FIELD AND LAB PROTOCOL: BREEDING LANDBIRD ABUNDANCE AND DIVERSITY

PREPARED BY:	ORGANIZATION:	DATE:
K. Thibault	FSU	09/25/2013

APPROVALS (Name):	ORGANIZATION:	APPROVAL DATE:
Dave Tazik	CCB PROJ SCI	10/09/2013
Mike Stewart	SE	12/30/2013

RELEASED BY (Name):	ORGANIZATION:	RELEASE DATE:
Stephen Craft	SE	01/13/2014

See Configuration Management System for Approval History

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A_DRAFT	10/03/2011	ECO-00280	Initial Draft Release
B_DRAFT	01/13/2013	ECO-01140	Updates from 2013. Will be finalized in next rev.

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1 DESCRIPTION

1.1 Purpose

The primary purpose of this document is to provide a change-controlled version of NEON protocols and procedures. This document provides the content for training and field-based materials for NEON staff and contractors. 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.

This document is a detailed description of the field data collection, 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 or laboratory processing activity 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
AD [06]	NEON.DOC.014002	FSU Science Requirements

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

2.3 Acronyms

RMBO	Rocky Mountain Bird Observatory
AKN	Avian Knowledge Network
BBS	North American Breeding Bird Survey
BCR	Bird Conservation Region
PRBO	Point Reyes Bird Observatory
IMBCR	Integrated Monitoring for Bird Conservation Regions

2.4 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.

3 BACKGROUND AND OBJECTIVES

3.1 Background

Breeding landbirds (Box 1) 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 (Box 1). 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.

BOX 1. What is a breeding landbird?

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 remainder of this document, I will use 'bird' and 'breeding landbird' interchangeably.

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 2).

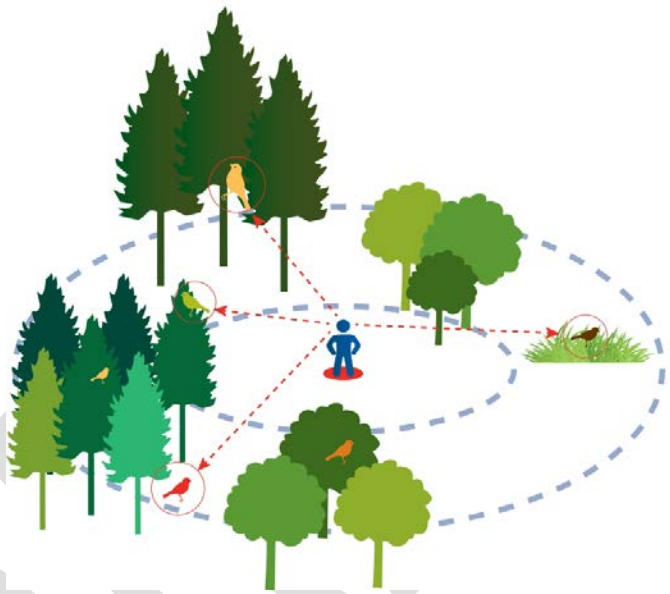

Figure 1. Schematic depicting the point count method of sampling birds.
In distance sampling, the distances from the observer to each bird (represented by dashed red lines), as well as the species, sex, and age, are recorded.

Box 2. 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).

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 include distance sampling techniques are the recommended sampling method (e.g., Nur et al. 1999, Bibby et al. 2000, Fancy and Sauer 2000, Rosenstock et al. 2002).

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 ([RD04]).

4 PROTOCOL

Breeding landbirds will be sampled using the point count method. Point counting entails one or more observers going to some number of pre-established points and recording all the birds heard and/or seen during a set period of time (Figure 1). 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.

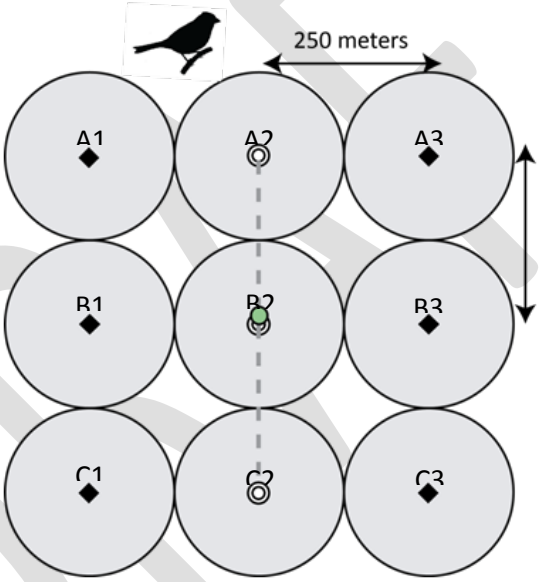

Figure 2. Design of the point count grid, consisting of 9 points separated by a minimum of 250 m. The center of the grid is just offset from a Distributed plot (green circle), where plants, soils, microbes, and insects will also be sampled.

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 timing of point count sampling for breeding birds is critical and varies across environmental gradients. The sampling window 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. Because the initiation of breeding activity varies between species, it is best to spread the sampling effort out evenly over the sampling window. Points will be counted only one or two times per breeding season, depending on the size of the site (see site-specific appendices for guidelines). This approach allows for greater spatial replication than an approach that would require repeated visitation to the same sites on different sampling days. Repeat sampling will be used primarily at small sites in order to increase the number of detections at that site, in order to fit a detection function.

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 1, with one modification suggested for Domain 17 by Kathryn Purcell. More refined windows of approximately 2-3 weeks for all sites can be found in the site-specific appendices.

Table 1. 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 will include:

- 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 data by HQ staff or contractor, if funding is made available.
- Regular bird identification quizzes, with the expectation that technicians will consistently successfully identify more than 90% of the tested species.

Field QA:

The crew lead will begin each sampling session by packing and completing a checklist of required equipment for all technicians. Once in the field, the sampling team will maintain a checklist of sampling points to ensure that all points are visited. The team will also be given a checklist containing a list of reminders to be completed prior to advancing from one sampling point to the next, to facilitate the thorough completion of the datasheets and to provide a quick reference to the critical aspects of the sampling protocol. Finally, the crew lead will have a checklist of tasks to be completed upon return from the field, to ensure immediate and proper organization of data and equipment (Appendix F).

Bird identification quizzes will be administered and scored throughout the season to assess and confirm the skills of each observer.

Reporting QA:

Technicians shall provide copies of the datasheets, either physical or digital, to an FSU staff scientist within 7 days after each week of sampling. The scientist will check the datasheets for errors and missing data. This cold check shall be repeated throughout the sampling season, providing an iterative process to improve error detection and assess error resolution.

The technicians that conducted the sampling shall enter the data into an electronic spreadsheet (provided by FSU staff scientist) as soon as possible within 14 days of data collection. Decreasing the time between data collection and transcription increases the possibility that the technician will notice errors based on her/his memory of the sampling. Another technician shall also enter in the same data within 14 days of data collection. Comparison of the two sets of data will reveal transcription errors. The accurately transcribed data can then be further checked for errors in usage of species codes by comparison to a master spreadsheet of species codes (Appendix A). The FSU staff scientist or contractor shall perform cold checks on these final data after each of the first 3 sampling sessions.

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

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.

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 insecticide 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]).

The training plan will 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 measures distances to an accuracy of ±5 meters.

9 FIELD STANDARD OPERATING PROCEDURE

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).

9.1 Sampling Frequency and Timing

9.1.1 Criteria for Determining Sampling Dates

Breeding season dates will be informed by local experts and by eBird data (ebird.org), which are 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). Sampling timing will be provided by Science Operations in the site-specific appendices to this protocol. All sampling must occur within the window provided.

9.1.2 Sampling Frequency

Sampling will occur once or twice per breeding season at each point at a site, as specified in the site-specific appendices.

9.1.3 Sampling Timing Parameters

For sites at which points are only visited once per season, the sampling must span a minimum of 5 days. For sites at which points are sampled twice within a season, points should be sampled 7 – 14 days after the first visit.

9.2 Equipment and Materials

Table 2. Field Equipment List

Maximo Item No.	Item Description	Quantity per technician	Habitat-Specific	Special Handling
MX104816	Handheld Weather Station that measures maximum, average, and current temperature with an accuracy of +- 1 degree F, humidity +- 3%, and wind speed +- 3%	1		
MX102191	Binoculars, Full Size, Magnification 10 x 42, Field of View 264 ft. @ 1000 yd, Water Proof, with Case, Strap, Lens Cover, & Cloth	1		
Required	Stopwatch / timer; must have notification chime every minute	1		
MX104742	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	1		
Suggested	The Sibley Guide to Birds	1		
Required	GPS Receiver, Handheld, Recreational Accuracy	1		
Suggested	Magnetic Compass, Handheld, Mirror-sighting, Floating	1		

9.3 Preparation

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) and **Red-winged Blackbird** (RWBL, not RWBB).
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.
3) Charge or replace, batteries for the 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.

9.4 Sample Collection in the Field

1) Use a GPS unit pre-loaded with the appropriate bird grid layers and waypoints to locate the first point in the grid.
   a) Record the date and start-time, the grid ID, and the GPS coordinates of the first point to be sampled on the Bird point count datasheet (Appendix A).
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 (e.g., point ID, start-time, temperature (degrees Fahrenheit), and average wind speed (kilometers per hour) on the Bird point count datasheet. These metadata are filled out once for each point.
   a) DO NOT begin counting until the 2 minutes have passed.
   b) DO identify and make a mental note of the locations of any birds flushed from around the point upon approach.
3) Set the timer for the point count duration and to indicate the passing of each minute with the counting period, begin the count-down, and begin recording the birds you see and/or hear onto the Bird point count datasheet.
4) For each independently detected bird, record the following information:
   a) The **species**, using the appropriate 4-letter code (Appendix C).
   b) The horizontal **distance** to the bird (measured with the rangefinder).
      i) 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.
      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*. Rounding at 5 to 10 m intervals causes heaping at particular values and complicates subsequent analysis.

iv) Flyovers do not require distance measurements.

v) 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!***

c) **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. Remember that how you detect a bird is different from how you identify it.

d) The **sex** of the bird (F = Female; M = Male; U = Unknown; J = juvenile).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 (Appendix A).

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

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

8) The following are a few general guidelines for collecting high-quality data:

a) If you do not detect any birds, record "NOBI" (No Birds).

b) If you see an "88" bird after the count period has elapsed, you may record this species on the datasheet. See site-specific documentation for a list of which species are considered "88" species for a given site.

c) DO NOT record any other birds (except an "88" bird)after the count is over, even if it is an interesting bird (though this could be recorded in the "Notes" section of the datasheet).

d) 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.

e) 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.

f) 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.

g) 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.

h) 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.

9) There are several potential issues when conducting point-counts that can lead to problems in the data:
   a) 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.
   b) Stand at observation points – do not sit or kneel. Altering your position will affect your ability to consistently and repeatably see and hear birds.
   c) No "pishing" – do not make noises that can attract birds to you and alter the density estimation.
   d) 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.
   e) Never guess the identity of a bird – If the bird species is unknown, use the table of unknown species codes in Appendix C.

9.5 Data Handling

At the end of each field day or within 7 - 14 days of the completion of the sampling bout, all information from field data sheets must be scanned, transcribed to electronic datasheets and saved to the specified network location. Data should be entered into the electronic spreadsheet provided by the FSU staff scientist. The data from the first day of sampling should be made available to the FSU staff scientist within a week of collection to provide an opportunity for issues to be addressed as soon as possible.

9.6 Equipment Maintenance, Cleaning and Storage

Details on equipment preparation are described in section 9.3. Conducting the same list of equipment-related activities after a sampling event is also recommended (see Appendix F 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.
3) Check, and charge or replace batteries for the GPS unit.
4) Check that the appropriate declination is set on the compasses.

10 REFERENCES

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APPENDIX A EXAMPLE FIELD DATA SHEET

NEON BIRD POINT COUNT DATASHEET (VER. 06/02/2013)																						
EventDate (yyyy/mm/dd):			GRID:		1st Point:					LAT:									Page:		of:	
RecordedBy:										LONG:												
START:		CLOUDS (%):		RH (%):		END:				CLOUDS (%):			RH (%):									
HOW : V = Visual | S = Singing | C = Calling | D = Drumming | O = Other | F = Flyover | SEX: M = Male | F = Female | U = Unk																					
HABITATS: MX = mixed; CE = Closed Evergreen; OE = Open Evgr; GR = grassland; SH = shrubland; MD = meadow; RP = riparian																						
	Point #	Habitat Code	Start Time (24 Hr)	Temp (°F)	Wind (kph)	Minute	TaxonID				idQ	Radial Distance (m)			How	Visual?	Sex	Cluster Size	Cluster Code			
1																						1
2																						2
3																						3
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REMARKS:																						

APPENDIX B MASTER LIST OF BIRD SPECIES CODES

Abert's Towhee	ABTO	Black Rosy-Finch	BLRF
Acadian Flycatcher	ACFL	Black Scoter	BLSC
Acorn Woodpecker	ACWO	Black Skimmer	BLSK
Alder Flycatcher	ALFL	Black Swift	BLSW
Allen's Hummingbird	ALHU	Black Tern	BLTE
American Avocet	AMAV	Black Turnstone	BLTU
American Bittern	AMBI	Black Vulture	BLVU
American Black Duck	ABDU	Black-and-white Warbler	BAWW
American Black Duck	ABDU	Black-backed Woodpecker	BBWO
American Coot	AMCO	Black-bellied Plover	BBPL
American Crow	AMCR	Black-billed Cuckoo	BBCU
American Dipper	AMDI	Black-billed Magpie	BBMA
American Flamingo	AMFL	Blackburnian Warbler	BLBW
American Golden-Plover	AMGP	Black-capped Chickadee	BCCH
American Goldfinch	AMGO	Black-capped Gnatcatcher	BCGN
American Green-winged Teal	AGWT	Black-capped Vireo	BCVI
American Kestrel	AMKE	Black-chinned Hummingbird	BCHU
American Oystercatcher	AMOY	Black-chinned Sparrow	BCSP
American Pipit	AMPI	Black-crested Titmouse	BCTI
American Redstart	AMRE	Black-headed Grosbeak	BHGR
American Robin	AMRO	Black-headed Gull	BHGU
American Three-toed Woodpecker	ATTW	Black-legged Kittiwake	BLKI
American Tree Sparrow	ATSP	Black-necked Stilt	BNST
American White Pelican	AWPE	Blackpoll Warbler	BLPW
American Wigeon	AMWI	Black-tailed Gnatcatcher	BTGN
Anna's Hummingbird	ANHU	Black-throated Blue Warbler	BTBW
Arizona Woodpecker	ARWO	Black-throated Gray Warbler	BTYW
Ash-throated Flycatcher	ATFL	Black-throated Green Warbler	BTNW
Audubon's Warbler	AUWA	Black-throated Sparrow	BTSP
Bachman's Sparrow	BACS	Blue Grosbeak	BLGR
Baird's Sparrow	BAIS	Blue Jay	BLJA
Bald Eagle	BAEA	Blue-gray Gnatcatcher	BGGN
Baltimore Oriole	BAOR	Blue-winged Teal	BWTE
Band-tailed Pigeon	BTPI	Bobolink	BOBO
Bank Swallow	BANS	Bohemian Waxwing	BOWA
Barn Owl	BANO	Bonaparte's Gull	BOGU
Barn Swallow	BARS	Boreal Chickadee	BOCH
Barred Owl	BADO	Boreal Owl	BOOW
Barrow's Goldeneye	BAGO	Botteri's Sparrow	BOSP
Bell's Vireo	BEVI	Brandt's Cormorant	BRAC
Belted Kingfisher	BEKI	Brewer's Blackbird	BRBL
Bendire's Thrasher	BETH	Brewer's Sparrow	BRSP
Bewick's Wren	BEWR	Bridled Titmouse	BRTI
Black Oystercatcher	BLOY	Broad-tailed Hummingbird	BTAH
Black Phoebe	BLPH	Broad-winged Hawk	BWHA
Black Rail	BLRA	Brown Creeper	BRCR

Brown Thrasher	BRTH
Brown-capped Rosy-Finch	BCRF
Brown-crested Flycatcher	BCFL
Brown-headed Cowbird	BHCO
Buff-breasted Sandpiper	BBSA
Bufflehead	BUFF
Bullock's Oriole	BUOR
Burrowing Owl	BUOW
Bushtit	BUSH
Cackling Goose	CACG
Cactus Wren	CACW
California Condor	CACO
California Gull	CAGU
California Quail	CAQU
California Thrasher	CATH
Calliope Hummingbird	CAHU
Canada Goose	CANG
Canada Warbler	CAWA
Canvasback	CANV
Canyon Towhee	CANT
Canyon Wren	CANW
Cape May Warbler	CMWA
Caspian Tern	CATE
Cassin's Finch	CAFI
Cassin's Kingbird	CAKI
Cassin's Sparrow	CASP
Cassin's Vireo	CAVI
Cattle Egret	CAEG
Cave Swallow	CASW
Cedar Waxwing	CEDW
Cerulean Warbler	CERW
Chestnut-backed Chickadee	CBCH
Chestnut-collared Longspur	CCLO
Chestnut-sided Warbler	CSWA
Chihuahuan Raven	CHRA
Chimney Swift	CHSW
Chipping Sparrow	CHSP
Chukar	CHUK
Cinnamon Teal	CITE
Clapper Rail	CLRA
Clark's Grebe	CLGR
Clark's Nutcracker	CLNU
Clay-colored Sparrow	CCSP
Cliff Swallow	CLSW
Colima Warbler	COLW
Common Black-Hawk	COBH
Glaucous-winged Gull	GWGU
Glossy Ibis	GLIB
Common Goldeneye	COGO
Common Grackle	COGR
Common Ground-Dove	COGD
Common Loon	COLO
Common Merganser	COME
Common Moorhen	COMO
Common Murre	COMU
Common Nighthawk	CONI
Common Poorwill	COPO
Common Raven	CORA
Common Yellowthroat	COYE
Connecticuct Warbler	CONW
Cooper's Hawk	COHA
Cordilleran Flycatcher	COFL
Costa's Hummingbird	COHU
Crissal Thrasher	CRTH
Curve-billed Thrasher	CBTH
Dark-eyed Junco	DEJU
Dickcissel	DICK
Double-crested Cormorant	DCCO
Downy Woodpecker	DOWO
Dunlin	DUNL
Dusky Flycatcher	DUFL
Dusky Grouse	DUGR
Eared Grebe	EAGR
Eastern Kingbird	EAKI
Eastern Meadowlark	EAME
Eastern Phoebe	EAPH
Eastern Screech-Owl	EASO
Elf Owl	ELOW
Eurasian Collared-Dove	EUCD
Eurasian Wigeon	EUWI
European Starling	EUST
Evening Grosbeak	EVGR
Ferruginous Hawk	FEHA
Field Sparrow	FISP
Five-striped Sparrow	FSSP
Flammulated Owl	FLOW
Forster's Tern	FOTE
Fox Sparrow	FOSP
Franklin's Gull	FRGU
Gadwall	GADW
Gambel's Quail	GAQU
Gila Woodpecker	GIWO
Gilded Flicker	GIFL
Glaucous Gull	GLGU
Hermit Warbler	HEWA
Herring Gull	HERG

Golden Eagle	GOEA	Hooded Merganser	HOME
Golden-cheeked Warbler	GCWA	Hooded Oriole	HOOR
Golden-crowned Kinglet	GCKI	Hooded Warbler	HOWA
Golden-crowned Sparrow	GCSP	Horned Grebe	HOGR
Golden-crowned Warbler	GCRW	Horned Lark	HOLA
Golden-winged Warbler	GWWA	House Finch	HOFI
Grace's Warbler	GRWA	House Sparrow	HOSP
Grasshopper Sparrow	GRSP	House Wren	HOWR
Gray Catbird	GRCA	Hutton's Vireo	HUVI
Gray Flycatcher	GRFL	Inca Dove	INDO
Gray Hawk	GRHA	Juniper Titmouse	JUTI
Gray Jay	GRAJ	Kentucky Warbler	KEWA
Gray Vireo	GRVI	Killdeer	KILL
Gray-crowned Rosy-Finch	GCRF	Ladder-backed Woodpecker	LBWO
Gray-headed Junco	GHJU	Lapland Longspur	LALO
Great Black-backed Gull	GBBG	Lark Bunting	LARB
Great Blue Heron	GBHE	Lark Sparrow	LASP
Great Crested Flycatcher	GCFL	Laughing Gull	LAGU
Great Egret	GREG	Lazuli Bunting	LAZB
Great Gray Owl	GGOW	Le Conte's Sparrow	LCSP
Great Horned Owl	GHOW	Le Conte's Thrasher	LCTH
Greater Pewee	GRPE	Least Bittern	LEBI
Greater Prairie-Chicken	GRPC	Least Flycatcher	LEFL
Greater Roadrunner	GRRO	Least Grebe	LEGR
Greater Sage-Grouse	GRSG	Least Sandpiper	LESA
Greater Scaup	GRSC	Least Tern	LETE
Greater White-fronted Goose	GWFG	Lesser Black-backed Gull	LBBG
Greater Yellowlegs	GRYE	Lesser Goldfinch	LEGO
Great-tailed Grackle	GTGR	Lesser Prairie-Chicken	LEPC
Green Heron	GRHE	Lesser Scaup	LESC
Green-tailed Towhee	GTTO	Lesser Yellowlegs	LEYE
Green-winged Teal	GWTE	Lewis's Woodpecker	LEWO
Gunnison Sage-Grouse	GUSG	Lincoln's Sparrow	LISP
Gyrfalcon	GYRF	Loggerhead Shrike	LOSH
Hairy Woodpecker	HAWO	Long-billed Curlew	LBCU
Hammond's Flycatcher	HAFL	Long-billed Dowitcher	LBDO
Harlan's Hawk	HALH	Long-eared Owl	LEOW
Harlequin Duck	HADU	Long-tailed Duck	LTDU
Harris's Hawk	HASH	Lucy's Warbler	LUWA
Harris's Sparrow	HASP	MacGillivray's Warbler	MGWA
Heermann's Gull	HEEG	Magnolia Warbler	MAWA
Henslow's Sparrow	HESP	Mallard	MALL
Hepatic Tanager	HETA	Marbled Godwit	MAGO
Hermit Thrush	HETH	Marsh Wren	MAWR
McCown's Longspur	MCLO	Pine Grosbeak	PIGR
Merlin	MERL	Pine Siskin	PISI
Mew Gull	MEGU	Pinyon Jay	PIJA
Montezuma Quail	MONQ	Piping Plover	PIPL

Mountain Bluebird	MOBL
Mountain Chickadee	MOCH
Mountain Plover	MOPL
Mountain Quail	MOUQ
Mountain White-crowned Sparrow	MWCS
Mourning Dove	MODO
Mourning Warbler	MOWA
Mute Swan	MUSW
Myrtle Warbler	MYWA
Nashville Warbler	NAWA
Northern Bobwhite	NOBO
Northern Cardinal	NOCA
Northern Flicker	NOFL
Northern Goshawk	NOGO
Northern Harrier	NOHA
Northern Hawk Owl	NHOW
Northern Mockingbird	NOMO
Northern Parula	NOPA
Northern Pintail	NOPI
Northern Pygmy-Owl	NOPO
Northern Rough-winged Swallow	NRWS
Northern Saw-whet Owl	NSWO
Northern Shoveler	NSHO
Northern Shrike	NSHR
Northern Waterthrush	NOWA
Nuttall's White-crowned Sparrow	NWCS
Olive Warbler	OLWA
Orange-crowned Warbler	OCWA
Oregon Junco	ORJU
Osprey	OSPR
Ovenbird	OVEN
Pacific Golden-Plover	PAGP
Pacific Loon	PALO
Pacific-slope Flycatcher	PSFL
Painted Bunting	PABU
Painted Redstart	PARE
Palm Warbler	PAWA
Pectoral Sandpiper	PESA
Peregrine Falcon	PEFA
Phainopepla	PHAI
Pied-billed Grebe	PBGR
Pileated Woodpecker	PIWO
Scaled Quail	SCQU
Scarlet Tanager	SCTA
Scissor-tailed Flycatcher	STFL
Scott's Oriole	SCOR
Sedge Wren	SEWR
Semipalmated Plover	SEPL
Plumbeous Vireo	PLVI
Prairie Falcon	PRFA
Prothonotary Warbler	PROW
Purple Finch	PUFI
Purple Martin	PUMA
Pygmy Nuthatch	PYNU
Pyrrhuloxia	PYRR
Red Crossbill	RECR
Red-bellied Woodpecker	RBWO
Red-breasted Merganser	RBME
Red-breasted Nuthatch	RBNU
Red-breasted Sapsucker	RBSA
Red-eyed Vireo	REVI
Red-faced Warbler	RFWA
Redhead	REDH
Red-headed Woodpecker	RHWO
Red-naped Sapsucker	RNSA
Red-necked Grebe	RNGR
Red-necked Phalarope	RNPH
Red-shafted Flicker	RSFL
Red-shouldered Hawk	RSHA
Red-tailed Hawk	RTHA
Red-throated Loon	RTLO
Red-winged Blackbird	RWBL
Ring-billed Gull	RBGU
Ring-necked Duck	RNDU
Ring-necked Pheasant	RNEP
Rock Pigeon	ROPI
Rock Wren	ROWR
Rough-legged Hawk	RLHA
Ruby-crowned Kinglet	RCKI
Ruby-throated Hummingbird	RTHU
Ruddy Ground-Dove	RUGD
Ruffed Grouse	RUGR
Rufous Hummingbird	RUHU
Rufous-crowned Sparrow	RCSP
Sage Sparrow	SAGS
Sage Thrasher	SATH
Sanderling	SAND
Sandhill Crane	SACR
Savannah Sparrow	SAVS
Say's Phoebe	SAPH
Virginia Rail	VIRA
Virginia's Warbler	VIWA
Warbling Vireo	WAVI
Western Bluebird	WEBL
Western Flycatcher	WEFL
Western Grebe	WEGR

Semipalmated Sandpiper	SESA	Western Gull	WEGU
Sharp-shinned Hawk	SSHA	Western Kingbird	WEKI
Sharp-tailed Grouse	STGR	Western Meadowlark	WEME
Short-billed Dowitcher	SBDO	Western Sandpiper	WESA
Short-eared Owl	SEOW	Western Screech-Owl	WESO
Smith's Longspur	SMLO	Western Scrub-Jay	WESJ
Snow Bunting	SNBU	Western Tanager	WETA
Snow Goose	SNGO	Western Wood-Pewee	WEWP
Snowy Egret	SNEG	Whimbrel	WHIM
Snowy Owl	SNOW	Whip-poor-will	WPWI
Snowy Plover	SNPL	White-breasted Nuthatch	WBNU
Song Sparrow	SOSP	White-crowned Sparrow	WCSP
Sooty Grouse	SOGR	White-faced Ibis	WFIB
Sora	SORA	White-headed Woodpecker	WHWO
Spotted Sandpiper	SPSA	White-tailed Ptarmigan	WTPT
Spotted Towhee	SPTO	White-throated Sparrow	WTSP
Sprague's Pipit	SPPI	White-throated Swift	WTSW
Spruce Grouse	SPGR	White-winged Crossbill	WWCR
Steller's Jay	STJA	White-winged Dove	WWDO
Summer Tanager	SUTA	White-winged Junco	WWJU
Surf Scoter	SUSC	White-winged Scoter	WWSC
Swainson's Hawk	SWHA	Whooping Crane	WHCR
Swainson's Thrush	SWTH	Wild Turkey	WITU
Tennessee Warbler	TEWA	Willet	WILL
Thayer's Gull	THGU	Williamson's Sapsucker	WISA
Townsend's Solitaire	TOSO	Willow Flycatcher	WIFL
Townsend's Warbler	TOWA	Wilson's Phalarope	WIPH
Traill's Flycatcher	TRFL	Wilson's Snipe	WISN
Tree Swallow	TRES	Wilson's Warbler	WIWA
Tufted Titmouse	TUTI	Winter Wren	WIWR
Tundra Swan	TUSW	Wood Duck	WODU
Turkey Vulture	TUVU	Yellow Rail	YERA
Upland Sandpiper	UPSA	Yellow Warbler	YWAR
Varied Bunting	VABU	Yellow-bellied Sapsucker	YBSA
Varied Thrush	VATH	Yellow-billed Cuckoo	YBCU
Vaux's Swift	VASW	Yellow-breasted Chat	YBCH
Veery	VEER	Yellow-headed Blackbird	YHBL
Verdin	VERD	Yellow-rumped Warbler	YRWA
Vermilion Flycatcher	VEFL	Yellow-shafted Flicker	YSFL
Vesper Sparrow	VESP	Zone-tailed Hawk	ZTHA

APPENDIX C 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.

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 D 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 E LOW-DENSITY TARGET SPECIES ("88" SPECIES)

Record these species as 88 birds when you encounter them between points.
You do not need to record distances, but please do record How, Sex, and Cluster information.

Colorado List – Hanni et al. 2011

Abert's Squirrel (tassel-eared squirrel)
All cuckoos
All galliforms
All nightjars
All owls
All phoebes
All raptors
All swifts
All woodpeckers (incl. sapsuckers but not NOFL)
American Dipper
American Redstart
Baltimore Oriole
Band-tailed Pigeon
Bank Swallow
Bell's Vireo
Black-throated Sparrow
Blue Grosbeak
Bobolink
Brown-capped Rosy-finch
Canyon Towhee
Canyon Wren
Cassin's Finch
Cassin's Kingbird
Cedar Waxwing
Chestnut-collared Longspur
Chihuahuan Raven
Curve-billed Thrasher
Evening Grosbeak
Field Sparrow
Fox Sparrow
Gray Catbird
Gray Vireo
Great Crested Flycatcher
Great-tailed Grackle
Hepatic Tanager
Indigo Bunting
Lesser Goldfinch
Loggerhead Shrike
Long-billed Curlew
McCown's Longspur
Mountain Plover
Northern Cardinal
Northern Waterthrush
Olive-sided Flycatcher
Ovenbird
Purple Martin
Red-eyed Vireo
Rufous-crowned Sparrow
Scissor-tailed Flycatcher
Scott's Oriole
Upland Sandpiper
Veery
White-winged Crossbill
Willow Flycatcher

APPENDIX F PROCEDURE CHECKLISTS

REQUIRED CHECKLIST BEFORE AND AFTER CONDUCTING BIRD SURVEYS

Complete this checklist IMMEDIATELY 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	☐	☐	☐	☐
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 G D1 – 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
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

Species	Mean RA	Year_start	Year_end
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
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

Species	Mean RA	Year_start	Year_end
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
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

APPENDIX H 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
Streptopelia decaocto	0.004	2005	2011
Athene cunicularia	0.004	1968	2006
Lanius ludovicianus	0.004	1968	2011

Species	Mean RA	Year_start	Year_end
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
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

Species	Mean RA	Year_start	Year_end
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

APPENDIX I 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
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

Species	Mean RA	Year_start	Year_end
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

APPENDIX J 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
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

Species	Mean RA	Year_start	Year_end
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
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

Species	Mean RA	Year_start	Year_end
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