# TOS PROTOCOL AND PROCEDURE:
# BREEDING LANDBIRD ABUNDANCE AND DIVERSITY

| PREPARED BY | ORGANIZATION | DATE |
|---|---|---|
| Katherine M. Thibault | FSU | 12/31/2013 |

| APPROVALS | ORGANIZATION | APPROVAL DATE |
|---|---|---|
| Dave Tazik | SCI | 03/13/2014 |
| Mike Stewart | SE | 03/16/2014 |
| | | |
| | | |

| RELEASED BY | ORGANIZATION | RELEASE DATE |
|---|---|---|
| Stephen Craft | SE | 03/17/2014 |

See configuration management system for approval history.

# Change Record

| REVISION | DATE | ECO # | DESCRIPTION OF CHANGE |
|---|---|---|---|
| A_DRAFT | 10/03/2011 | ECO-00280 | Initial Draft Release |
| B_DRAFT | 01/13/2014 | ECO-01140 | Draft release. Will be finalized in next rev. |
| C | 03/17/2014 | ECO-01667 | Production release, template change, and other changes as detailed in Appendix C |

**TABLE OF CONTENTS**

**LIST OF TABLES AND FIGURES**

# 1 DESCRIPTION

## 1.1 Purpose

The primary purpose of this document is to provide a change-controlled version of Observatory protocols and procedures for Plot Establishment. This document provides the content for training and field-based materials for NEON staff and contractors. Content changes (i.e. changes in particular tasks or safety practices) occur via this change controlled document, not through field manuals or training materials.

This document is a detailed description of the field establishment process, relevant pre- and post-field tasks, and safety issues as they relate to this procedure and protocol.

## 1.2 Scope

This document relates the tasks for a specific field sampling and directly associated activities and safety practices. This document does not describe:

- General safety practices
- Site-specific safety practices
- General equipment maintenance

It does identify procedure-specific safety hazards and associated safety requirements such as safe handling of small mammals or safe use of required chemicals and reagents.

## 1.3 Acknowledgements

My thanks to Richard Podolsky, Courtney Meier, and Dave Schimel who wrote the first versions of this protocol. The method is heavily adapted from the Rocky Mountain Bird Observatory 2010 field protocol for spatially balanced sampling of landbird populations (Hanni et al. 2010), in combination with the Integrated Monitoring for Bird Conservation Regions (IMBCR) program (White et al. 2012). The protocol was also informed by the breeding landbird abundance and diversity working group (Jennifer Blakesley, Richard Chandler, Tom Gardali, Allen Hurlbert, Douglas Johnson, Ken Pollock, Kathryn Purcell, Ted Simons, Susan Skagen).

# 2 RELATED DOCUMENTS AND ACRONYMS

## 2.1 Applicable Documents

Applicable documents contain information that shall be applied in the current document. Examples are higher level requirements documents, standards, rules and regulations.

| | | |
|---|---|---|
| AD [01] | NEON.DOC.004300 | EHS Safety Policy and Program Manual |
| AD [02] | NEON.DOC.004316 | Operations Field Safety and Security Plan |
| AD [03] | NEON.DOC.000724 | Domain Chemical Hygiene Plan and Biosafety Manual |
| AD [04] | NEON.DOC.001155 | NEON Training Plan |
| AD [05] | NEON.DOC.050005 | Field Operations Job Instruction Training Plan |

## 2.2 Reference Documents

Reference documents contain information complementing, explaining, detailing, or otherwise supporting the information included in the current document.

| | | |
|---|---|---|
| RD [01] | NEON.DOC.000008 | NEON Acronym List |
| RD [02] | NEON.DOC.000243 | NEON Glossary of Terms |
| RD [03] | NEON.DOC.000916 | TOS Science Design Breeding Landbird Abundance and Diversity |
| RD [04] | NEON.DOC.005003 | NEON Scientific Data Products Catalog |
| RD [05] | NEON.DOC.014051 | Field Audit Plan |
| RD [06] | NEON.DOC.000824 | Data and Data Product Quality Assurance and Control Plan |
| RD [07] | NEON.DOC.001584 | Datasheets for TOS Protocol and Procedure: Breeding Landbird Abundance & Diversity |
| RD [08] | NEON.DOC.001407 | Raw Data Ingest Workbook for Breeding Landbird Abundance & Diversity |
| RD [09] | NEON.DOC.001271 | TOS Protocol: Manual Data Transcription |

## 2.3 Definitions

A **protocol** is a formal summary description of a procedure and its related rationale, and includes information on knowledge and resources needed to implement the procedure. A **procedure** is a set of prescribed actions that must take place to achieve a certain result, and can also be called a method. It differs from a science design in that science designs provide a more complete description of the rationale for selecting specific protocols. It differs from a training manual in that training manuals provide materials in support of skills acquisition in the topic areas including information on how to best train staff rather than detailing only the steps of the procedure.

According to Ralph et al. 1993, a **landbird** is "the general term used for the generally smaller birds (usually exclusive of raptors and upland game birds) not usually associated with aquatic habitats." Landbirds are typically censused during the first half of the breeding season, when birds are "most active, paired, on territories, and vocal" (Ralph et al. 1993). For the purposes of this document, 'bird' and 'breeding landbird' are used interchangeably.

## 3 BACKGROUND AND OBJECTIVES

### 3.1 Background

Breeding landbirds were chosen to be a component of NEON's suite of biodiversity measurements (Kao et al. 2012), because breeding birds (a) have proven useful in large-scale modeling of climate change impacts (Stralberg et al. 2009, Tingley et al. 2012); (b) are consumers of other NEON taxa (i.e., insects, plants); (c) serve as reservoirs for mosquito-borne diseases of interest to NEON (e.g., West Nile Virus; LaDeau et al. 2007, McKenzie and Goulet 2010); (d) can be impacted by nest predation by small mammals (also a NEON target taxon; Schmidt et al. 2008); (e) are vulnerable to climate change (Gardali et al. 2012); and (f) respond strongly to land-use change (Luther et al. 2008, Newbold et al. 2012, Jongsomjit et al. 2012). Moreover, the long history of data collection at the regional and national scales allows for the integration of NEON sampling into larger datasets to examine regional and continental-scale and decadal-scale trends (e.g., Bart et al. 1995, Saracco et al. 2008).

In North America, there are over 650 species of breeding birds, and many approaches have been developed to sample them, given their diversity of habits and habitats (Bibby et al. 2000, Fancy and Sauer 2000). As a result of this diversity, no single sampling method can be used with equal efficacy on songbirds, seabirds, waterfowl, and raptors (e.g., Ralph et al. 1993, Fancy and Sauer 2000). The breeding bird component of the NEON TOS is designed to sample songbirds and other birds that are diurnal and resident in or migrating through terrestrial habitats, commonly referred to as landbirds. The most common methods for sampling breeding birds are spot mapping of territories, area searches of specific sites, strip transects along predetermined routes, nest searches, and point counts (Ralph et al. 1993, Nur et al. 1999), as well as mist-netting for marking and recapture.

Of these, point counts are the most commonly used method of sampling birds (Bibby et al. 2000, Rosenstock et al. 2002), and they have been described as 'the most efficient and data rich method of counting birds' (Ralph et al. 1993). Point counts involve an observer standing at a point for a predetermined amount of time (typically 3-20 minutes), typically during the peak of singing activity that occurs in the early morning, and recording all of the individuals seen or heard (Ralph et al. 1995; Figure 1). The original design for NEON bird sampling formulated by the group of experts known as the Tiger team included point counts as the method of choice (Hansen 2008). Acoustic monitoring is being considered as a complementary method to collect data on bird diversity and phenology (e.g., Celis-Murillo et al. 2009, Blumstein et al. 2011), but is contingent on additional funding and advances in machine learning algorithms to automate species identification of bird songs and calls.

The advantages of point counts include (1) minimal disturbance to the birds; (2) provides data on a diversity of species (Hutto and Young 2002); and (3) provides comparability with many other datasets. The major disadvantages of point counts are (1) the need for highly skilled observers for only a limited portion of the year; (2) the challenges associated with even highly skilled observers to process all of the necessary data in a 3 – 20 minute count; and (3) the fact that the detectability of birds is not constant across space, time, and species (Rosenstock et al. 2002). Detectability is significantly affected by (1) observers who significantly vary in visual and auditory acuity and experience (Sauer et al. 1994); (2) environmental variables such as weather, light conditions, vegetation, and topography; and (3) the physical and behavioral variation within and among species (Rosenstock et al. 2002). Variation in detectability is ameliorated by the use of statistical methods that have been developed to account for this issue (e.g., distance sampling - Box 1).

The objective of the NEON breeding landbird sampling is to provide robust estimates of species diversity, abundance and density. To that end, point counts that are randomly distributed in the areas of interest (i.e., not along roadsides) and that use techniques that account for variation in detectability are the recommended sampling methods (e.g., Nur et al. 1999, Bibby et al. 2000, Fancy and Sauer 2000, Rosenstock et al. 2002). Distance sampling is one such technique, and it involves recording distance from the observer to the bird. Distance data are then used in statistical analyses designed to adjust the count of birds that were present but undetected (Box 1).

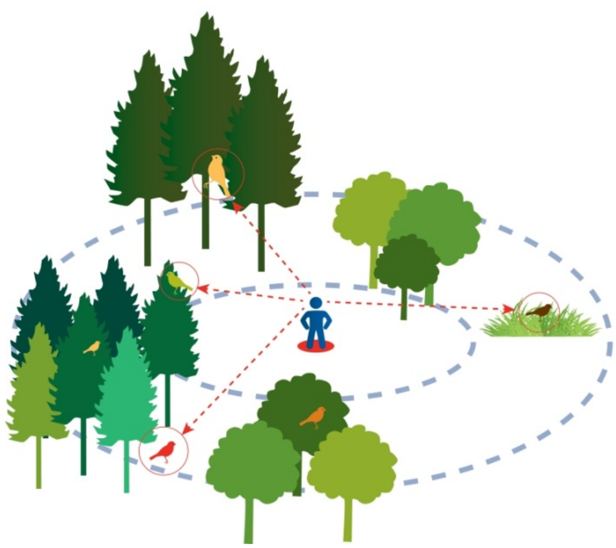

**Figure 1.** Schematic depicting the point count method of sampling birds.

In distance sampling, the distances from the observer to each bird (represented by dashed red lines in Figure 1), as well as the species, sex, and age, are recorded.

| Box 1. Overview of Distance Sampling (Excerpted from White et al. 2012) |
|---|
| Distance sampling theory was developed to account for the decreasing probability of detecting an object of interest (e.g., a bird) with increasing distance from the observer to the object (Buckland et al. 2001). The detection probability is used to adjust the count of birds to account for birds that were present but undetected. Application of distance theory requires that three critical assumptions be met: 1) all birds at and near the sampling location (distance = 0) are detected; 2) distances of birds are measured accurately; and 3) birds do not move in response to the observer's presence (Buckland et al. 2001, Thomas et al. 2010). |

## 3.2 NEON Science Requirements

This protocol fulfills Observatory science requirements that reside in NEON's Dynamic Object-Oriented Requirements System (DOORS). Copies of approved science requirements have been exported from DOORS and are available in NEON's document repository, or upon request.

## 3.3 NEON Data Products

Execution of this protocol procures samples and/or generates raw data satisfying NEON Observatory scientific requirements. These data and samples are used to create NEON data products, and are documented in the NEON Scientific Data Products Catalog (RD [04]).

# 4 PROTOCOL

**Point count method**

Breeding landbirds will be sampled using the point count method. Point counting entails one or more observers going to pre-established points and recording all the birds heard and/or seen during a set period of time (Figure 1). The NEON point count method is adapted from the Rocky Mountain Bird Observatory 2010 field protocol for spatially balanced sampling of landbird populations (Hanni et al. 2010; http://bit.ly/17ekDNB). Point counts are six minutes long, with each minute tracked by the observer, following a two-minute settling-in period. All birds shall be recorded to species and sex, whenever possible, and the distance to each individual or flock shall be measured with a laser rangefinder, except in the case of flyovers.

**Spatial distribution of point counts**

As a guiding principle, bird sampling is stratified such that grid positions achieve representative coverage of important bird breeding vegetation types. The grids will be collocated with a subset of the TOS Distributed Plots (see RD[03] for additional details). To increase efficiency, point counts will be distributed in 9 point 0.56 $km^2$ grids, in a 3 x 3 array, with 250m spacing between points (Figure 2). This differs from the grid size used in the IMBCR protocol (4 x 4, 1 $km^2$ grids), in order to accommodate sample sizes of 5 – 15 grids at most NEON sites. At sites that cannot accommodate a minimum of 5 grids, points will be distributed randomly throughout the site (collocated with Distributed plots; minimum distance of 250m between points) to achieve these sample sizes. These sample sizes are minimum requirements to characterize spatial variability across the site. These deviations from the IMBCR design will still allow for comparable estimates of density across all sites.

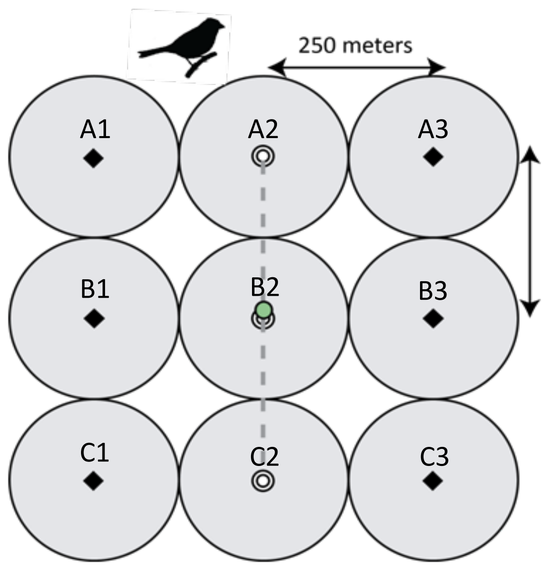


**Figure 2.** Design of the point count grid, consisting of 9 points separated by a minimum of 250 m. The center of the grid is just offset from a Distributed plot (green circle), where plants, soils, microbes, and insects will also be sampled.

**Timing of point counts**

Point counts will be conducted only during the early morning, from 30 minutes before sunrise to 3-4 hours after sunrise, depending on the weather and other ambient conditions (see site-specific appendices for daily sampling guidelines). Audible detection of birds can be limited because of vegetation, as well as high ambient noise from such sources as the wind or from other species such as insects or frogs. Similarly, visual detection of birds can be hampered from dust, low clouds, flying snow, fog, or rain. Handheld weather stations should be used at every point by technicians to keep track of weather conditions that can inhibit detection, particularly wind speed. When ambient conditions significantly inhibit detectability, sampling should not be conducted.

The sampling window for breeding birds for each site corresponds to when most of the birds encountered will likely be resident, breeding birds, rather than species that either over-winter or migrate through during the spring or fall. Timing is therefore critical and varies across environmental gradients. The initiation of breeding activity also varies among species, so it is best to spread the sampling effort out evenly over the sampling window. Points will be counted only one to two times per breeding season, depending on the size of the site (i.e., sites with grids will be sampled once; small sites will be sampled twice; see site-specific appendices for guidelines; Table 1). This approach allows for greater spatial replication; repeat sampling will be used primarily at small sites in order to increase the number of detections at that site, in order to fit detection functions.

**Table 1.** Summary of temporal and spatial sampling design.

| Relative site area | Point arrays | Number of arrays | Repeated sampling | Sampling Window |
|---|---|---|---|---|
| Large | 9-pt grids | 5 - 15 | No | ≥ 5 days, ≤ 14 days |
| Small | Single points | 5 - 25 | Yes – 2x per season | ≥ 7 days, ≤ 21 days |

Breeding season dates will be informed by local experts and by eBird data (ebird.org), which is known to provide large amounts of data pertaining to the arrival of spring migrants, particularly in well-populated regions of the U.S. (Hurlbert and Liang 2012). For example, RMBO recommends that breeding bird sampling in Colorado should occur between May 10 and June 15 for sites below 7,500 feet in elevation, and from June 5 to June 30 for 7,500 – 9,300 feet (N. Van Lanen, pers. comm.). The approximate timelines that have been provided in historical NEON documentation are listed in Table 2, with a modification for Domain 17 (Kathryn Purcell, pers. comm). More refined windows of 2-3 weeks for all sites can be found in the site-specific appendices.

**Table 2.** Domain specific schedules for breeding bird observations, to be refined.

| Schedule for bird observations | Domains | Domain regions |
|---|---|---|
| March 21 - April 30 | 17 | Pacific Southwest |
| April 8th – June 16th | 3, 4, 14, 20 | Puerto Rico, HI, FL, Desert Southwest |
| April 23rd – June 28th | 2, 6, 7, 8, 10, 11, 13, 15, 17 | Mid-Atlantic, Ozarks, Appalachians, Prairie, Southern plains, Southern Rockies, Great Basin, Pacific Southwest |
| May 1st – July 5th | 1, 5, 9, 12, 16 | Northeast, Great Lakes, Northern Plains, Pacific Northwest |
| May 15th – July 20th | 18, 19 | Alaska |

## 5 QUALITY ASSURANCE AND CONTROL

The procedures associated with this protocol will be audited according to the Field Audit Plan (RD[05]). Additional quality assurance will be performed on data collected via these procedures according to the NEON Data and Data Product Quality Assurance and Control Plan (RD[06]).

The QA/QC plan for Breeding Landbird Abundance and Diversity Sampling is in development, and all details will ultimately be found in the associated document (see Birek et al. 2011 for a good example) .

The plan includes:

- Double-review of at least 10% of the entered data, if data are transcribed from paper datasheets, with error rates reported to the FSU Staff Scientist.
- Cold checks of field data collection (sensu USFS Forest Inventory Analysis; http://1.usa.gov/HTBWK2), if funding is made available.

- Regular bird identification quizzes for field technicians, with the expectation that technicians will consistently successfully identify more than 90% of the tested species. Bird identification quizzes will be administered and scored throughout the season to assess and confirm the skills of each observer, with a minimum of 3 quizzes per observer (i.e., beginning, middle, and end of breeding season). The individual quiz scores for each observer may be published as metadata, using anonymized IDs for the observers, rather than names.
- Scanned copies of the paper datasheets will be provided to the Avian Ecologist within 7 days after the first week of sampling per breeding season. The datasheets will be checked for errors and missing data. This cold check shall be repeated throughout the sampling season, if necessary, providing an iterative process to improve error detection and assess error resolution.
- Equipment and task checklists are provided in Appendix A and B.

Audible detection of birds can be limited because of vegetation, as well as high ambient noise from such sources as the wind or from other species such as insects or frogs. Similarly, visual detection of birds can be hampered from dust, low clouds, flying snow, fog, or rain. When ambient conditions significantly inhibit detectability, sampling should not be conducted.

- No landbird sampling shall occur during precipitation events or in dense fog.
- No landbird sampling shall occur in winds greater than 25 mph (40 kph), as determined with a handheld anemometer.

Sampling can be resumed as soon as conditions allow for effective detections, as long as sampling occurs within the morning sampling window within the specified breeding season window. All points on a grid do not have to be sampled on the same day, but it is preferable to complete sampling for a single grid within a window of 7 days.

When unexpected field conditions require deviations from this protocol, the following field implementation guidance must be followed to ensure quality standards are met:

**Table 3.** Contingency matrix of sampling actions and outcomes

| Delay | Action | Adverse Outcome | Outcome for Data Products |
|---|---|---|---|
| **Hours** | Continue with sampling if there is still time in the sampling window around dawn. Otherwise, skip sampling for the day. An additional sampling day should be added within 7 days. | If additional time is not available, fewer samples will be collected. | Fewer sampling points could result in less precise estimation of breeding bird species richness, diversity, or density. |
| **1-7 days** | Add additional days of sampling as soon as possible to sample all points. | If additional time is not available, fewer samples will be collected. | Fewer sampling points could result in less precise estimation of breeding bird species richness, diversity, or density |
| **8 or more days** | Contact appropriate scientific lead(s) on the FSU team for guidance. | May miss target sampling window. | 1. Species richness due to changes in seasonal phenology could be influenced by significant changes in temporal sampling window. 2. Not completing all plots impacts diversity metrics and target sample size. |

## 6 SAFETY

Personnel working at a NEON site must be compliant with safe field work practices as outlined in the Operations Field Safety and Security Plan (AD[02]) and EHS Safety Policy and Program Manual (AD[01]). The Field Operations Manager and the Lead Field Technician have primary authority to stop work activities based on unsafe field conditions; however, all employees have the responsibility and right to stop their work in unsafe conditions.

As the bird sampling protocol involves no extraordinary procedures, safe field work practices should suffice. These include the use of insect repellent in areas with ticks and fleas, ready availability of a field first aid kit, and working within sight of another person.

## 7 PERSONNEL REQUIREMENTS

All field ornithologists should have the following expertise:

- Demonstrated knowledge and experience identifying the species of birds that occur at a particular site both visually and aurally.
- Prior experience conducting avian field surveys, with preference given for technicians with experience conducting breeding bird surveys, particularly in a similar region.

## 8 TRAINING REQUIREMENTS

All technicians must complete required safety training as defined in the NEON Training Plan (RD[04]). Additionally technicians complete protocol specific training for safety and implementation of protocol as required in Field Operations Job Instruction Training Plan (RD[05]).

Training should minimally include the following components:

1) Technicians who have been identified to conduct bird sampling will be provided with study materials, including field guides and song recordings, as soon as possible after hiring.
2) A workshop including lectures and field work will be conducted for 1-5 days (depending on the experience of the technicians) prior to the onset of field sampling to provide an overview of the procedures and the goals of the sampling. Hands-on work with the sampling equipment and review of common bird species for a domain will be included. A quiz of the technicians' knowledge of birds by sight and song will be administered and scored at the end of the workshop. Only technicians that score >90% on the final test will be deemed sampling-ready.
3) During the field-based training, technicians that need additional training will shadow experienced ornithologists, followed by the experienced ornithologists performing hot checks on the technicians.
4) All technicians will practice measuring known distances to objects with the laser rangefinders until they can reliably measure distances up to 150 meters to an accuracy of ±5 meters.

## 9 SAMPLE FREQUENCY AND TIMING

### 9.1 Sampling Frequency

Sampling will occur once or twice per breeding season at each point at a site, depending on the size of the site (i.e., sites with grids will be sampled once; small sites will be sampled twice; see site-specific appendices for guidelines).

### 9.2 Sampling Timing Parameters

At sites that can accommodate the minimum of five 9-point grids, points within each grid are sampled once per season. At these sites, the sampling window must span a minimum of 5 days (i.e., all grids at a site should not be sampled on the same day) and a maximum of 14 days. For example, at a site with 15 grids,three grids could be sampled on each of 5 consecutive days or eight grids could be sampled on day 1 and the remaining seven on day 5 or day 14, etc. . At sites that cannot accommodate the minimum of five 9-point grids, points are sampled twice within a season. At these smaller sites, points should be sampled with a minimum of 7 days between sampling bouts and no longer than 21 days (see Table 1 above). Breeding season dates will be informed by local experts and by eBird data (ebird.org), which can provide large amounts of data pertaining to the arrival of spring migrants, particularly in well-populated regions of the U.S. (Hurlbert and Liang 2012). Sampling timing will be provided by Science Operations in the site-specific appendices to this protocol. All sampling must occur within the window provided.

## 10 STANDARD OPERATING PROCEDURES

### SOP A: Preparing for Sampling

*See Appendix A and B for handy equipment and task checklists.*

1) Familiarize yourself with the species codes *before going into the field*.

   Species that often cause problems include: **Cackling Goose** (CACG not CAGO), **Canada Goose** (CANG not CAGO), **Northern Shoveler** (NSHO, not NOSH), Ring-necked Pheasant (RINP, not RNPH), **Barn Owl** (BNOW not BAOW), **Barred Owl** (BDOW not BAOW), **Broad-tailed Hummingbird** (BTLH not BTHU), **Western Wood-Pewee** (WEWP, not WWPE), **Gray Jay** (GRAJ, not GRJA), **Tree Swallow** (TRES, not TRSW), **Bank Swallow** (BANS, not BASW), **Barn Swallow** (BARS, not BASW), **Cactus Wren** (CACW not CAWR), **Canyon Wren** (CANW not CAWR), **Cedar Waxwing** (CEDW not CEWA), **Black-throated Gray Warbler** (BTYW not BTGW), **MacGillivray's Warbler** (MGWA, not MAWA), **Yellow Warbler** (YWAR, not YEWA), **Canyon Towhee** (CANT not CATO), **Lark Bunting** (LARB, not LABU), **Sage Sparrow** (SAGS not SASP), **Savannah Sparrow** (SAVS, not SASP), **Lazuli Bunting** (LAZB, not LABU), **Red-winged Blackbird** (RWBL, not RWBB).

2) Clean and check binoculars to make sure they are in good working condition.
3) Check, charge, or replace batteries for the laser rangefinder, camera, handheld weather station, stopwatch, and GPS unit.
4) Upload background images, layers, and waypoints associated with bird grids to the GPS unit.
5) Print and organize data sheets.
6) Set appropriate declination on the compasses.

#### Field Equipment and Materials

**Table 4**. Field equipment list

| Maximo Item No. | Item Description | Purpose | Quantity per technician | Habitat-Specific | Special Handling |
|---|---|---|---|---|---|
| Required | Handheld Weather Station that measures maximum, average, and current temperature with an accuracy of +- 1 degree F, humidity +- 3%, and wind speed +- 3% | Measuring temperature, RH, and wind speed | 1 | No | No |
| Required | Binoculars, Full Size, Magnification 10 x 42, Field of View 264 ft. @ 1000 yd, Water Proof, with Case, Strap, Lens Cover, & Cloth | Visual identification of birds | 1 | No | No |
| Required | Stopwatch / timer; must have notification chime every minute | Tracking minutes of point count | 1 | No | No |
| Required | Laser rangefinder, Minimum specs: 6X multicoated monocular, waterproof, fogproof, 18mm of eye relief, Accurate to 1/2-yd. increments to 99.5 yds. and 1-yd. increments to 550 yds | Measuring distances | 1 | No | No |

| | | | | | |
|---|---|---|---|---|---|
| Required | The Sibley Guide to Birds | Visual identification of birds | 1 | No | No |
| Required | Camera, digital – minimum specifications: 10 megapixel, compact, 5x optical zoom | Photographing rare or unknown birds | 1 | No | No |
| Required | GPS Receiver, Handheld, Recreational Accuracy | Navigating to points | 1 | No | No |
| Suggested | Magnetic Compass, Handheld, Mirror-sighting, Floating | Navigating between points | 1 | No | No |

## SOP B: Field Sampling

The method is heavily adapted from the Rocky Mountain Bird Observatory 2010 field protocol for spatially balanced sampling of landbird populations (Hanni et al. 2010). The bird point count datasheet is provided separately (RD[07]), but a key to the datasheet can be found in Appendix A.

1) Record the date, plot ID, start cloud cover, and start relative humidity on the Bird point count datasheet (RD[07]).
   - Date (YYYY-MM-DD) and plot ID (SITE_XXX) should be filled out on every datasheet.
   - Start and ending cloud cover (%) and relative humidity (%) need to be completed only once per plot ID per date.
   - Cloud cover is estimated visually, while relative humidity should be measured with handheld weather station.
2) Upon reaching each point on the grid, wait 2 minutes in order to allow the local birds to become accustomed to your presence (the 'settling in period'). While waiting, fill in the required metadata (i.e., point ID (XX), start-time (XX:XX), habitat code, temperature (degrees Celcius), and average wind speed (kilometers per hour) on the Bird point count datasheet (RD[07]). These metadata are filled out once for each point at all sites.
   - DO NOT begin counting until the 2 minutes have passed.
   - DO identify and note the locations of any birds flushed from around the point upon approach. These data should be recorded when the counting period begins.
3) Set the timer for the point count duration (i.e., 6 minutes), with a chime to indicate the passing of each minute within the counting period. Begin the count-down, and begin recording the birds you see and/or hear onto the Bird point count datasheet (RD[07]).
4) For each independently detected bird, record the following information:
   - The **species**, using the appropriate 4-letter code (Pyle and DeSante 2012).
     i) If there is any uncertainty in the species identification, please note this in the **idQ** (i.e., identification qualifier) column on the datasheet – using one of the codes below (Table 5). Leave blank if there is not uncertainty.

**Table 5.** Codes for identification qualifier entries

| idQ | Identification Qualifier Description* |
|---|---|
| CS | cf. species |
| AS | aff. species |
| CG | cf. genus |
| AG | aff. genus |
| CF | cf. family |
| AF | aff. family |

* cf. roughly equals "not sure"; aff. roughly equals "similar to, but is not"

ii) Use the digital camera to take pictures of (a) species for which the identification is uncertain (except in very common cases), (b) species that are very rare or has state or federal status, or (c) if there is something unusual or noteworthy about a particular individual.

- The horizontal **distance** to the bird (measured with the rangefinder).

i) Distance to birds is recorded radially in 2-dimensions from the observer; only the horizontal distance is recorded. That is, a bird 10 meters up in a tree directly overhead is recorded as zero meters from the observer.

ii) If you cannot get a direct line of sight to a bird, estimate the distance the bird is from a visible point and use the rangefinder to measure to that point. Then add or subtract the estimated distance between that point and the bird to obtain the best possible distance estimate. **Estimate the distance from the visible point to the bird BEFORE using the rangefinder.** Distance-sampling assumes that you measure all distances accurately, so be sure to use your rangefinders as much as possible.

iii) Always measure distances to where you first detected the bird, not to where you first identified it. For birds that are vocalizing but not seen, try to determine their locations relative to a landmark, such as a tree or shrub, then measure the distance to that landmark. If you are unable to pin-point its location, then estimate the distance *to the nearest meter*. **Do not round distances to 5 or 10 m intervals**, as this causes heaping at particular values and complicates data analysis.

iv) Flyovers do not require distance measurements.

This method uses distance-sampling techniques and analyses; bird data recorded without associated distances (with the exception of flyovers) can NOT be used in the analysis.

- **How** the bird was detected:

i) V=visual, C=calling, S=singing, D=drumming, F=Flyover, or O=other aural (e.g., wing beats).

ii) Enter the code for how you **first** detected each individual (only one entry per field). Remember that how you detect a bird is different from how you identify it.

- The **sex** of the bird (F = Female; M = Male; U = Unknown).The **cluster size** and **cluster ID code** for **any birds** observed as part of a cluster (i.e. non-independent detections). See Appendix C for more information on how to distinguish and record clusters.

5) **Record the passing of each minute** in the appropriate column of the datasheet (RD[07]).

6) Before moving to the next sample point, **review the datasheet** to ensure that all required data have been recorded.

7) **Skip a line** on the datasheet between sampling points within a grid.

**Tips and Tricks (from Hanni et al. 2010)**

1) The following are a few **general guidelines** for collecting high-quality data :
   - If you do not detect any birds, record "NOBI" (No Birds).
   - If you see a rare or unexpected bird after the count period has elapsed, you may record this species on the datasheet, entering '88' as the point ID.
   - If you detect a bird that was flushed from the survey point upon your arrival, record the bird's original distance from the survey point. We assume that these birds would have remained at their original locations were it not for the disturbance created by the observer.
   - Focus primarily on birds that are close to the observation point. This is because missing distant birds has only a small effect on density estimates, but missing birds that are close by has a much larger effect on density estimates.
   - Look and listen in all directions – **including UP**.
     i) Note that distance to birds is recorded radially in 2-dimensions from the observer. That is, a bird 10 meters up in a tree directly overhead is recorded as zero meters from the observer.
   - Do not move from the observation point. That said, it is acceptable to take a step or two away from the point to identify a bird spotted from the point, but **ALWAYS** return ASAP to the point to continue observations.
   - Do NOT chase birds before or during the count. After the observation period has elapsed, you may chase down a bird to identify it, if you couldn't identify it from the point.
2) There are **several potential issues** that can lead to problems in the data:
   - Window species – these are species that you see or listen through, because they are common. For example, Mourning Dove is a common window species. This can result in the observer failing to count individuals of these species. The goal is to get an accurate count of all species, so be aware of this issue and strive to count all individuals seen and heard. Look and listen everywhere – Look up regularly, and do not wear hats that obscure hearing (including wide-brimmed hats that deflect sound), or sunglasses that obscure vision.
   - Stand at observation points – do not sit or kneel. Altering your position will affect your ability to consistently and repeatably see and hear birds.
   - No "pishing" – do not make noises that can attract birds to you and alter the density estimation.
   - Airplanes and other external noises – If audibility of birds is reduced by mechanical noise, then interrupt the count and resume when the noise abates. The total time spent counting should still equal 6 minutes.
   - <u>Never</u> guess the identity of a bird – If the bird species is unknown, use the table of unknown species codes in Appendix B.

## SOP C: Equipment Maintenance: Cleaning and Storage

Conducting the same list of equipment-related activities after a sampling event as done prior to a sampling event is also recommended (see Appendix A for checklist), and so they are reproduced here.

1) Clean and check binoculars to make sure they are in good working condition.
2) Check, and charge or replace batteries for the laser rangefinder, camera, handheld weather station, stopwatch, and GPS unit.
3) Check that the appropriate declination is set on the compasses.

## SOP D: Data Entry and Verification

1) Transcribe information from datasheet into the provided spreadsheet (RD[08]). This should be done at the end of the sampling day. If not possible, then as soon as possible, but no more than 14 days after the end of the sampling bout.
    a. Enter data in format provided in Excel file (RD[08]).
    b. Follow QA/QC procedures for ensuring accurate transcription of data (RD[09]).
    c. Include notes on all deviations from procedures. Indicate what was done and why.
2) Scan and then file hard copy of datasheet, as described in RD[09].
3) Another technician shall review the transcribed data to reveal transcription errors. Double-review of at least 10% of the entered data is required, if data are transcribed from paper datasheets, with transcription error rates reported to the Avian Ecologist.
4) The transcribed data can then be further checked for errors in usage of species codes by comparison to a master spreadsheet of species codes.

## 11 REFERENCES

Bart, J., M. Hofschen, and B. G. Peterjohn. 1995. Reliability of the Breeding Bird Survey: effects of restricting surveys to roads. The Auk 112:758–761.

Bibby, C. J., N. D. Burgess, D. A. Hill, and S. Mustoe. 2000. Bird Census Techniques. Page 302, 2nd edition. Academic Press, London.

Birek, J. J., C. M. White, and J. A. Fogg. 2011. Point Transect Quality Assurance/Quality Control Protocol. Page 15. Brighton, CO, USA.

Blumstein, D. T., D. J. Mennill, P. Clemins, L. Girod, K. Yao, G. Patricelli, J. L. Deppe, A. H. Krakauer, C. Clark, K. a. Cortopassi, S. F. Hanser, B. McCowan, A. M. Ali, and A. N. G. Kirschel. 2011. Acoustic monitoring in terrestrial environments using microphone arrays: applications, technological considerations and prospectus. Journal of Applied Ecology 48:758–767. doi: 10.1111/j.1365-2664.2011.01993.x.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Page 448. Oxford University Press, USA, New York, NY.

Celis-Murillo, A., J. L. Deppe, and M. F. Allen. 2009. Using soundscape recordings to estimate bird species abundance, richness, and composition. Journal of Field Ornithology 80:64–78. doi: 10.1111/j.1557-9263.2009.00206.x.

Fancy, S. G., and J. R. Sauer. 2000. Recommended methods for inventorying and monitoring landbirds in national parks. Page 13.

Gardali, T., N. E. Seavy, R. T. DiGaudio, and L. a Comrack. 2012. A climate change vulnerability assessment of California's at-risk birds. PloS one 7:e29507. doi: 10.1371/journal.pone.0029507.

Hanni, D. J., C. M. White, R. A. Sparks, J. A. Blakesley, G. J. Levandoski, and J. J. Birek. 2010. Field Protocol for Spatially Balanced Sampling of Landbird Populations. Page 34. Brighton, Colorado, USA.

Hansen, A. J. 2008. Birds, Fundamental Sentinel Units Tiger team report.

Hurlbert, A. H., and Z. Liang. 2012. Spatiotemporal variation in avian migration phenology: citizen science reveals effects of climate change. PloS one 7:e31662. doi: 10.1371/journal.pone.0031662.

Hutto, R. L., and J. S. Young. 2002. Regional landbird monitoring: perspectives from the Northern Rocky Mountains. Wildlife Society Bulletin 30:738–750.

Jongsomjit, D., D. Stralberg, T. Gardali, L. Salas, and J. Wiens. 2012. Between a rock and a hard place: the impacts of climate change and housing development on breeding birds in California. Landscape Ecology 28:187–200. doi: 10.1007/s10980-012-9825-1.

Kao, R. H., C. M. Gibson, R. E. Gallery, C. L. Meier, D. T. Barnett, K. M. Docherty, K. K. Blevins, P. D. Travers, E. Azuaje, Y. P. Springer, K. M. Thibault, V. J. McKenzie, M. Keller, L. F. Alves, E. S. Hinckley, J. Parnell, and D. S. Schimel. 2012. NEON terrestrial field observations: designing continental-scale, standardized sampling. Ecosphere 3:115. doi: 10.1890/ES12-00196.1.

LaDeau, S. L., A. M. Kilpatrick, and P. P. Marra. 2007. West Nile virus emergence and large-scale declines of North American bird populations. Nature 447:710–3. doi: 10.1038/nature05829.

Luther, D., J. Hilty, J. Weiss, C. Cornwall, M. Wipf, and G. Ballard. 2008. Assessing the impact of local habitat variables and landscape context on riparian birds in agricultural, urbanized, and native landscapes. Biodiversity and Conservation 17:1923–1935. doi: 10.1007/s10531-008-9332-5.

McKenzie, V. J., and N. E. Goulet. 2010. Bird community composition linked to human West Nile virus cases along the Colorado Front Range. EcoHealth 7:439–47. doi: 10.1007/s10393-010-0360-8.

Newbold, T., J. P. W. Scharlemann, S. H. M. Butchart, C. H. Sekercioglu, R. Alkemade, H. Booth, and D. W. Purves. 2012. Ecological traits affect the response of tropical forest bird species to land-use intensity. Proceedings of the Royal Society B: Biological Sciences 280:20122131–20122131. ROYAL SOC. doi: 10.1098/rspb.2012.2131.

Nur, N., S. L. Jones, and G. R. Geupel. 1999. Statistical Guide to Data Analysis of Avian Monitoring Programs. Page 61. Washington, D.C.

Pyle, P., and D. F. DeSante. 2012. List of North American birds and alpha codes according to American Ornithologists' Union taxonomy through the 53rd AOU Supplement. Retrieved January 5, 2014, from http://www.birdpop.org/alphacodes.htm.

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, editors. Monitoring bird populations by point counts. Gen. Tech. Rep. PSW-GTR-149. U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, CA.

Ralph, C. J., T. E. Martin, G. R. Geupel, D. F. Desante, and P. Pyle. 1993. Handbook of Field Methods for Monitoring Landbirds. Gen. Tech. Rep. PSW-GTR-144-www. Page 41. Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture, Albany, CA.

Rosenstock, S. S., D. R. Anderson, K. M. Giesen, T. Leukering, and F. Carter. 2002. Landbird counting techniques: current practices and an alternative. The Auk 119:46–53. doi: 10.1642/0004-8038(2002)119[0046%3ALCTCPA]2.0.CO%3B2.

Saracco, J. F., D. F. Desante, and D. R. Kaschube. 2008. Assessing landbird monitoring programs and demographic causes of population trends. Journal of Wildlife Management 72:1665–1673. doi: 10.2193/2008-129.

Sauer, J. R., J. E. Hines, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski, Jr., and W. A. Link. 2011. The North American Breeding Bird Survey 1966-2009. Version 3.23.2011. USGS Patuxent Wildlife Research Center, Laurel, MD, Laurel, MD.

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.

Schmidt, K. A., S. A. Rush, and R. S. Ostfeld. 2008. Wood thrush nest success and post-fledging survival across a temporal pulse of small mammal abundance in an oak forest. Journal of Animal Ecology 77:830–7. doi: 10.1111/j.1365-2656.2008.01378.x.

Stralberg, D., D. Jongsomjit, C. A. Howell, M. A. Snyder, J. D. Alexander, J. A. Wiens, and T. L. Root. 2009. Re-Shuffling of Species with Climate Disruption : A No- Analog Future for California Birds ? 4. doi: 10.1371/journal.pone.0006825.

Thomas, L., S. T. Buckland, E. a Rexstad, J. L. Laake, S. Strindberg, S. L. Hedley, J. R. Bishop, T. A. Marques, and K. P. Burnham. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. Journal of Applied Ecology 47:5–14. doi: 10.1111/j.1365-2664.2009.01737.x.

Tingley, M. W., M. S. Koo, C. Moritz, A. C. Rush, and S. R. Beissinger. 2012. The push and pull of climate change causes heterogeneous shifts in avian elevational ranges. Global Change Biology 18:3279–3290. doi: 10.1111/j.1365-2486.2012.02784.x.

White, C. M., N. J. Van Lanen, D. C. Pavlacky, J. A. Blakesley, R. Sparks, J. Fogg, M. McLaren, J. Birek, and D. J. Hanni. 2012. Integrated Monitoring in Bird Conservation Regions (IMBCR): 2011 Annual Report. Page 113. Brighton, Colorado, USA.

## APPENDIX A QUICK REFERENCE: BREEDING BIRD POINT SAMPLING DATASHEET

| Data Field | Description/What to Enter |
|---|---|
| eventDate | Date that sampling was conducted (YYYYMMDD) |
| plotID | Plot identifier (4-character site code _XXX) |
| recordedBy | Full name of personnel conducting the point count(s) (First name Last name) |
| cloudsStart | Estimate of % cloud cover, at the start of sampling of the plotID |
| cloudsEnd | Estimate of % cloud cover, at the end of sampling of the plotID |
| rhStart | Relative humidity (%), as measured by handheld weather station, at the start of sampling of the plotID on a given eventDate |
| rhEnd | Relative humidity (%) at the end of sampling of the plotID |
| pointID | Relative coordinate of the point within the given plotID (A1 – C3) |
| habitatCode | The dominant habitat surrounding the point |
| startTime | 24-hr format (hhmm; e.g., 0812 or 1432) |
| temperature | The air temperature measured at beginning of each point count with a handheld weather station, in degrees Celsius |
| wind | The average wind speed measured at beginning of each point count with a handheld weather station, in kilometers per hour |
| minute | The minute of sampling within the 6-minute point count sampling period |
| taxonID | Unique 4 character species code, following AOU conventions |
| idqCode | Code expressing the determiner's doubts about the Identification |
| radial distance | Radial distance between the observer and the bird(s), in meters |
| how | How the bird(s) is (are) **first** detected by the observer |
| visual | Whether the bird(s) was (were) seen after the initial detection (Y or N) |
| sex | M = male; F = Female; U = Unknown |
| clusterSize | Clusters consist of either flocks or paired birds of the same species observed together; the size of the cluster is simply the count of individuals. |
| clusterCode | Clusters consist of either flocks or paired birds of the same species observed together; alphabetic codes (A:Z) are used to link clusters that span multiple records. |
| remarks | Technician notes; free-form |

| NEON BIRD POINT COUNT DATASHEET (VER. 11/30/2013) | | Page: of: | |
|---|---|---|---|
| EventDate (YYYYMMDD): 20110618 | PlotID: CPER_005 | START: CLOUDS (%): 80 | RH (%): 23 |
| RecordedBy: Josephine A. Schmoe | | END: CLOUDS (%): 0 | RH (%): 12 |

HOW : V = Visual | S = Singing | C = Calling | D = Drumming | O = Other | F = Flyover | SEX: M = Male | F = Female | U = Unk

idQ: CS = cf. species; AS = aff. species; CB = cf. subspecies; AB = aff. subspecies [cf. ≈ not sure about; aff. ≈ Similar to, but is not]

HABITATS: MX = mixed; CE = Closed Evergreen; OE = Open Evgr; GR = grassland; SH = shrubland; MD = meadow; RP = riparian

| | PointID | Habitat Code | Start Time (24 Hr) | Temp (°C) | Wind (kph) | Minute | TaxonID | idQ | Radial Distance (m) | How | Visual | Sex | CLUSTER Size | CLUSTER Code | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | GR | 5:00 | 63 | 1.6 | 1 | HOLA | | 071 | S | | M | | | 1 |
| 2 | | | | | | | LISP | | 122 | S | | M | | | 2 |
| 3 | | | | | | 2 | STJA | | 036 | C | | U | | | 3 |
| 4 | | | | | | 3 | MOCH | | 184 | C | | U | 2 | | 4 |
| 5 | | | | | | 4 | AMPI | | 046 | C | | U | | | 5 |
| 6 | | | | | | 5 | NOBI | | | | | | | | 6 |
| 7 | | | | | | 6 | CORA | | 177 | V | | U | | | 7 |
| 8 | | | | | | | | | | | | | | | 8 |
| 9 | 2 | | 0.2 | 65 | 1.2 | 1 | DEJU | | 040 | S | | M | 1 | A | 9 |
| 10 | | | | | | | DEJU | | 041 | V | | U | 1 | A | 10 |
| 11 | | | | | | | YRWA | | 133 | C, S | | M | | | 11 |
| 12 | | | | | | 2 | NOBI | | | | | | | | 12 |
| 13 | | | | | | 3 | AMRO | | | F | | U | 3 | | 13 |
| 14 | | | | | | 4 | HAWO | | 028 | O | | M | | | 14 |
| 15 | | | | | | | MOCH | | 108 | C | | U | | | 15 |
| 16 | | | | | | | MOCH | | 122 | C | | U | | | 16 |
| 17 | | | | | | 5 | NOBI | | | | | | | | 17 |
| 18 | | | | | | 6 | RWBL | | 076 | V | | U | 34 | | 18 |
| 19 | | | | | | | DEJU | | 101 | S | | M | 1 | B | 19 |
| 20 | | | | | | | DEJU | | 102 | V | | U | 1 | B | 20 |
| 21 | | | | | | | | | | | | | | | 21 |
| 22 | 88 | | 0.2 | | | | BRCR | | | S | | U | | | 22 |

## APPENDIX B CHECKLISTS

### REQUIRED TASK CHECKLIST BEFORE AND AFTER CONDUCTING BIRD SURVEYS

*Complete this checklist before and after EACH field sampling event*

| | |
|---|---|
| **Binoculars cleaned and checked to make sure they are in good working condition** | ☐ |
| **Batteries for the laser rangefinder checked and charged if necessary** | ☐ |
| **Batteries for the GPS unit checked and charged if necessary** | ☐ |
| **Appropriate declination is set on the compasses** | ☐ |
| **Print datasheets for next sampling event** | ☐ |
| **Double-check completed datasheets to ensure thoroughness** | ☐ |
| **File completed datasheets in designated safe place for subsequent scanning and data entry** | ☐ |

**EQUIPMENT FOR CONDUCTING BIRD SURVEYS**

*Complete this checklist for each team member prior to EACH field sampling event*

| Item Description | Crew #1 | Crew #2 | Crew #3 | Crew #4 |
|---|---|---|---|---|
| 10 × 40 binoculars | ☐ | ☐ | ☐ | ☐ |
| GPS | ☐ | ☐ | ☐ | ☐ |
| Laser rangefinder | ☐ | ☐ | ☐ | ☐ |
| Sibley Field Guide to Birds | ☐ | ☐ | ☐ | ☐ |
| Datasheets | ☐ | ☐ | ☐ | ☐ |
| Declination adjustable compass w/ mirror sight | ☐ | ☐ | ☐ | ☐ |
| Countdown timer w/ chime | ☐ | ☐ | ☐ | ☐ |
| Master list of 4-letter species codes | ☐ | ☐ | ☐ | ☐ |
| Kestrel (temp & wind measurements) | ☐ | ☐ | ☐ | ☐ |

## APPENDIX C PROTOCOL CHANGE SUMMARY

The following changes to SOPs have been made between Rev B and Rev C protocols:

- Specification that sites that can accommodate grids are sampled only once per season, while sites that are too small to accommodate grids will have points that are to be sampled twice a season
- Changed sampling window specifications (see section 9.2):
- At sites that can accommodate the minimum of five 9-point grids, points within each grid are sampled once per season. At these sites, the sampling window must span a minimum of 5 days (i.e., all grids at a site should not be sampled on the same day) and a maximum of 14 days. For example, at a site with 15 grids,three grids could be sampled on each of 5 consecutive days or eight grids could be sampled on day 1 and the remaining seven on day 5 or day 14, etc. . At sites that cannot accommodate the minimum of five 9-point grids, points are sampled twice within a season. At these smaller sites, points should be sampled with a minimum of 7 days between sampling bouts and no longer than 21 days (see Table 1 above). Moved datasheet to separate change-controlled document
- SOP B: Modified datasheet to reflect the changes made to metadata recording:
  - Date (YYYY-MM-DD) and plot ID (SITE_XXX) should be filled out on every datasheet.
  - Start and ending cloud cover (%) and relative humidity (%) need to be completed only once per plot ID per date.
- SOP B: Removed '88' bird list and relaxed recording requirements for rare species. Protocol changed to:
  - If you see a rare or unexpected bird after the count period has elapsed, you may record this species on the datasheet, entering '88' as the point ID.
- SOP B: added identification qualifier to recorded data fields
- SOP B: added explicit instructions on when to take photographs
- Lumped site-specific information into one appendix

## APPENDIX D UNKNOWN BIRD CODES

If you detect a bird that you are unable to identify, use the appropriate unknown bird code (below). Never guess on the identity of a bird. This is falsifying data. If you are unsure, record UNBI rather than incorrectly identifying a bird. However, recording a lot of unidentified birds is an indication that you need to study up and practice before performing more point counts.

| Bird Type | Code |
|---|---|
| Unknown Accipiter | UNAC |
| Unknown Bird | UNBI |
| Unknown Blackbird | UNBL |
| Unknown Buteo | UNBU |
| Unknown Chickadee | UNCH |
| Unknown Corvid | UNCO |
| Unknown Dove | UNDO |
| Unknown Duck | UNDU |
| Unknown Empidonax | UNEM |
| Unknown Falcon | UNFA |
| Unknown Finch | UNFI |
| Unknown Flycatcher | UNFL |
| Unknown Gnatcatcher | UNGN |
| Unknown Grouse | UNGR |
| Unknown Gull | UNGU |
| Unknown Hawk | UNHA |
| Unknown Hummingbird | UNHU |
| Unknown Jay | UNJA |
| Unknown Nuthatch | UNNU |
| Unknown Oriole | UNOR |
| Unknown Owl | UNOW |
| Unknown Pipit | UNPI |
| Unknown Raptor | UNRA |
| Unknown Sparrow | UNSP |
| Unknown Swallow | UNSW |
| Unknown Swift | UNSI |
| Unknown Tanager | UNTA |
| Unknown Thrush | UNTH |
| Unknown Thrasher | UNTR |
| Unknown Vireo | UNVI |
| Unknown Warbler | UNWA |
| Unknown Woodpecker | UNWO |
| Unknown Wren | UNWR |

## APPENDIX E CLUSTER INFORMATION

Clusters consist of either flocks or paired birds – i.e., birds of the same species observed together (foraging, flying, perching, or obviously interacting with each other). Two males of the same species singing 20 meters apart do NOT constitute a cluster.

How to record clusters:

**Flocks:** When two or more individuals of the same species are obviously in a flock and cannot be readily sexed (e.g. Cliff Swallow or Pine Siskin), record the distance to the center of the flock and record the number of individuals in the "Cluster Size" column of your data form. You do not need to enter a Cluster Code. When you can determine sex, enter the number of males on one line, and the number of females on the next line, with the appropriate number of each sex in the corresponding "Cluster Size" boxes.

Then enter the same letter on both lines for the "Cluster Code" (a, b, c …). The Cluster Code is only used to link clusters that take up multiple lines on the data sheet.

**Pairs:** Often you may hear a bird singing or calling, look up, and see that it is a male bird with a female perched or foraging nearby. Or you may see one individual moving about, raise your binoculars to identify it, and observe that there are actually two individuals of the same species but opposite sex in that location. In these cases, enter the male and female on separate lines of your data form, with the appropriate codes for "HOW" detected. In the first scenario, the male "HOW" = S(inging) and the female "HOW" = V(isual). In the second scenario, "HOW" = V(isual) for both the male and female. In both cases enter the same letter for the "Cluster Code" of each member of the pair.

## APPENDIX F SITE-SPECIFIC INFORMATION

### D01 – CORE - HARV (Harvard Forest)

**Recommended Sampling Window**: June 1 - June 30

**Recommended Daily Sampling Period**: 20 minutes after official sunrise - 10:30 AM

**Source**: Rocky Mountain Bird Observatory

**Species Lists**:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the route that passes east of Petersham, MA (Route 900 – Ware River) – in descending order. Source: (Sauer et al. 2011).

| Species | Mean RA | Year_start | Year_end |
|---|---|---|---|
| *Seiurus aurocapilla* | 0.105 | 1993 | 2011 |
| *Vireo olivaceus* | 0.073 | 1993 | 2011 |
| *Turdus migratorius* | 0.051 | 1993 | 2011 |
| *Catharus fuscescens* | 0.042 | 1993 | 2011 |
| *Cyanocitta cristata* | 0.041 | 1993 | 2011 |
| *Zenaida macroura* | 0.036 | 1993 | 2011 |
| *Corvus brachyrhynchos* | 0.035 | 1993 | 2011 |
| *Vireo solitarius* | 0.031 | 1993 | 2011 |
| *Piranga olivacea* | 0.030 | 1993 | 2011 |
| *Bombycilla cedrorum* | 0.028 | 1993 | 2011 |
| *Tachycineta bicolor* | 0.027 | 1993 | 2011 |
| *Branta canadensis* | 0.027 | 1994 | 2011 |
| *Agelaius phoeniceus* | 0.026 | 1993 | 2011 |
| *Setophaga pensylvanica* | 0.024 | 1993 | 2011 |
| *Geothlypis trichas* | 0.024 | 1993 | 2011 |
| *Poecile atricapillus* | 0.021 | 1993 | 2011 |
| *Dumetella carolinensis* | 0.020 | 1993 | 2011 |
| *Spizella passerina* | 0.019 | 1993 | 2011 |
| *Baeolophus bicolor* | 0.019 | 1993 | 2011 |
| *Molothrus ater* | 0.017 | 1993 | 2011 |
| *Stelgidopteryx serripennis* | 0.016 | 1994 | 2005 |
| *Sturnus vulgaris* | 0.016 | 1993 | 2008 |

| Species | Mean RA | Year_start | Year_end |
|---|---|---|---|
| *Pheucticus ludovicianus* | 0.016 | 1993 | 2011 |
| *Quiscalus quiscula* | 0.015 | 1993 | 2011 |
| *Hirundo rustica* | 0.014 | 1993 | 2011 |
| *Catharus guttatus* | 0.014 | 1993 | 2011 |
| *Empidonax minimus* | 0.013 | 1993 | 2010 |
| *Spinus tristis* | 0.013 | 1993 | 2010 |
| *Icterus galbula* | 0.012 | 1993 | 2011 |
| *Setophaga virens* | 0.012 | 1993 | 2011 |
| *Hylocichla mustelina* | 0.012 | 1993 | 2011 |
| *Pipilo erythrophthalmus* | 0.011 | 1993 | 2011 |
| *Mniotilta varia* | 0.011 | 1993 | 2011 |
| *Setophaga petechia* | 0.011 | 1993 | 2011 |
| *Sitta carolinensis* | 0.010 | 1993 | 2011 |
| *Setophaga ruticilla* | 0.010 | 1993 | 2011 |
| *Setophaga pinus* | 0.010 | 1993 | 2011 |
| *Melospiza melodia* | 0.009 | 1993 | 2011 |
| *Riparia riparia* | 0.008 | 1993 | 1999 |
| *Sayornis phoebe* | 0.008 | 1993 | 2011 |
| *Cathartes aura* | 0.008 | 1995 | 2011 |
| *Setophaga coronata* | 0.008 | 1993 | 2011 |
| *Tyrannus tyrannus* | 0.008 | 1993 | 2010 |
| *Myiarchus crinitus* | 0.008 | 1993 | 2011 |
| *Chaetura pelagica* | 0.007 | 1994 | 2005 |
| *Picoides villosus* | 0.007 | 1993 | 2011 |
| *Contopus virens* | 0.007 | 1993 | 2011 |
| *Sitta canadensis* | 0.007 | 1993 | 2011 |
| *Setophaga caerulescens* | 0.006 | 1993 | 2010 |
| *Carpodacus mexicanus* | 0.006 | 1993 | 2002 |
| *Corvus corax* | 0.006 | 1994 | 2011 |
| *Anas platyrhynchos* | 0.006 | 1993 | 2010 |
| *Troglodytes hiemalis* | 0.006 | 1993 | 2005 |
| *Cardinalis cardinalis* | 0.006 | 1993 | 2011 |
| *Dolichonyx oryzivorus* | 0.006 | 1993 | 2011 |
| *Picoides pubescens* | 0.005 | 1993 | 2011 |
| *Troglodytes aedon* | 0.005 | 1993 | 2011 |

| Species | Mean RA | Year_start | Year_end |
|---|---|---|---|
| *Vermivora cyanoptera* | 0.005 | 1993 | 2011 |
| *Dryocopus pileatus* | 0.005 | 1993 | 2011 |
| *Coccyzus erythropthalmus* | 0.005 | 1995 | 2009 |
| *Setophaga fusca* | 0.004 | 1994 | 2011 |
| *Archilochus colubris* | 0.004 | 1993 | 2011 |
| *Zonotrichia albicollis* | 0.004 | 1993 | 2010 |
| *Passer domesticus* | 0.004 | 1993 | 2008 |
| *Polioptila caerulea* | 0.004 | 1997 | 2002 |
| *Mimus polyglottos* | 0.004 | 1993 | 1993 |
| *Colaptes auratus* | 0.004 | 1993 | 2005 |
| *Setophaga discolor* | 0.004 | 1993 | 2010 |
| *Coccothraustes vespertinus* | 0.004 | 1995 | 2002 |
| *Charadrius vociferus* | 0.004 | 1994 | 2011 |
| *Sialia sialis* | 0.004 | 1993 | 2011 |
| *Meleagris gallopavo* | 0.004 | 1996 | 2011 |
| *Strix varia* | 0.004 | 1993 | 2010 |
| *Passerina cyanea* | 0.003 | 1993 | 2011 |
| *Sphyrapicus varius* | 0.003 | 2003 | 2011 |
| *Carpodacus purpureus* | 0.003 | 1993 | 2010 |
| *Ardea herodias* | 0.003 | 1994 | 2010 |
| *Parkesia noveboracensis* | 0.003 | 1993 | 2006 |
| *Bonasa umbellus* | 0.003 | 1994 | 2010 |
| *Scolopax minor* | 0.003 | 2003 | 2003 |
| *Megaceryle alcyon* | 0.003 | 1998 | 1998 |
| *Empidonax alnorum* | 0.003 | 1993 | 2006 |
| *Columba livia* | 0.003 | 1997 | 1997 |
| *Vireo flavifrons* | 0.003 | 1995 | 2004 |
| *Cardellina canadensis* | 0.003 | 1996 | 2009 |
| *Aix sponsa* | 0.003 | 1999 | 2003 |
| *Setophaga magnolia* | 0.003 | 1994 | 2004 |
| *Certhia americana* | 0.003 | 1993 | 2008 |
| *Spizella pusilla* | 0.003 | 1993 | 2008 |
| *Buteo platypterus* | 0.003 | 1993 | 2009 |
| *Melospiza georgiana* | 0.002 | 1993 | 2009 |
| *Buteo lineatus* | 0.002 | 1993 | 1998 |

| Species | Mean RA | Year_start | Year_end |
|---|---|---|---|
| *Accipiter cooperii* | 0.002 | 1995 | 2003 |
| *Empidonax traillii* | 0.002 | 1993 | 1993 |
| *Oreothlypis ruficapilla* | 0.002 | 1993 | 1993 |
| *Vermivora chrysoptera x cyanoptera* | 0.002 | 1994 | 1994 |
| *Botaurus lentiginosus* | 0.002 | 1994 | 1994 |
| *Larus argentatus* | 0.002 | 1995 | 1995 |
| *Falco sparverius* | 0.002 | 1995 | 1995 |
| *Junco hyemalis* | 0.002 | 1995 | 1995 |

### D10 – CORE – CPER (Central Plains Experimental Range)

**Recommended Sampling Window**: May 10 - June 15

**Recommended Daily Sampling Period**: official sunrise - 10:30 AM

***Source***: Rocky Mountain Bird Observatory

**Species Lists**:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the route that passes through CPER (Route 901 – Rockport) – in descending order. Source: (Sauer et al. 2011).

| Species | Mean RA | Year_start | Year_end |
|---|---|---|---|
| *Calamospiza melanocorys* | 0.348 | 1994 | 2010 |
| *Eremophila alpestris* | 0.187 | 1994 | 2010 |
| *Sturnella neglecta* | 0.170 | 1994 | 2010 |
| *Rhynchophanes mccownii* | 0.102 | 1994 | 2010 |
| *Spizella breweri* | 0.023 | 1994 | 2010 |
| *Sturnus vulgaris* | 0.018 | 1994 | 2010 |
| *Tyrannus verticalis* | 0.018 | 1994 | 2010 |
| *Peucaea cassinii* | 0.015 | 1996 | 2010 |
| *Lanius ludovicianus* | 0.012 | 1995 | 2010 |
| *Petrochelidon pyrrhonota* | 0.010 | 1999 | 2010 |
| *Buteo swainsoni* | 0.010 | 1994 | 2010 |
| *Hirundo rustica* | 0.009 | 1994 | 2010 |
| *Chordeiles minor* | 0.008 | 1994 | 2010 |
| *Calcarius ornatus* | 0.006 | 1994 | 2010 |

| **Species** | **Mean RA** | **Year_start** | **Year_end** |
|---|---|---|---|
| *Falco sparverius* | 0.006 | 2004 | 2005 |
| *Sayornis saya* | 0.005 | 1994 | 2010 |
| *Buteo jamaicensis* | 0.005 | 1994 | 2009 |
| *Chondestes grammacus* | 0.004 | 2008 | 2008 |
| *Mimus polyglottos* | 0.004 | 1994 | 2010 |
| *Columba livia* | 0.004 | 2009 | 2009 |
| *Agelaius phoeniceus* | 0.004 | 1994 | 2004 |
| *Buteo regalis* | 0.004 | 1994 | 2010 |
| *Turdus migratorius* | 0.003 | 1996 | 2010 |
| *Quiscalus quiscula* | 0.003 | 1995 | 2010 |
| *Ammodramus savannarum* | 0.003 | 1996 | 2010 |
| *Passer domesticus* | 0.003 | 1994 | 2008 |
| *Stelgidopteryx serripennis* | 0.003 | 2000 | 2008 |
| *Charadrius vociferus* | 0.003 | 1994 | 2009 |
| *Athene cunicularia* | 0.002 | 1994 | 2010 |
| *Charadrius montanus* | 0.002 | 2002 | 2005 |
| *Carpodacus mexicanus* | 0.002 | 1995 | 2002 |
| *Contopus sordidulus* | 0.002 | 1998 | 2007 |
| *Circus cyaneus* | 0.002 | 1996 | 2007 |
| *Oreoscoptes montanus* | 0.002 | 1994 | 2004 |
| *Anas clypeata* | 0.002 | 2000 | 2000 |
| *Aquila chrysaetos* | 0.002 | 1996 | 2010 |
| *Recurvirostra americana* | 0.002 | 2003 | 2005 |
| *Tyrannus tyrannus* | 0.002 | 1998 | 2009 |
| *Molothrus ater* | 0.002 | 1994 | 2009 |
| *Icterus bullockii* | 0.002 | 2001 | 2010 |
| *Falco mexicanus* | 0.001 | 2000 | 2010 |
| *Euphagus cyanocephalus* | 0.001 | 2009 | 2009 |

## D10 – RELOCATABLE – STER (Sterling)

**Recommended Sampling Window**: May 10 - June 15

**Recommended Daily Sampling Period**: official sunrise - 10:30 AM

***Source***: Rocky Mountain Bird Observatory

**Species Lists**:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the route that passes approximately 15 miles north of the site (Route 7 – Fleming) – in descending order. Source: (Sauer et al. 2011).

| Species | Mean RA | Year_start | Year_end |
|---|---|---|---|
| *Eremophila alpestris* | 0.195 | 1968 | 2011 |
| *Passer domesticus* | 0.151 | 1968 | 2011 |
| *Sturnella neglecta* | 0.128 | 1968 | 2011 |
| *Calamospiza melanocorys* | 0.099 | 1968 | 2011 |
| *Zenaida macroura* | 0.093 | 1968 | 2011 |
| *Phasianus colchicus* | 0.075 | 1968 | 2011 |
| *Agelaius phoeniceus* | 0.059 | 1968 | 2011 |
| *Ammodramus savannarum* | 0.040 | 1968 | 2011 |
| *Quiscalus quiscula* | 0.031 | 1968 | 2011 |
| *Tyrannus verticalis* | 0.027 | 1968 | 2011 |
| *Sturnus vulgaris* | 0.016 | 1968 | 2011 |
| *Anas platyrhynchos* | 0.012 | 1968 | 2011 |
| *Hirundo rustica* | 0.011 | 1968 | 2011 |
| *Molothrus ater* | 0.009 | 1990 | 2011 |
| *Turdus migratorius* | 0.009 | 1968 | 2011 |
| *Quiscalus mexicanus* | 0.009 | 2005 | 2011 |
| *Corvus brachyrhynchos* | 0.008 | 1968 | 1999 |
| *Colinus virginianus* | 0.007 | 1973 | 2003 |
| *Charadrius vociferus* | 0.007 | 1968 | 2011 |
| *Branta canadensis* | 0.007 | 1975 | 2005 |
| *Carpodacus mexicanus* | 0.007 | 1969 | 2006 |
| *Columba livia* | 0.006 | 1968 | 2006 |
| *Bartramia longicauda* | 0.006 | 2006 | 2006 |
| *Pica hudsonia* | 0.005 | 1968 | 2006 |

| Species | Mean RA | Year_start | Year_end |
|---|---|---|---|
| *Streptopelia decaocto* | 0.004 | 2005 | 2011 |
| *Athene cunicularia* | 0.004 | 1968 | 2006 |
| *Lanius ludovicianus* | 0.004 | 1968 | 2011 |
| *Passerina amoena* | 0.004 | 1980 | 2011 |
| *Buteo swainsoni* | 0.004 | 1973 | 2006 |
| *Chaetura pelagica* | 0.004 | 1968 | 2011 |
| *Actitis macularius* | 0.003 | 2006 | 2006 |
| *Tyrannus tyrannus* | 0.003 | 1968 | 2006 |
| *Circus cyaneus* | 0.003 | 1968 | 2006 |
| *Aix sponsa* | 0.002 | 1977 | 2005 |
| *Larus delawarensis* | 0.002 | 1991 | 1991 |
| *Ardea herodias* | 0.002 | 1992 | 2003 |
| *Phalaropus tricolor* | 0.002 | 1987 | 1987 |
| *Falco sparverius* | 0.002 | 1969 | 2011 |
| *Colaptes auratus* | 0.002 | 1980 | 2006 |
| *Picoides pubescens* | 0.002 | 2006 | 2006 |
| *Asio flammeus* | 0.002 | 1980 | 2006 |
| *Anas crecca* | 0.002 | 1973 | 2003 |
| *Peucaea cassinii* | 0.002 | 1990 | 1991 |
| *Buteo regalis* | 0.002 | 1999 | 2004 |
| *Spiza americana* | 0.002 | 1977 | 2011 |
| *Anas discors* | 0.002 | 1973 | 2003 |
| *Buteo jamaicensis* | 0.002 | 1968 | 2011 |
| *Anas strepera* | 0.002 | 1968 | 1985 |
| *Chondestes grammacus* | 0.002 | 1968 | 2005 |
| *Falco mexicanus* | 0.002 | 1981 | 2003 |
| *Anas acuta* | 0.002 | 1977 | 2003 |
| *Icterus bullockii* | 0.002 | 1980 | 2006 |
| *Oxyura jamaicensis* | 0.002 | 1977 | 1977 |
| *Numenius americanus* | 0.002 | 1977 | 1977 |
| *Mimus polyglottos* | 0.002 | 1970 | 2005 |
| *Anas clypeata* | 0.002 | 1973 | 1988 |
| *Toxostoma rufum* | 0.001 | 1968 | 2005 |
| *Cyanocitta cristata* | 0.001 | 1972 | 2011 |
| *Bubo virginianus* | 0.001 | 1977 | 2005 |

| Species | Mean RA | Year_start | Year_end |
|---|---|---|---|
| *Recurvirostra americana* | 0.001 | 1973 | 1988 |
| *Sialia sialis* | 0.001 | 1970 | 2003 |
| *Chordeiles minor* | 0.001 | 1984 | 1988 |
| *Melanerpes erythrocephalus* | 0.001 | 2006 | 2006 |
| *Vireo gilvus* | 0.001 | 2006 | 2006 |
| *Icterus spurius* | 0.001 | 1988 | 2005 |
| *Sayornis saya* | 0.001 | 1991 | 1991 |
| *Aythya americana* | 0.001 | 1977 | 1977 |
| *Icterus bullockii / galbula* | 0.001 | 1987 | 1987 |
| *Trochilid rufus / sasin* | 0.001 | 1983 | 1983 |
| *Accipiter cooperii* | 0.001 | 1969 | 1969 |

### D10 – RELOCATABLE – RMNP (Rocky Mountain National Park)

**Recommended Sampling Window**: June 5 - June 30

**Recommended Daily Sampling Period**: official sunrise - 10:30 AM

***Source***: Rocky Mountain Bird Observatory

**Species Lists**:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the route that passes through RMNP (Route 904 – Trail Ridge Road) – in descending order. Source: (Sauer et al. 2011).

| Species | Mean RA | Year_start | Year_end |
|---|---|---|---|
| *Regulus calendula* | 0.090 | 2003 | 2011 |
| *Anthus rubescens* | 0.073 | 2003 | 2011 |
| *Selasphorus platycercus* | 0.070 | 2003 | 2011 |
| *Eremophila alpestris* | 0.068 | 2003 | 2011 |
| *Turdus migratorius* | 0.063 | 2003 | 2011 |
| *Catharus guttatus* | 0.053 | 2003 | 2011 |
| *Tachycineta thalassina* | 0.050 | 2003 | 2011 |
| *Corvus corax* | 0.043 | 2003 | 2011 |
| *Zonotrichia leucophrys* | 0.038 | 2003 | 2011 |
| *Setophaga coronata* | 0.038 | 2003 | 2011 |
| *Junco hyemalis* | 0.029 | 2003 | 2011 |

| Species | Mean RA | Year_start | Year_end |
|---|---|---|---|
| *Nucifraga columbiana* | 0.028 | 2003 | 2011 |
| *Pipilo chlorurus* | 0.027 | 2005 | 2011 |
| *Tachycineta bicolor* | 0.026 | 2003 | 2011 |
| *Pica hudsonia* | 0.025 | 2003 | 2011 |
| *Corvus brachyrhynchos* | 0.022 | 2004 | 2011 |
| *Hirundo rustica* | 0.018 | 2004 | 2011 |
| *Loxia curvirostra* | 0.017 | 2004 | 2011 |
| *Cyanocitta stelleri* | 0.017 | 2003 | 2011 |
| *Spinus pinus* | 0.017 | 2006 | 2007 |
| *Melospiza lincolnii* | 0.017 | 2003 | 2011 |
| *Pinicola enucleator* | 0.017 | 2004 | 2011 |
| *Myadestes townsendi* | 0.017 | 2003 | 2007 |
| *Leucosticte australis* | 0.016 | 2011 | 2011 |
| *Poecile gambeli* | 0.016 | 2003 | 2011 |
| *Carpodacus mexicanus* | 0.015 | 2005 | 2011 |
| *Zenaida macroura* | 0.015 | 2004 | 2006 |
| *Stelgidopteryx serripennis* | 0.015 | 2003 | 2003 |
| *Spizella passerina* | 0.015 | 2003 | 2007 |
| *Sitta carolinensis* | 0.014 | 2007 | 2007 |
| *Carpodacus cassinii* | 0.014 | 2003 | 2011 |
| *Vireo gilvus* | 0.013 | 2003 | 2011 |
| *Anas platyrhynchos* | 0.013 | 2003 | 2006 |
| *Petrochelidon pyrrhonota* | 0.012 | 2005 | 2007 |
| *Sitta canadensis* | 0.012 | 2003 | 2007 |
| *Molothrus ater* | 0.011 | 2003 | 2004 |
| *Pooecetes gramineus* | 0.011 | 2011 | 2011 |
| *Colaptes auratus* | 0.011 | 2004 | 2007 |
| *Sialia currucoides* | 0.010 | 2003 | 2007 |
| *Troglodytes aedon* | 0.010 | 2003 | 2007 |
| *Empidonax occidentalis* | 0.010 | 2003 | 2011 |
| *Euphagus cyanocephalus* | 0.010 | 2007 | 2007 |
| *Perisoreus canadensis* | 0.010 | 2004 | 2007 |
| *Oreothlypis celata* | 0.009 | 2003 | 2004 |
| *Patagioenas fasciata* | 0.009 | 2004 | 2005 |
| *Lagopus leucura* | 0.009 | 2003 | 2011 |

| Species | Mean RA | Year_start | Year_end |
|---|---|---|---|
| *Agelaius phoeniceus* | 0.009 | 2004 | 2004 |
| *Columba livia* | 0.008 | 2006 | 2011 |
| *Melospiza melodia* | 0.007 | 2003 | 2007 |
| *Cardellina pusilla* | 0.007 | 2003 | 2007 |
| *Salpinctes obsoletus* | 0.007 | 2005 | 2007 |
| *Cathartes aura* | 0.007 | 2005 | 2005 |
| *Setophaga petechia* | 0.007 | 2005 | 2005 |
| *Pheucticus melanocephalus* | 0.006 | 2003 | 2007 |
| *Actitis macularius* | 0.006 | 2003 | 2005 |
| *Buteo jamaicensis* | 0.006 | 2005 | 2007 |
| *Vireo plumbeus* | 0.006 | 2003 | 2011 |
| *Geothlypis tolmiei* | 0.005 | 2004 | 2005 |
| *Sphyrapicus varius / nuchalis / ruber* | 0.005 | 2011 | 2011 |
| *Piranga ludoviciana* | 0.005 | 2003 | 2011 |
| *Anas crecca* | 0.005 | 2006 | 2006 |
| *Cinclus mexicanus* | 0.005 | 2003 | 2006 |
| *Glaucidium gnoma* | 0.005 | 2006 | 2007 |
| *Sturnus vulgaris* | 0.005 | 2007 | 2007 |
| *Contopus sordidulus* | 0.005 | 2003 | 2007 |
| *Empidonax hammondii* | 0.005 | 2003 | 2004 |
| *Empidonax oberholseri* | 0.005 | 2003 | 2004 |
| *Lanius ludovicianus* | 0.004 | 2004 | 2004 |
| *Megaceryle alcyon* | 0.004 | 2004 | 2004 |