U.S. Department of the Interior
National Park Service

Inventory and Monitoring Program

Land Bird Monitoring Protocol for the Park Units in the Northern Colorado Plateau Network

Prepared by:

Sonya Daw (Biological Technician)[1]
Margaret Beer (Data Manager)[1]
Steven L. Garman (Ecologist)[1]

[1]Northern Colorado Plateau Network Inventory and Monitoring Program
2282 S. West Resource Blvd.
Moab, Utah 84532

Prepared for:

Northern Colorado Plateau Network Inventory and Monitoring Program
National Park Service, U.S. Department of the Interior

Version 1.01 (May 10, 2007)

Note: This protocol is the Rocky Mountain Bird Observatory - Monitoring Colorado's Birds (RMBO-MCB) protocol written to National Park Service standards. This protocol is designed for long-term monitoring of breeding birds in sagebrush, pinyon-juniper, and riparian habitats using permanent survey transects. The selection of monitored sites in the Northern Colorado Plateau Network (NCPN) has not been performed, but is scheduled to be completed by February 2005, prior to the field season. Procedures for selecting upland sites are described. Procedures for selecting riparian areas for monitoring are suggested, but will require further exploration. This narrative describes the RMBO-MCB protocol in full. After all monitoring sites in the NCPN have been selected, this Protocol Narrative and the associated Standard Operating Procedures will be updated with the locations of monitored transects.

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	10 May 2007	S. L. Garman – NCPN Ecologist	Corrected numbers of transects established, updated site-selection procedures, documented locations/descriptions of monitoring locations	To document procedures actually used to select sites, to document monitoring locations, incorporate peer-review suggestions	1.01

Important Note: This sampling protocol consists of this Protocol Narrative and the following Standard Operating Procedures (SOPs):

SOP 1: Before the Field Season
SOP 2: Training Observers
SOP 3: Using Global Positioning System (GPS) Units
SOP 4: Establishing and Marking Sampling Plots
SOP 5: Conducting the Survey
SOP 6: Documenting Habitat Variables
SOP 7: Data Management
SOP 8: After the Field Season
SOP 9: Revising the Protocol Narrative and SOPs

Table of Contents

I. Background and Objectives 6
Issue being Addressed and Rationale for Monitoring Landbird Populations 6
Historical Development of Bird Monitoring in the NCPN 7
Measurable Objective 8
II. Sampling Design 9
Rationale for Selecting this Sampling Design Over Others 9
Site Selection 10
Population Being Monitored 11
Sampling Frequency and Replication 11
III. Field Methods 11
Field Season Preparations, Field Schedule, and Equipment Setup 11
Sampling Methods 12
Conducting the Survey 12
Collecting Habitat Data 13
IV. Data Management 13
Database Overview 13
Metadata Procedures 14
Data Archiving Procedures 14
V. Summary of Rocky Mountain Bird Observatory Analysis and Reporting 14
VI. Personnel Requirements and Training 14
Roles and Responsibilities 14
Qualifications and Training 15
VII. Operational Requirements 15
Annual Workload and Field Schedule 15
Facility and Equipment Needs 15
Startup Costs and Budget 15
Procedure for Revising the Protocol and Archiving Previous Versions of the Protocol 15
VIII. References 17

Appendix A - Avian Monitoring in NCPN Park Units **20**
Appendix B - Monitoring Colorado's Birds: The Plan for Count-based Monitoring - Rocky Mountain Bird Observatory **21**
Appendix C - Point Transect Protocol for Monitoring Colorado's Birds – Rocky Mountain Bird Observatory **21**
Appendix D - Changes to the RMBO Monitoring Program Vegetation and Bird Count Protocols 2004 – Rocky Mountain Bird Observatory **22**
Appendix E -List of established bird-monitoring transects by NCPN park unit and habitat type **26**

Table of Contents

Appendix F. UTM coordinates of each point on each bird-monitoring transect (available upon request)

Appendix G. Directions to NPS Transects Established and Surveyed by RMBO (established in the first year of monitoring [2005]) (available upon request)

I. Background and Objectives

Issue being Addressed and Rationale for Monitoring Landbird Populations

Landbirds are a key component of the Northern Colorado Plateau Network (NCPN). Landbirds occupy various levels in the food web, and functionally, play an important role in the flow of energy through ecosystems. Landbirds consume insects as nestlings, rely on insects and plant components for food as adults, and serve as food resources for higher-trophic bird and mammal species. Landbirds also have high public appeal. Unlike many other animal taxa in the xeric NCPN, landbirds are mostly diurnal and thus, are more visible to park visitors. Public demand for bird-species information is common, ranging from requesting species' lists for tracking birds during park visits to status and trend inquiries to interpretive staff.

Landbirds have been shown to be useful indicators of ecosystem integrity (as defined by Karr and Dudley 1981). Bryce et al. (2002) successfully assessed riparian-habitat integrity in Oregon using a bird integrity index developed from abundance and species richness. In the Prairie Pothole Region of North Dakota, Browder et al. (2002) developed an index from the presence and abundance of breeding-bird species that consistently predicted grassland integrity. In a literature review of 109 studies conducted in the past 20 years, Bock and Jones (2004) found, with exceptions, a positive relationship between bird abundance and reproduction, confirming that bird counts are useful indicators of breeding habitat quality.

Continental and local declines in many bird species have lead to concern for the future of migratory and resident species. Breeding Bird Survey (BBS) data suggest that long-term, large-scale declines in bird populations have occurred over large portions of North America (Robbins et al. 1989). Some declines have been regional, while others have occurred in suites of species such as Neotropical Migratory Birds. Loss of wintering and breeding habitat, agro-chemical pollution, and various other factors have been postulated as reasons for declines in bird populations. The broad-scale inference of the BBS data, however, has been questioned by avian researchers. The difficulty associated with interpreting index counts (Sauer 2000), and other confounding factors (e.g., Robbins et al. 1986, James et al. 1996, Thomas 1996) have been highlighted as critical limitations of the BBS data. Also, since the BBS is a road-based survey, roadless areas and habitats not commonly adjacent to roads (e.g., riparian systems) are not surveyed (Norvell et al. 2003a). The BBS lacks an explicit habitat component, which limits the use of the data to understand responses to environmental change and management (Leukering et al. 2000). Given these short comings, regional habitat-based bird monitoring programs have been recommended to complement data generated by BBS (Leukering et al. 2000, and citations within; e.g., Sauer 2000, Sauer and Cooper 2000).

The Northern Colorado Plateau Network (NCPN) chose landbird communities as a vital sign because of the value of birds as indicators of ecosystem integrity, potential population declines, and high public appeal. Another key reason is the potential for NCPN to contribute to, and benefit from existing, regional breeding-bird monitoring

programs (e.g., Leukering et al. 2000, Norvell et al. 2003a). The NCPN will collaborate with one of these programs, the Rocky Mountain Bird Observatory's *Monitoring Colorado's Birds* (MCB), to monitor landbirds.

Central to this partnership is the use of similar survey methods throughout the intermountain west. The MCB program in NCPN park units will provide comparable information with the existing 900+ transects established in four other western states. Given land-use histories of national parks and other ownerships in the west, data from NCPN park lands will provide status and trend information for relatively 'natural' habitats. These data will afford useful comparisons with more impacted areas on other land ownerships. Comparable methods also will aid in discerning between local and global affects on breeding-bird populations. Global factors, such as the loss of migratory and wintering habitat or wide-spread pollution, will influence breeding populations similarly among land ownerships and locations. In such cases, trends in breeding-bird densities likely would be coincident across a large region. Conversely, local factors, such as breeding-habitat degradation, will manifest as site-specific or management-unit specific trends. The extent of the MCB program will allow comparisons between NCPN and extra-regional trends in breeding-bird populations, and aid in discerning between large-scale and local effects. Distinguishing between these effects is critical to recommending effective management actions. Lastly, the MCB program uses distance-based estimates of species' density in trend assessments. Detection functions employed in estimating density require a minimum number of observations. Sample-size needs often can not be achieved without pooling among surveys. Where necessary, data from similar habitats could be pooled among NCPN and other MCB surveys to derive credible detection functions for NCPN species.

Historical Development of Bird Monitoring in the NCPN

Birds have been monitored in the NCPN park units by a variety of projects (Appendix A). Raptor surveys are ongoing in several park units. Waterfowl and shorebird surveys have been conducted at Curecanti NRA. Park units participate or have participated in national monitoring programs, such as Monitoring Avian Productivity and Survivorship (MAPS), BBS, Breeding Bird Census (BBC), and Christmas Bird Count (CBC). Several park units conduct long-term (6+ years) point count or line-transect monitoring of land birds. Habitats primarily focused on by these long-term monitoring programs are riparian (Daw 2002) and pinyon-juniper. These monitoring efforts have attempted to follow state or national monitoring program protocols. However, most were not designed to achieve specific levels of change, and notably lack random site selection. Inference in these studies is generally limited to the sampled areas.

The Rocky Mountain Bird Observatory (RMBO) program known as *Monitoring Colorado's Birds* (MCB) was originally designed to provide population trend or status data on all regularly-occurring breeding species in the state of Colorado (Leukering et al. 2000). A recent goal of the MCB program is to expand to the level of Bird Conservation Regions (BCR) (Leukering et al. 2000). BCRs encompass distinct ecoregions. The North American Bird Conservation Initiative (NABCI) (NABCI Committee 2000) has selected BCRs as the focal unit for ranking conservation priorities among bird species.

The MCB program has already supplemented the approximate 400 sites in Colorado with about a total of 550 sites in South Dakota, New Mexico, and Wyoming. The collaborative effort between RMBO and NCPN will enhance the MCB program by including the ecosystems of Utah, and possibly northern Arizona (i.e., Pipe Springs National Monument). NCPN park units in the state of Colorado already are included in the MCB network. MCB is in its first phase, which involves collecting count-based data for all species that can be monitored effectively using a habitat-based approach. The second phase will involve demographic studies targeted at known declines to aid in management.

This NCPN Land Bird Monitoring Protocol is the RMBO-MCB Protocol written to NPS standards (as specified in Oakley et al. 2003), with one exception. A simple random selection of habitat patches has been used in the past by RMBO. This NCPN protocol uses a systematic sample of habitat patches (see SOP #4). This ensures that monitored patches are spatially distributed across the NCPN park units. All other procedures directly follow the MCB protocol. The RMBO-MCB protocol documents are included in Appendices B-D.

Three habitats are monitored in this protocol. These include sagebrush and pinyon-juniper, which dominate the NCPN landscape. The third is riparian habitat. Riparian areas are biodiversity 'hotspots' in dryland systems, and are highly vulnerable to adjacent land-use activities (e.g., water diversion) and to changes in climatic regimes. The selection of habitat patches and riparian areas to be monitored is scheduled to be completed by early 2005, prior to the field season. The number of park units included in this monitoring and exact location of transects are unknown at this time. Site-selection methods are described in this protocol without actual locations of survey sites. Sections related to the recommended time period for bird surveys also can not be completed until habitat patches are determined. Upon completing the selection of sites early in 2005, this Protocol Narrative and associated Standard Operating Procedures (SOPs) will be updated.

Measurable Objective

The objective of this protocol is to:

1. Determine the status and trends in breeding-bird species' density in sagebrush, pinyon-juniper, and riparian habitats.

The collaborative effort with RMBO is intended to provide access to regional trends as well as trend information based solely on locations in park units. Thus, the unit of analysis of this objective is both the regional scale and the collection of sites within NCPN park units. The sampling objective of the MCB protocol is an 80% probability of detecting a 3% decline in species' density over a 30-yr period, with a Type I error rate of 10%. This objective applies to the MCB program in NCPN park units.

II. Sampling Design

Rationale for Selecting this Sampling Design Over Others

The RMBO-MCB protocol uses a combination of two distance sampling methods to survey breeding birds – transect and point-count sampling. Thirty randomly-located transects are used to sample a focal habitat, with transects randomly distributed among habitat patches. A total of 15 point-count stations spaced 250-m apart are located on each transect. Observers walk the transect, stopping at each point for 5-minutes, and record information for each detected bird. Species, sex, method of detection, and radial distance from the observer to the first detection of an individual are recorded. All birds detected from a station are recorded, regardless of the distance from the observer. The point-count stations in this protocol are effectively variable circular plots. While walking between stations on the transect, observations are recorded for low-density, rare, or unusual species. Distance and bearing are recorded for individuals detected on the line-transect instead of just radial distance. The time-dependent, distance-based sampling at point-count stations provides a standard sampling effort within and among habitats. The majority of trend information is derived using data from the point-count stations. The line transect component is designed to generate a larger sample size for low-density species. Although survey methods permit trend assessments for low-density species, line-transect component ensures that at least status information is collected for uncommon and rare species.

Including a distance measurement to the point and transect count methods permits derivation of a species-specific density estimate adjusted by a species' detectability (Ralph et al. 1995). A measure of relative abundance (e.g., no. observations/visits/area sampled) has been widely used in previous studies (e.g., Chambers et al. 1999, Hansen et al. 1995). Inherent in this measure is the assumption that the proportion of birds detected is the same among species and observers. Adjusting for detectability eliminates these assumptions, and overall, reduces a significant source of variation in trend data (Norvell et al. 2003b). In the MCB program, density is not intended as an end-product, but rather as an index of population trend that is not confounded by detectability issues. The Distance program is used to derive detection functions, and ultimately density estimates (Thomas et al. 1998). Each transect is treated as a sample; point-count stations are sub-samples.

Other bird-sampling methods employ area-based searches or point counts without consideration of detection probabilities. Programs such as MAPS, BBC, and BBIRD (Breeding Biology Research & Monitoring Database) involve intensive monitoring of fixed-sized plots (e.g., 20-ha), and collectively, involve marking individuals, mapping nests and territories, and recording fledging success through repeat visits. These approaches provide very detailed information about relatively small areas, and are relatively expensive. Also, the scope of inference of these methods is dependent on the network of similarly monitored plots. The CBC and BBS are point-count methods with inherent limitations due to the lack of an explicit habitat component, and the use of index counts rather than detectability-adjusted density estimates. The use of habitat-based,

point-count distance sampling is a very cost-effective method to survey diurnal breeding-bird populations when demographic information is not required. This protocol emphasizes diurnal breeding-bird species. Nocturnal species are not considered.

Site Selection

Details on site selection are provided in SOP #4. Sagebrush, pinyon-juniper, and riparian habitats are monitored in NCPN park units using 15 transects per habitat type. Park units included in landbird monitoring were determined by availability of target habitat. Sagebrush and pinyon-juniper habitat types are identified on land-cover maps from the Southwest Regional Re-GAP Analysis Project (http://fws-nmcfwru.nmsu.edu/SWREGAP/factsheet.htm) or using vegetation-association maps. Areas only accessible by traversing ≥50% slopes or that are on ≥50% slopes are excluded from consideration. For each park unit included in landbird monitoring, a gridded sampling frame is overlaid on the land-cover maps, and the UTM coordinates of grid points (i.e., centroid of a 500-m grid cell) included in sagebrush and pinyon-juniper habitats are recorded. This protocol emphasizes monitoring and inference on a habitat level, not a park level. Thus, for each selected habitat type, points corresponding to a habitat type are combined across the park units selected for monitoring. From this collection of points, 30 points are randomly selected, and ordered in the selection order. This ordering provides a sequential list for evaluating the suitability of points as monitoring transects. Points are mapped onto topographic and habitat maps to double-check accessibility, patch size, and to determine if a transect originating from the point overlaps a transect of a previously selected point. Transects originating from previously selected points are estimated using ArcMap drawing and distance tools. If the three criteria are not met, the point is discarded and the next sequential point is evaluated. This is performed until 15 suitable transects are identified per habitat type.

Riparian habitats in the NCPN were limited to wadeable streams, which excluded the Green, Colorado, Gunnison, and Virgin rivers. Given the limited number of streams, riparian systems for monitoring are hand picked.

Once habitat patches and riparian corridors have been selected, MCB protocol procedures are used to determine the location of each transect. Access points from roads and trails are determined during the initial visit. The start of a transect is determined by randomly determining a bearing from the access point if the habitat patch is adjacent, or by walking until reaching the patch if it is located away from the access point. Transect orientation follows the initial randomly selected bearing from the access point to the habitat patch. An exception is when monitoring linear habitats such as riparian areas. In such cases, a transect is located in the middle of the habitat and follows the orientation of the habitat. The 15 point-count stations are spaced 250-m apart, using the “way-points” feature on the GPS unit to ensure the correct straight-line distance. Point-count stations are not physically marked, so it is imperative that waypoints are accurate, and recorded in the GPS as well as on the RMBO-UTM Data Sheet (see SOP #4).

As of 2005, 45 monitoring locations were established in three habitat types (Appendix E). The coordinates and descriptions of each location are documented in Appendices F, G.

Population Being Monitored

Monitoring will be limited to the bird-breeding season (mid-May to mid-June), and will include those species that may potentially breed in the selected habitat types. The emphasis of this landbird protocol is to monitor breeding-bird species at a habitat level over the NCPN region, not at a park level. Sample sites for each of the three habitat types may be distributed over multiple NCPN park units, with only a minority of samples in any one park unit. Inference at the park level likely will not be appropriate. Thus, this protocol is designed to provide inference to the populations of breeding-bird species that occur in each of the three monitored habitat types within the collection of selected park units. As an extension of the RMBO-MCB program, target populations also include those in similar habitats within the MCB network.

Sampling Frequency and Replication

Three habitat types will be surveyed annually. Each of three observers will survey 15 transects each year within a designated 3-week time period, completing up to two transects per field day. Sampling effort may be adjusted to accommodate the ability to derive credible detection functions for density estimation. Buckland et al. (1993) recommends 60-80 detections per species for adequate estimation of a detection function. This sample-size requirement can be met by polling data from NCPN units among years, or by polling data from other MCB surveys in similar habitats. Both the number of detections per habitat and the inter-annual variability will be examined after several years of data collection to determine necessary adjustments to sampling effort.

III. Field Methods

Field Season Preparations, Field Schedule, and Equipment Setup

The Rocky Mountain Bird Observatory is responsible for hiring, training, and supervising field technicians conducting this Land Bird Monitoring Protocol in NCPN park units. Observers must attend a 5-day training program conducted by RMBO in early May of each year. This training covers bird identification, distance estimation, and habitat-collection procedures. Additionally, a detailed explanation of the MCB protocol is provided (see SOP #2 for training topics). Even before this training program, it is important to become familiar with, or to review the bird species likely to be observed in the NCPN park units. Reference materials and guides for the NCPN area are documented in SOP #1. Equipment should be organized prior to the field season to ensure availability and that necessary repairs are made (see SOP #1). Observers working in NCPN park units will be provided with a recreational GPS unit for initially recording transect waypoints, and for subsequent navigating. Instructions for using recreational GPS units

are provided in SOP #3. Before going into the field, waypoints of established transects must be uploaded into the GPS. Also, transect-location information should be transcribed to the field-data sheets (see SOP #5). A portion of field-data sheets should be copied onto write-in-rain paper.

Surveys must be conducted within a three-week window after all migratory species have returned to an area. Scheduling transects for monitoring must be done prior to the field season. Each observer is responsible for monitoring 30 transects per year. An observer must survey two transects in a portion of the field days. Transects separated by the least amount of distance should be scheduled for completion within the same day.

Sampling Methods

Methods for locating transects are detailed in SOP #4. Survey locations are not physically marked, but must be relocated using previously recorded UTM coordinates. The use of a GPS to mark and to navigate to survey transects and point-count stations is thus critical, and is described in SOP #3.

General survey procedures are described in SOP #5. Surveys should only be conducted in weather conditions that allow for birds to be adequately heard and seen. Counts should be stopped if winds exceed 13-18 mph (raising dust, leaves, loose paper; small branches in motion) and if precipitation exceeds a drizzle. Surveys begin approximately one half hour before sunrise and end no later than 10:00 am.

Conducting the Survey

5-Minute Point Counts. Details of how to conduct point counts during the breeding season and for filling in the data form are given in SOP #5. Upon reaching a point-count station, habitat data are first collected following procedures described in SOP #6, and summarized below. Bird observations are then recorded during a five-minute period. All birds, regardless of the distance from the observer, are recorded. The species, method of detection, sex, and distance from station center to the individual are recorded. Species that usually occur in flocks are recorded as a cluster unit. The distance from the station center to the first detection of an individual is a key variable. Distance is used to derive a detection function that is subsequently used to derive density estimates with the program Distance (Thomas et al. 1998). Using a range finder, distances are to be measured to the nearest 1 meter. Rounding (e.g., to the nearest 5 or 10 meters) is to be avoided because this introduces bias in a detection function. A key assumption of distance-based sampling is that birds located at station center have a 100% probability of being detected. It is thus critical to record the distance from station center to birds that moved away from the center upon arriving at a point-count station. While at the station center, avoid movement, making loud noises, and other actions that would encourage nearby birds to move away without being detected. It also important not to attract birds to station center because this inflates the probability of detectability.

After the count is completed and the data sheet filled out, the GPS unit and written instructions are used to navigate to the next plot to sample.

Line Transect Component for Low-Density Target Species. The line transect component of the survey is conducted by continuously recording detections of low-density target bird species as the observer travels between point-count stations. In order to obtain an accurate density estimate, detections of low-density target species either at the point count station or while traveling between stations must have an associated radial distance and bearing from the observer to the bird. Specific guidelines are detailed in Appendix C and SOP #5 "Conducting the Survey". A list of low-density species for each habitat type is provided by RMBO prior to the field season. This list may change over time, depending on population trends.

Transects in Linear Habitat. Two adjustments are necessary to accommodate transects through linear habitats (e.g., riparian habitats). First, the start of the transect is strategically placed near the end of the habitat to make sure the entire length of the survey is accommodated. Second, the transect does not follow a prescribed bearing, but instead is located in the middle of the habitat and follows the orientation of the habitat.

Collecting Habitat Data

Habitat data are collected annually to aid in understanding potential reasons for trends in breeding-bird densities. These potential relationships may have practical applications in the management of habitat. The Rocky Mountain Bird Observatory currently collects two sets of habitat data based on protocols developed in 2000 and revised in 2004 (see SOP #6). For the 2000 protocol, habitat variables collected at each plot describe dominant and sub-dominant habitat type, seral stage, and canopy closure, as well as understory classification and percent cover. Data are collected at the landscape level (general habitat characteristics), and in a 50-m radius plot (understory characteristics) centered on each point-count station. In the 2004 protocol, measures are recorded within a 50-m radius plots for volume of individual plant species in sub-canopy and ground layers. Habitat data are collected at point-count stations before starting a bird count.

IV. Data Management

NCPN data-management procedures are detailed in SOP #7.

Database Overview

The Rocky Mountain Bird Observatory has designed and maintains a Microsoft Access database for entering and managing data collected during surveys. Data from field forms are entered into a local copy of the database by the person conducting the surveys. After a series of quality control checks, these database records are then uploaded into the central MCB database located at the RMBO offices in Ft. Collins. In December, 2004, the database was undergoing an upgrade and redesign in order to improve functions and normalization. RMBO also is designing an Internet-based application of the database so that data entry can be completed on-line. Both developments are expected to be completed in 2005.

At the conclusion of a field season, after data have been entered, verified, and validated by RMBO, a subset of the database in Access format will be provided to NCPN. This subset will comprise all records entered to date for survey locations within NCPN park units.

Metadata Procedures

Documentation of all database tables and fields will be maintained by RMBO. The NCPN will complete and maintain an I&M Dataset Catalog record for the project and the database, and will update the record contents annually. Any spatial datasets created by the NCPN that are used for data analysis or distribution will have associated FGDC-compliant metadata records completed using ArcCatalog.

Data Archiving Procedures

Archived versions of the database will be created and stored by RMBO. Original field forms will be stored at the RMBO office in Ft. Collins, with a set of copies stored off-site at a different RMBO office.

The annual database files received by the NCPN will be archived on the NCPN server in their native Access format. This will be supplemented by a platform-independent copy of the database tables in ASCII format, which NCPN staff will create using the Access_to_ASCII utility developed by NCPN. All archived files are designated as read-only.

V. Summary of Rocky Mountain Bird Observatory Analysis and Reporting

Analysis of data collected in NCPN Park units, as well as reporting of final results, is the responsibility of RMBO. Population trends will be analyzed using density estimates as an index that is not confounded by detectability issues. Status and trend information will be analyzed at multiple levels for comparisons. Levels include ecoregion, management unit (NCPN park units vs. others), and habitat. The RMBO will produce annual summaries of observations, as well as periodic trend analyses, and send copies to the NCPN Inventory and Monitoring Project Manager. These reports and publications also will be available on the World Wide Web.

VI. Personnel Requirements and Training

Roles and Responsibilities

The NCPN Ecologist will be responsible for coordinating the implementation of this monitoring protocol with the RMBO. The Ecologist is specifically responsible for obtaining copies of all data collected in NCPN Park units by RMBO. The Data Manager is responsible for data archiving, data security, dissemination, and metadata procedures.

Qualifications and Training

Observer bias can have a strong influence on trend analysis of songbird populations (Peitz et al. 2002, Scott et al. 1986, Sauer et al. 1994, Kendall et al. 1996). Thus, the most essential component for the collection of credible, high-quality data on birds is a competent observer. The Rocky Mountain Bird Observatory is responsible for ensuring the competency of field technicians conducting the monitoring protocol.

VII. Operational Requirements

Annual Workload and Field Schedule

Monitoring will occur within a 3-week time frame (e.g., between mid May to mid June) that corresponds to when all migratory species have returned to an area. The exact time frame for each habitat type or transect will be determined by NCPN and RMBO after site selection is completed. In early May, RMBO requires observers to attend a 5-day training workshop that covers the MCB protocol procedures.

Three observers will monitor 45 transects in the NCPN park units. Each observer will be responsible for completing 15 transects per year. Up to two 15-point transects are to be completed in one field day.

Facility and Equipment Needs

Facility needs include normal office space at RMBO to administer the program, and use of the data management work station at the NCPN Inventory and Monitoring headquarters for metadata and archival purposes. SOP #1 “Before the Field Season” lists equipment needs for one observer.

Startup Costs and Budget

A pending agreement between NCPN and RMBO includes a funding level of $30,000 per year for landbird monitoring. At this funding level, RMBO will be responsible for: 1) the establishment and monitoring of 45 transects in selected habitats in NCPN park units; 2) hiring and training observers; 3) dispersing payment of salary and per diem to observers; 4) providing all necessary equipment with the exception of NCPN-provided GPS units; 5) performing data entry, management, and analysis; and 6) generating the annual status and trend reports.

Procedure for Revising the Protocol and Archiving Previous Versions of the Protocol

Revisions to the Protocol Narrative and SOPs will be inevitable over time. Explicit documentation of these changes is critical for proper interpretation and analysis of bird-survey data. Procedures for changing the protocol narrative and related SOPs are documented in SOP #9. The Protocol Narrative and all SOPs are labeled with version

numbers, and include a Revision History Log. Changes to either document type are to be accompanied by changes in version numbers; version numbers and dates, the changes, reasons for the changes, and the author of the changes are to be recorded in the Revision History Log. The updated version numbers must be recorded in the Land Bird MasterVersion Table (MVT) (see SOP #9) and conveyed to the Data Manger for proper updating of the master version table database. Previous versions of the Protocol Narrative and SOPs must be archived in the NCPN Land Bird Protocol Library (X:\Archive\Monitoring_Archive\Landbird\Protocol_Library\).

VIII. References

Bock, C.E., and Z.F. Jones. 2004. Avian Habitat Evaluation: Should Counting Birds Count? Front Ecol Environ **2**:403-410.

Browder, S.F., D.H. Johnson, and I.J. Ball. 2002. Assemblages of Breeding Birds as Indicators of Grassland Condition. Ecological Indicators **2**:257-270.

Bryce, S.A., R.M Hughes, and P.R. Kaufmann. 2002. Development of a Bird Integrity Index: Using Bird Assemblages as Indicators of Riparian Condition. Environmental Management **30**: 294-310.

Buckland, S.T., D.R. Anderson, K.P. Burnham, and J.L. Laake. 1993. Distance Sampling: Estimating Abundance of Biological Populations. Chapman and Hall, London, reprinted in 1999 by RUWPA, University of St. Andrews, Scotland. 446pp.

Chambers, C.L., W.C. McComb, and J.C. Tappeiner, II. 1999. Breeding bird responses to three silvicultural treatments in the Oregon Coast Range. Ecological Applications **9**:171-185.

Daw, S. 2002. Avian population monitoring in riparian habitats – the Southeast Utah Group of the National Park Service. 2002 Annual Report, Southeast Utah Group, National Park Service, Moab, UT. 26pp.

Hansen, A. J., W. C. McComb, R. Vega, M. G. Raphael, and M. Hunter. 1995. Bird habitat relationships in natural and managed forests in the west Cascades of Oregon. Ecological Applications **5**:555-569.

James, F.C., C.E. McCullough, and D.A. Weidenfeld. 1996. New approaches to the analysis of population trends in landbirds. Ecology **77**:13-27.

Karr, J. R., and D. R. Dudley. 1981. Ecological perspective on water quality goals. Environmental Management **5**:55-68.

Kendall, W. L., B. G. Peterjohn, and J. R. Sauer. 1996. First-time observer effects in the North American Breeding Bird Survey. The Auk **113**:823-829.

Leukering, T., M.F. Carter, A.Panjabi, D. Faulkner, and R. Levad. 2000. Monitoring Colorado's Birds: The Plan for Count-based Monitoring. Rocky Mountain Bird Observatory. Brighton, CO. 11 pp. with appendices.

NABCI Committee. 2000. North American Bird Conservation Initiative in the United States: A vision of American bird conservation. USFWS, Div. of North American Waterfowl and Wetlands, Arlington, VA.

Norvell, R.E., F.P. Howe, and J.R. Parrish. 2003a. Riparian bird population monitoring in Utah, 1992-2001. USDA Forest Service Gen. Tech. Report, PSW-GTR-191.

Norvell, R.E., F.P. Howe, and J.R. Parrish. 2003b. A Seven-Year Comparison of Relative-Abundance and Distance-Sampling Methods. The Auk **120**:1013-1028.

Oakley, K. L., L. P. Thomas, and S. G. Fancy. 2003. Guidelines for long-term monitoring protocols. Wildlife Society Bulletin **31**:1000-1003.

Peitz, David G., S.G. Fancy, L.P. Thomas, and B. Witcher. 2002. Bird Monitoring Protocol for Agate Fossil Beds National Monument, Nebraska and Tallgrass Prairie National Preserve, Kansas. U.S. Department of Interior. National Park Service. 24 pp + 4 Appendices and 8 Standard Operating Procedures.

Ralph, C. J., S. Droege, and J. R. Sauer. 1995. Managing and monitoring birds using point counts: standards and applications. Pages 161-168 *in* C. J. Ralph, J. R. Sauer, and S. Droege, eds. Monitoring Bird Populations by Point Counts, USDA Forest Service, Pacific Southwest Research Station, General Technical Report PSW-GTR-149.

Robbins, C.S., D. Bystrak, and P.H. Geissler. 1986. The Breeding Bird Survey: It's first fifteeen years, 1965-1979. U.S. Fish and Wildlife Resource Publication 157. 196 pp.

Robbins, C. S., J. R. Sauer, R. S. Greenburg, and S. Droege. 1989. Population declines in North American birds that migrate to the neotropics. Proc. Natl. Acad. Sci., USA **86**:7658-7662.

Sauer, J.R. 2000. Combining information from monitoring programs: complications associated with indices and geographic scale. In R. Bonney et al. (eds.), Strategies for Bird Conservation: The Partners in Flight Planning Process. Proceedings of the 3rd Partners In Flight Workshop; 1995 Oct. 1-5, Cape May, NJ. USDA Forest Service, Rocky Mountain Research Station. 281 pp.

Sauer, J.R., and R. Cooper. 2000. Population and habitat assessment: Monitoring bird populations over large areas. In R. Bonney et al. (eds.), Strategies for Bird Conservation: The Partners in Flight Planning Process. Proceedings of the 3rd Partners in Flight Workshop; 1995 Oct. 1-5, Cape May, NJ. USDA Forest Service, Rocky Mountain Research Station. 281 pp.

Sauer, J. R., B. G. Peterjohn, and W. A. Link. 1994. Observer differences in the North American Breeding Bird Survey. The Auk **111**:50-62.

Scott, J. M., S. Mountainspring, F. L. Ramsey, and C. B. Kepler. 1986. Forest bird communities of the Hawaiian Islands: Their dynamics, ecology and conservation. Studies in Avian Biology **9**:1-431.

Thomas, L. 1996. Monitoring long-term population change: why are there so many analysis methods? Ecology **77**:49-58.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, M. L. Burt, and others. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, UK.

Appendix A - Avian Monitoring in NCPN Park Units

Information is current as of 12 December, 2002. Years of monitoring are shown where known; an "X" indicates intermittent monitoring or monitoring of unknown duration; Historic indicates monitoring that was discontinued by 2002.

	National Programs				Local Programs		
	Monitoring Avian Productivity and Survivorship (MAPS) – mist-netting	Breeding Bird Census (BBC) – territory/spot mapping	Breeding Bird Survey (BBS) – point counts	Christmas Bird Count (CBC) – area search	General Raptor Surveys	General Point Counts or Line Transects	Species Specific
Arches NP		19 yrs in pinyon-juniper	13 yrs	X	X	10 yrs - riparian	great blue heron
Black Canyon of the Gunnison NP					X	6 yrs	Gunnison sage grouse, peregrine falcon
Bryce Canyon NP			Historic	Historic		Historic	SW willow flycatcher, Northern goshawk, peregrine falcon
Canyonlands NP		11 yrs – pinyon-juniper	11 yrs		X	10 yrs - riparian	Mexican spotted owl, SW willow flycatcher, peregrine falcon
Capitol Reef NP	7 yrs - riparian		12 yrs		X	10 yrs – riparian by UT Dept. Wildl. Res.	Mexican spotted owl, peregrine falcon
Cedar Breaks NM					X		peregrine falcon
Colorado NM (COLM)				X (1946-02) - data distinguished for COLM since 1992	1990-02 – mainly peregrine falcon		Gray, plumbeous vireos, peregrine falcon
Curecanti NRA					X	10 yrs	Gunnison sage grouse, great blue heron, peregrine falcon, migratory waterfowl, shorebirds
Dinosaur NM				X		ca. 20 yrs – fire-effects monitoring	Canada goose, peregrine falcon
Fossil Butte NM							sage grouse
Golden Spike NHS						Historic	
Natural Bridges NM					X	10 yrs - riparian	peregrine falcon
Pipe Springs NM				X			
Zion NP				X	X	4 yrs	Mexican spotted owl, peregrine falcon, Northern goshawk, bald eagle, SW willow flycatcher

Appendix B - Monitoring Colorado's Birds: The Plan for Count-based Monitoring - Rocky Mountain Bird Observatory

http://www.nature.nps.gov/im/units/ncpn/bib_library/land_birds/Leukering_2000_572052.pdf

Appendix C - Point Transect Protocol for Monitoring Colorado's Birds – Rocky Mountain Bird Observatory

http://www.nature.nps.gov/im/units/ncpn/bib_library/land_birds/RMBO_2004_574056.pdf

Appendix D - Changes to the RMBO Monitoring Program Vegetation and Bird Count Protocols 2004 – Rocky Mountain Bird Observatory

Weather data

Please see clipboard sheet for explanations of the various weather data requested: sky code, wind speed, and temperature.

Atlas page and location

Enter the page number on which the Access Point of the current transect is located – putting this value in the correct set of boxes (either the De Lorme atlas or the "Roads of" atlas). Then enter the horizontal and vertical grid reference of the Access Point of the current transect. ALWAYS list the letter first, regardless of whether letters make up the X axis or the Y axis of the maps. You may use "half-grids" to indicate points approximately halfway between either two numbers OR two letters, e.g., A.5-2 or C-3.5; use a hyphen to separate the two components of the value. If you are using only whole grid references, e.g., B1 or D7, then do NOT use a hyphen to separate the components.

GPS info

Unit # - Write the last four digits of the GPS unit number (from the silver sticker affixed to the unit) in the appropriate space.

Point # - Enter the saved waypoint number referable to the point at which you are standing (from the GPS unit) in the appropriate space.

Point info

<100m to road? - Enter 'Y' here if the point at which you are standing is within 100 meters of a road; otherwise, enter 'N'.

Private property? - (Not for Wyoming program) Enter 'Y' if the point at which you are standing is on private property; otherwise, enter 'N'.

Distance to edge - (For Wyoming program ONLY) Enter estimate or measured distance to nearest habitat edge.

Bearing to point – Enter the bearing (either from the Access Point or from the previous point) that you took to get TO the point at which you are standing.

Overstory

Seral (i.e., structural) stage - At each point-count station, identify and record the *average* structural stage of the overstory trees within a 50-m radius of the point-count station. Please use the following scale:

1 grass-forb (i.e., no or very few overstory trees present)
2 shrub-seedling (i.e., generally trees below head height)
3 sapling-pole
4 mature
5 old-growth

Canopy Closure - Estimate the percent closure of the canopy trees within a 50-m radius of the point-count station and select the best choice from the following categories:

A <40%
B 40-70%
C >70%

Height - At each point-count station, estimate the average height of the canopy trees (in meters) within a 50-m radius circle to the nearest meter. Use a range finder to help gauge estimates.

Species Composition - Identify the dominant tree species in the overstory and record the *relative* percent of the total overstory occupied by each species within a 50-m radius of each point-count station; as many as five species may be listed. Note that if only one tree species is present in the overstory, the relative percent should be 100% (9), regardless of how much of the circle is occupied by the tree species. Tree species should be recorded on the data forms using the correct 2-letter vegetation code provided in the list. Please use the following scale for recording relative abundance of each overstory tree species:

0 01-09%
1 10-19%
2 20-29%
3 30-39%
4 40-49%
5 50-59%
6 60-61%
7 70-71%
8 80-81%
9 90-100%

Additional Habitats

In some cases, additional distinct habitats may be present within the 50-m radius circle around the point-count station that do not get adequately characterized in any of the assessments of specific habitat components (e.g. overstory, shrub layer). For example, a meadow or riparian area may occur within the circle, along with the dominant forest or other habitat, but may contribute little to either the shrub layer, mid story or overstory. Nonetheless, these minor habitats may by significant for the birds present within the 50-m circle. In these situations, list up to three additional habitats in the appropriate space, using the 2-letter habitat codes provided.

Sub-canopy/mid-story

In forest, this category is intended to assess the foliage mass roughly in the middle vertical third, particularly if there is a distinct sub-canopy of a different species mix than that present in the overstory.

Volume – Estimate the foliage mass in the middle vertical third of the forest in 20% increments: 1 = 1-20%, 2 = 21-40%; 3 = 41-60%; 4 = 61-80%; and 5 = 81-100%. Note that it would be quite rare for this category to score greater than 3 and that many (most?) probably score less than 3.

Species – If, and only if, there is a distinct sub-canopy comprised of tree species different from that making up the overstory, enter as many as three species' 2-letter codes in the spaces provided. If there is no distinct sub-canopy, enter "N" in the Species #1 space.

Shrub Layer

This category is intended to estimate the amount and species makeup of any woody shrub (*including* seedling trees) layer present. Generally, shrubs are >0.5 meter high and <5.0 meters high. Anything taller than 5.0 meters should be considered part of the sub-canopy (e.g., very tall oaks or aspens that are of greater height); anything shorter than 0.5 meter should be considered in the ground cover category.

Volume – Estimate the foliage mass of all woody shrub species AND seedling trees present (see definition above) scored on a 10-point scale, for which, see **Overstory** Species compostion.

Mean height – Estimate the average height (to the nearest meter) of the shrub layer within a 50-m radius of the count station.

Species composition - Identify the shrub species (including seedling trees) present and record the *relative* percent of the total shrub layer occupied by each species within a 50-m radius of each point-count station; as many as five species may be listed. Note that if only one shrub species is present, the relative percent should be 100% (9), regardless of how much of the circle is occupied by the species. Shrub species should be recorded on the data forms using the correct 2-letter vegetation code provided in the list. Please use the same 10-point scale as above, for recording relative abundance of each species.

Ground Cover

Ground cover is classified into four categories:

1) woody vegetation below 0.5 m (roughly knee height),
2) broad-leaved herbaceous plants (forbs),
3) grass, and
4) bare ground and/or leaf litter.

At each point-count station, estimate (to the nearest 10 percent) the total percent of ground cover within the 50-m radius circle around the point-count station that qualifies for each category. Please use the same 10-point scale as presented above, but note that for ground cover, this is an absolute scale, rather than a relative scale.

At each point count that is conducted, please put an "N" in the box for any category that is absent from the 50-m circle, rather than leaving it blank. It will be assumed that blank boxes represent point counts where the ground cover was not assessed, either because the count was not conducted or because you forgot to record it.

Appendix E - List of established bird-monitoring transects by NCPN park unit and habitat type.

Transect Name	Park Unit	Habitat Type
CP-LR-01	ARCH	Low-elevation Riparian
CP-LR-02	ARCH	Low-elevation Riparian
CP-LR-03	ARCH	Low-elevation Riparian
CP-LR-04	CANY	Low-elevation Riparian
CP-LR-05	CANY	Low-elevation Riparian
CP-LR-06	CANY	Low-elevation Riparian
CP-LR-07	CARE	Low-elevation Riparian
CP-LR-08	CARE	Low-elevation Riparian
CP-LR-09	DINO	Low-elevation Riparian
CP-LR-10	DINO	Low-elevation Riparian
CP-LR-11	DINO	Low-elevation Riparian
CP-LR-12	NABR	Low-elevation Riparian
CP-LR-13	NABR	Low-elevation Riparian
CP-LR-14	ZION	Low-elevation Riparian
CP-LR-15	ZION	Low-elevation Riparian
CP-PJ-01	ARCH	Pinyon-Juniper
CP-PJ-02	BLCA	Pinyon-Juniper
CP-PJ-03	BRCA	Pinyon-Juniper
CP-PJ-04	CARE	Pinyon-Juniper
CP-PJ-05	CARE	Pinyon-Juniper
CP-PJ-06	COLM	Pinyon-Juniper
CP-PJ-07	COLM	Pinyon-Juniper
CP-PJ-08	DINO	Pinyon-Juniper
CP-PJ-09	DINO	Pinyon-Juniper
CP-PJ-10	DINO	Pinyon-Juniper
CP-PJ-11	DINO	Pinyon-Juniper
CP-PJ-12	NABR	Pinyon-Juniper
CP-PJ-13	ZION	Pinyon-Juniper
CP-PJ-14	CANY	Pinyon-Juniper
CP-PJ-15	CANY	Pinyon-Juniper
CP-SA-01	BLCA	Sage Shrubland
CP-SA-02	BRCA	Sage Shrubland
CP-SA-03	BRCA	Sage Shrubland
CP-SA-04	CURE	Sage Shrubland
CP-SA-05	CURE	Sage Shrubland
CP-SA-06	CURE	Sage Shrubland
CP-SA-07	CURE	Sage Shrubland
CP-SA-08	CURE	Sage Shrubland
CP-SA-09	DINO	Sage Shrubland
CP-SA-10	DINO	Sage Shrubland
CP-SA-11	DINO	Sage Shrubland
CP-SA-12	DINO	Sage Shrubland
CP-SA-13	DINO	Sage Shrubland
CP-SA-14	FOBU	Sage Shrubland
CP-SA-15	FOBU	Sage Shrubland