TOS PROTOCOL AND PROCEDURE:
BREEDING LANDBIRD ABUNDANCE AND DIVERSITY

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<th>DATE</th>
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<td>Jennifer DeNicholas</td>
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See configuration management system for approval history.
## Change Record

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<td>ECO-00280</td>
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<td>01/13/2014</td>
<td>ECO-01140</td>
<td>Draft release. Will be finalized in next rev.</td>
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<td>03/17/2014</td>
<td>ECO-01667</td>
<td>Production release, template change, and other changes as detailed in Appendix C (rev C only)</td>
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<td>04/10/2014</td>
<td>ECO-01792</td>
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<td>Migration to new protocol template</td>
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<td>F</td>
<td>03/16/2015</td>
<td>ECO-02653</td>
<td>Added site-specific appendices for new sites</td>
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# TOS Protocol and Procedure: Breeding Landbird Abundance and Diversity

**Title:** TOS Protocol and Procedure: Breeding Landbird Abundance and Diversity  
**Date:** 03/16/2015  
**NEON Doc. #:** NEON.DOC.014041  
**Author:** K. Thibault  
**Revision:** F

## TABLE OF CONTENTS

1 **OVERVIEW** ................................................................................................................................. 1  
1.1 Background ................................................................................................................................... 1  
1.2 Scope ............................................................................................................................................. 3  
1.2.1 NEON Science Requirements and Data Products ................................................................. 3  
1.3 Acknowledgments ......................................................................................................................... 3  

2 **RELATED DOCUMENTS AND ACRONYMS** ..................................................................................... 4  
2.1 Applicable Documents .................................................................................................................. 4  
2.2 Reference Documents ................................................................................................................... 4  
2.3 Acronyms ...................................................................................................................................... 4  
2.4 Definitions ..................................................................................................................................... 4  

3 **METHOD** .................................................................................................................................... 5  
3.1 Point count method ...................................................................................................................... 5  
3.2 Spatial distribution of point counts .............................................................................................. 5  
3.3 Timing of point counts .................................................................................................................. 6  

4 **SAMPLING SCHEDULE** ................................................................................................................. 7  
4.1 Sampling Frequency and Timing ................................................................................................... 7  
4.2 Criteria for Determining Onset and Cessation of Sampling .......................................................... 8  
4.3 Timing for Laboratory Processing and Analysis ............................................................................ 8  
4.4 Sampling Timing Contingencies .................................................................................................... 8  

5 **SAFETY** ....................................................................................................................................... 9  

6 **PERSONNEL AND EQUIPMENT** ................................................................................................. 10  
6.1 Equipment ................................................................................................................................... 10  
6.2 Training Requirements ................................................................................................................ 12  
6.3 Specialized Skills .......................................................................................................................... 12  
6.4 Estimated Time ........................................................................................................................... 13  

7 **STANDARD OPERATING PROCEDURES** ...................................................................................... 14  
SOP A PREPARING FOR SAMPLING ............................................................................................... 14  
SOP B FIELD SAMPLING ................................................................................................................. 15  
SOP C EQUIPMENT MAINTENANCE: CLEANING AND STORAGE .................................................... 18
LIST OF TABLES AND FIGURES

Table 1. Summary of temporal and spatial sampling design ................................................................. 6
Table 2. Contingent decisions .................................................................................................................. 9
Table 3. Equipment list – Field sampling ............................................................................................... 10
Table 4. Codes for identification qualifier entries ............................................................................... 15
Table 5. Datasheets associated with this protocol ................................................................................ 23

Figure 1. Schematic depicting the point count method of sampling birds ............................................. 2
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 may also be sampled ...................................................................................................................... 5
1 Overview

1.1 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.
1.2 Scope

This document provides a change-controlled version of Observatory protocols and procedures. Documentation of content changes (i.e. changes in particular tasks or safety practices) will occur via this change-controlled document, not through field manuals or training materials.

1.2.1 NEON Science Requirements and Data Products

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.

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[03]).

1.3 Acknowledgments

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 (Richard Chandler, Tom Gardali, Allen Hurlbert, Ken Pollock, Kathryn Purcell, Ted Simons, Susan Skagen).

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).
2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

Applicable documents contain higher-level information that is implemented in the current document. Examples include designs, plans, or standards.

| 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 |
| AD[06] | NEON.DOC.000916 | TOS Science Design for Breeding Landbird Abundance and Diversity |
| AD[07] | NEON.DOC.014051 | Field Audit Plan |
| AD[08] | NEON.DOC.000824 | Data and Data Product Quality Assurance and Control Plan |

2.2 Reference Documents

Reference documents contain information that supports or complements the current document. Examples include related protocols, datasheets, or general-information references.

| RD[01] | NEON.DOC.000008 | NEON Acronym List |
| RD[02] | NEON.DOC.000243 | NEON Glossary of Terms |
| RD[03] | NEON.DOC.005003 | NEON Scientific Data Products Catalog |
| RD[04] | NEON.DOC.001271 | NEON Protocol and Procedure: Manual Data Transcription |
| RD[05] | NEON.DOC.001584 | Datasheets for TOS Protocol and Procedure: Breeding Landbird Abundance & Diversity |
| RD[06] | NEON.DOC.001407 | Raw Data Ingest Workbook for Breeding Landbird Abundance & Diversity |

2.3 Acronyms

All acronyms used in this document are defined in RD[01].

2.4 Definitions

**Landbird:** (According to Ralph et al. 1993) “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 METHOD

3.1 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.

3.2 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 AD[06] for additional details). To increase efficiency, point counts will be distributed in 9 point 0.56 km² 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 km² 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](image-url). 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 may also be sampled.
### 3.3 Timing of point counts

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. 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

<table>
<thead>
<tr>
<th>Relative site area</th>
<th>Point arrays</th>
<th>Number of arrays</th>
<th>Repeated sampling</th>
<th>Sampling Window</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>9-pt grids</td>
<td>5 - 15</td>
<td>No</td>
<td>≥ 5 days, ≤ 14 days</td>
</tr>
<tr>
<td>Small</td>
<td>Single points</td>
<td>5 - 25</td>
<td>Yes – 2x per season</td>
<td>≥ 7 days, ≤ 21 days</td>
</tr>
</tbody>
</table>

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.). Sampling windows of 2-3 weeks for all sites can be found in the site-specific appendices.

Standard Operating Procedures (SOPs), in Section 7 of this document, provide detailed step-by-step directions, contingency plans, sampling tips, and best practices for implementing this sampling procedure. To properly collect and process samples, field technicians must follow the protocol and associated SOPs.

The value of NEON data hinges on consistent implementation of this protocol across all NEON domains, for the life of the project. It is therefore essential that field personnel carry out this protocol as outlined in this document. In the event that local conditions create uncertainty about carrying out these steps, it is critical that technicians document the problem and communicate it to NEON Headquarters.

The procedures described in this protocol will be audited according to the Field Audit Plan (AD[07]). 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 (AD[08]).

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 NEON Vertebrate 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 B and Appendix C.

4 SAMPLING SCHEDULE

4.1 Sampling Frequency and Timing

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).

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).

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.

4.2 Criteria for Determining Onset and Cessation of Sampling

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.

4.3 Timing for Laboratory Processing and Analysis

There is no lab work or processing associated with this protocol, so no timing details are provided.

4.4 Sampling Timing Contingencies

The procedures associated with this protocol will be audited according to the Field Audit Plan (AD[07]). 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 (AD[08]).

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 2. Contingent decisions

<table>
<thead>
<tr>
<th>Delay/Situation</th>
<th>Action</th>
<th>Outcome for Data Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours</td>
<td>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.</td>
<td>Fewer sampling points could result in less precise estimation of breeding bird species richness, diversity, or density.</td>
</tr>
<tr>
<td>1-7 days</td>
<td>Add additional days of sampling as soon as possible to sample all points.</td>
<td></td>
</tr>
<tr>
<td>8 or more days</td>
<td>Contact NEON Vertebrate Ecologist for guidance.</td>
<td>• Species richness due to changes in seasonal phenology could be influenced by significant changes in temporal sampling window.</td>
</tr>
</tbody>
</table>
<pre><code>                                                    |                                                                                                                      | • Not completing all plots impacts diversity metrics and target sample size.          |
</code></pre>

5 SAFETY

This document identifies procedure-specific safety hazards and associated safety requirements. It does not describe general safety practices or site-specific safety practices.

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]). Additional safety issues associated with this field procedure are outlined below. 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, general safe field work practices should suffice. These include the use of insect repellent in areas with ticks and fleas and ready availability of a field first aid kit.
6 PERSONNEL AND EQUIPMENT

6.1 Equipment

The following equipment is needed to implement the procedures in this document. Equipment lists are organized by task. They do not include standard field and laboratory supplies such as charging stations, first aid kits, drying ovens, ultra-low refrigerators, etc.

Table 3. Equipment list – Field sampling

<p>| Item No.  | R/S | Description                                                                 | Purpose                                               | Quantity | Special Handling |
|-----------|-----|------------------------------------------------------------------------------|                                                      |          |                 |
| Durable items                                           |                                           |                                                      |          |                 |
| MX101642   | R   | Handheld weather meter (maximum, average, and current temperature; +- 1 degree F, humidity +- 3%, and wind speed +- 3%) | Measure temperature, RH, and wind speed               | 1        | N               |
| MX102191   | R   | Binoculars, 10 x 42, Field of View 264 ft. @ 1000 yd                      | Aid in visual identification of birds                 | 1        | N               |
| MX100523   | R   | Stopwatch, with notification chime every minute                           | Time minutes of point count                          | 1        | N               |
| MX104742   | R   | Laser Rangefinder, 1 yard accuracy                                       | Measure distances to observed bird                    | 1        | N               |
| R          |     | The Sibley Guide to Birds                                                 | Aid in visual identification of birds                 | 1        | N               |
| MX100696   | R   | Digital camera, 12 megapixel                                               | Capture images of rare or unknown birds              | 1        | N               |
| MX100703   | R   | GPS receiver, recreational accuracy                                       | Navigate to points                                   | 1        | N               |</p>
<table>
<thead>
<tr>
<th>Item No.</th>
<th>R/S</th>
<th>Description</th>
<th>Purpose</th>
<th>Quantity</th>
<th>Special Handling</th>
</tr>
</thead>
<tbody>
<tr>
<td>MX100320</td>
<td>S</td>
<td>Compass with mirror and declination adjustment</td>
<td>Navigate between points</td>
<td>1</td>
<td>N</td>
</tr>
</tbody>
</table>

**Consumable items**

(No items listed)

R/S=Required/Suggested
6.2 Training Requirements

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

Training for all technicians 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.

6.3 Specialized Skills

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.
6.4 Estimated Time

The time required to implement a protocol will vary depending on a number of factors, such as skill level, system diversity, environmental conditions, and distance between sample plots. The timeframe provided below is an estimate based on completion of a task by a skilled two-person team (i.e., not the time it takes at the beginning of the field season). Use this estimate as framework for assessing progress. If a task is taking significantly longer than the estimated time, a problem ticket should be submitted.

Each point count will last for 6 minutes plus an additional 2-minute settling-in period. Travel time between points will likely average 15 minutes (250 m). If an experienced two-person team travels together to one grid, and then each samples approximately half of the points in the grid:

- Technician 1 – 5 points = within grid travel time of 60 minutes and 40 minutes of sampling
- Technician 2 – 4 points = within grid travel time of 45 minutes and 32 minutes of sampling
- Total time per grid per team of 2 = 100 minutes
- Estimate with inter-grid travel time = 2 grids completed per 2 person team per sampling morning
7  STANDARD OPERATING PROCEDURES

SOP A  Preparing for Sampling

See Appendix B and Appendix C for equipment and task checklists.

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

   Species that often cause problems include:

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

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.
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[05]), but a key to the datasheet can be found in Appendix B.

1. Record the date, plot ID, start cloud cover, and start relative humidity on the Bird point count datasheet (RD[05]).
   a. Date (YYYY-MM-DD) and plot ID (SITE_XXX) should be filled out on every datasheet.
   b. Start and ending cloud cover (%) and relative humidity (%) need to be completed only once per plot ID per date.
   c. 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[05]). These metadata are filled out once for each point at all sites.
   a. DO NOT begin counting until the 2 minutes have passed.
   b. 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[05]).

4. For each independently detected bird, record the following information:
   - The species, using the appropriate 4-letter code (Pyle and DeSante 2012).
     - 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 4). Leave blank if there is no uncertainty.

<table>
<thead>
<tr>
<th>idQ</th>
<th>Identification Qualifier Description*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td>cf. species</td>
</tr>
<tr>
<td>AS</td>
<td>aff. species</td>
</tr>
<tr>
<td>CG</td>
<td>cf. genus</td>
</tr>
<tr>
<td>AG</td>
<td>aff. genus</td>
</tr>
<tr>
<td>CF</td>
<td>cf. family</td>
</tr>
<tr>
<td>AF</td>
<td>aff. family</td>
</tr>
</tbody>
</table>

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

  o 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.

  o 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.

  o 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.

  o Flyovers do not require distance measurements.

  o 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:

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

  o 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 F 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[05]).

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.
B.1 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. 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.
     - 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.
   - Never guess the identity of a bird – If the bird species is unknown, use the table of unknown species codes in Appendix E.
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 C 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[06]). 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 the breeding landbird data ingest workbook (RD[06]).
   b. Follow QA/QC procedures for ensuring accurate transcription of data (RD[04]).
   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[04].

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 NEON Vertebrate 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.
REFERENCES


APPENDIX A   DATASHEETS

The following datasheets are associated with this protocol:

Table 5. Datasheets associated with this protocol

<table>
<thead>
<tr>
<th>NEON Doc. #</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEON.DOC.001584</td>
<td>Datasheets for TOS Protocol and Procedure: Breeding Landbird Abundance &amp; Diversity</td>
</tr>
</tbody>
</table>

These datasheets can be found in Agile or the NEON Document Warehouse.
APPENDIX B QUICK REFERENCES

B.1 Breeding Bird Point Sampling Datasheet

<table>
<thead>
<tr>
<th>Data Field</th>
<th>Description/What to Enter</th>
</tr>
</thead>
<tbody>
<tr>
<td>date</td>
<td>Date that sampling was conducted (YYYYMMDD)</td>
</tr>
<tr>
<td>plotID</td>
<td>Plot identifier (4-character site code _XXX)</td>
</tr>
<tr>
<td>recordedBy</td>
<td>Full name of personnel conducting the point count(s) (First name Last name)</td>
</tr>
<tr>
<td>cloudsStart</td>
<td>Estimate of % cloud cover, at the start of sampling of the plotID</td>
</tr>
<tr>
<td>cloudsEnd</td>
<td>Estimate of % cloud cover, at the end of sampling of the plotID</td>
</tr>
<tr>
<td>rhStart</td>
<td>Relative humidity (%), as measured by handheld weather station, at the start of sampling of the plotID on a given eventDate</td>
</tr>
<tr>
<td>rhEnd</td>
<td>Relative humidity (%) at the end of sampling of the plotID</td>
</tr>
<tr>
<td>pointID</td>
<td>Relative coordinate of the point within the given plotID (A1 – C3)</td>
</tr>
<tr>
<td>habitatCode</td>
<td>The dominant habitat surrounding the point</td>
</tr>
<tr>
<td>startTime</td>
<td>24-hr format (hhmm; e.g., 0812 or 1432)</td>
</tr>
<tr>
<td>temperature</td>
<td>The air temperature measured at beginning of each point count with a handheld weather station, in degrees Celsius</td>
</tr>
<tr>
<td>wind</td>
<td>The average wind speed measured at beginning of each point count with a handheld weather station, in kilometers per hour</td>
</tr>
<tr>
<td>minute</td>
<td>The minute of sampling within the 6-minute point count sampling period</td>
</tr>
<tr>
<td>taxonID</td>
<td>Unique 4 character species code, following AOU conventions</td>
</tr>
<tr>
<td>idqCode</td>
<td>Code expressing the determiner’s doubts about the Identification</td>
</tr>
<tr>
<td>radial distance</td>
<td>Radial distance between the observer and the bird(s), in meters</td>
</tr>
<tr>
<td>how</td>
<td>How the bird(s) is (are) first detected by the observer</td>
</tr>
<tr>
<td>visual</td>
<td>Whether the bird(s) was (were) seen after the initial detection (Y or N)</td>
</tr>
<tr>
<td>sex</td>
<td>M = male; F = Female; U = Unknown</td>
</tr>
<tr>
<td>clusterSize</td>
<td>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.</td>
</tr>
<tr>
<td>clusterCode</td>
<td>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.</td>
</tr>
<tr>
<td>remarks</td>
<td>Technician notes; free-form</td>
</tr>
<tr>
<td>PointID</td>
<td>Habitat Code</td>
</tr>
<tr>
<td>---------</td>
<td>--------------</td>
</tr>
<tr>
<td>1</td>
<td>101</td>
</tr>
<tr>
<td>2</td>
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<tr>
<td>23</td>
<td>101</td>
</tr>
<tr>
<td>24</td>
<td>101</td>
</tr>
</tbody>
</table>
### APPENDIX C  REMINDERS

#### C.1  Required task checklist before and after conducting bird surveys

Complete this checklist before and after EACH field sampling event.

<table>
<thead>
<tr>
<th>Task</th>
<th>completeness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binoculars cleaned and checked to make sure they are in good working condition</td>
<td>□</td>
</tr>
<tr>
<td>Batteries for the laser rangefinder checked and charged if necessary</td>
<td>□</td>
</tr>
<tr>
<td>Batteries for the GPS unit checked and charged if necessary</td>
<td>□</td>
</tr>
<tr>
<td>Appropriate declination is set on the compasses</td>
<td>□</td>
</tr>
<tr>
<td>Print datasheets for next sampling event</td>
<td>□</td>
</tr>
<tr>
<td>Double-check completed datasheets to ensure thoroughness</td>
<td>□</td>
</tr>
<tr>
<td>File completed datasheets in designated safe place for subsequent scanning and data entry</td>
<td>□</td>
</tr>
</tbody>
</table>
## C.2 Equipment for conducting bird surveys

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

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Crew #1</th>
<th>Crew #2</th>
<th>Crew #3</th>
<th>Crew #4</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 × 40 binoculars</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>GPS</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Laser rangefinder</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Sibley Field Guide to Birds</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Datasheets</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Declination adjustable compass w/ mirror sight</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Countdown timer w/ chime</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Master list of 4-letter species codes</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Kestrel (temp &amp; wind measurements)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>
APPENDIX D     SITE-SPECIFIC INFORMATION

D.1         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).

<table>
<thead>
<tr>
<th>commonName</th>
<th>scientificName</th>
<th>meanRA</th>
<th>minYear</th>
<th>maxYear</th>
<th>landbird</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovenbird</td>
<td>Seiurus aurocapilla</td>
<td>0.105</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Red-eyed Vireo</td>
<td>Vireo olivaceus</td>
<td>0.073</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>American Robin</td>
<td>Turdus migratorius</td>
<td>0.051</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Veery</td>
<td>Catharus fuscensens</td>
<td>0.042</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Blue Jay</td>
<td>Cyanocitta cristata</td>
<td>0.041</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Mourning Dove</td>
<td>Zenaida macroura</td>
<td>0.036</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>American Crow</td>
<td>Corvus brachyrhynchos</td>
<td>0.035</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Blue-headed Vireo</td>
<td>Vireo solitarius</td>
<td>0.031</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Scarlet Tanager</td>
<td>Piranga olivacea</td>
<td>0.03</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Cedar Waxwing</td>
<td>Bombycilla cedrorum</td>
<td>0.028</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Tree Swallow</td>
<td>Tachycineta bicolor</td>
<td>0.027</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Red-winged Blackbird</td>
<td>Agelaius phoeniceus</td>
<td>0.026</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Common Yellowthroat</td>
<td>Geothlypis trichas</td>
<td>0.024</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Chestnut-sided Warbler</td>
<td>Setophaga pensylvanica</td>
<td>0.024</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Black-capped Chickadee</td>
<td>Pocile atricapillus</td>
<td>0.021</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Gray Catbird</td>
<td>Dumetella carolinensis</td>
<td>0.02</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Tufted Titmouse</td>
<td>Baeolophus bicolor</td>
<td>0.019</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Chipping Sparrow</td>
<td>Spizella passerina</td>
<td>0.019</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Brown-headed Cowbird</td>
<td>Molothrus ater</td>
<td>0.017</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Rose-breasted Grosbeak</td>
<td>Pheucticus ludovicianus</td>
<td>0.016</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Northern Rough-winged Swallow</td>
<td>Stelgidopteryx serripennis</td>
<td>0.016</td>
<td>1994</td>
<td>2005</td>
<td>TRUE</td>
</tr>
<tr>
<td>European Starling</td>
<td>Sturnus vulgaris</td>
<td>0.016</td>
<td>1993</td>
<td>2008</td>
<td>TRUE</td>
</tr>
<tr>
<td>Common Grackle</td>
<td>Quiscalus quiscula</td>
<td>0.015</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Hermit Thrush</td>
<td>Catharus guttatus</td>
<td>0.014</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>commonName</td>
<td>scientificName</td>
<td>meanRA</td>
<td>minYear</td>
<td>maxYear</td>
<td>landbird</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------------</td>
<td>--------</td>
<td>---------</td>
<td>---------</td>
<td>----------</td>
</tr>
<tr>
<td>Barn Swallow</td>
<td>Hirundo rustica</td>
<td>0.014</td>
<td>1993</td>
<td>2011</td>
<td>TRUE</td>
</tr>
<tr>
<td>Least Flycatcher</td>
<td>Empidonax minimus</td>
<td>0.013</td>
<td>1993</td>
<td>2010</td>
<td>TRUE</td>
</tr>
<tr>
<td>American Goldfinch</td>
<td>Spinus tristis</td>
<td>0.013</td>
<td>1993</td>
<td>2010</td>
<td>TRUE</td>
</tr>
<tr>
<td>Wood Thrush</td>
<td>Hylocichla mustelina</td>
<td>0.012</td>
<td>1993</td>
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D.2  D01 – RELOCATABLE - BART (Barlett Experimental Forest)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the JEFFERS NTCH route (New Hampshire Route 116) – in descending order. Source: (Sauer et al. 2011).

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D.3  D02 – CORE – SCBI (Smithsonian Conservation Biology Institute)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the FRONT ROYAL route (Route 923) – in descending order. Source: (Sauer et al. 2011).

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D.4  D02 – RELOCATABLE – SERC (Smithsonian Environmental Research Center)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the DAVIDSNVILLE route (Route 123) – in descending order. Source: (Sauer et al. 2011).

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D.6  D02 – RELOCATABLE – BLAN (Blandy Experimental Farm)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the STAR TANNERY route (Route 001) – in descending order. Source: (Sauer et al. 2011).

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D.7  D03 – CORE – OSBS (Ordway-Swisher Biological Station)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the BELMORE route (Route 21) – in descending order. Source: (Sauer et al. 2011).

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D.8  D03 – RELOCATABLE – DISN (Disney Wilderness Preserve)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the KISSIMMEE route (Route 69) – in descending order. Source: (Sauer et al. 2011).

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D.9  D03 – RELOCATABLE – JERC (Jones Ecological Research Center)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the NEWTON route (Georgia Route 21) – in descending order. Source: (Sauer et al. 2011).

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D.10  D04 – CORE – GUAN (Guanica Forest)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

The species list below is based on observations reported to eBird for the Bosque Estatal de Guánica (http://ebird.org/ebird/hotspot/L323786?yr=all&m=&rank=mrec, downloaded on 23 Jan 2015).

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D.11 D05 – CORE – UNDE (University of Notre Dame Environmental Research Center)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the LAND O LAKES route (Wisconsin Route 8) – in descending order. Source: (Sauer et al. 2011).

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D.12 D05 – RELOCATABLE – STEI (Steigerwaldt Land Services)

**Recommended Sampling Window:** TBD

**Recommended Daily Sampling Period:** TBD

**Source:** TBD

**Species Lists:**

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the Irma route (Wisconsin Route 22) – in descending order. Source: (Sauer et al. 2011).

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D.13  D05 – RELOCATABLE – TREE (Treehaven)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the Irma route (Wisconsin Route 22) – in descending order. Source: (Sauer et al. 2011).

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D.14  D06 – CORE – KONZ (Konza Prairie Biological Station)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the WREFORD route (Kansas Route 16) – in descending order. Source: (Sauer et al. 2011).

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D.15  D05 – RELOCATABLE – UKFS (University of Kansas Field Station)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the OLATHE route (Kansas Route 13) – in descending order. Source: (Sauer et al. 2011).

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D.16 D07 – CORE – ORNL (Oak Ridge National Laboratory)

**Recommended Sampling Window:** TBD

**Recommended Daily Sampling Period:** TBD

**Source:** TBD

**Species Lists:**

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the LOVELL route (Tennessee Route 33) – in descending order. Source: (Sauer et al. 2011).

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D.17   D08 – CORE – TALL (Talladega National Forest)

**Recommended Sampling Window:** TBD

**Recommended Daily Sampling Period:** TBD

**Source:** TBD

**Species Lists:**

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the GREENSBORO route (Alabama Route 23) – in descending order. Source: (Sauer et al. 2011).

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D.18  D08 – RELOCATABLE – LENO (Lenoir Landing)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the MILLRY route (Alabama Route 39) – in descending order. Source: (Sauer et al. 2011).

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D.19 D09 – CORE – WOOD (Woodworth Field Station)

**Recommended Sampling Window:** TBD

**Recommended Daily Sampling Period:** TBD

**Source:** TBD

**Species Lists:**

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the BUCHANAN route (North Dakota Route 12) – in descending order. Source: (Sauer et al. 2011).

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D.20  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 (Colorado Route 901 – Rockport) – in descending order. Source: (Sauer et al. 2011).

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D.21 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 (Colorado Route 7 – Fleming) – in descending order. Source: (Sauer et al. 2011).

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D.22 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 (Colorado Route 904 – Trail Ridge Road) – in descending order. Source: (Sauer et al. 2011).

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D.23  D11 – CORE – OAES (Klemme Range Research Station)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the ARAPAHO route (Oklahoma Route 62) – in descending order. Source: (Sauer et al. 2011).

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D.24  D13 – CORE – NIWO (Niwot Ridge Mountain Research Station)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the GOLD HILL route (Colorado Route 354) – in descending order. Source: (Sauer et al. 2011).

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D.25  D13 – RELOCATABLE – MOAB (Moab)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the CANYON RIMS route (Utah Route 318) – in descending order. Source: (Sauer et al. 2011).

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D.26  D14 – CORE – SRER (Santa Rita Experimental Range)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the SAHUARITA route (Arizona Route 82) – in descending order. Source: (Sauer et al. 2011).

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D.27 D15 – CORE – ONAQ (Onaqui-Benmore)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the VERNON route (Utah Route 155) – in descending order. Source: (Sauer et al. 2011).

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D.28  D17 – CORE – SJER (San Joaquin Experimental Range)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the ONEALS route (California Route 191) – in descending order. Source: (Sauer et al. 2011).

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D.29  D19 – RELOCATABLE – HEAL (Healy)

Recommended Sampling Window: TBD

Recommended Daily Sampling Period: TBD

Source: TBD

Species Lists:

Mean relative abundances (species abundance/total community abundance) of bird species observed during the Breeding Bird Survey on the SAVAGE route (Alaska Route 115) – in descending order. Source: (Sauer et al. 2011).

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<th>scientificName</th>
<th>meanRA</th>
<th>minYear</th>
<th>maxYear</th>
<th>landbird</th>
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</table>
APPENDIX E  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.

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APPENDIX F   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.