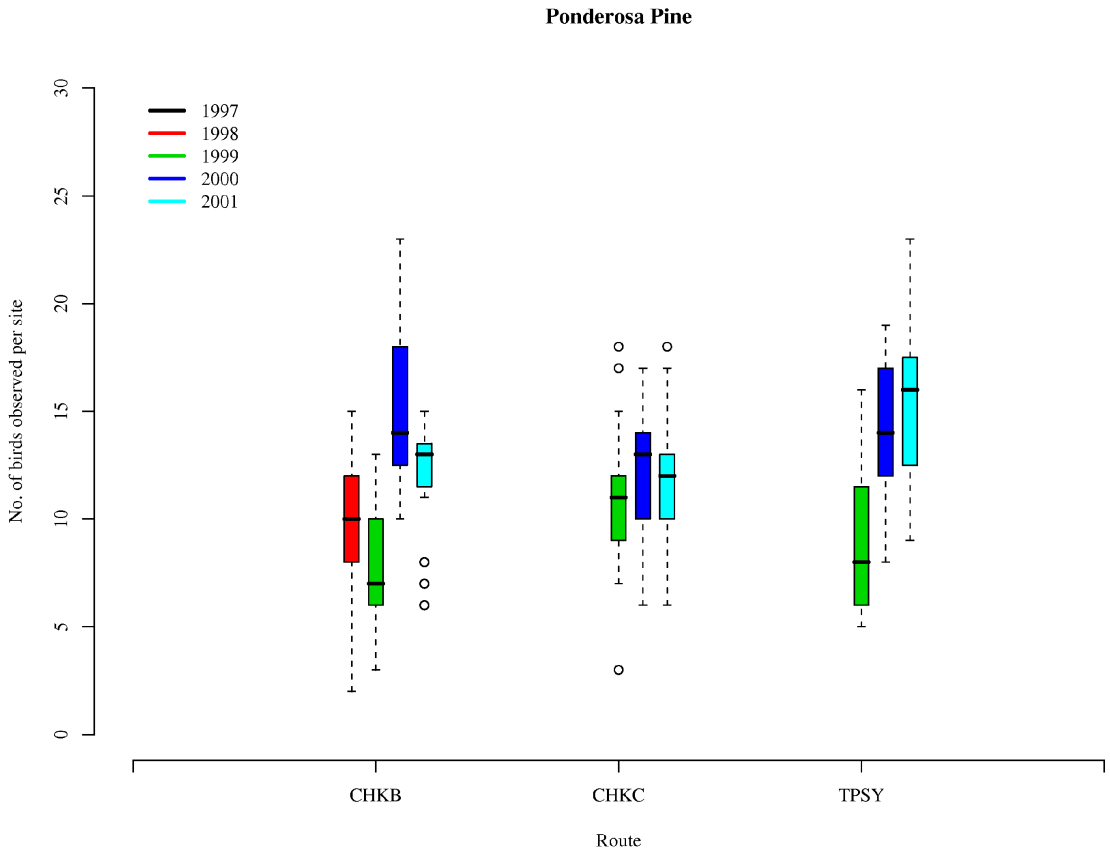


Figure 5. Variability of the number of birds observed per site by year for routes in the oak woodland\riparian habitat.

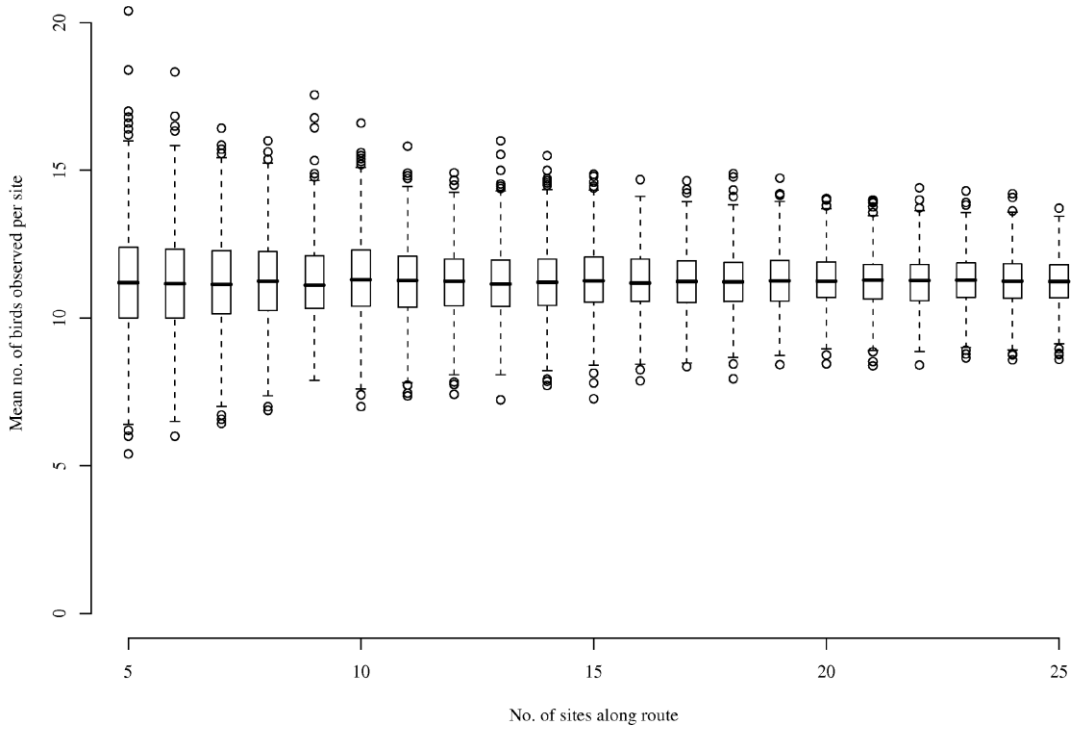


Figure 6. Distribution of the mean number of birds observed per site from 1000 bootstrap re-samples as a function of number of sites.

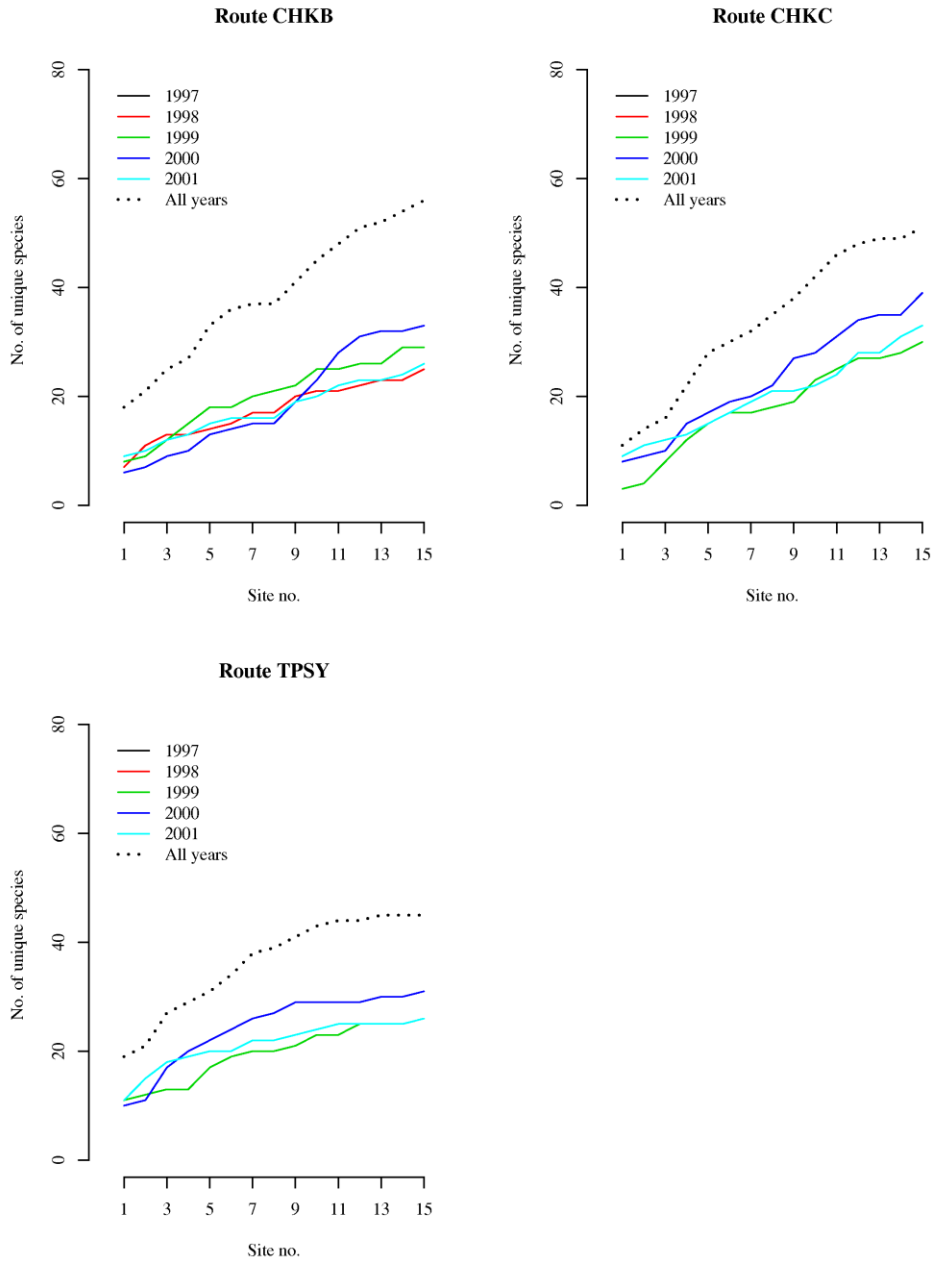


Figure 7. Cumulative number of unique species observed by route/year for the oak woodland/riparian habitat.

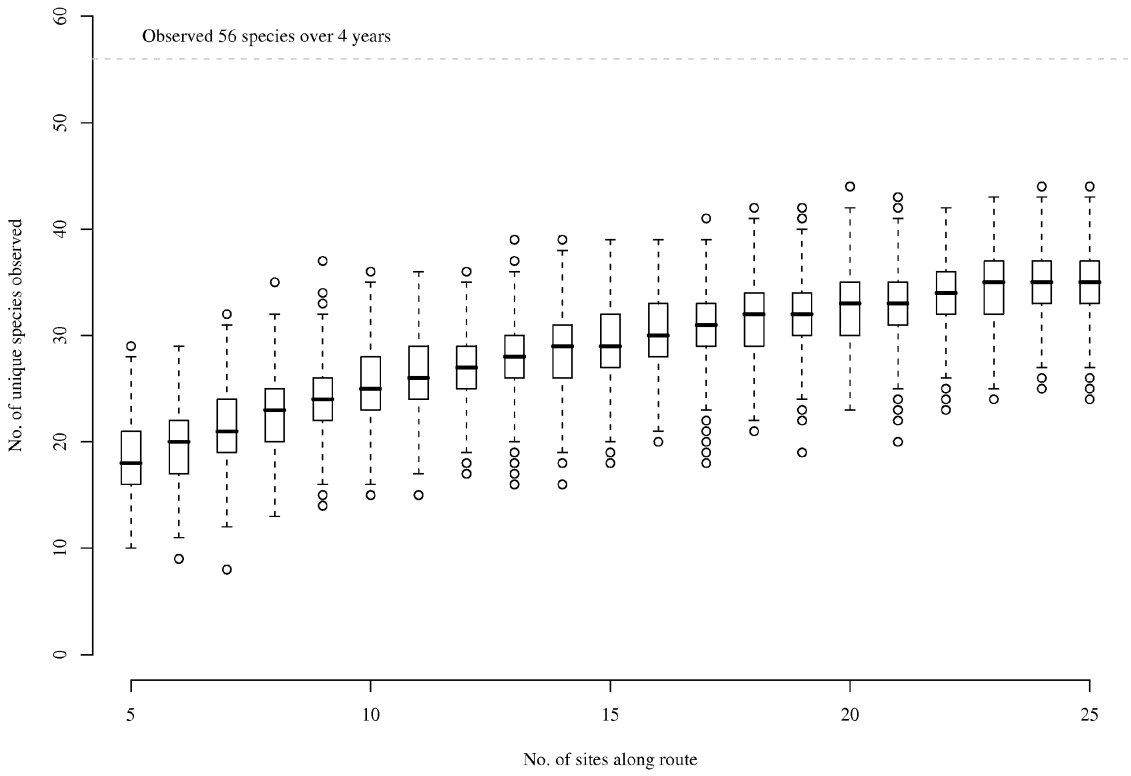


Figure 8. Distribution of the number of unique species encountered for 1000 bootstrap re-samples as a function of number of sites.

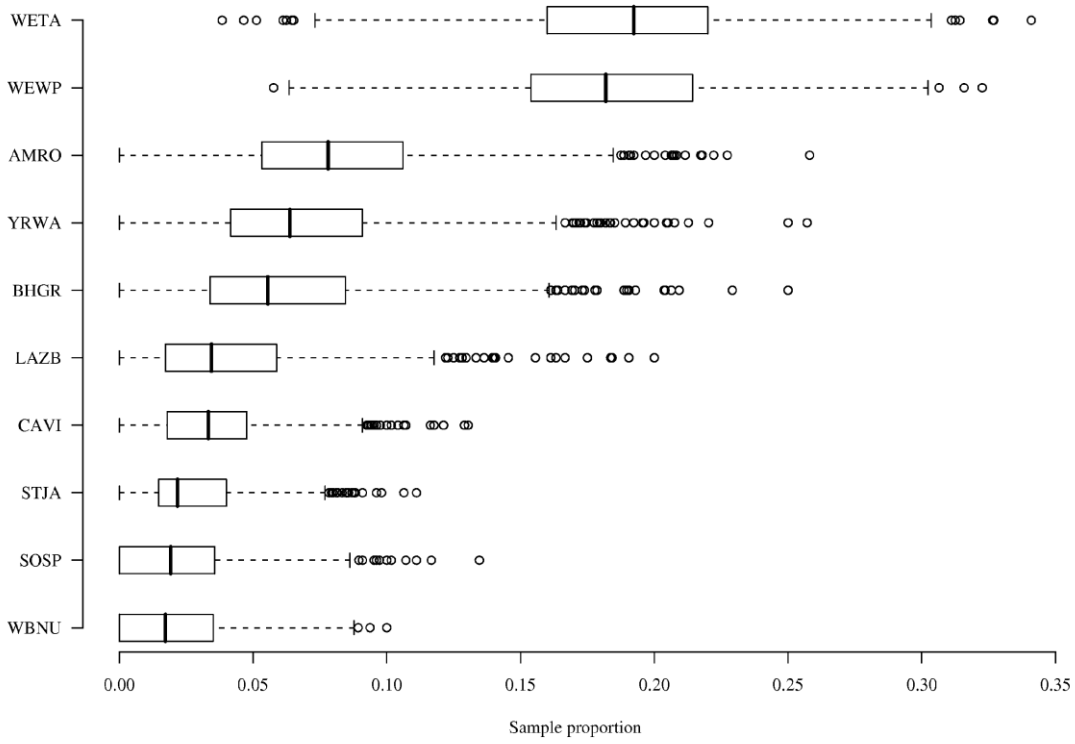


Figure 9. Simulated sample proportions for the top 10 species for route CHKB with five sites.

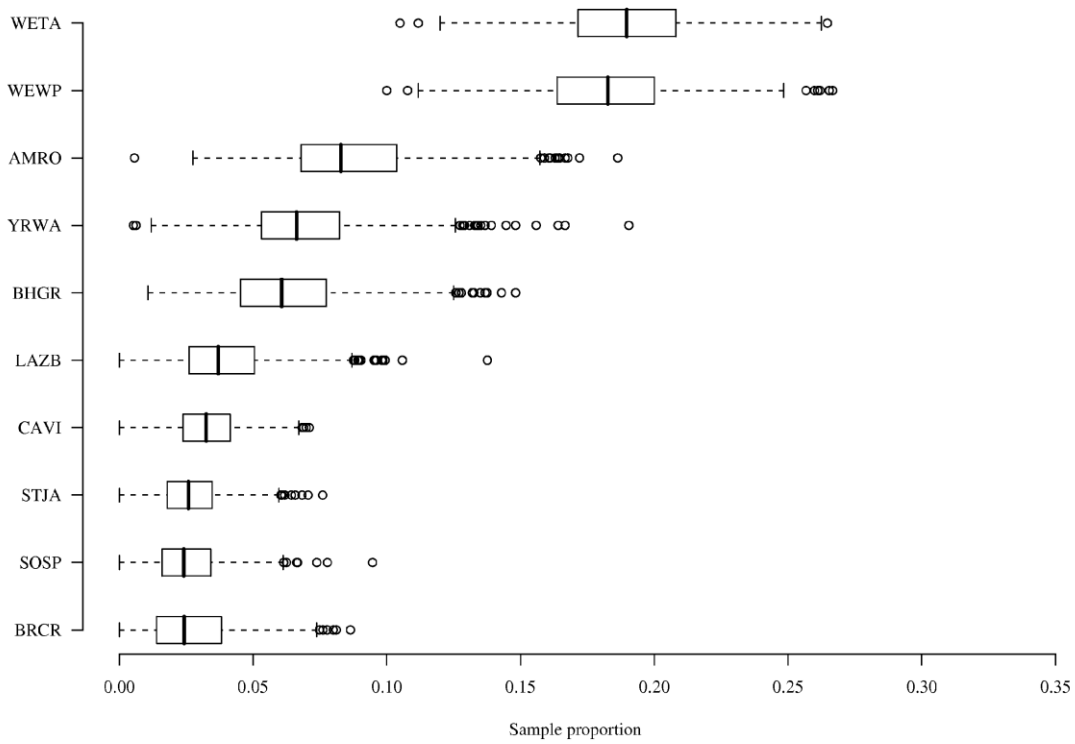


Figure 10. Simulated sample proportions for the top 10 species for route CHKB with 15 sites.

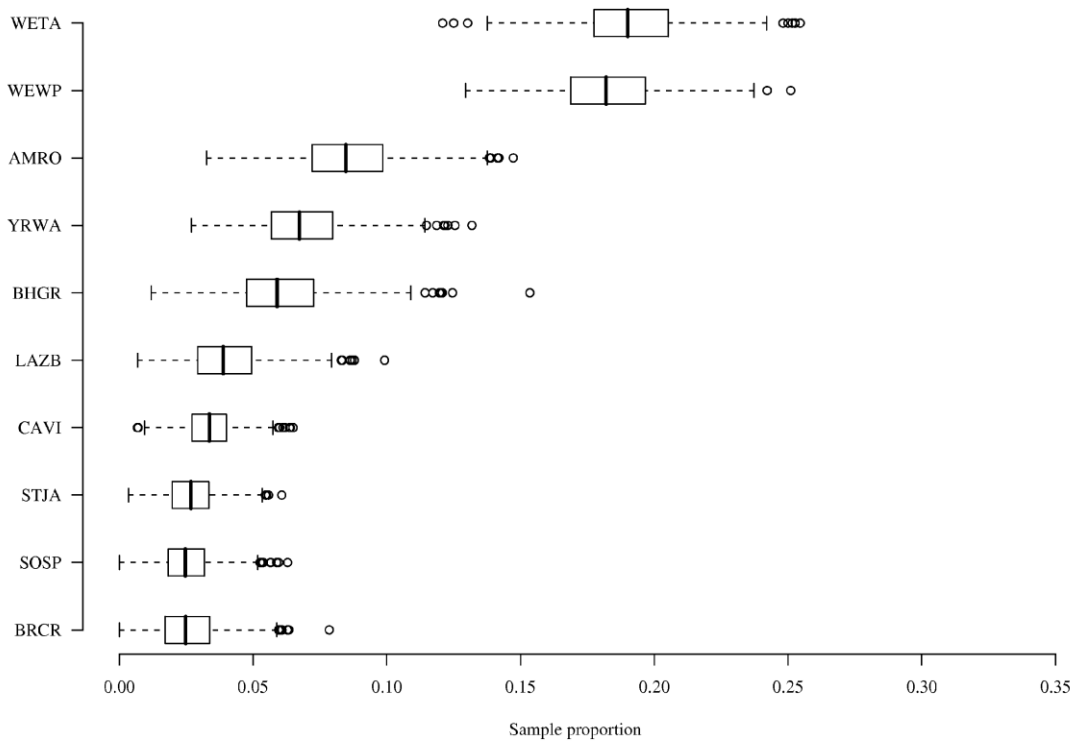


Figure 11. Simulated sample proportions for the top 10 species for route CHKB with 25 sites.

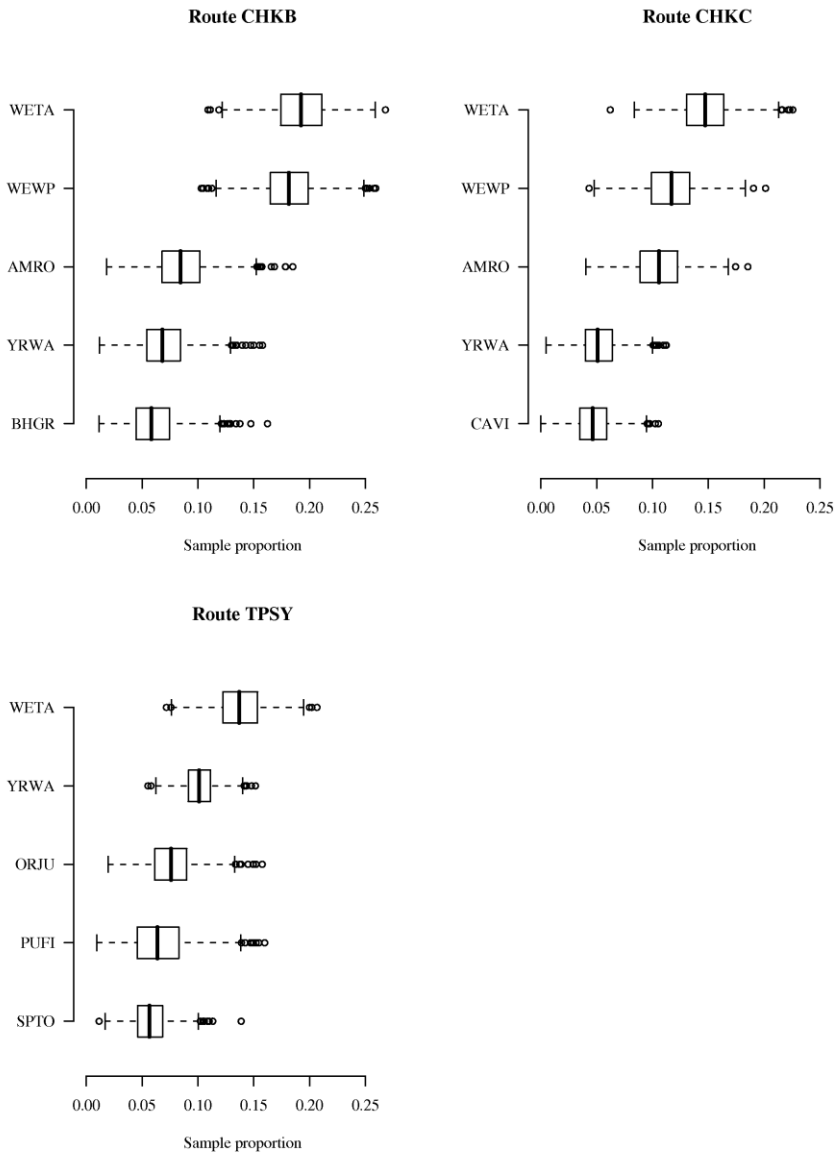


Figure 12. Simulated sample proportion for the top five species for each route of the oak woodland/riparian habitat.

Appendix F. Power Analysis for Oregon Caves National Monument Mist Netting Site.

By Jaime L. Stephens, John D. Alexander, and Nathaniel E. Seavy
October 17, 2007

One measure of the efficacy of long-term monitoring is the ability to detect population trends. The power to detect trends should be balanced with other considerations of the monitoring program's performance (e.g., the value of demographic data, bird abundance relative to external variables [i.e., habitat and climate], and the contribution to other monitoring efforts). We present the results of a power analyses to help assess bird monitoring efforts at Oregon Caves National Monument. These analyses follow recommendations established by Bart et al. (2004), that population trend monitoring programs be designed to meet a standard of 80% power to detect 50% decline over 20 years at a significance level of 0.10. These results should be interpreted cautiously, recognizing the assumptions of trend and annual variance models and limitations associated with only four years of data. We conducted the power analysis using R version 2.5.1 (2007). Frey et al. (2007) previously reported methods and results for the banding program at Oregon Caves National Monument between 2002 and 2006.

We performed power analyses on five commonly captured species and determined the power to detect a 50% decline over 20 years at significance levels of 0.05 and 0.10 (Table 1). The power analysis incorporates four parameters: annual variance, desired trend, population abundance at year one (intercept of the model), and number of sample years. We log transformed the data to achieve a normal distribution. It is advantageous to transform the linear model data used in these analyses; the error is linear on a log scale (i.e., the error increases with the mean on the true scale) and when we fit a linear additive slope on a log scale, it is a multiplicative slope on the true scale. To quantify the variance, we fit a linear model with only an intercept term that provides the mean (intercept) and standard deviation (residual error) for the distribution. The annual variation (residual error) and population size (intercept) determine the power to detect trends.

Power analyses were conducted for a diverse set of species, season, and age combinations (Table 1). Annual relative abundance data for after hatch year birds provide a measure of population trends and hatch year birds provide annual measures of productivity. Breeding season abundance data provide annual measures for local populations; migration data provide annual measures for regional populations. We have sufficient power to detect trends for three species as recommended by Bart et al. (2004; 80% power to detect 50% decline over 20 years, $p \leq 0.10$). The same subset of species met the 80% cutoff at a significance level of 0.05. Data provide sufficient power to detect trends for local MacGillivray's Warbler and Dark-eyed Junco populations, local Dark-eyed Junco productivity, and regional Dark-eyed Junco and Hermit Thrush populations. This mist netting site will yield important trend information over time, as well as contribute to the trends generated by larger regional monitoring efforts conducted by the Klamath Bird Observatory.

Table 1. Power analysis was performed on five species that are commonly caught at the Oregon Caves National Monument mist netting site to determine the power to detect a 50% decline over 20 years at p≤0.05 and 0.1. Results with power greater than or equal to 80% are highlighted.

Species, Season, and Age	Intercept	Residual Error	P≤0.05	P≤0.10
Chestnut-backed Chickadee				
Breeding season HY	-4.53	0.99	0.13	0.22
Breeding season AHY	-5.96	0.71	0.24	0.34
MacGillivray's Warbler				
Breeding season HY	-4.11	0.41	0.58	0.71
Breeding season AHY	-4.31	0.31	0.82	0.90
Dark-eyed (Oregon) Junco				
Breeding season HY	-3.30	0.22	0.98	0.99
Breeding season AHY	-3.14	0.29	0.88	0.93
Migration HY	-4.16	0.77	0.23	0.33
Migration AHY	-3.95	0.26	0.92	0.97
Red-breasted Nuthatch				
Breeding season HY	-5.00	0.95	0.15	0.26
Breeding season AHY	-6.17	0.65	0.29	0.40
Hermit Thrush				
Migration HY	-4.88	0.72	0.23	0.37
Migration AHY	-5.54	0.27	0.92	0.96

References

Bart, J., K. P. Burnham, E. H. Dunn, C. M. Francis, and C. J. Ralph. 2004. Goals and strategies for estimating trends in landbird abundance. Journal of Wildlife Management **68**:611-626.

Frey, B. I., K. W. Larson, and J. D. Alexander. 2007. Report to the National Park Service Klamath Network on bird monitoring efforts by the Klamath Bird Observatory in the Oregon Caves National Monument, 2002-2006. Klamath Bird Observatory, Ashland, OR.

R version 2.5.1. 2007. The R project for statistical computing. Online. (http://www.r-project.org/). Accessed 9 January 2008.

Appendix G. Roles and Responsibilities for Implementation of the KLMN Landbird Monitoring Protocol.

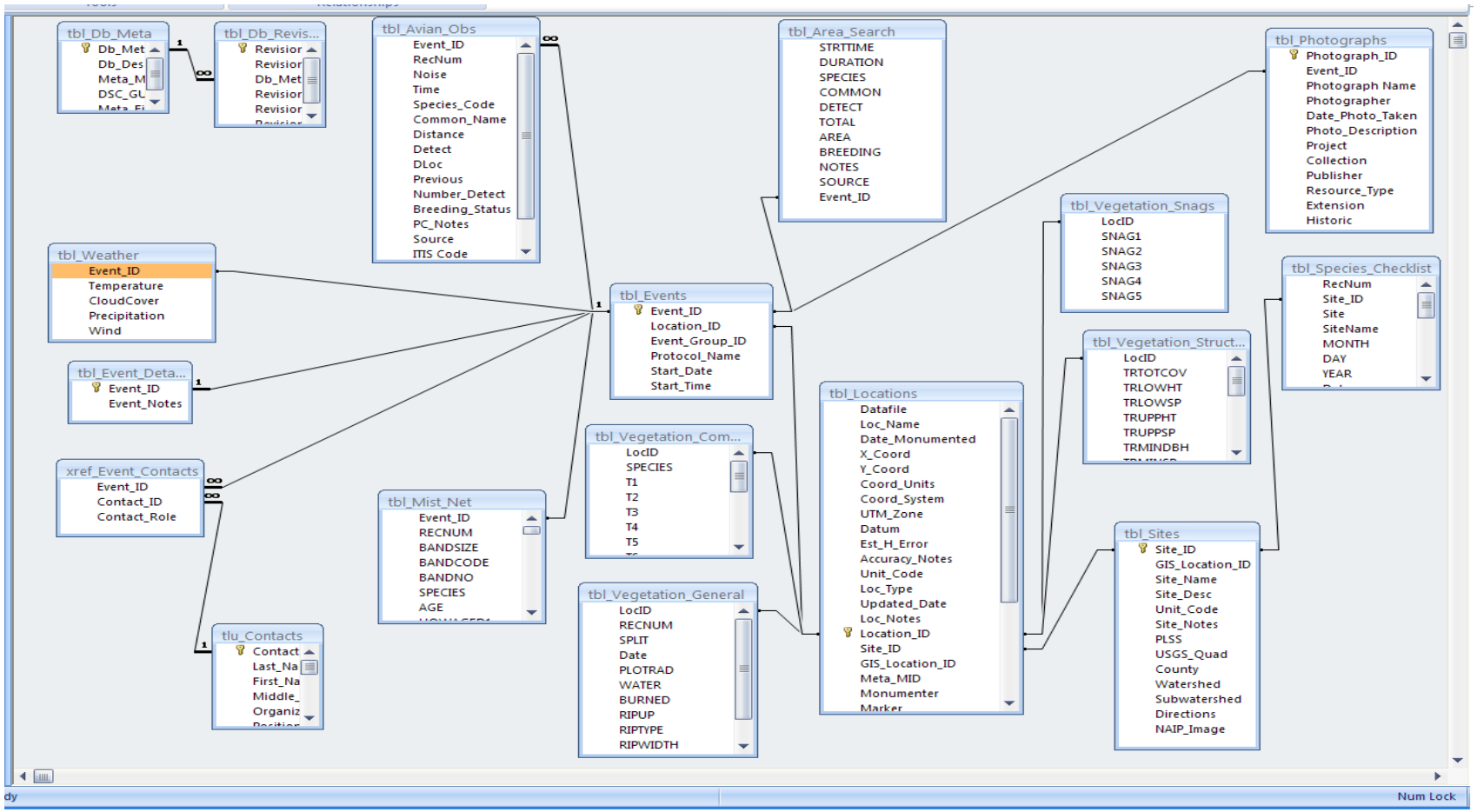
Role	Responsibilities	Name / Position
NPS Lead	• Oversee and administer project • Track project objectives, budget, requirements, and progress toward project objectives • Facilitate communications between NPS and cooperator(s) • Coordinate and ratify changes to protocol • Assist in performing data summaries and analyses, assist interpretation and report preparation • Review annual reports and other project deliverables for completeness and compliance with Inventory and Monitoring Program specifications • Maintain and archive project records	Sean Mohren, Network Data Manager, KLMN
Principal Investigator	• Oversee project operations and implementation • Perform data summaries and analysis, interpretation and report preparation	Jaime Stephens, Research and Monitoring Director, KBO
Project Lead	• Oversee project operations and implementation • Certify each season's data for quality and completeness • Complete reports, metadata, and other products according to schedule • Train and ensure safety of field crew • Plan and execute field visits • Acquire and maintain field equipment • Oversee data collection and entry, verify accurate data transcription into database • Complete a field season report	Jaime Stephens, Research and Monitoring Director, KBO; and Bob Frey, Research Biologist, KBO
Data Analyst	• Perform data summaries and analysis, assist interpretation and report preparation	
Technicians and Interns	• Collect, record, enter, and verify data	KBO technicians and interns
Data Manager	• Consult on data management activities • Facilitate check-in, review and posting of data, metadata, reports, and other products to national databases and clearinghouses according to schedule • Maintain and update database application • Provide database training as needed	Sean Mohren, Network Data Manager, KLMN

Role	Responsibilities	Name / Position
GIS Specialist	• Consult on spatial data collection, GPS use, and spatial analysis techniques • Facilitate spatial data development and map output generation • Work with Project Lead and Data Analyst to analyze spatial data and develop metadata for spatial data products • Act as primary steward of GIS data and products	Lorin Groshong, Southern Oregon University, SOU
Network Coordinator	• Review annual reports for completeness and compliance with I&M standards and expectations	Daniel Sarr, Network Coordinator, KLMN
Park Biologists	• Facilitate logistics planning and coordination • Ensure project compliance with park requirements • Review reports, data, and other project deliverables	Park Wildlife Biologists and Resource Managers
Park Curator	• Receive and catalogue voucher specimens • Receive and archive copies of annual reports, analysis reports, and other publications • Facilitate archival of other project records (e.g., original field forms, etc.)	Sean Mohren, Network Data Manager, KLMN

* These individuals act as coordinators and primary points of contact for this project. Their responsibility is to facilitate communication among Network and park staff and to coordinate the work which may be shared among various staff to balance work load and to enhance the efficiency of operations.

Appendix H. Klamath Network Landbird Monitoring Database Structure.

The Klamath Network Landbird database was designed following the Natural Resource Database Template. This appendix provides the relationship diagram for the back-end of the database and the data dictionary for each table in the database. Fields that have a pick list associated with them are shown in the relationship diagram. However, the relationship between the field(s) and the table containing the pick list values are not shown.



Data Dictionary For the KLMN Landbird Database

tbl_Sites

This table stores the data directly related to the route or CES

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
Site_ID	Y	Text	50						Unique ID value that relates to the sites table
GIS_Location_ID	Y	Text	50						Unique ID value that relates to the GIS Record
Site_Name	Y	Text	100						Name of the route, EMS
Site_Desc	Y	Text	255						General description of the site
Unit_Code	Y	Text	4		CRLA, LABE, LAVO, ORCA, REDW, WHIS				Park where the site occurs
Site_Notes	Y	Memo	255						General notes
PLSS	Y	Text	50						Public Land Survey System location for the sites
USGS_Quad	Y	Text	50		all USGS quads in the Network				USGS map where the site occurs
County	Y	Text	50		all counties in the network				County where the site occurs
Watershed	Y	Text	50		all watersheds in the network				Watershed where the site occurs
Subwatershed	Y	Text	50		all subwatersheds in the network				Subwatershed where the site occurs
Directions	Y	Text							General directions to the start of the route
Naip_Image	Y	Ole Object							NAIP image of the route.

tbl_Locations

This table stores the data related to the listening stations along each route and the mist net locations

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
Source	Y	Text	6						Name of the KBO file where this data came from
Loc_Name	Y	Text	6		See monumented sites				Name of the point, area search, or mist net
Date_Monumented	Y	Date/Time							Date the site was monumented
X_Coord	Y	Number	6						Easting coordinate for the site
Y_Coord	Y	Number	7						Northing coordinate for the site
Coord_Units	Y	Text	2		m, ft				Unit of measure
Coord_System	Y	Text	3		Geo, UTM				Unit of measure
UTM_Zone	Y	Text	3		10				Zone
Datum	Y	Text	5		Nad83, WGS84				Datum

Est_H_Error	N	Number	3				Estimated error
Accuracy_Notes	N	Memo					General notes about the accuracy of the site
Unit_Code	Y	Text	4	CRLA, LABE, LAVO, ORCA, REDW, WHIS			Park code
Loc_Type	Y	Text	25	Area Search, Mist Net, Point Count Station			Type of location
Updated_Date	N	Date/Time					Date a record was updated
Loc_Notes	N	Memo					General notes about the location
Location_ID	Y	Text	50				Unique ID value that relates to other tables
Site_ID	Y	Text	50				Unique ID value that relates to the sites table
GIS_Location_ID	Y	Text	50				Unique ID value that relates to the GIS Record
Meta_MID	N	Text	50				Unique ID value that relates to the metadata
Monumenter	Y	Text	255				Person who monumented the site
Marker	Y	Text	50				Type of marker used to monument the site
Marker_Substrate	Y	Text	100				Substrate that the monumenting marker was attached too
Marker_Height	Y	Number	3				Height the marker was attached
Offset_Dist	Y	Number	3				Distance the marker is from the true survey point
Offset_Bearing	Y	Number	3				Bearing the marker is from the true survey point
Elevation	Y	Number	3				Elevation of the site
Aspect	Y	Number	3		0	359	Aspect at the site
Slope	Y	Number	3		0	90	Slope at the site
Directions	Y	Memo					General directions to the site
Sort_Order	Y	**Number**	2		1	12	Order the site is surveyed in along the route
Marker_Notes	Y	Memo					General notes about the marker

tbl_Events

This table stores the data related to the date and time a survey was started

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
Event_ID	Y	Text	50						Unique ID that relates this record to the event
Location_ID	Y	Text	50						Unique ID that relates this record to the location
Event_Group_ID	N	Text	50						Unique ID that relates this record to the location Group
Protocol_Name	Y	Text	100		Draft Landbird Monitoring Protocol v1.0				Name of the protocol used to implement this field work
Start_Date	Y	Date/Time							Date the field work was started
Start_Time	N	Date/Time							Time the field work was started

tbl_Area_Search

This table stores the data related to the Area Searches at the Constant Effort Monitoring Station.

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
Strttime	Y	Text	4		00:01 - 24:00	0:01	24:00		Time the survey started
Duration	Y	Number	3	0				Minutes	Length of the survey
Species	Y	Text	4		AOU Bird Codes				Four letter code for the species observed during the survey
Common	Y	Text	255		AOU Bird List				Common name of the species observed during the survey
Detect	Y	Text	2		S = Song, C = Call, V = Visual, W = Wing, D = Drumming, F = Fly Over, -9 = No Data				Type of detection
Total	Y	Number	2	0		0			Total number of the particular species detected
Area	Y	Text	2		On = bird was observed on or near the search area, Off = bird was observed outside the search area, -8, -9 = No Data				Used to determine if the bird is on or off the area
Breeding	Y	Text	2		N = current year's **N**est found with eggs or young, in the process of being built, or already depredated or abandoned; M = adult seen gathering or carrying nesting **M**aterial to a likely nest site in the study area; F = adult seen carrying Food or **F**ecal sac to or from a likely nest site in the study area; D = **D**istraction display or injury feigning by an adult bird; L = a young bird incapable of sustained flight (a "**L**ocal") in the study area or very young (stub-tailed) fledglings being fed by parents in the study area; C = **C**opulation or **C**ourtship observed of a species within its breeding range; T = other **T**erritorial behavior observed; S = territorial **S**ong or drumming heard;B= Bird Captured, E = Encountered in study area, O = Encountered flying over study area				Breeding status of the bird
Notes	N	Text	255						Notes about the survey
Source	Y	Text	6						Name of the KBO file where this data came from
Event_ID	Y	Text	50						Unique ID used to relate this record to the event record.

tbl_Avian_Obs

This table stores the data related to the surveys using the VCP Point Count methods.

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
Event_ID	Y	Text	50						Unique ID used to relate this record to the event record.
RecNum	Y	Integer	3	0	NA	NA	NA	NA	Unique number assigned by KBO to represent this record
Noise	Y	Integer	1	0	1 = none, 2 = moderate, 3 = too much noise, cannot hear birds >15 m away from point	NA	NA	NA	Noise level at the area
Time	Y	Date/Time	4	NA	NA	0:01	24:00:00	Military	Time the species was observed
Species_Code	Y	Text	4	NA	North American Bird Banding Manual	NA	NA	NA	4 character species code of observed species
Common_Name	Y	Text	255	NA	North American Bird Banding Manual	NA	NA	NA	Common name of the observed species
Distance	N	Integer	3	0	NA	NA	NA	meters	Distance to the species
Detect	N	Text	1	NA	S = Song, C = Call, V = Visual, W = Wing (e.g., Mourning Dove or hummingbird wing whir), D = Drumming, F = Fly over.	NA	NA	NA	
Dloc	N	Text	1	NA	R = Riparian, Blank = Non-Riparian	NA	NA	NA	
Previous	N	Text	1	NA	P = Previous, Blank = Not Previous	NA	NA	NA	Determines if the species was detected at a previous site
Number_Detect	N	Integer	3	0	NA	NA	NA	NA	Total number of detections
PC_Notes	N	Memo							General notes about the point count survey
Source	Y	Text	6						Name of the KBO file where this data came from
Data_ID									Unique ID field used for this record.

Breeding_Status	N	Text	1	NA	N = current year's **N**est found with eggs or young, in the process of being built, or already depredated or abandoned; M = adult seen gathering or carrying nesting **M**aterial to a likely nest site in the study area; F = adult seen carrying Food or **F**ecal sac to or from a likely nest site in the study area; D = **D**istraction display or injury feigning by an adult bird; L = a young bird incapable of sustained flight (a "**L**ocal") in the study area or very young (stub-tailed) fledglings being fed by parents in the study area; C = **C**opulation or **C**ourtship observed of a species within its breeding range; T = other **T**erritorial behavior observed; S = territorial **S**ong or drumming heard;B= Bird Captured, E = Encountered in study area, O = Encountered flying over study area	NA	NA	NA	Breeding status

tbl_Mist_Net

This table stores the data related to the surveys using the Mist Netting methods.

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
Event_ID	Y	Text	50						Unique ID that relates this record to the event
RecNum	Y	Integer	3	0	NA	NA	NA	NA	Unique number assigned by KBO to represent this record
BandSize	Y	Text	2	NA	Pyle (1997) and the Tabular Pyle	NA	NA	NA	2 digit code for the size of the band
BandCode	Y	Text	2	NA	N = New Band, D = Destroyed, R = Repeat, L = Band Lost, U = Unbanded, C = Band Changed	NA	NA	NA	KBO/RSL Band Code
BandNo	Y	Integer	9	0				NA	Number of the band placed on the bird
Species	Y	Text	4	NA				NA	4 digit AOU species code
Age	Y	Text	2	NA	A = After Hatch Year, H = Hatch Year, L = Local, O = After Second Year, S = Second Year, T = Third Year, U = Undetermined, V = After Third Year, X = Not Attempted, -9 =	NA	NA	NA	Age of the bird
HowAged1	Y	Text	2	NA				NA	First method used to age the bird
HowAged2	Y	Text	2	NA				NA	Second method used to age the bird

Sex	Y	Text	2	NA	M = Male, F = Female, U = Undetermined, X = Not Attempted	NA	NA	NA	Sex of the bird
HowSex1	Y	Text	2	NA	B = Brood Patch, C - Cloacal Protuberance, @ = Egg in Oviduct, E = Eye Color, I = Mouth/Bill Color or Striation on Bill, G = Gape, F = Feet or Legs, S = Skull Ossification, Q = Measurements, Y = Symmetrical Flight Feather Molt, A = Adult Definitive Plumage, H = First Winter Plumage, J = Juvenal Plumage, P = Plumage, L - Plumage Color Patch Lenth or Extent, D = Primary Covert Shape or Wear, W = Differential Feather Wear, V= Feather Shape, T = Feather Texture, R = Pre Juvenal Molt, "=" = Fault Bar Alignment, # = Growth Bar Alignment, O = Other, U = Undetermined After Examination, X = Age or Sex Determination not attempted, Z - Less Precise Age, M = Age by Molt Limits	NA	NA	NA	First method used to sex the bird
HowSex2	Y	Text	2	NA	B = Brood Patch, C - Cloacal Protuberance, @ = Egg in Oviduct, E = Eye Color, I = Mouth/Bill Color or Striation on Bill, G = Gape, F = Feet or Legs, S = Skull Ossification, Q = Measurements, Y = Symmetrical Flight Feather Molt, A = Adult Definitive Plumage, H = First Winter Plumage, J = Juvenal Plumage, P = Plumage, L - Plumage Color Patch Lenth or Extent, D = Primary Covert Shape or Wear, W = Differential Feather Wear, V= Feather Shape, T = Feather Texture, R = Pre Juvenal Molt, "=" = Fault Bar Alignment, # = Growth Bar Alignment, O = Other, U = Undetermined After Examination, X = Age or Sex Determination not attempted, Z - Less Precise Age, M = Age by Molt Limits	NA	NA	NA	Second method used to sex the bird
Skull	Y	Text	2	NA	SY, ASY, ATY = After 3rd Year				Degree of skull ossification
CP	Y	Text	2	NA				??	Cloacal Protuberance
BP	Y	Text	2	NA				??	Brood Patch
Fat	Y	Text	2	NA				??	Fat
BodyMolt	Y	Text	2	NA				NA	Body Molt
FFMolt	Y	Text	2	NA				NA	Flight feather molt
FFWear	Y	Text	2	NA				NA	Flight feather wear
JuvPlum	Y	Text	2	NA				NA	Juvenal plumage
MoltLim1	Y	Text	2	NA				NA	First molt limit
MoltLim2	Y	Text	2	NA				NA	Second molt limit
Wing	Y	Integer	2	0	NA	NA	NA	NA	Wing cord

Weight	Y	Integer	4	1	NA	NA	NA	??	Weight
Status	Y	Text	2	NA	N = Normal, C = Color Band, I = Injured, D = Dead			NA	Bird status
Month	Y	Integer	2	0				NA	Month the bird was captured
Day	Y	Integer	2	0				NA	Day the bird was captured
Year	Y	Integer	4	0				NA	Year the bird was captured
Date	Y								
CapTime	Y	Integer	3	0				NA	3 digit time the bird was captured
Site	Y	Text	4	NA				NA	Banding location
Point	Y	Integer	2	0				NA	Net number
NoteNum	Y	Integer	2	0				NA	Note number
OldBand	N	Integer	9	0				NA	Old band number that was replaced
UpColor	N	Text	2	NA				NA	Upper part color
UnColor	N	Text	2	NA				NA	Under part color
ThrColor	N	Text	2	NA				NA	Throat color
ChnColor	N	Text	2	NA				NA	Chin color
LgColor1	N	Text	2	NA				NA	Leg color
LgColor2	N	Text	2	NA				NA	Leg color
RngShp1	N	Text	2	NA				NA	Eye ring shape
RngShp2	N	Text	2	NA				NA	Eye ring shape
RngCol1	N	Text	2	NA				NA	Eye ring color
RngCol2	N	Text	2	NA				NA	Eye ring color
MandBase	N	Text	2	NA				NA	Color at the base of the mandible
MandTip	N	Text	2	NA				NA	Color at the tip of the mandible
Culmen	N	Integer	4	1				CM	Length of culmen from nares
BillWidth	N	Integer	4	1				CM	Width of the bill
LppLss	N	Text	4	NA				NA	Longest primary, longest secondary
Lpp6	N	Text	4	NA				NA	Longest Primary - p6
P6P10	N	Text	2	NA				NA	p6-p10
P9P5	N	Text	2	NA				NA	p9-p5
P10P5	N	Text	2	NA				NA	p10-p5
P10P4	N	Text	2	NA	> , <, =			NA	p10-p4
P6EMarg	N	Text	2	NA	Y, N			NA	p6 emarginated
Tail	N	Integer	2	0				CM	Tail length
WingTail	N	Integer	2	0				CM	Wing-tail
R6R1	N	Text	2	NA				NA	R6-61
WebRect	N	Text	2	NA	N, S, M			NA	Outer web of rectrices

Clipped	N	Text	3	NA				NA	Clipped rectrice feather. Left / Right and number
BillGrv	N	Integer	3	0		0	100	%	Bill length with grooves
R2EMarg1	N	Text		NA				NA	R2 emarginated: in
R2EMarg2	N	Text		NA				NA	R2 emarginated: out
R5Width	N	Integer	4	0				NA	R5 width
Notes	N	Memo		NA				NA	General Notes

tbl_Species_Checklist

This table stores the data related to the surveys using the Species Checklist methods.

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
RecNum	Y	Integer	3	0	NA	NA	NA	NA	Unique number assigned by KBO to represent this record
Site_ID	Y	Text	50						Unique ID value that relates to the sites table
Site	Y	Text	4						Name of the Route, Mist Net Location, or Area Search Zone
SiteName	N	Text	100						Name sometimes used by KBO
Month	Y	Number				1	12		Month the bird was observed
Day	Y	Number				1	31		Day the bird was observed
Year	Y	Number							Year the bird was observed
Date	Y	Date/Time							Date the bird was observed
PrimObs	Y	Text	255						Primary Observer for the day
SecObs	N	Text	255						Secondary Observer for the day
NumObs	Y	Number							Total number of observers
Survey_Type	Y	Text	3		B, PC, CES, O				Type of survey
Start_Time	Y	Date/Time							Time the survey started
End_Time	Y	Date/Time							Time the survey ended
Species	Y	Text	4		AOU Bird Codes				Four letter code for the species observed during the survey
Common	Y	Text	255		AOU Bird List				Common name of the species observed during the survey
Notes	N								General Notes about the day
Source	Y	Text	6						Name of the KBO file where this data came from
Data_ID	Y								Field data table row identifier
Data_Location_ID	N								Optional link to tbl_Data_Locations
Project	Y								Project name used by KBO

Breeding	Y	Text	2		N = current year's **N**est found with eggs or young, in the process of being built, or already depredated or abandoned; M = adult seen gathering or carrying nesting **M**aterial to a likely nest site in the study area; F = adult seen carrying Food or **F**ecal sac to or from a likely nest site in the study area; D = **D**istraction display or injury feigning by an adult bird; L = a young bird incapable of sustained flight (a "**L**ocal") in the study area or very young (stub-tailed) fledglings being fed by parents in the study area; C = **C**opulation or **C**ourtship observed of a species within its breeding range; T = other **T**erritorial behavior observed; S = territorial **S**ong or drumming heard;B= Bird Captured, E = Encountered in study area, O = Encountered flying over study area				Breeding status of the bird

tbl_Photographs

This table stores the metadata for each image taken as part of this project.

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
Event_ID	Y	Text	50						Unique ID that relates this record to the event
Photograph_ID	Y	Text	50						Unique ID for this record
Photograph_Name	Y	Text	50						Name of the image
Photographer	Y	Text	50						Person who took the photograph
Date_Photo_Taken	Y	Date/Time							Date the photograph was taken
Photo_Description	Y	Memo							Detailed description of the photograph
Project	Y	Text	40		"Landbird Monitoring Project"				Name of the project
Collection	Y	Text	4		KLMN				Collection this photo is part of.
Publisher	Y	Text	3		NPS				Who is the publisher of this photo
Resource_Type	Y	Text	5		Image				Type of product
Extension	Y	Text	4		.jpg, .bpm				Extension of the photo
Historic	Y	Yes/No							Was this image taken before 2003

tbl_Vegetation_Composition

This table stores the data related to the composition parameters of the vegetation data

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
Location_ID	Y	Text	50	0					Unique ID value that relates to other tables
Species	Y	Text	4	0					4 letter code for the species
T1	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss
T2	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss
T3	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss
T4	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss
T5	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss
T6	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss
S1	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss
S2	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss
S3	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss
S4	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss
S5	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss
S6	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss
H1	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss
H2	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss
M1	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss
M2	Y	Text	2	0	0, 1, 2, 3, 4, 5, +, -, R				Sublayer where T = Tree, S = Shrub, H = Herb, M = Moss

tbl_Vegetation_General

This table stores the data related to the general parameters of the vegetation data

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
Location_ID	Y	Text	50						Unique ID value that relates to other tables
RecNum	Y	Integer	3	0	NA	NA	NA	NA	Unique number assigned by KBO to represent this record
Split	N	Text	1	NA	Y, N	NA	NA	NA	
Date		date/Time							
PlotRad	Y	Integer	3	0		NA	NA	meters	Radius of the vegetation plot
Water	Y	Text	2	NA	"+"= water is present in the plot,"-" = water is	NA	NA	NA	Determines the presence of water on the site

					not present in the plot				
Burned	Y	Text	2	NA	B = Recently burned vegetation (e.g., scorched shrubs, trees with brown leaves still on branches, etc.) with greater than 10% cover within the plot. U = Plot is unburned or with less than 10% burned vegetation	NA	NA	NA	Determines if the site has been recently burned.
RipUp	N	Text	2	NA	R = Riparian plant species comprise a minimum of 5% of the plot radius. U = Plot radius is not composed of at least 5% riparian plant species	NA	NA	NA	Determines if the site contains riparian or upland vegetation
RipType	N	Text	2	NA	F = Flowing water (e.g., river, stream, or creek), P = Pond, W = Wetland, L = Lake, -9, -8	NA	NA	NA	Type of riparian area
RipWidth	N	Text	3	NA	1 = less than 0.5 hectares, 2 = between 0.5 and 4 ha, 3 = >4 ha.	NA	NA	NA	The size of the entire riparian area (includes contiguous riparian outside the plot)
SiteNotes	N	Memo	NA	NA	NA	NA	NA	NA	General notes about the site
VegNotes	N	Memo	NA	NA	NA	NA	NA	NA	General notes about the vegetation

tbl_Vegetation_Snags

This table stores the data related to the snag parameters of the vegetation data

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
Location_ID	Y	Text	50						Unique ID value that relates to other tables
Snag1	Y	Integer	3	0	NA	NA	NA	NA	Number of snags in XXX size class
Snag2	Y	Integer	3	0	NA	NA	NA	NA	Number of snags in XXX size class
Snag3	Y	Integer	3	0	NA	NA	NA	NA	Number of snags in XXX size class
Snag4	Y	Integer	3	0	NA	NA	NA	NA	Number of snags in XXX size class
Snag5	Y	Integer	3	0	NA	NA	NA	NA	Number of snags in XXX size class

tbl_Vegetation_Structure

This table stores the data related to the structure parameters of the vegetation data

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
Location_ID	Y	Text	50						Unique ID value that relates to other tables
TrTotCov	Y	Integer	3	0	5 = >75, 4 = 51-75. 3 =26-50, 2 = 5-25, 1 = numerous, but less than 5% or scattered with cover up to 5%, + = few with small cover, r = rare, solitary, with small cover	NA	NA	%	Total cover in the tree layer

TrLowHt	Y	Integer	3	1	NA	0	NA	meters	Lower tree height
TrLowSP	Y	Text	4	NA	NA	NA	NA	NA	Species used for lower tree heght
TrUppHt	Y	Integer	3	1	NA	0	NA	meters	Upper tree height
TrUppSp	Y	Text	4	NA	NA	NA	NA	NA	Species used for upper tree height
TrMinDBH	Y	Integer	3	0	NA	NA	NA	centimeter	Diameter at breast height for the smallest tree layer
TrMinSp	Y	Text	4	NA	NA	NA	NA	NA	Species used for smallest DBH
TRMaxDBH	Y	Integer	3	0	NA	NA	NA	centimeter	Diameter at breast height for the largest tree layer
TrMaxSp	Y	Text	4	NA	NA	NA	NA	NA	Species used for Largest DBH
TrNumSub	Y	Integer	3	0	NA	NA	NA	NA	Number of tree sublayers
ShTotCov	Y	Integer	3	0	5 = >75, 4 = 51-75. 3 =26-50, 2 = 5-25, 1 = numerous, but less than 5% or scattered with cover up to 5%, + = few with small cover, r = rare, solitary, with small cover	NA	NA	NA	Total Cover in the shrub layer
ShLowHt	Y	Integer	3	1	NA	0	NA	meters	Lower shrub height
ShLowSP	Y	Text	4	NA	NA	NA	NA	NA	Species used for lower shrub height
ShUppHt	Y	Integer	3	1	NA	0	NA	meters	Upper shrub height
ShUppSp	Y	Text	4	NA	NA	NA	NA	NA	Species used for upper shrub height
ShNumSu	Y	Integer	3	0	NA	NA	NA	NA	Number of shrub sublayers
HbTotCov	Y	Integer	3	0	5 = >75, 4 = 51-75. 3 =26-50, 2 = 5-25, 1 = numerous, but less than 5% or scattered with cover up to 5%, + = few with small cover, r = rare, solitary, with small cover	NA	NA	NA	Total cover in the herb layer
MsTotCov	Y	Integer	3	0	5 = >75, 4 = 51-75. 3 =26-50, 2 = 5-25, 1 = numerous, but less than 5% or scattered with cover up to 5%, + = few with small cover, r = rare, solitary, with small cover	NA	NA	NA	Total cover in the moss layer

tbl_Vegetation_Structure

This table stores the data related to the structure parameters of the vegetation data

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
Event_ID	Y	Text	50						Unique ID that relates this record to the event
Temperature	Y	Integer	3	0	NA	NA	NA	Celcius	Temperature
CloudCover	Y	Integer	3	0	NA	0	100	%	Cloud cover

Precipitation	Y	Text	2	NA	N, F, M, D, R	NA	NA	Precipitation during the survey
Wind	Y	Integer	2	0	0 = calm, smoke rises vertically and the sea is mirror smooth. 1 = light air, smokes moves slightly with breeze and shows direction of wind. 2 = you can feel wind on your face and hear the leaves start to rustle. 3 = gentle breeze, small branches start to sway, wind extends a light flag. 4 = moderate breeze, loose dust or sand on the ground will move and larger branches will sway. >4 = Do not survey, too much wind. -9 = No Data	NA	NA	Wind speed using Beaufort code

tlu_Avian_Species_list

This table is a lookup list of landbirds and can be used to link to ITIS

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
Name	Y	Text	255	NA		NA	NA	NA	Common name of the species
ABBR	Y	Text	4	NA		NA	NA	NA	4 letter code for the species
Bad_Codes	N	Text	4	NA		NA	NA	NA	bad codes for the species
PyleCode	N	Text	4	NA		NA	NA	NA	
Scientific	N	Text	255	NA		NA	NA	NA	Scientific name of the species
Kingdom	N	Text	8	NA		NA	NA	NA	Taxonomic classification for the species
Phylum	N	Text	8	NA		NA	NA	NA	Taxonomic classification for the species
Class	N	Text	4	NA		NA	NA	NA	Taxonomic classification for the species
Order	N	Text	50	NA		NA	NA	NA	Taxonomic classification for the species
Family	N	Text	50	NA		NA	NA	NA	Taxonomic classification for the species
Genus	N	Text	50	NA		NA	NA	NA	Taxonomic classification for the species
Species	N	Text	50	NA		NA	NA	NA	Taxonomic classification for the species
Subspecies	N	Text	50	NA		NA	NA	NA	Taxonomic classification for the species
PC	Y	Text	5	NA	True / False	NA	NA	NA	
SendAKN	Y	Text	5	NA	True / False	NA	NA	NA	Record sent to Avian Knowledge Network
At_Sea	Y	Text	5	NA	True / False	NA	NA	NA	Species found at the Sea
Costa_Rica	Y	Text	5	NA	True / False	NA	NA	NA	Species found in Costa Rica
Non_Bird	Y	Text	5	NA	True / False	NA	NA	NA	
Banding	Y	Text	5	NA	True / False	NA	NA	NA	Species is banded by KBO
Species_Num	Y	Integer	10	5	NA	NA	NA	NA	

Sci_Code	N	Text	20	NA		NA	NA	NA	
PyleTax	N	Integer	15	5		NA	NA	NA	
BandSize	N	Text	20	NA		NA	NA	NA	Size of the band used on these species
Sci_Code_U	N	Text	20	NA		NA	NA	NA	
Notes	N	Memo	NA	NA	NA	NA	NA	NA	General notes about the species

tlu_Contacts

This table is a lookup list that stores the contact information for each person working on the project.

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
Contact_ID	Y	Text	50						Unique ID for this record
Last_Name	Y	Text	50						Last name of the person
First_Name	Y	Text	50						First name of the person
Middle_Init	Y	Text	4						Middle initial of the person
Organization	Y	Text	50						Organization the person works for
Position_Title	Y	Text	50						Position title of the person
Address_Type	Y	Text	50						Address for the person
Address_Type	Y	Text	50						Address for the person
Address2	Y	Text	50						Address for the person
City	Y	Text	50						Address for the person
State_Code	Y	Text	8						Address for the person
Zip_Code	Y	Text	50						Address for the person
Country	Y	Text	50						Address for the person
Email_Address	Y	Text	50						Address for the person
Work_Phone	Y	Text	50						Phone number for the person
Work_Extension	Y	Text	50						Phone number for the person
Contact_Notes	N	Memo							General notes about the person
Initials	Y	Text	3						Initials of the person

tlu_Enumeration

This table is a lookup list that stores lookup values for all of the fields not associated with the species or contact lookup tables.

Field Name	Required	Field Type	Field Size	Decimal	Enumerated Domain	Min Value	Max Value	Unit of Measure	Field Description
Enum_Code	Y	Text	50						Code for lookup value
Enum_Description	Y	Memo	50						Lookup value description
Enum_Group	Y	Text	50						Category for lookup value
Sort_Order	Y	Number							Sort order for lookup values

Appendix I. Route and Point Locations for Landbird Monitoring Following the KLMN Protocol

Appendix I is an automated report that can be produced by using the reporting tools available in the KLMN master landbird database. This report provides navigational information to landbird routes and points along the routes at each park. The report contains NAIP imagery of each route and provides the following information:

- Park
- USGS Quad Map
- County
- Public Land Survey System location
- Watershed and Subwatershed
- Directions to the route
- Directions to the points along a route
- Monumenting information such as marker type, height, offset information
- Elevation, aspect, and slope

This appendix was not included because of the potential for these sites to contain locations of sensitive species. A copy of this appendix can be obtained by contacting the natural resource staff at the park you are interested in or by contacting the Klamath Network Data Manager. In addition, the document is posted on the KLMN intranet which can be accessed by NPS staff.

Appendix J. Power Analysis Modeling of Selected Species for the KLMN Landbird Monitoring Protocol.

Introduction

This appendix includes a compilation of memos and analysis completed by Kathi Irvine, PhD, in the Department of Math Science from Montana State University. The Klamath Network (KLMN) worked with Kathi to develop R code that could be used to determine the number of routes and years of sampling needed to achieve 80% power to detect a 50% decline in relative abundance for an individual species after 20 years based on the monitoring strategy described in the KLMN Landbird Monitoring Protocol.

The first memo dated October 13, 2009 (see below) provides a description of the models used as part of our power analysis. In addition, this memo provides instructions on how to use the R Code and a few examples of the output from the code.

The second memo dated October 28, 2009 (see below) provides the results of two examples (Spotted Towhee at LABE and Pacific-Slope Flycatcher at RNSP) of our ability to have enough power to detect trends as described in the protocol narrative. As stated in the memo, the site-by-year variance (sig2c) plays a significant role in determining the results of the models. If sig2c is estimated to be 0.05, with 25 sites at Lava Beds National Monument (LABE), we would have 91.4% power to detect a 50% decline after 20 years within 10 years (three sampling events), which exceeds our goal of 80% power. However, if we estimate sig2c as 1.00, then after 10 years we would have 40.5% power to detect a 50% decline after 20 years. It would take 30 years (10 sampling events) to reach our goal of 80% power.

At this point in time, the KLMN has completed one sampling event at two (LABE, RNSP) of the six parks where we plan on implementing this project. Since we have only completed one visit, we had to bring in additional data to try and estimate the site-by-year variance described above. In an effort to make the best determination of the site-by-year variance, we examined the Breeding Bird Survey data from four routes that were near LABE. This effort is described in the third memo dated November 3, 2009, which is provided below. As the memo states, in some cases, species that have a high site-by-year variability make it difficult to detect trends. This is shown in example 1 (Spotted Towhee) and 2 (Brown Headed Cowbird), where it is predicted it will take 30+ years (10+ sampling events) to be able to detect trends in these species. However, for species that have very little site-by-year variance, we will be able to detect trends in as little as 15 years (five sampling events), as in shown in example 3 for the Western Meadowlark.

Assumptions

It is assumed that the BBS routes that surround our parks cover a larger area (routes are 24.5 miles long) and bisect more heterogeneous habitats than the routes we have established within the park. Based on the design of the route layout in this protocol, we are assuming the site-by-year variance will be less variable than the BBS routes. If this holds true, the power estimates in this analysis are underestimates. In order to test this assumption, a power analysis will be completed as part of our third Analysis and Synthesis report. Although we have already shown we have the power to detect trends in common species that have little site-by-year variance

within 15 years, this analysis will provide us with a list of species that we can potentially provide trend data on as part of the fifth Analysis and Synthesis report.

In addition, as described in SOP 17: Data Analysis and Reporting, in the first Analysis and Synthesis report, we will be developing detection functions for individual species. A detection function was not used for the analysis described in the memos below. Instead, any species observation that was beyond 50 meters from the listening station was dropped. It is likely that developing detection functions will help provide better estimates of relative abundance, which will improve our power to detect trends. Since detection functions were not created, there is the chance the power estimates provided in these examples are underestimates. Similar to the above assumption, we will test this assumption when completing the power analysis in the third Analysis and Synthesis report.

MEMO 1: October 13, 2009

October 13, 2009
Prepared by K. Irvine, PhD

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Consultation with the author is recommended before using the code.

This document pertains to the following R code files: powercommands051808, Rcode_CalcPowerBIRDS, Rcode_CalcPowerRandom, Rcode_SimPopnChangeBIRDS, Rcode_SimPopnChangeRandomBIRDS, and Satterthwaite_DF_functions. Specific documentation is provided within the code itself. These files were used to produce the May 18, 2008 memo titled "Trend Power Analysis for Landbirds Monitoring Protocol for Klamath Network Parks."

The file powercommands051808 contains all the R commands that were used for the memo results. The other files (essentially R functions) must be read into R in order for the commands to work properly.

The code is specific to Model 1 and Model 2 described in the memo. If a different model is used to estimate the variance components from pilot data, then the power code is essentially worthless. Also, the degrees of freedom used for the test of linear trend is an approximation to the Satterthwaite method as described in the Giesbrecht and Burns (1985). This approximation could improve in time as statistical research progresses. Further the trend model is dependent on the species of interest. Thus a decision needs to be made based on pilot data as to the particular variance component structure. In other words, the power code should not be used blindly once the NPS land birds protocol has been implemented for several years and it is time to perform the power analysis and submit report 3 as outlined in SOP 17.

F. G. Giesbrecht and J. C. Burns 1985 **Two-Stage Analysis Based on a Mixed Model: Large-Sample Asymptotic Theory and Small-Sample Simulation Results** Biometrics, Vol. 41, No. 2 pp. 477-486

Instructions for Use of Code

Option 1: Random effect of sites

If you want to investigate the number of routes effect on power, you will need to assume a random effect of site. The following files are needed:

1. Rcode_CalcPowerRandom.txt
2. Rcode_SimPopnChangeRandomBIRDS.txt
3. Satterthwaite_DF_functions.txt

Option 2: Fixed effect of sites

This option is when you already have pilot data for the sites where you plan on sampling. OR the number of routes is fixed and you are only interested in the effect of number of years of sampling on power. You need the following files:

1. Rcode_CalcPowerBIRDS
2. Rcode_SimPopnChangeBIRDS
3. Satterthwaite_DF_functions

Instructions for either option:

Step 1: Change the directory that R is using as the default. File menu → Change dir…-→ select the folder where your files are located

Step 2: The main file that contains the commands used in the memo is powercommands051808.txt. Open this file within the R package by using File→ Open Script → select "powercommands051808.txt"

Step 3: To submit all the functions needed to estimate the power; open all the files within the R program by following step 2 for the following files listed under option 1 or 2.

If using Option 1:

Step 4: To estimate the power for either 25, 30, or 35 number of routes and different number of visits (=sampling periods). You will need the following things as inputs to the function CalcPowerRandom

alpha,its,nosites,yrs,StartYear,change,sig2a,sig2b, sig2t,and sig2c defined as follows:

alpha desired type I error rate
its number of iterations for simulated power
nosites is the number of sites(=routes)
yrs number of years of sampling: revisit design so if every 3 years 0,3,6 etc
** change is the percent decline over 20 years of interest : 50% decline would be -.50
sig2a is the variance component for random intercept
sig2b is the year to year variability
sig2t is the variance component for the random slopes
sig2c is the error variance of site*year variance component

****The code is currently set-up to only investigate only a percent change over 20 years, so say 50% decline or 30% decline over 20 years. This can be changed such that you can change the interval over which you want the decline/increase to occur.**
EXAMPLE

#Power estimated based on 50% decline over 20 years for 40 routes, alpha=.10, and different sampling durations

CalcPowerRandom(.10,1000,40,c(0,3,6,9,12,15,18,21,24,27),2004,-.5,sig2a=.023,sig2b=.21, sig2t=.003,sig2c=.047)

#Power estimated based on 50% decline over 38 years for 40 routes, alpha=.10, and different sampling durations

CalcPowerRandom(.10,1000,40,c(seq(0,38,by=2)),2004,-.5,sig2a=.023,sig2b=.21, sig2t=.003,sig2c=.047)

The estimates from the variance components are based on pilot data. In order to estimate sig2a, sig2b, sig2t, and sig2c you will need at least two years of data. However, for a start I don't think there is harm in using the estimates of sig2c from the KBO data for a species and the first year of data for sig2a to estimate the site-to-site variability within a given park.

If using Option 2:

Step 4: You will need the following things as inputs to the CalcPowerBIRDS function:

alpha,its,nosites, yrs, StartYear, change, ai,sig2b, sig2t,sig2c

defined as follows:

alpha desired type I error rate;
its number of iterations for simulated power;
nosites is the number of sites(=routes);
yrs number of years of sampling: revisit design so if every 3 years 0,3,6 etc ;
**change is the percent decline over 20 years of interest : 50% decline would be -.50;
ai are the fixed site intercepts;
sig2b is the year to year variability;
sig2t is the variance component for the random slopes;
sig2c is the error variance of site*year variance component.

EXAMPLE:

#"fixsite" are fixed site intercepts estimated from the pilot dataset in SAS for model 1

fixsite<-c(0.5311834,
0.8897791,0.5603643,0.8182710,0.3307078,0.5493261,0.7564269,0.9434209,0.8915809, 0.9087020, 0.4266378)

#Power estimated based on a 50% decline over 20 years with 4 sampling periods (every 3 years) for 11 routes.

CalcPowerBIRDS(.10,1000,11,c(0,3,6,9),2004,-.5, fixsite,sig2b=.008, sig2t=.004,sig2c=.0467)

MEMO 2: October 28, 2009

October 28, 2009
Prepared by K. Irvine, PhD

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In this document, I investigate the number of routes and years of sampling to achieve 80% power to detect a 50% decline in relative abundance of Spotted Towhee after 20 years in Lava Beds National Monument. Also, the second example is for the Pacific-slope Flycatcher in Redwood National Park.

I assume that the routes are fixed. If some sort of panel design was used, the code should be changed to reflect that revisit design.

The example used the pilot data provided by Sean Mogren: *PointCounts.xls.* The following used the R code developed previously and tested using KBO data.

Example 1: Spotted Towhee Lava Beds

The code for the Spotted Towhee examples is provided within the file: PilotDataCommands_SPTO.txt.

In order to run the wrapper function POWER.RandomInterceptsModel() in step 6, the following files need to be submitted to the R console in the following order

1. Rcode_SimPopnChangeRandomBIRDS
2. Satterthwaite_DF_functions
3. Rcode_CalPowerRandom
4. Rcode_PowerFunction

The steps followed in the example file PilotDataCommands_SPTO.txt.

1) Create a .csv file to import into R (done outside of R in excel). Import csv file into R.
2) Subset data to one park and one species of interest
3) Calculate relative abundance for each species at a route as # birds detected <50m/ # points. One issue is that the denominator varies for Redwoods. To accommodate that, I have included additional code needed for the Redwoods sites at this step. See PilotDataCommands_PSFL.txt code for that example.
4) Look at the data to assess assumption of normality. For instance, with SPTO the histogram on the log scale appears ok. This is hard to assess with minimal pilot data, but needs to be done before proceeding with a power analysis once more data is available.

5) Calculate the site-to-site variance observed in the pilot data. Calculate the estimate of mu.

6) Run the power function for one species and park based on a set of inputs.

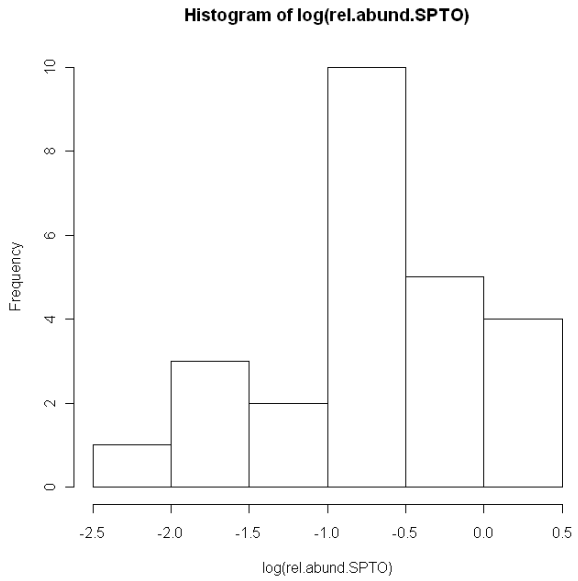


Figure 13. Histogram of relative abundance on the log scale for the Spotted Towhee used to examine the assumption of normality.

For step 6, you need to decide on the alpha-level for the trend test, the number of iterations for the simulation, the range of sample sizes of interest (e.g., 20,25,30 sites), the number of years between sampling (off years), the range of the number of years of sampling of interest (5, 10, 20, 30 years of sampling), the start year (not that critical), the % decrease/increase in median relative abundance after 20 years, variance component estimates.

I used the following in the SPTO example:

#.10 = alpha level for trend test
500 is the number of iterations for each simulation
c(20,25,30) is the number of sites
2 is the number of off years between sampling 0,3,6,9 for 10 years period of sampling
c(5,10,20,30) is the number of years of sampling
2008 start year
-50% decrease over 20 years
mu is the estimated overall mean across sites
sig2a is the variance component for random intercept
sig2b is the year to year variability
sig2t is the variance component for the random slopes
sig2c is the error variance of site*year variance component

One issue I ran into is the estimate of the site*year variance component. A range of variance estimates should be considered. Also, because of the general model formulation in the code, I got the following error message "In mer_finalize(ans) ... : singular convergence (7)" which is

probably due to the zero variance component for year. The results should still yield valid estimates of power under the assumed model and given variance inputs.

Step 6: Example Results Output SPTO Lava Beds:

OUT<-POWER.RandomInterceptsModel(.10,500,c(20,25,30),2,c(5,10,20,30),2008,-.5,mu=-.64,sig2a=.491,sig2b=0, sig2t=0,sig2c=.05)

	Years			
Sites	**5**	**10**	**20**	**30**
20	0	**0.814**	0.972	0.980
25	0	0.914	0.992	0.996
30	0	0.956	0.994	1.000

The table is set-up such that reading across a row indicates the power for the given *row* sample size for different sampling durations (columns). For example, the power to detect a 50% decline after 20 years is 81.4% with 10 years of sampling (2008-2018) every 3rd year with 20 fixed routes; 97.2% with 20 years of sampling (2008-2028); 98% with 30 years of sampling (2008-2038). This is based on estimated variance components, and may be an overestimated if the variances are too small.

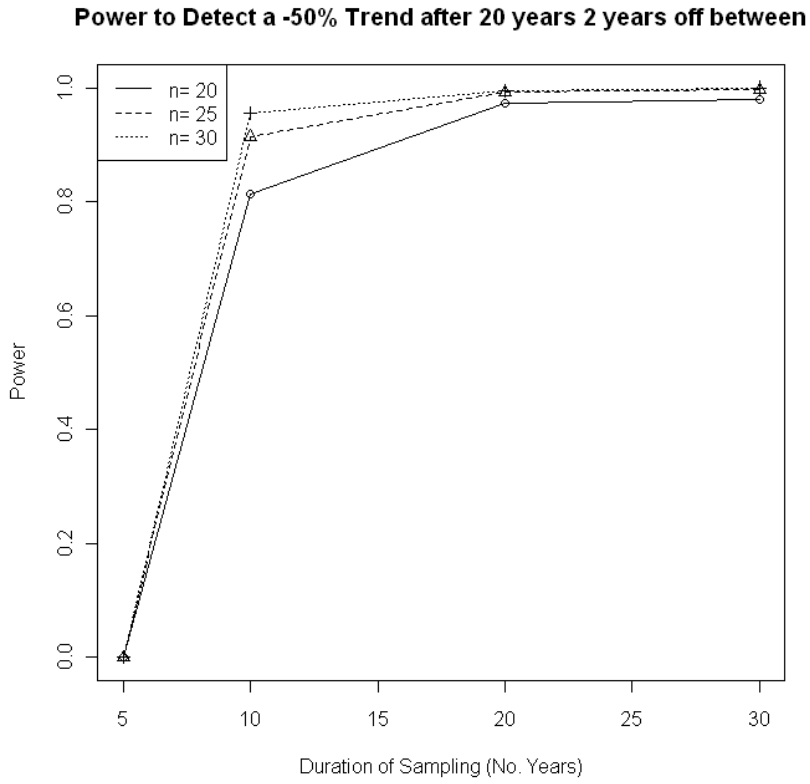


Figure 14. Power to detect trends in Spotted Towhee over a 30 year period using 20, 25, and 30 routes at Lava Beds National Monument using an estimated variance component equal to 0.05.

For another example, to demonstrate the role of the estimated variance component for sig2c, I changed the input to 1 from .05, the power decreases as expected. The power to detect a 50% decline after 20 years is 31.5% with 10 years of sampling (2008-2018) every 3rd year with 20 fixed routes as opposed to 81.4%.

Sites	5	10	20	30
20	0	0.315	0.74	0.845
25	0	0.405	0.84	0.940
30	0	0.515	0.93	0.985

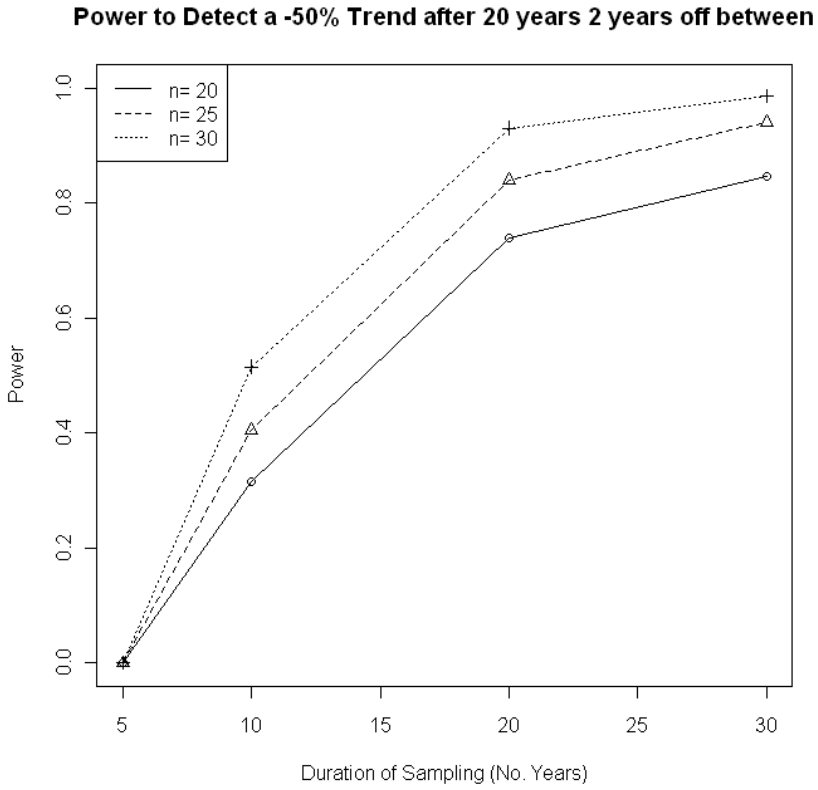


Figure 15. Power to detect trends in Spotted Towhee over a 30 year period using 20, 25, and 30 routes at Lava Beds National Monument using an estimated variance component equal to 1.00.

Example 2: Pacific-Slope Flycatcher Redwood National Park

The code for this example is in the file "PilotDataCommands_PSFL.txt."

Step 3:

Notice Step 3 for calculating relative abundance is the only difference in the code for this example compared to the SPTO example.

**When I calculate the number of points sampled for each site, I find there were 7 sampled at site RW12; however, in the annual report Table 3 says there were only 6. My calculations correspond with the "Route and Points.xls" file as well.

Step 4:

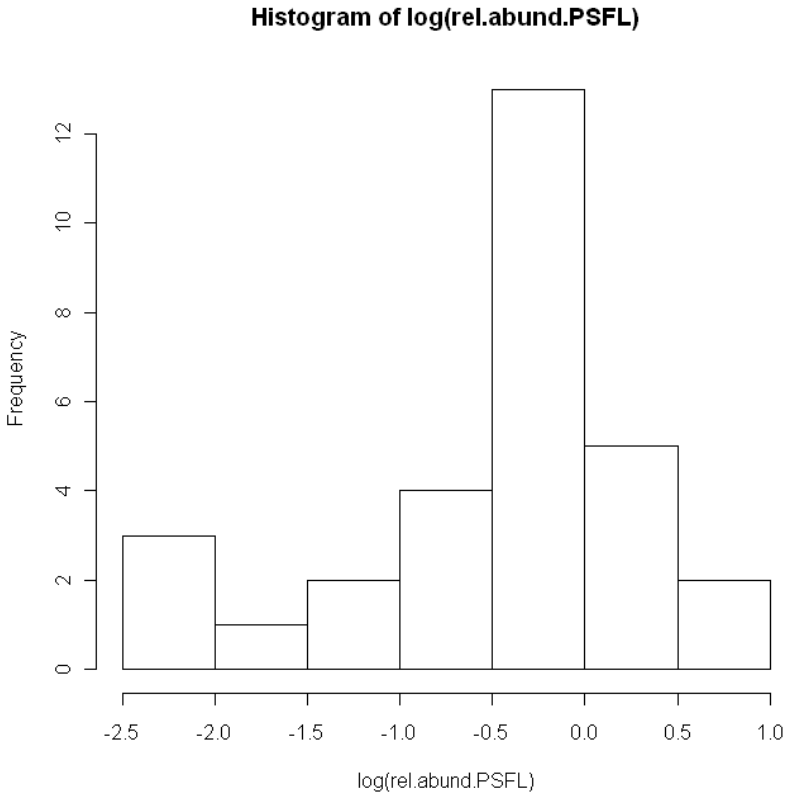


Figure 16. Histogram of relative abundance on the log scale for the Pacific-Slope Flycatcher used to examine the assumption of normality.

Step 5: Pilot Values calculated for PSFL in Redwoods

sig2a = .611; mu = -.45

Step 6: Example Results Output PSFL Redwoods:

OUT.PSFL1<-POWER.RandomInterceptsModel(.10,500,c(20,25,30),2,c(5,10,20,30),2008,-.5,mu=-.45,sig2a=.611,sig2b=0,sig2t=0,sig2c=1)

5 10 20 30
20 0 0.132 0.402 0.598
25 0 0.124 0.544 0.630
30 0 0.148 0.584 0.744

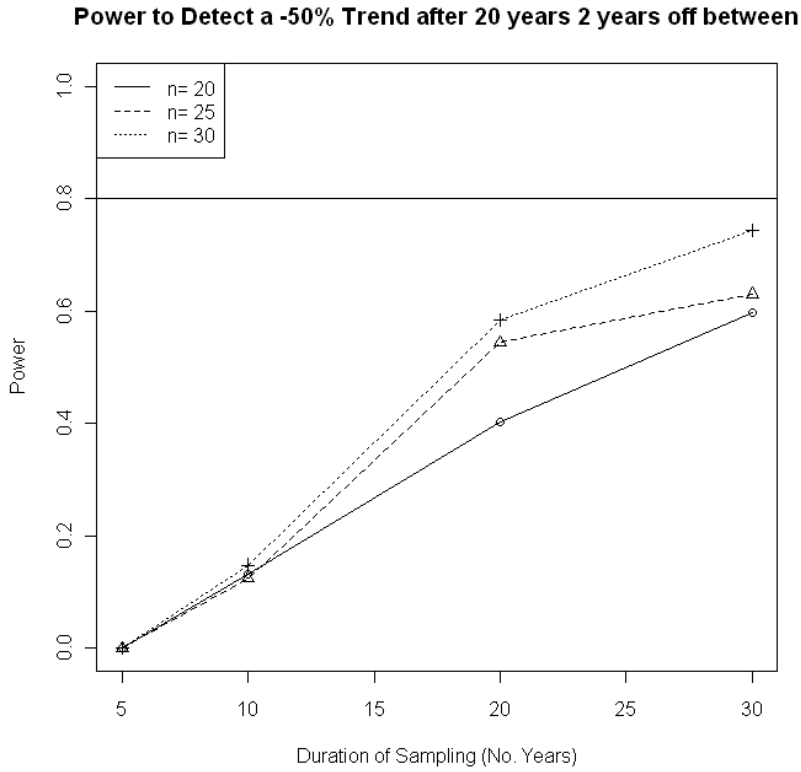


Figure 17. Power to detect trends in Pacific-Slope Flycatchers over a 30 year period using 20, 25, and 30 routes at Lava Beds National Monument using an estimated variance component equal to 0.05.

Appendix 1.

R-Code for example SPTO

Code for SPTO example: “PilotDataCommands_SPTO.txt”

```
# K. Irvine October 26, 2009
# KLMN Landbirds Protocol Development
# Importing Pilot Data and Extracting relevant values for power analysis
# Running an example for a power analysis based on pilot data from lava beds and SPTO (Spotted Towhee)
#########################################################################

#**************************
# STEP 1. IMPORT DATA
# The data file should be in a .csv file to import into R
# ****************************

Birds<-read.csv("PointCounts.csv",header=T)
names(Birds)

attach(Birds)

#*************
# STEP 2. SUBSET DATA TO DESIRED PARK, SPECIES
# subset to SPTO for Spotted Towhee data within Lava Beds example
#**************************

# 25 sites surveyed at Lava Beds
# 12 points each route

sites.SPTO<-SITE[PROJECT=="NPS_LABE"&SPECIES=="SPTO"& DISTANCE<=50]
points.SPTO<-POINT[PROJECT=="NPS_LABE"&SPECIES=="SPTO"& DISTANCE<=50]
#

# STEP 3.A CALCULATE RELATIVE ABUNDANCE FOR EACH ROUTE LAVA BEDS
table(sites.SPTO,points.SPTO)[1:25,] #calculating the number of detect for each point*site combination < 50 m
rel.abund.SPTO<-apply(table(sites.SPTO,points.SPTO)[1:25,],1,sum)/12 #taking the sum for a row divided by 12
points

# STEP 4. LOOK AT THE DATA TO ASSESS NORMALITY ON THE LOG-SCALE

hist(log(rel.abund.SPTO)) #check that looks like a "normal" distribution

# STEP 5. CALCULATE SITE-TO-SITE VARIANCE COMPONENTS AND OVERALL MEAN ACROSS SITES

sig2a<-var(log(rel.abund.SPTO)) #estimate of the site-to-site variability for log relative abundance
sig2a #0.4907695
mu<-mean(log(rel.abund.SPTO))
mu #-0.6430166

#
**********************************************************************************************
*******************#
#
                                                    #
```

```
# STEP 6. EXAMPLE FOR ONE SPECIES: IN ORDER TO INVESTIGATE HOW MANY TRANSECTS AND
YEARS OF SAMPLING                        #
#  IS REQUIRED TO HAVE 80% POWER TO DETECT GIVEN LEVEL OF DECLINE/INCREASE OVER 20
YEARS
#
                                          #
#*****************************************************************************************
**********************#

#.10 = alpha level for trend test
# 500 is the number of iterations for each simulation
# c(20,25,30) is the number of sites
# 2 is the number of off years between sampling 0,3,6,9 for 10 years period of sampling
# c(5,10,20,30) is the number of years of sampling
# 2008 start year
# -50% decrease over 20 years
# mu is the grand mean
# sig2a is the variance component for random intercept
# sig2b is the year to year variability
# sig2t is the variance component for the random slopes
# sig2c is the error variance of site*year variance component

#We have no estimate of sig2b, sig2t, or sig2c. We can assume sig2b and sig2t are zero but we do need an estimate
of site*year variance
# from the Ashroot data anywhere between .05 to .01 might be reasonable guesses...

OUT<-POWER.RandomInterceptsModel(.10,500,c(20,25,30),2,c(5,10,20,30),2008,-.5,mu=-
.64,sig2a=.491,sig2b=0, sig2t=0,sig2c=.05)

#THE OUTPUT WILL BE A TABLE OF THE ESTIMATED POWER FOR A GIVEN NUMBER OF ROUTES
AND NUMBER OF YEARS OF SAMPLING [ROWS=NO.SITES, COLUMNS=NO.YEARS]
#WITH THE EXAMPLE ABOVE WE GOT

# 5  10  20  30
#20 0 0.814 0.972 0.980
#25 0 0.914 0.992 0.996
#30 0 0.956 0.994 1.000

OUT3<-POWER.RandomInterceptsModel(.10,200,c(20,25,30),2,c(5,10,20,30),2008,-.5,mu=-
.64,sig2a=.491,sig2b=0, sig2t=0,sig2c=1)
OUT3

# 5  10  20  30
#20 0 0.315 0.74 0.845
#25 0 0.405 0.84 0.940
#30 0 0.515 0.93 0.985
```

Appendix 2. R-code for PSFL example

Code for PSFL example: "PilotDataCommands_PSFL.txt"

```
# K. Irvine October 26, 2009
# KLMN Landbirds Protocol Development
# Importing Pilot Data and Extracting relevant values for power analysis
# Running an example for a power analysis based on pilot data from redwood and Pacific-Slope Flycatcher
#############################################################################

#**************************
# STEP 1. IMPORT DATA
# The data file should be in a .csv file to import into R
# ******************************

Birds<-read.csv("PointCounts.csv",header=T)
names(Birds)

attach(Birds)

#**************
# STEP 2. SUBSET DATA TO DESIRED PARK, SPECIES
# subset to PSFL for Pacific slope flycatcher data within Redwoods example
#**************************

sites.PSFL<-SITE[PROJECT=="NPS_RNSP"&SPECIES=="PSFL"& DISTANCE<=50]
points.PSFL<-POINT[PROJECT=="NPS_RNSP"&SPECIES=="PSFL"& DISTANCE<=50]

# STEP 3.B CALCULATE RELATIVE ABUNDANCE FOR EACH ROUTE FOR REDWOODS

# 30 sites surveyed at Redwoods
# variable number of points each route

Routes<-read.csv("RouteandPoints.csv",header=T) #loading the route and points dataset
pts<-apply(table(Routes$ROUTE[Routes$PROJECT=="NPS_RNSP"],
Routes$STATION[Routes$PROJECT=="NPS_RNSP"])[27:56,],1,sum) #calculating the number of points surveyed each route
for all parks
pts

rel.abund.PSFL<-apply(table(sites.PSFL,points.PSFL)[27:56,],1,sum)/pts #taking the sum for a row divided by # points

# STEP 4. LOOK AT THE DATA TO ASSESS NORMALITY ON THE LOG-SCALE

hist(log(rel.abund.PSFL)) #check that looks like a "normal" distribution

# STEP 5. CALCULATE SITE-TO-SITE VARIANCE COMPONENTS AND OVERALL MEAN ACROSS SITES

sig2a<-var(log(rel.abund.PSFL)) #estimate of the site-to-site variability for log relative abundance
sig2a #.611
mu<-mean(log(rel.abund.PSFL))
mu #-.45

#
**********************************************************************************************************
********#
#
                                                    #
# STEP 6. EXAMPLE FOR ONE SPECIES: IN ORDER TO INVESTIGATE HOW MANY TRANSECTS AND YEARS OF
SAMPLING                                  #
#  IS REQUIRED TO HAVE 80% POWER TO DETECT GIVEN LEVEL OF DECLINE/INCREASE OVER 20 YEARS
```

```
#
                                                    #
#*****************************************************************************************************
**********#

#.10 = alpha level for trend test
# 500 is the number of iterations for each simulation
# c(20,25,30) is the number of sites
# 2 is the number of off years between sampling 0,3,6,9 for 10 years period of sampling
# c(5,10,20,30) is the number of years of sampling
# 2008 start year
# -50% decrease over 20 years
# mu is the grand mean
# sig2a is the variance component for random intercept
# sig2b is the year to year variability
# sig2t is the variance component for the random slopes
# sig2c is the error variance of site*year variance component

#We have no estimate of sig2b, sig2t, or sig2c. We can assume sig2b and sig2t are zero but we do need an estimate of site*year
variance
# from the Ashroot data anywhere between .05 to .01 might be reasonable guesses, but these seem low

OUT.PSFL1<-POWER.RandomInterceptsModel(.10,500,c(20,25,30),2,c(5,10,20,30),2008,-.5,mu=-.45,sig2a=.611,sig2b=0,
sig2t=0,sig2c=1)

#THE OUTPUT WILL BE A TABLE OF THE ESTIMATED POWER FOR A GIVEN NUMBER OF ROUTES AND
NUMBER OF YEARS OF SAMPLING [ROWS=NO.SITES, COLUMNS=NO.YEARS]
#WITH THE EXAMPLE ABOVE WE GOT

OUT.PSFL1

# 5  10  20  30
#20 0 0.132 0.402 0.598
#25 0 0.124 0.544 0.630
#30 0 0.148 0.584 0.744
```

MEMO 3: November 3, 2009

November 3, 2009
Prepared by K. Irvine, PhD

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In this document, I show how to calculate the variance components for the power analysis for trend based on BBS survey routes located near the parks.

Again I assume that the routes are fixed.

Example 1. Spotted Towhee

The example used the pilot data provided by Sean Mohren: *BBS_SPTO_4_Routes_20091102.xls.* The R code is provided in *VarianceComponentEstimates.txt*

Step 1: In Excel

I made the following changes in excel:

1) Changed dashes to "NA"
2) Saved as a comma delimited file

Step 2: Imported into R

Once imported into R, I subset to only the relevant rows, for some reason it was reading in a much larger file.

Step 3: Plotted the pilot data

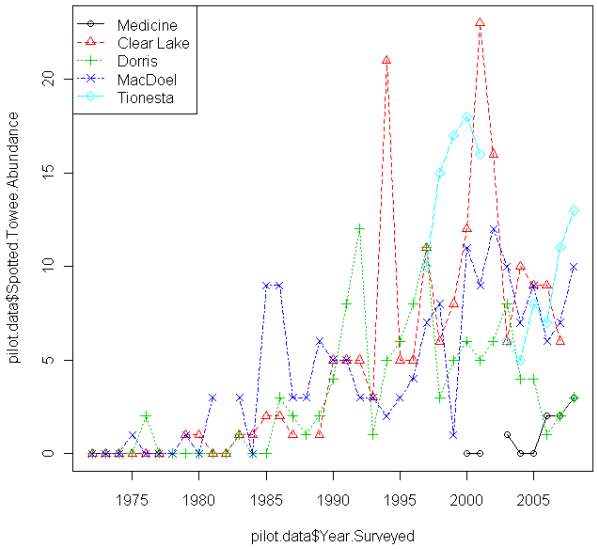


Figure 18. Plot of the abundance of Spotted Towhee along five Breeding Bird Survey routes in the proximity of LABE.

There is a lot of year-to-year variability and site-to-site variability, as expected.

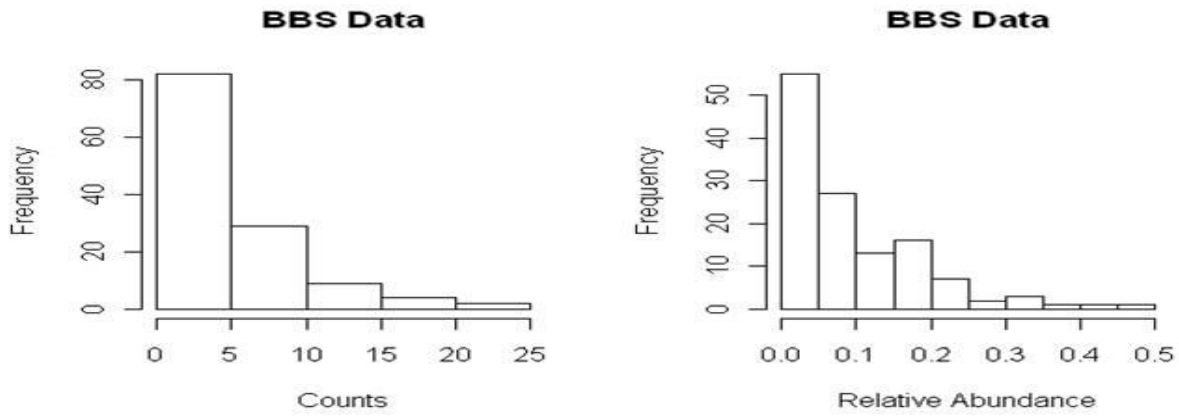


Figure 19. Histograms examining the year-to-year and site-to-site variability of the number and relative abundance of Spotted Towhee at five breeding bird survey routes.

Step 4: Calculating log transformed Relative Abundance

I divide by 50 stops for each count. Then I take the natural log transformation, ln(relative abundance+.001).

Step 5: Fit model to estimate variance components

```
> fit<- lmer(log.RE~Year.Surveyed +(1|Route.Surveyed)+(1|Year.Surveyed), data=pilot.data
)
> summary(fit)
Linear mixed model fit by REML
Formula: log.RE ~ Year.Surveyed + (1 | Route.Surveyed) + (1 | Year.Surveyed)
  Data: pilot.data
  AIC  BIC logLik deviance REMLdev
 438.7 452.9 -214.4   423  428.7
Random effects:
 Groups     Name    Variance Std.Dev.
 Year.Surveyed (Intercept) 0.3696  0.60794
 Route.Surveyed (Intercept) 2.2257  1.49188
 Residual          1.2084  1.09929
Number of obs: 126, groups: Year.Surveyed, 37; Route.Surveyed, 5

Fixed effects:
       Estimate Std. Error t value
(Intercept)  -313.82704  27.14663 -11.56
Year.Surveyed  0.15558  0.01362  11.42

Correlation of Fixed Effects:
     (Intr)
Year.Survyd -1.000
```

Just making sure the residuals appear relative normal…

Step 6: Estimating Power for based on assumed variance component estimates

In the power code, we would use

```
#mu=-313
        # sig2a is the variance component for random intercept
        # sig2b is the year to year variability
        # sig2t is the variance component for the random slopes
        # sig2c is the error variance of site*year variance component
```

sig2a=2.22, sig2b=.37, and sig2c=1.099 based on this output.

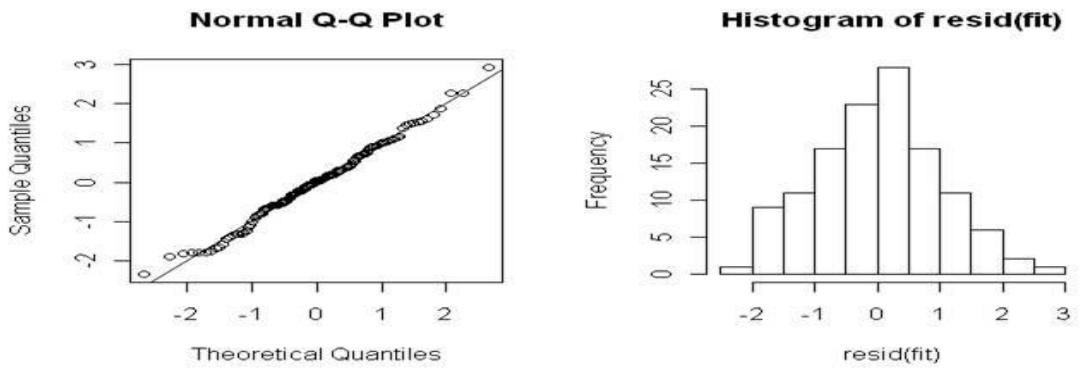


Figure 20. Examination of the normality of the residuals using Q-Q plots and histograms.

OUT<-POWER.RandomInterceptsModel(.10,500,c(20,25,30),2,c(5,10,20,30),2008,-.5,mu=-313,sig2a=2.22,sig2b=.37, sig2t=0,sig2c=1.1)

Sites	**10**	**20**	**30**	**40**
20	0.122	0.424	0.584	0.682
25	0.094	0.398	0.536	0.654
30	0.086	0.376	0.564	**0.654**

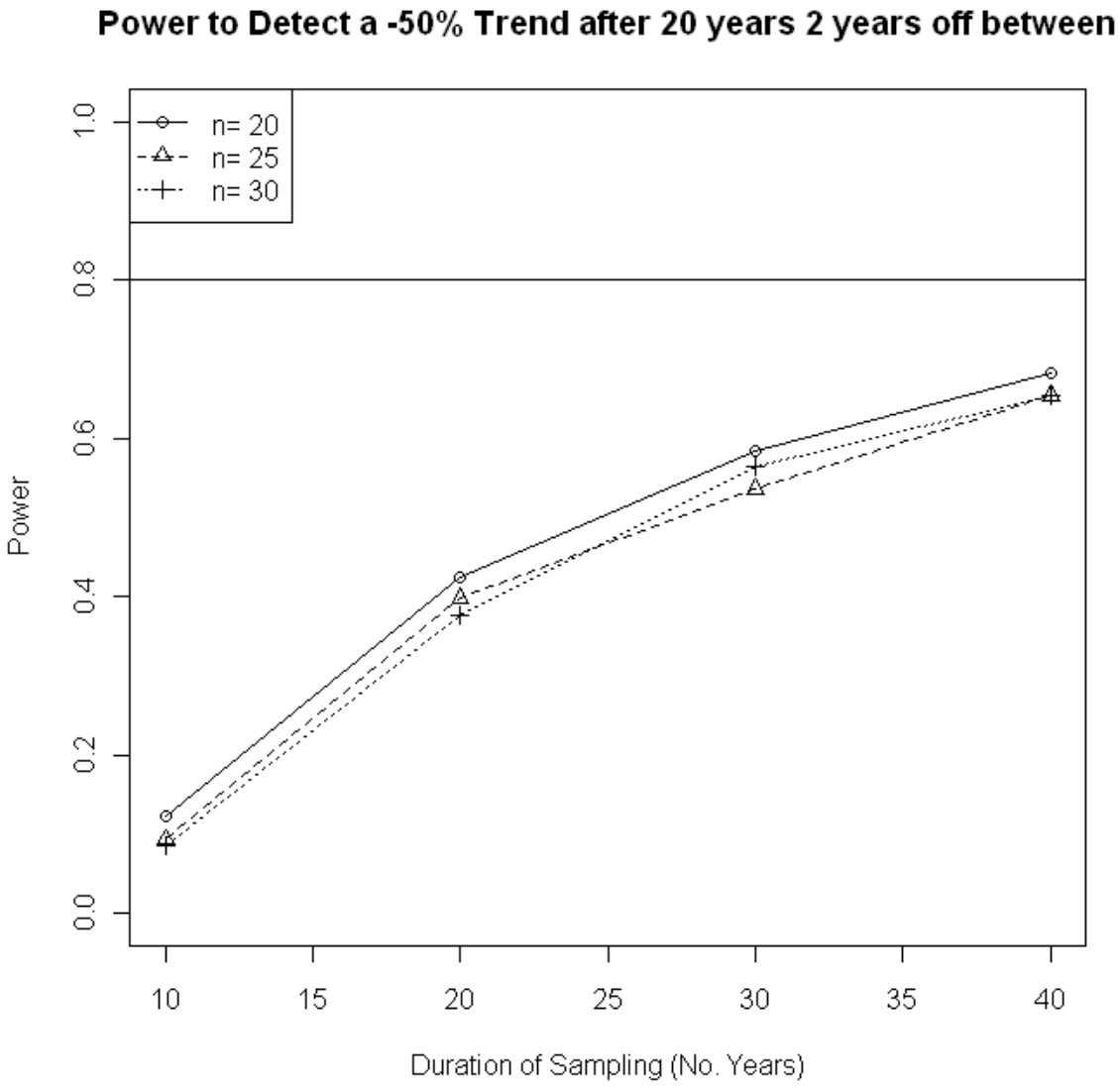


Figure 21. Power to detect trends in Spotted Towhee over a 30 year period using 20, 25, and 30 routes at Lava Beds National Monument using an estimated variance component equal to 0.05.

Example 2. Brown Headed Cowbird

Plot of the BBS data:

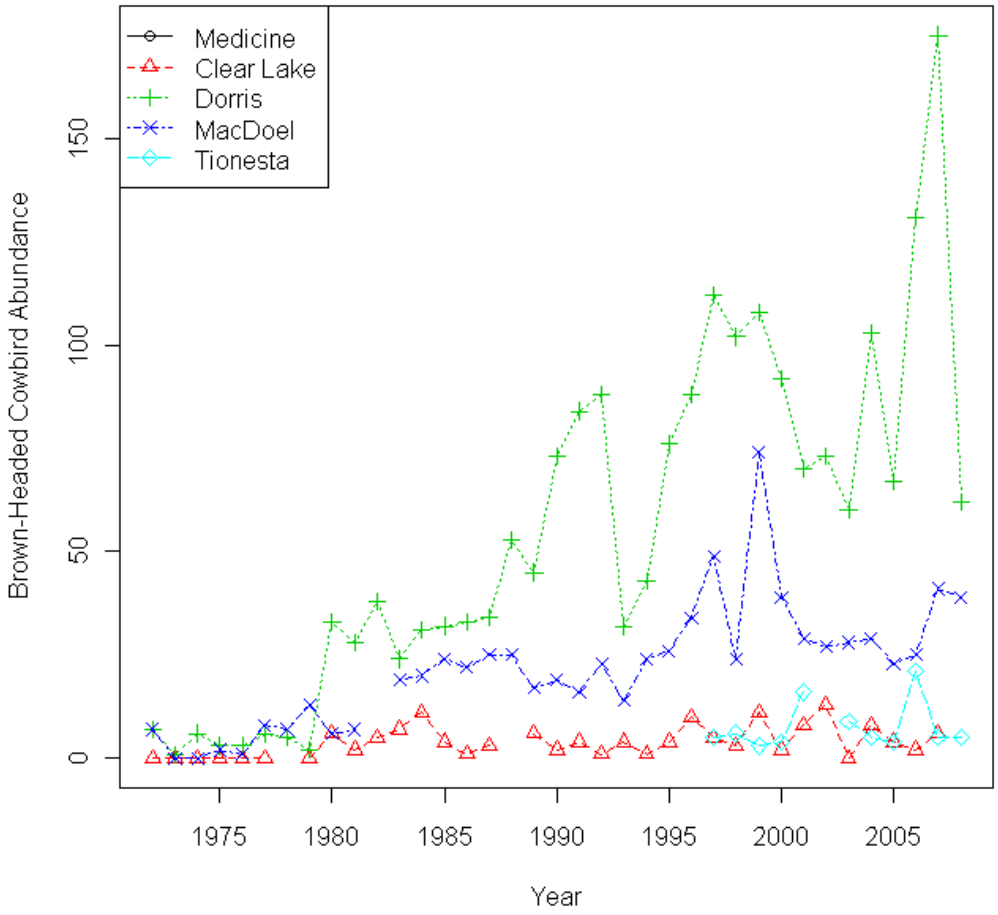


Figure 22. Plot of the abundance of Brown Headed Cowbird along five Breeding Bird Survey routes in the proximity of LABE.

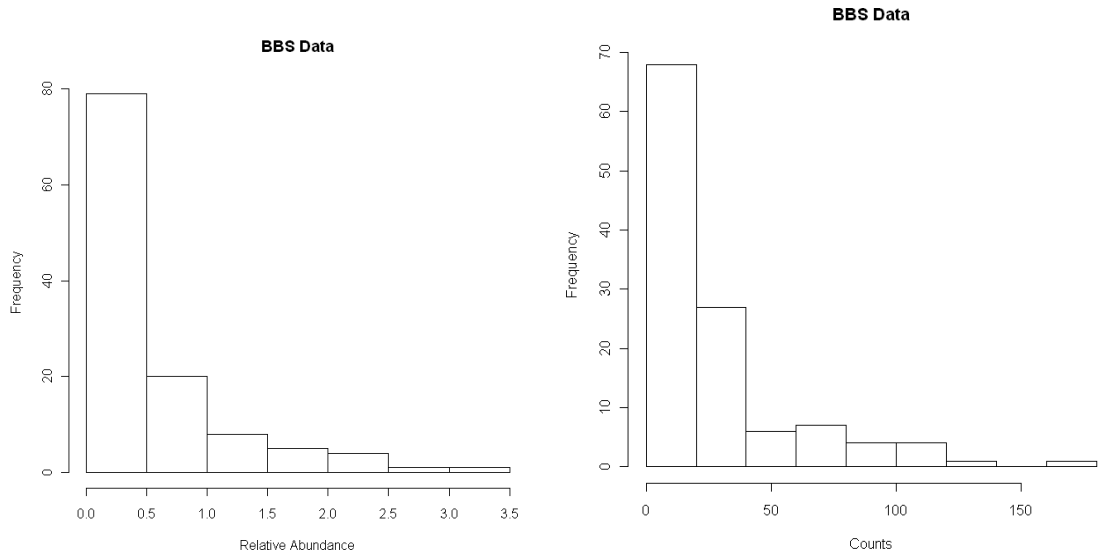


Figure 23. Histograms examining the year-to-year and site-to-site variability of the number and relative abundance of Brown Headed Cowbird at five breeding bird survey routes.

Results from fitting the mixed model for trend:

Linear mixed model fit by REML
Formula: log.RE ~ Year.Surveyed + (1 | Route.Surveyed) + (1 | Year.Surveyed)
Data: pilot.data

Random effects:
Groups Name Variance Std.Dev.
Year.Surveyed (Intercept) **0.59220** 0.76955
Route.Surveyed (Intercept) **2.12162** 1.45658
Residual **0.81467** 0.90259
Number of obs: 118, groups: Year.Surveyed, 37; Route.Surveyed, 4

Fixed effects:
Estimate Std. Error t value
(Intercept) -206.04608 28.66948 -7.187
Year.Surveyed 0.10249 0.01439 7.120

Notice we would interpret the trend as an 11% annual increase (1.11=exp(0.10249)) in the median relative abundance of Brown Headed Cowbirds for these 4 routes surveyed.

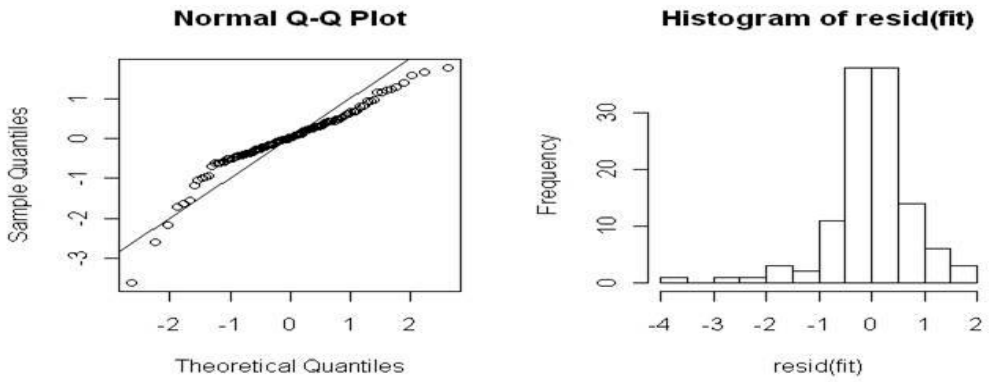


Figure 24. Examination of the normality of the residuals using Q-Q plots and histograms.

OUT<-POWER.RandomInterceptsModel(.10,500,c(20,25,30),2,c(5,10,20,30),2008,-.5,mu=-206,sig2a=2.12,sig2b=.59, sig2t=0,sig2c=.82)

The residuals appear alright with the log-transformed plus .001.

OUT

Sites	**5**	**10**	**20**	**30**
20	0.004	0.118	0.438	0.582
25	0.000	0.100	0.442	0.548
30	0.000	0.112	0.432	**0.588**

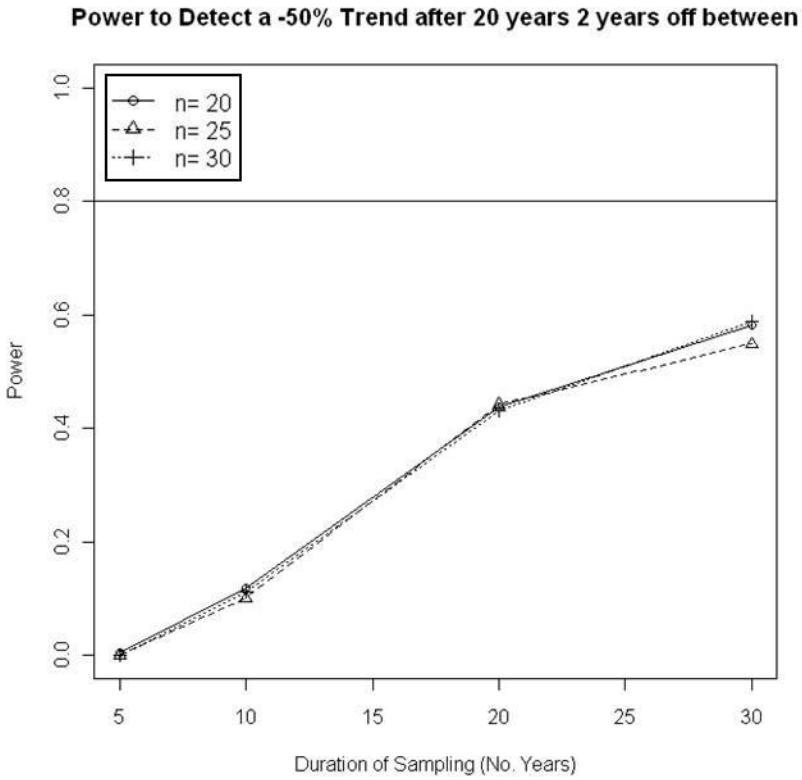


Figure 25. Power to detect trends in Brown Headed Cowbirds over a 30 year period using 20, 25, and 30 routes at Lava Beds National Monument using an estimated variance component equal to 0.05.

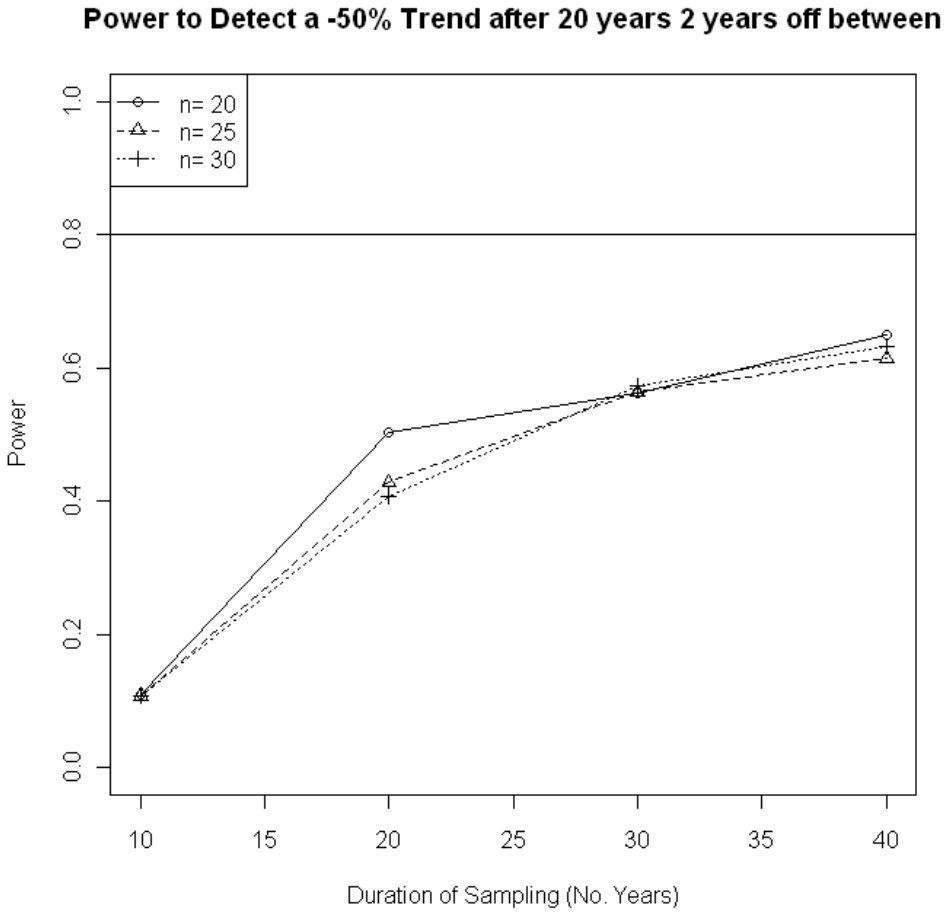


Figure 26. Power to detect trends in Brown Headed Cowbirds over a 40 year period using 20, 25, and 30 routes at Lava Beds National Monument using an estimated variance component equal to 0.05.

Example 3. Western Meadowlark

Plot of the BBS data:

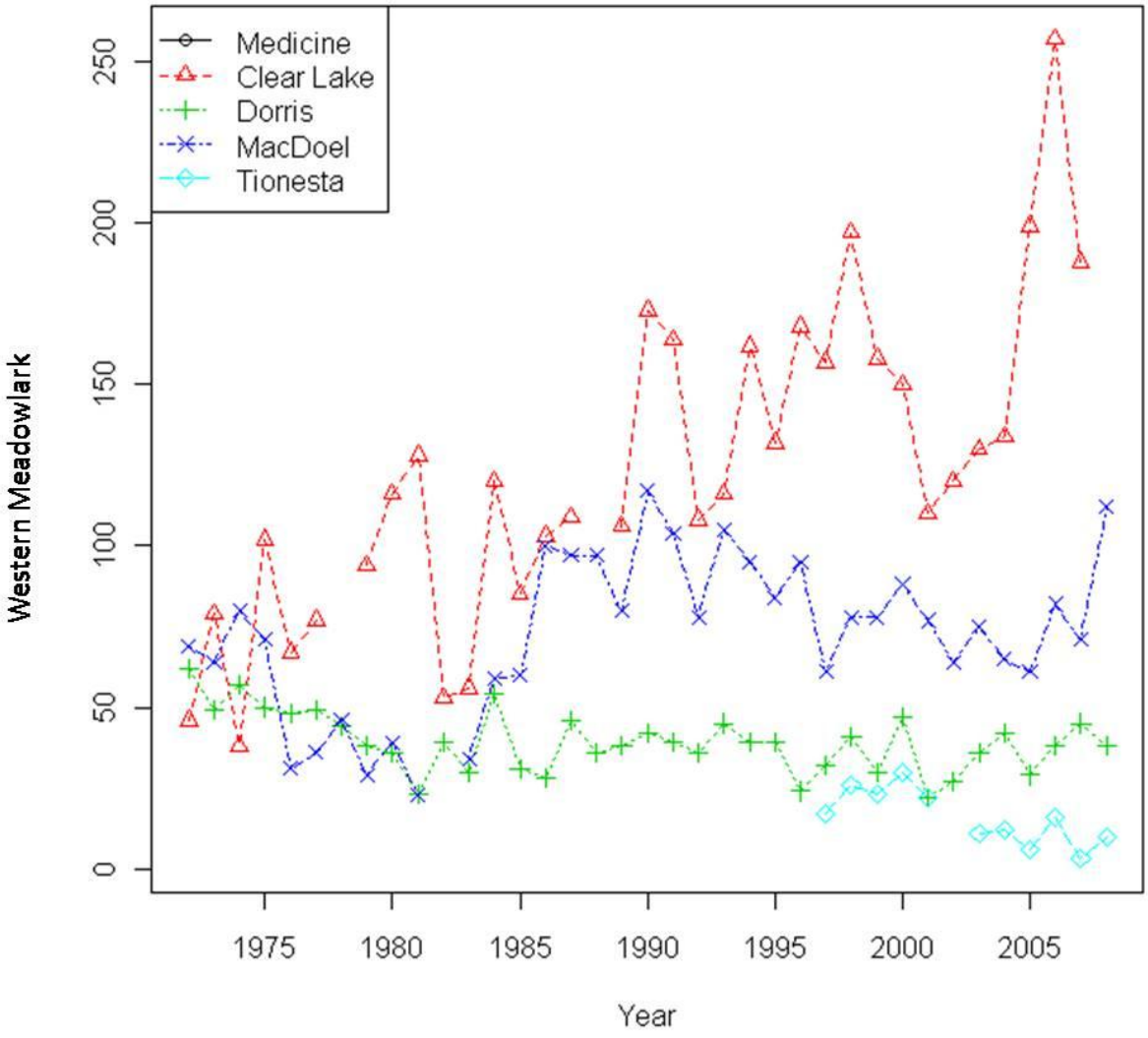


Figure 27. Plot of the abundance of Western Meadowlarks along five Breeding Bird Survey routes in the proximity of LABE.

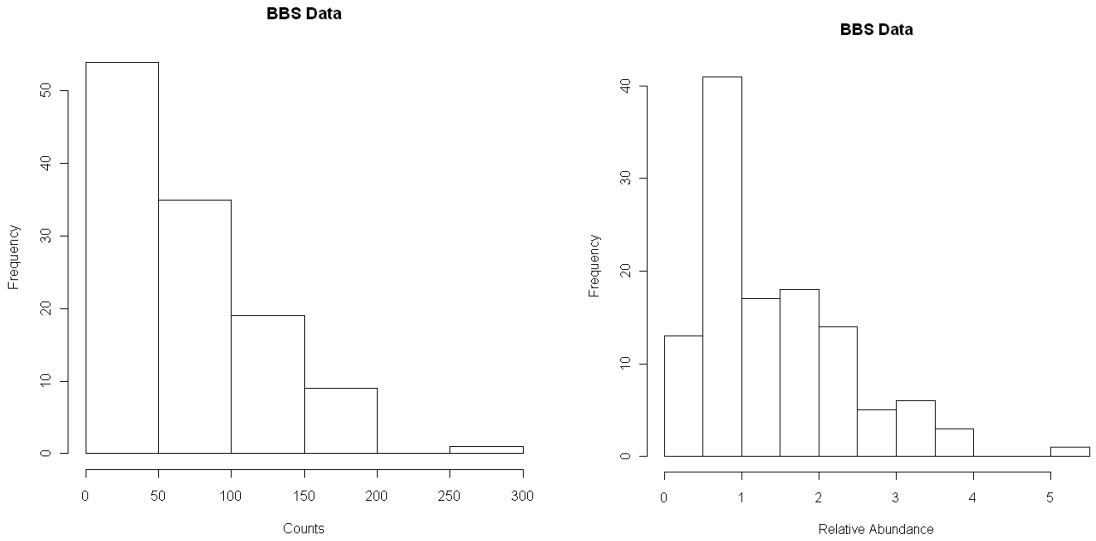


Figure 28. Histograms examining the year-to-year and site-to-site variability of the number and relative abundance of Western Meadowlarks at five breeding bird survey routes.

.

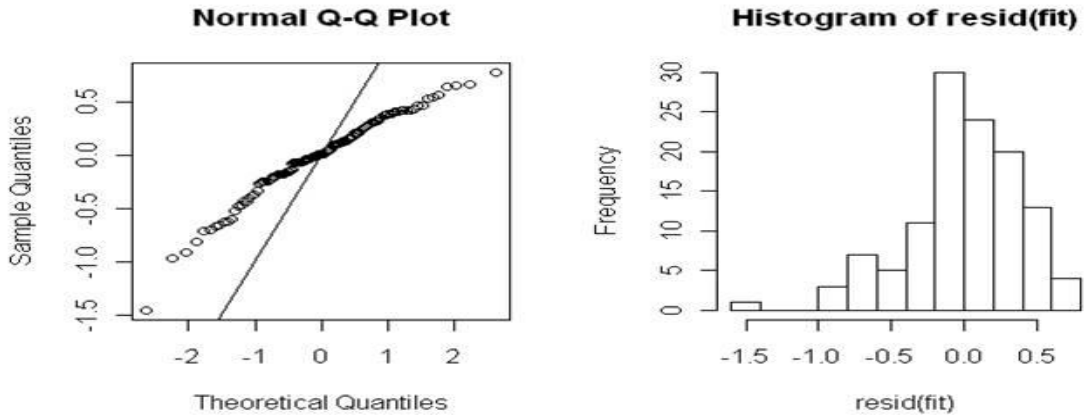


Figure 29. Examination of the normality of the residuals using Q-Q plots and histograms.

Results from fitting the mixed model for trend:

The residuals appear not that great with the log-transformed plus .001.

Linear mixed model fit by REML
Formula: log.RE ~ Year.Surveyed + (1 | Route.Surveyed) + (1 | Year.Surveyed)
Data: pilot.data
AIC BIC logLik deviance REMLdev
147.7 161.5 -68.83 128.5 137.7
Random effects:
Groups Name Variance Std.Dev.

Year.Surveyed (Intercept) 1.0699e-15 3.2710e-08
Route.Surveyed (Intercept) 9.0112e-01 9.4927e-01
Residual 1.4894e-01 3.8593e-01
Number of obs: 118, groups: Year.Surveyed, 37; Route.Surveyed, 4

Fixed effects:
Estimate Std. Error t value
(Intercept) -21.330410 6.958447 -3.065
Year.Surveyed 0.010654 0.003483 3.059

OUT.WEME.BBS<-
POWER.RandomInterceptsModel(.10,500,c(20,25,30),2,c(10,20,30,40),2008,-.5,mu=-21,sig2a=.901,sig2b=0, sig2t=0,sig2c=.15)

Sites	**5**	**10**	**15**	**20**
20	0	0.342	**0.878**	1
25	0	0.454	0.956	1
30	0	0.536	0.976	1

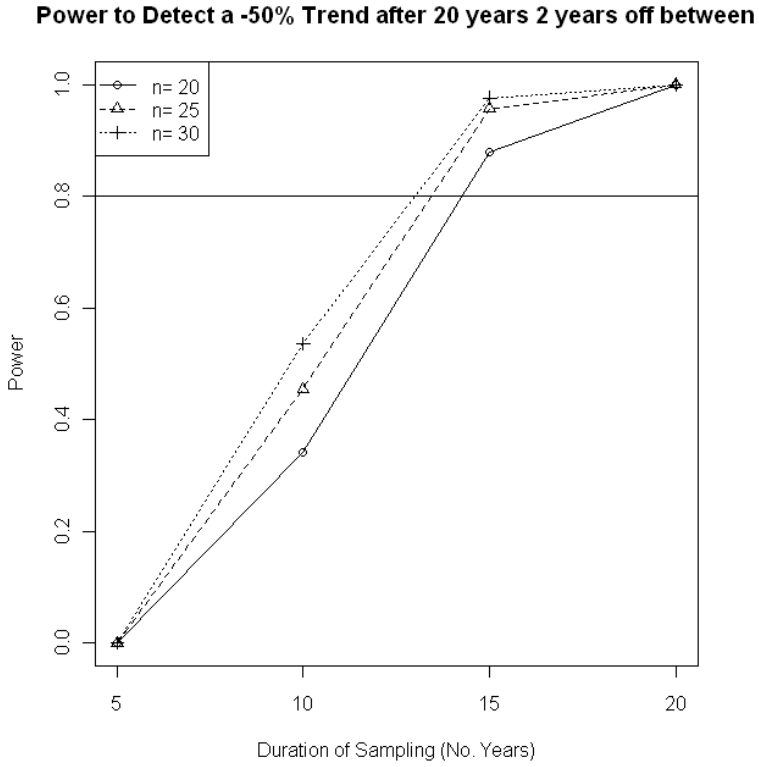


Figure 30. Power to detect trends in Western Meadowlarks over a 20 year period using 20, 25, and 30 routes at Lava Beds National Monument using an estimated variance component equal to 0.05.

Appendix K. Job Hazard Analysis for the KLMN Landbird Monitoring Protocol.

The Klamath Network will make every effort to comply with the NPSafe program and with local park safety programs. KLMN takes safety seriously and it is the number one priority when developing and implementing these protocols. Crews are expected to be trained on all safety aspects of this project prior to entering the field.

The vision of the NPSafe program is:

> *"The NPS is widely recognized for providing world-class resource stewardship and visitor experiences. Just as the NPS excels at protecting natural and cultural resources and serving park visitors, the NPS can excel in providing our employees with a safe work environment. All employees deserve the opportunity to do their jobs safely and effectively so they can go home healthy at the end of the day to fully enjoy their lives and families."*

The beliefs of the NPSafe program are:

We believe that healthy productive employees are our most important resource, and employee safety is our most important value

- Injuries and occupational illnesses are unacceptable and all are preventable
- At risk behaviors can be eliminated
- Operating hazards and risks can be controlled
- Safety is everyone's responsibility
- Managing for safety excellence can enhance employee productivity, save millions of dollars in workers compensation costs, and improve overall management effectiveness.

The goals of the NPSafe program are:

1) The NPS becomes the safest place to work in DOI.
2) Safety is integrated into all NPS activities.
3) The NPS organizational culture values employee safety as much as it values protecting resources and serving visitors.
4) Employees, supervisors, and managers demonstrate unwavering commitment to continuous improvement in employee health and safety.

To meet these goals, the KLMN has included several Job Hazard Analyses (JHA) in this appendix that should be followed while implementing this protocol.

JOB HAZARD ANALYSIS (JHA)		Date: 11/21/2009	
Park Unit: KLMN	Division: IMD	Branch: NRPC	Location: Ashland, Oregon
Task Title: Driving vehicles in the course of one's job		JHA Number: KLMN JHA 1	Page: 1 of 4
Job Performed By: ALL	Analysis By: Jaime Stephens	Supervisor: Jaime Stephens	Approved By: Sean Mohren
Required Standards and General Notes:	Employees driving as part of their duties must have a valid state issued driver's license.		
Required Training:	Standard drivers training and need to know how to change tires.		
Required Personal Prospective Equipment:	Seatbelts must be used.		
Tools and Equipment:	Vehicle		

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Starting vehicle, basic operation	• Lights not functioning, visibility impaired. • Brakes non-functional • Low tire pressure • Low fluid levels • Spare tire not in vehicle or deflated • Low gas	• Test headlights, turn signals, brake lights, breaks, tire pressure and all fluids • Check status of spare; insure that jack, properly sized lug wrench and all necessary tools are present in vehicle. • Check gas
Using 4 wheel drive, if applicable.	• Not knowing how to engage, getting stuck in the field • Unsafe driving procedures due to perceived safety of 4 wheel drive	• Practice engaging 4 wheel drive • Engage 4 wheel drive prior to rough conditions • Use 4 wheel drive when increased traction is necessary; e.g., steep slopes, slick conditions, snow. • Even in 4 wheel drive, use common sense and defensive driving practices.
Driving in reverse	• Hitting objects, people, wildlife	• Check area behind vehicle prior to leaving site • Use a person outside the vehicle (other crew member) to direct traffic. • Back into parking spots, so leaving sites after long field day is easier.

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 1	Page: 2 of 4
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Transporting gear and heavy equipment	• Gear flying around, hitting driver and passenger in accident • Damage to gear during turns or stops	• Ensure that gear is adequately stowed. • If the gear comes with protective gear (e.g., electrofisher), properly stow in container. • Do not put gear on top of vehicle; stow inside.	
Passenger/driver safety	• Distracted driving	• Wear seatbelts at all times while driving. • Practice safe and defensive driving habits. • Obey traffic laws. • Do not text or talk on cell phones. • Keep windshields clean. • Drive with both hands on the wheel. • Do not pick up hitch hikers. • Use turn signals/indicators • Know, in advance, where you are going. • Make sure seat and mirrors are properly adjusted for driver • Use headlights, even during day time driving.	
	• Driving on narrow, single lane roads with bumpy or "washboard" surfaces.	• Maintain a safe speed (this may be below the legal limit). • Stay to the right, especially on curves, and be aware for oncoming traffic. • If turning around, "face the danger," in other words, turn towards a steep slope, instead of backing into a steep slope cliff.	
	• Driving with limited visibility, as in heavy rain, fog, or dust.	• Slow down. • If necessary, wait for hazard to pass. • Drive with lights on. In some conditions, low lights may penetrate better than brights.	

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 1	Page: 3 of 4
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Passenger/driver safety	• Fatigue driving	• Be aware of signs of fatigue. Pull over and catnap if necessary, eat a snack, or have a partner drive. If in doubt, do not drive.	
	• Storm conditions (snow, mud, wind)	• Keep informed of the weather (see radio SOP). • If excess wind (tree top swaying, twigs falling) consider postponing trip. • Avoid wet clay roads as much as possible.	
	• Road obstacles	• Get out and move rocks in the road as necessary. If large amounts of rockfall or trees, report to the park staff. • If you hit rocks, stop and check tire conditions (wear, sidewall, and inflation) for damage. • If obstacle is an animal, slow down! Be aware of high animal traffic areas and drive appropriately. It is better to "ride out" an impact than suddenly swerve. This is true for animals of all sizes, from squirrels to cattle.	
Working/Parking on or near a roadside	•Being hit by a car	• Stay off of the road. • Use pullouts or secondary road when parking. • Be aware of the traffic. • Walk on the side of the road facing traffic.	

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 1	Page: 4 of 4
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Working/Parking on or near a roadside	•Running into objects, parking too far off the road, getting stuck, rolling vehicle	• Park on stable surface. • Don't park on a blind corner or a solid striped road area. • Set parking break.	

Description of Task When it is Done Safely

Crew returns safe from the field day/season, with no injuries, damages, or law suit.

JOB HAZARD ANALYSIS (JHA)		Date: 11/21/2009	
Park Unit: KLMN	Division: IMD	Branch: NRPC	Location: Ashland, Oregon
Task Title: Remote field site access/ trail travel/ cross-country travel		JHA Number: KLMN JHA 2	Page: 1 of 3
Job Performed By: ALL	Analysis By: Jaime Stephens	Supervisor: Jaime Stephens	Approved By: Sean Mohren
Required Standards and General Notes:	Crew members should be physically fit		
Required Training:	None required.		
Required Personal Prospective Equipment:	Footwear appropriate to terrain (probably hiking boots); pants if hiking through brush or poison oak; Tec-nu poison oak wash, park radio with charged batteries, GPS units, eyewear, first aid kit.		
Tools and Equipment:			

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Hiking on and off trails	• Getting lost	• Use and be trained in navigation techniques using both maps and GPS units. • Allow ample time to access site and return. • Bring safety gear (e.g., radio); extra clothes, water, food, etc. • Look at notes from crews that previously accessed this site.
	• Physical injury (e.g., twisted ankle, broken bones)	• Wear appropriate footwear, preferably boots with vibram soles and tops above the ankle, broken in prior to field season. • Walk cautiously and don't run. • Take breather breaks as necessary. • Stay physically fit. • Know basic first aid. • Be trained in radio SOP. • Avoid talus slopes. On steep slopes, avoid walking directly below others. • Take care walking on wet or slippery ground, especially bridges.
	• Getting hit with tool, implement, or vegetation branch	• Maintain 6 foot spacing • Warn people behind of "snap-back" from vegetation branches; wear safety glasses (or other glasses).

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 2	Page: 2 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Hiking on and off trails	• Blisters	• Wear broken in and proper fitting boots	
	• Carrying heavy loads	• Use backpack appropriate to load; do not carry heavy items in arms or hands; make hands available to break a fall. • Properly fit backpack. • Use crew member to assist in putting pack on. • Be physically fit. • Report problems or issues to supervisor. • Stay hydrated.	
	• Loose footing; falls, broken bones, etc.	• Avoid steep slopes. • If unavoidable, walk at angle up slope; not straight up. • Wear good boots. • Do not go up hazardous slopes. • Watch for branches, wet, slick rocks, etc. Avoid as necessary. • Take your time, ascending and descending. • Plan your route so that hazardous terrain is minimized and the use of trails is maximized. • Do not travel alone (e.g., if one crew member is faster, only travel as fast as your slowest person).	
	• Branches and trees, other dangerous obstacles	• Examine for the safest way around. • Do not jump off trees. • Avoid going underneath large trees that could shift and crush a person.	

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 2	Page: 3 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Wildfires	• Exposure to smoke and fire	• Don't panic. Be alert. Keep calm. Think clearly & act decisively. Get out of the area immediately. • Maintain communication with other crew members and with dispatch. Follow local district policies regarding reporting fire.	
Water Crossing	• Loose footing; falls, broken bones, etc.	• Choose stream crossing routes by scouting the area first • Avoid crossing when water levels are higher than knee height. Avoid crossing on logs whenever possible. • Use a stick or pole to secure footing. Place it upstream at a slight angle. Use pole to test for depth & walk to the pole. • Stay out of areas with swift current, especially after heavy snowfall, rain, or spring melt. • Use footwear with non-slip soles while walking in streams. Do not wear sandals in streams. • When possible, step on streambed proper instead of the tops of boulders that may be slippery.	

Description of Task When it is Done Safely

Crew returns safe from the field day/season, with no injuries, damages, or law suit.

JOB HAZARD ANALYSIS (JHA)		Date: 11/21/2009	
Park Unit: KLMN	Division: IMD	Branch: NRPC	Location: Ashland, Oregon
Task Title: Environmental Exposure		JHA Number: KLMN JHA 3	Page: 1 of 3
Job Performed By: ALL	Analysis By: Jaime Stephens	Supervisor: Jaime Stephens	Approved By: Sean Mohren
Required Standards and General Notes:	Field crew members in the field are expected to use common sense in dealing with exposure to elements or wildlife. Ideally, they have experience in outdoor work prior to initiating the field season.		
Required Training:	None required.		
Required Personal Propective Equipment:	Appropriate clothing for conditions.		
Tools and Equipment:			

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Being outdoors, far from facilities for long time periods	• Hypothermia	• Consult First Aid book for treatment. • Seek assistance. • Recognize the signs: Shivering; Numbness; Drowsiness; Muscle Weakness; Dizziness; Nausea; Unconsciousness; Low, weak pulse; Large pupils. • Practice prevention: stay dry; wear appropriate clothing; cotton kills; wear layers, shed layers as needed (don't overheat as sweat can cause hypothermia); watch or listen to the weather forecast (see Radio SOP), and plan accordingly; stay hydrated, cover head with warm clothing, stay active. • Be aware of the role that wind-chill can play in hypothermia; under certain conditions, hypothermia can occur without any rain or being wet.
	• Hyperthermia (heat exhaustion; heat stroke)	• Consult First Aid book for treatment but generally get the victim to cooler conditions. NOTE: HEAT STROKE IS A LIFE THREATENING CONDITION. • Recognize signs: above normal body temps; headaches, nausea, cramping, fainting, increased heart rate, pale and clammy skin, heavy sweating, etc. • Practice prevention: Stay hydrated: in the midst of the summer, it may be necessary to drink 1 liter of water per hour; wear a broad brimmed hat; take rest stops in shade.

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 3	Page: 2 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Being outdoors, far from facilities for long time periods	• Electrical Storms – lightning	• Watch the sky for signs of thunderstorms and seek shelter before the weather deteriorates. • Stop work in streams and lakes. • If caught in electrical storms, seek shelter inside a vehicle or building; keep away from doors and windows, plugged in appliances, and metal. Avoid contact with metal objects in vehicles.	
	• Electrical Storms – lightning	• Do not use telephones. • If outside with no shelter, do not congregate. In case of lightning strike, someone must be able to begin revival techniques (e.g., CPR). • Do not use metal objects. • Avoid standing near isolated trees. • Seek lower elevations such as valleys or canyons; avoid being on peaks and trees. • If you feel your hair standing on end and your skin tingling, this is a sign that lightning might be about to strike – crouch immediately (feet together, hands on knees).	
	• Sunburn	• The risk of sunburn is higher when working at high elevations, or when working around water (from reflection). In these conditions, you can be burned even in overcast conditions. • Wear protective clothing and use sunscreen.	
	• High wind events	• Severe wind events can create “windthrows” where strong winds can blow down trees, causing hazardous conditions to field personnel. Crews should avoid areas during high wind, exhibiting obvious previous wind damage.	

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 3	Page: 3 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
	• Altitude sickness	• Know and recognize signs of "acute mountain sickness:" headaches; light-headedness; unable to catch your breath; nausea; vomiting. • Practice prevention: acclimate to high elevations slowly and stay hydrated. • If symptoms progress and include: difficulty breathing, chest pain, confusion, decreased consciousness or loss of balance, descend to lower elevations immediately and seek medical attention.	
	• Giardia	• Treat, filter, or boil all drinking water. Do not drink untreated water from streams, lakes, or springs.	

Description of Task When it is Done Safely

Crew returns safe from the field day/season, with no injuries, damages, or law suit.

JOB HAZARD ANALYSIS (JHA)		Date: 11/21/2009	
Park Unit: KLMN	Division: IMD	Branch: NRPC	Location: Ashland, Oregon
Task Title: Wildlife and Botanical Exposure		JHA Number: KLMN JHA 4	Page: 1 of 4
Job Performed By: ALL	Analysis By: Jaime Stephens	Supervisor: Jaime Stephens	Approved By: Sean Mohren
Required Standards and General Notes:	Field crew members in the field are expected to use common sense in dealing with exposure to elements or wildlife. Ideally, they have experience in outdoor work prior to initiating the field season.		
Required Training:	None required.		
Required Personal Prospective Equipment:	Appropriate clothing for conditions.		
Tools and Equipment:			

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Driving to the site	• Animal in the road	• Slow down! Be aware of high animal traffic areas and drive appropriately. It is better to "ride out" an impact, rather than a sudden swerve. This is true for animals of all sizes, from squirrels to cattle.
Being in the field	• Rattlesnakes	• Be alert • Do not put your feet or hands where you cannot see • Do not pick up rattlesnakes • Give a wide berth • Avoid stepping over logs, when you cannot see the otherside • If bitten, seek immediate professional medical attention if possible send someone for aid. • Lower bitten extremity below your heart, cover wound with sterile bandage while enroute to medical attention.

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 4	Page: 2 of 4
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Being in the field	• Bears	• Be alert and stay calm. • If you encounter a bear, give it as much room as possible. • Try to leave the area but DO NOT RUN. Back away slowly, but if the bear follows, stop and hold your ground. • Wave your arms, make yourself look big, and talk in a normal voice • If the bear makes contact, surrender! Fall to the ground and play dead. Typically, a bear will break off its attack once it feels the threat has been eliminated. If the bear continues to bite after you assume a defensive posture, the attack is predatory and you should fight back vigorously.	
	• Mountain Lions	• Be alert, calm, and do not panic. • If you see a mountain lion, do not run; you may stimulate its predatory nature. Shout and wave arms to let it know that you are not prey. FIGHT BACK.	
	• Ticks	• Use DEET based repellants on exposed skin. • Check for ticks during and after field work. • Remove with tweezers within 24 hours, preferably immediately. • DO NOT leave the head imbedded. • DO NOT extract with matches, petreoleum jelly, or other coatings (e.g., motor oil).	
	• Roughskin newts (*Taricha granulosa*)	• Avoid handling Roughskin newts; their skin contains a potent neurotoxin. If necessary for the protocol, handle only when wearing gloves. Do not “lick” for “killer buzz.” People have died from attempting to eat roughskin newts.	

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 4	Page: 3 of 4
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Being in the field	• Insect Sting	• Do not provoke insects by swatting at them. Remain calm and move away from the area. • Be alert for buzzing insects both on the ground and in the air. Walk around any nests you encounter. Inform others of nests. • Flag if necessary. Wear long sleeved shirt and pants. Tuck in shirt. Wear bright colors. Perfumes & metal objects may attract bees. • If stung, scrape stinger off skin. Cold can bring relief. Do not use tweezers. Tweezers can squeeze venom sac and worsen injury. • If you are allergic, carry an unexpired doctor prescribed bee sting kit (EpiPen) with you at all times. • Know the allergic reactions of co-workers as well as the location of the bee sting kit. If victim develops hives, asthmatic breathing, tissue swelling, or a drop in blood pressure, seek medical help immediately. Give victim antihistamine (Benadryl or chol-amine tabs). Use EpiPen. • Prevent bug/mosquito bites by using repellent. Spray on clothing to avoid prolonged exposure to skin. Wear long sleeved shirts and pants. • Be aware of insect transmitted diseases (West Nile Virus, Lyme Disease, Plague).	
Being in the field	• Rabies	• Be aware of animals acting strangely. If bitten by a wild or domestic animal get medical attention and report to local health authorities or animal control officer. Locate animal if possible. Follow accident procedures for animal bites.	

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 4	Page: 4 of 4
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Encountering irrigation pipes, marijuana plantation, or grow operations.	• Unfriendly encounters with criminal elements	• Do not wear uniforms. • Carry radio in backpack, not visible. • Act like tourists (AKA, act dumb). • Work in pairs of larger groups. • If working in areas likely to contain operations, check in with park staff when leaving vehicle and returning to vehicle. • Do not confront strangers. • Watch for suspicious vehicles and people and report to rangers. • Watch for black piping or other signs. • If finding a definite grow operation, LEAVE IMMEDIATELY, note location, and report to park ranger.	
Travel, movement or work in area with Poison Oak	• Allergic reaction to poison oak plants	• Learn to recognize Poison Oak. • Avoid contact and wear long pants and long-sleeve shirts if travelling in dense areas. • If skin contact is made, flush with cold water as soon as possible. • DO NOT flush with warm water or use soap. This can open your pores and increase the reaction. • Use Tec-nu or similar product to wash and rinse with cold water to remove oils (follow label instructions).	

Description of Task When it is Done Safely

Crew returns safe from the field day/season, with no injuries, damages, or law suit.

JOB HAZARD ANALYSIS (JHA)		Date: 11/21/2009	
Park Unit: KLMN	Division: IMD	Branch: NRPC	Location: Ashland, Oregon
Task Title: Communication		JHA Number: KLMN JHA 5	Page: 1 of 2
Job Performed By: ALL	Analysis By: Jaime Stephens	Supervisor: Jaime Stephens	Approved By: Sean Mohren
Required Standards and General Notes:			
Required Training:	Radio / Spot use		
Required Personal Prospective Equipment:			
Tools and Equipment:	Professional Grade Radio, SPOT Monitoring System		

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Radio communication	• Communication not possible	• Make sure radio is working before you leave the office or field station. Make sure batteries are changed. Carry a second rechargeable battery as back up. • Check in mornings and evenings. If in a dead zone, try to check in from a better location throughout the day. Be prepared to relay messages in an emergency. If you are working alone, be sure to check in and out with dispatch. • Make sure that your supervisor knows your planned itinerary before you leave in case your radio fails. Follow crew-specific safety check in/check out procedures. • Know which radio frequencies to use and which to monitor. Know who to call in case of an emergency. Know how to reach repeaters. • Carry a list of employee call numbers. Be prepared to relay messages in an emergency. • Keep messages short, less than 30 seconds per transmission. If a longer message is necessary, break every 30 seconds. • Conserve batteries. Carry a spare and don't leave scanner on. Turn radio off over night. You life may depend on it.

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 4	Page: 2 of 2
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Spot System	• Communication not possible	• Make sure system is working before you leave the office or field station. Make sure batteries are changed. Carry a second rechargeable battery as back up. • Make sure that your supervisor knows your planned itinerary before you leave in case your system fails. Follow crew specific safety check in/check out procedures. • Make certain system is setup properly and includes an accurate contact list.	

Description of Task When it is Done Safely

Crew returns safe from the field day/season, with no injuries, damages, or law suit.

Appendix L: Rules for Designating Landbird Point Count Routes in ArcGIS

Jaime L. Stephens
December 6, 2009

For choosing VCP sampling locations, we used an algorithm termed the Generalized Random Tessellation Stratified (GRTS) method to develop spatially balanced sampling locations within each selected sampling frame for each park. To establish a systematic random sampling route around each GRTS sample, 11 adjacent points are placed 250 m apart, according to a set of rules. These rules ensure that a grid is set up as closely around the GRTS sample as possible, using a systematic, random approach within constraints of the defined sampling frame. Depending on the sampling frame, the routes are established either in a block (matrix, alpine, wetland) or line (roads, streams).

For Non-linear Routes (CRLA, LABE, LAVO Wetland Sampling Frame, ORCA, RNSP):

1) Grids were built in ArcGIS placing points 250 m apart within a 1000 m radius on cardinal direction orientation, using Hawths Tools conditional point sampling tools. This provided plenty of potential points (47 points) to accommodate the selection process detailed below.

    a. If the GRTS sample is less than 125 m from the park edge, then the GRTS sample will be dropped and replaced with the next GRTS sample within the same time series.
    b. While following the subsequent rule set, if any point along a route is less than 250 m from a previously established point, it will not be included.
    c. If a point is less than 125 m from the park edge, it will not be included.
    d. Each route must be established within a contiguous piece of sampling frame (e.g., it can not cross a road) for CRLA, LABE, LAVO, and RNSP. This rule could not be met for ORCA.
    e. For any given route, the situation where the extra distance traveled between points (to travel around an area that is not included in the sampling frame [e.g., lava field]) cannot exceed 350 m total.
    f. If greater than 1/6 of the interior of the route is non-sampling frame (e.g., lava field), then the GRTS sample will be dropped and replaced with the next GRTS sample within the same time series.

2) From these grid points, build a block of eight points around the GRTS sample, with the GRTS sample in the center.

3) If not possible, role a die to choose a random direction in which to build a block of eight points with the GRTS sample in the center of one edge.

4) If not possible, role a die to choose a random direction in which to build a block of eight points with the GRTS sample in the corner of the block.

5) If not possible to fit an entire eight point block, build as much of it as possible using steps 2-4. Afterwards, refer to the next step for placing remaining points.

    a. If the establishment of the initial block is limited by a previously established point count route, the GRTS sample will be dropped and replaced with the next GRTS sample from the same time series.

6) Place remaining points to make a 12 point route (and an extra three points as oversamples) in sets of three around and adjacent to the grid, rolling a die for a random direction until all points are placed.

7) If sets of three do not fit around the grid, repeat rolling dice for random direction, for sets of two points until all points are placed.

8) If sets of two do not fit around the grid, repeat rolling dice for random direction, for one point at a time until all points are placed.

9) If no more points fit around the gird, choose points in a random direction by sets of three, then two, then one.

10) If the above criteria cannot be met, and thus 12 points (and three oversamples) cannot be fit contiguously within a block of the sampling frame, the GRTS sample will be dropped and replaced with the next GRTS sample within the same time series.

For Linear Routes (LAVO Stream Sampling Frame, WHIS):

1. Points are placed 250 m apart in both directions from the GRTS sample to form a 12 point route.

    a. If the GRTS sample is less than 125 m from the park edge, then the GRTS sample will be dropped and replaced with the next GRTS sample within the same time series.
    b. While following the subsequent rule set, if any point along a route is less than 250 m from a previously established point, it will not be included.
    c. If a point is less than 125 m from the park edge, it will not be included.
    d. For any given route, an extra 1000 m of road or trail distance between one point and the next is allowable. If this is exceeded, add points to the road/trail in the other direction as needed. For any given route, an extra 350 m of stream distance between one point and the next is allowable. If this is exceeded, add points to the stream in the other direction as needed.

2. If there are not road/trail/stream junctions, build a route with an equal amount of points on each side of the GRTS sample. Roll a die to determine which end of the route to add the last point to, to complete a 12 point route.

    a. If you cannot place a point due to proximity of a previously established route, continue along that road/trail/stream in the same direction until you reach the first possible place to put a point.
    b. If you cannot place a point due to proximity to the park boundary, add points to the road/trail/stream in the other direction as needed.

3. If there are road/trail/stream junctions encountered when designating the route, lay out the points as indicated in step 2 until you reach an intersection. At the intersection, role a die to choose a random direction to indicate which road/trail/stream the route will continue on.

4. If the road/trail/stream ends or you exceed the allowable extra travel distance, trace back to either:
    a. The first intersection you encounter going backwards and add remaining points; or
    b. If you do not encounter an intersection, add points to the end in the opposite direction from the GRTS sample.

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