CP33- Upland Habitat Buffers Monitoring Protocol

Prepared by:

Southeast Quail Study Group, Research Committee

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INTRODUCTION

USDA-FSA Notice CRP-479 provides policy for CRP continuous signup practice CP-33, Habitat Buffers for Upland Wildlife. Notice CRP-479 specifies that:

"A monitoring and evaluation plan must be developed in consultation with the state technical committee, including the U.S Fish and Wildlife Service, State Fish and Game agencies, and other interested quail parties. The plan must provide the ability to establish baseline data on quail populations and estimate increasing quail populations and impact on other upland bird populations as a result of practice CP-33, Habitat Buffers for Upland Birds, including the following:

- verification that suitable Northern Bobwhite quail cover is established
- verification that appropriate cover management practices are implemented on a timely basis
- states must control acreage within their allocation
- implementing a statewide sampling process that will provide reliable estimates of the number of quail per acre (or some other appropriate measure):
  - before practice CP-33, Habitat Buffers for Upland Birds, is implemented (baseline)
  - resulting from the established CRP cover."

The Research Committee of the Southeast Quail Study Group has been charged with developing a suggested national protocol for monitoring northern bobwhite response to CP-33 that can be deployed through a combined effort of State Offices of USDA-FSA/NRCS and state resource management agencies in such a manner to: 1) provide statistically valid estimates of northern bobwhite density (or some other appropriate measure) on fields enrolled in CP-33 at state, regional (BCR), and national levels and 2) provide a measure of the relative effect size of the CP-33 practice. This document outlines a suggested multi-stage sampling framework for monitoring CP-33 to insure consistency in data collection among states and to facilitate statistically valid measures of the effectiveness of CP-33, regionally and nationally.

This document provides a suggested framework for determining:

- which states to sample
- which measures of population response to monitor

- sampling intensity (i.e., number of contracts and fields to sample) required to achieve monitoring objectives
- how to draw a representative and random sample of contracts and fields for monitoring at state and national levels
- specific monitoring protocols for fall covey counts and breeding season call counts

Which States to Monitor

FSA Notice CRP-479 requires that state level monitoring be conducted within each state that received an allocation of CP-33 acres (*n* = 35). However, acreage allocation varied substantially among states in relation to number of acres of row crop, rate of bobwhite decline, and core range of the bobwhite. FSA recognizes that monitoring intensity may vary among states in relation to these factors. Additionally, discussions with FSA suggest that they would be receptive to a 2-tier monitoring program in which detailed population data is collected at the state level for a core group of states that received the primary CP-33 allocation and are within the core bobwhite range. For the remainder of states some reduced intensity of sampling, producer survey, or extrapolation of CP-33 effects from intensively monitored states may suffice.

Of the total CP-33 allocation of 250,000 acres, 78% (194,700 ac) occurs in just 13 states and 95% (235,700 ac) occurs in 20 states (Table 1). The remaining 5% of the acreage is distributed among 15 states that are outside of the core range of the bobwhite. Intensive monitoring in the 20 states that received 95% of the CP-33 allocation would largely characterize the national impact of CP-33 on northern bobwhite populations. The Research Committee of the SEQSG recommends that field-level monitoring of northern bobwhite and select grassland birds be conducted in the 20 states receiving the majority of the acreage and relative population responses of these species be extrapolated to the remaining states, proportional to allocation. Additionally, a producer survey of these states might provide a subjective assessment of wildlife benefits.

Which Population Metrics

Bobwhite abundance has been estimated or indexed during the breeding season using calling male surveys and during the fall using a myriad of methods including flush counts, line transect, capture-recapture, and fall covey counts. Population goals in the Northern Bobwhite Conservation Initiative are stated in terms of coveys added to the fall population. Previous research in Mississippi and North Carolina indicate that fall populations are more responsive to field border practices than breeding season populations. Therefore, the Research Committee recommends that state-level monitoring programs primarily focus on estimating fall density using fall covey counts and point-transect distance sampling methodology and monitor breeding season relative abundance using call counts or male density using call count point-transects, as resources permit. Additionally, to establish broader conservation benefits of CP-33 it would be desirable to monitor relative abundance/density of grassland/shrub successional songbirds during the breeding season. The Research Committee recommends that bobwhite breeding season monitoring be accompanied by point-transect monitoring of a select suite of early successional birds likely to respond to CP-33 (Dickcissel, Indigo Bunting, Common Yellowthroat, Eastern/Western Meadowlark, Grasshopper Sparrow, Song Sparrow, Eastern Bluebird, Loggerhead Shrike).

Sampling Intensity

CRP-479 requires a "statewide sampling process that will provide reliable estimates of the number of quail per acre." Relative to adequate sampling, 2 questions are germane, 1) what is the fundamental sampling unit and 2) how many sampling units must be measured to produce reliable population estimates at the state level? Although CP-33 state allocations were expressed in terms of acres of buffer, the experimental unit to which these acres will be applied on the ground is the field. As such, the field is a logical sampling unit for monitoring.

For fall sampling, either covey density or bird density is a logical population metric. We recommend estimating fall covey density, using distance sampling methodology in a point transect context applied to fall covey counts adjusted for calling probability (Wellendorf et al. 2002, 2004). This approach requires estimation of a detection function, which is then applied to observed detections to generate a density estimate. With regard to sampling intensity, 2 questions are relevant 1) how many points are required to estimate the detection function and 2) how many points must be sampled at the state level to generate density estimates with an acceptable level of precision? Literature recommendations suggest that estimation of the detection function in a point-transect context generally requires 75-100 observations. However, analysis of empirical point distance information from the Georgia BQI project (Hamrick 2002) suggests that, at the expected bobwhite density in agricultural landscapes, as many as 170 points may be needed to generate sufficient detections to adequately estimate the detection function. Clearly, most states will not be able to sample intensively enough to estimate state-specific detection functions. We suggest that detection functions be estimated at BCR or regional levels by pooling observations across states with similar landscape composition and bobwhite density. These global detection functions could then be applied to observed detections at the state level to generate state-level density estimates. Given that reliable detection functions could be estimated at the BCR or state-level, sufficient fields must be sampled within each state to produce state-level density estimates with acceptable precision.

To determine the expected effect of number of points (fields) on precision of density estimates, we used observed bobwhite detections from 701 point mornings from BQI monitoring in GA (Hamrick 2002) to estimate a global detection function (best fit function was a Uniform with cosine adjustment) and determine the expected number of detections per point (~ I covey/point). We then used simulation models to determine the expected Coefficient of Variation (CV) on density in relation to number of points sampled. We *a priori* set a CV of 15% as an acceptable level of precision. We generated 1000 sets of random samples in increments of 10 at each sample size of 10 – 100 and in increments of 100 from 100 – 1000. At each sample size (number of points surveyed (10,20,30 and so on) we generated the respective number of observations from a Poisson distribution with a mean of 0.5 - 3 and computed the density and associated statistics using the global detection function from Hamrick (2002). We then calculated the expected (mean) CV on *covey density* at each sample size.

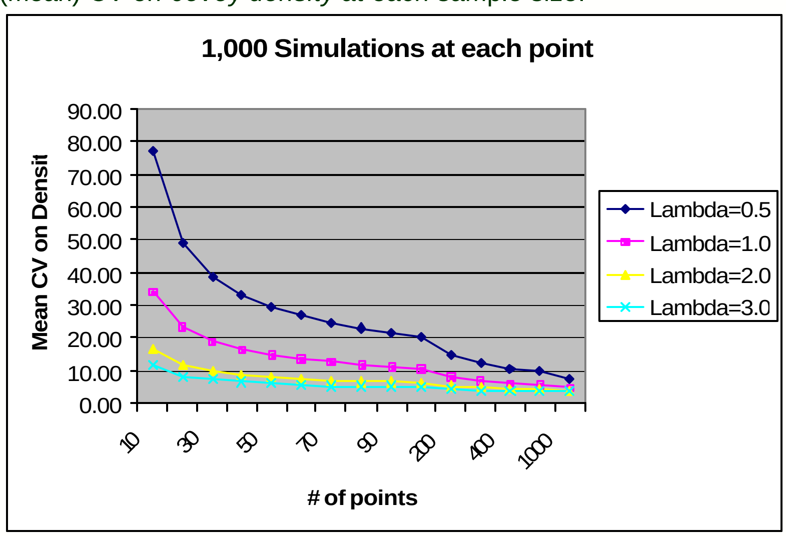

Figure 1. Illustrates the relationship between sample size (number of points) and CV over a range of expected detection rates.

This simulation suggests that at a sample of 40 points we can expect a CV of 16.39 and at 50 points a CV of 14.69. The research committee believes that this is sufficiently precise to meet the language in CRP-479 *at the state level* and will produce CVs on regional and national data in the 5-6% range. If fields enrolled in CP-33 were paired with un-enrolled control fields in the vicinity of each contract we could estimate the effect size of the CP-33 practice (number of quail/ac added to the landscape as a result of CP-33) and extrapolate that to the national enrollment to produce a defensible estimate of the national effect of CP33 on bobwhite and select songbirds. Insofar as detections of calling males during the breeding season are typically higher than fall coveys, sampling at an intensity sufficient to estimate fall density with an acceptable level of precision would likely yield acceptable breeding season density estimates. The Research Committee suggests that 40 points per state represents an absolute minimum sampling intensity sufficient to produce state-level density estimates. Projected labor costs ($8550/year/state) associated with monitoring at the minimum of 40 contracts per state are illustrated in Table 2. These cost estimates assume labor at $7.50/hour + fringe (25%) for 6 weeks during the fall and 4 weeks during the breeding season. The total cost of labor for national monitoring under this scenario would be approximately $171,000/year. Cost estimates **do not** reflect the cost of vehicles, gas, lodging, or per diem which would likely equal or exceed labor costs.

Ideally, sampling intensity should vary in relation to number of acres enrolled in the state. However, a stratified sampling scheme proportional to acreage allocation substantially increases the cost of monitoring over simply monitoring each state at the minimum level. Under a proportional stratified sampling scheme states would monitor from 40 – 141 fields and costs would range from $8550 - $27,556/state/yr (Table 3). These cost estimates assume labor at $7.50/hour + fringe (25%) for 6 weeks during the fall and 2 weeks during the breeding season. The total cost of labor for national monitoring under this scenario would be approximately $340,885/yr. Cost estimates **do not** reflect the cost of vehicles, gas, lodging, or per diem which would likely equal or exceed labor costs.

Under either of these sampling intensities it is yet unclear which agency(ies) would pay for sampling.

Drawing a Representative Sample

Selection of a random and representative sample of experimental units from the population to which inference is to be made (target population) requires a sampling frame. Ideally, the target population and the sampled population should be identical. Under the suggested protocol, we recognize that the sampled population actually represents 95% of the target population. Furthermore, the experimental unit to which CP-33 is applied (the field) is not subject to direct sampling because the available sampling frame (FSA CRP contract database) treats the contract as the observational unit. A given contract will consist of ≥ 1 fields consisting of a variable number of acres of field border. An important sampling issue relates to whether to sample a single field/contract or multiple fields/contract. In implementing a sampling design, there exists a tradeoff between sampling efficiency and independence. A multistage sampling scheme (randomly select contract, then randomly select multiple points/fields within contracts) enhances efficiency because it reduces total number of landowner contacts required and travel time. However, points within contracts must still be reasonably independent (not sample the same area). During fall sampling, the effective audible range of calling coveys is approximately 500 m. During the breeding season, Hansen and Guthery (2001) assumed that the radius of audibility was 400 m. A 500-m radius circle has an area of approximately 194 acres. A pure cluster sampling (randomly select contracts, then sample all fields within contracts) approach would not be feasible because multiple fields within contracts would likely overlap in the radius of audibility, and as such would result in double-counting and lack of independence. The Research Committee recommends a multistage sampling approach in which contracts are randomly selected, then a field within the contract is randomly selected. Additional fields within the contract may be sampled, up to a total of 3 fields, if the property is large enough and fields distributed such that 500-m radii around the sample point do not overlap (Figure 2). For each bordered field in the sample, a non-bordered field within the same landscape (1000 m < distance from bordered field < 3000 m) must also be sampled. Non-bordered fields should be paired with bordered fields under the management of the same producer if possible.

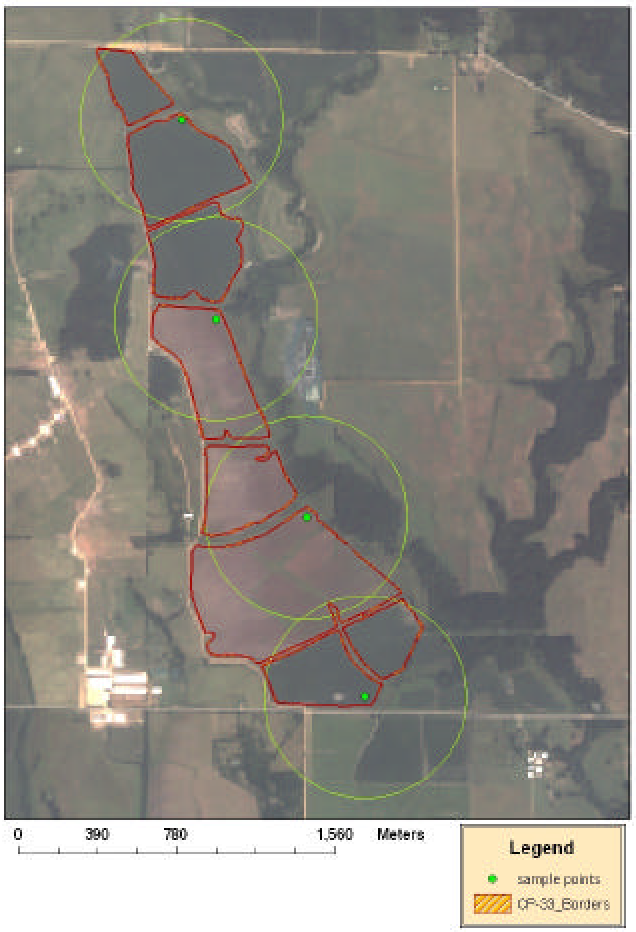

Figure 2. Farm level GIS illustrating selection of independent points (fields) within contract for sampling. Sampled fields should be selected such that 500-m radii of audibility do not overlap.

Selection of Contracts within States

Drawing a random sample of contracts, stratified by state, will require access to the FSA CRP contract database. A random sample of contracts, stratified by state can be drawn from the national database. This sample should contain 20% more contracts than needed to serve as replacements if the landowner cannot be located or refuses access. This database will contain information about contract number, date of enrollment, state and county FIPS, and total acreage. However, it is likely that the individual county offices will need to be visited to secure information regarding number of fields, individual field size, landowner contact information, and spatial data. From county-level data landowners can be contacted, permission secured, and field-level spatial databases (GIS) developed (Figure 3). Selection of individual fields and determination of the number of fields/contract to be sampled will have to be made at the county level.

To characterize temporal change in vegetation structure and bobwhite population response over the life of the contract, the initial sample of contracts should be followed over time for at least 5 years. As such, the same fields and contracts should be sampled each year. However, to quantify temporal change in program implementation, it may be desirable to add contracts to the sample in future years as programmatic guidelines evolve (i.e., 2007 Farm Bill). Monitoring will begin during the 2005 growing season. All contracts enrolled in CP33 from 1 October, 2004 through 30 April 2005 will be considered within the sampling frame for year 2005. A minimum of 40 contracts/state will be randomly selected from this population. These contracts will be monitored during the breeding season and early fall of year 2005 - 2010.

Selection of Fields within Contracts

Multiple fields may be sampled within each contract. An initial field should be randomly selected from those within the contract and then from remaining fields under the contract up to 2 additional fields with non-overlapping 500-m radii may be selected. Fields enrolled in CP-33 selected for sampling will be paired with a non-enrolled field in the same landscape to make inferences regarding effect size of CP-33 practice. Control fields should be located greater than 1 km and less than 3 km from the fields sampled in the contract. Control fields should be of the same crop type (soybean, corn, cotton, etc.) and growth stage as the crop within the bordered fields.

Selection of Sampling Points Within Fields

The sampling point should be positioned within a randomly selected corner of the field, on the field border/crop interface (Figure 3). The sample point should be georeferenced with a differentially corrected GPS and collected in Decimal Degree, WGS84 datum. The same sampling points should be used during fall and breeding season sampling.

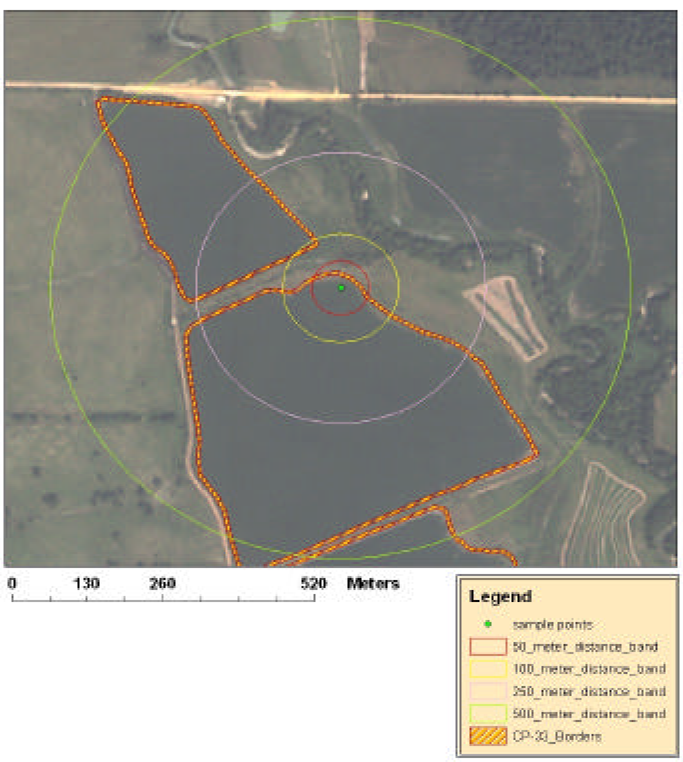

Figure 3. Example of a call station with concentric rings depicting distance bands corresponding to 50, 100, 250, and 500 meters. Observers will be required to estimate the locations of the calling male or covey within one of these distance bands (0–50, 50–100, 100–250, 250–500) at each station.

FIELD-LEVEL MONITORING PROTOCOL OF NORTHERN BOBWHITE

Sampling protocol for breeding and fall monitoring will be based on point-distance methodology (Buckland et al. 2001). Number of calling male northern bobwhite (breeding season) or coveys (fall) within concentric distance bands (Figure 3) from the call station will be recorded and used to estimate detection functions and subsequently density.

Fall Covey Counts

The following guidelines have been developed to assist individuals interested in conducting early morning covey call counts to estimate northern bobwhite fall density. Recent research has determined optimal timing, conditions, and analysis for conducting surveys (Wellendorf 2000, Seiler 2001, Hamrick 2002, Seiler et al. 2002, Wellendorf et al. 2004). Density will be estimated using distance sampling procedures (Buckland et al. 2001). For more detailed information on conducting covey call surveys go to: *"Guidelines for Estimating Autumn Abundance and Density of Northern Bobwhites".* Listed below are summarized points of interest for conducting covey call surveys:

- Prior to conducting covey call counts, observers should receive training that consists of a minimum of 3 mornings of monitoring covey calling.
- Surveys can be conducted between the last week of September and the second week of November with the optimal time the last 2 weeks of October.
- Pilot monitoring should be conducted from mid-Sept – early October to determine peak calling period.
- The effective listening radius under most conditions will be out to 500 m from the survey point, which gives an inference area of 194 acres. This may be increased in open, flat landscapes. Adjacent survey points should be spaced at least 1000 m apart to ensure independence.
- On heterogeneous landscapes it is necessary to locate points that incorporate representative portions of each landscape feature that are considered potentially usable by coveys.
- When possible, survey paired sites, such as a field with buffers and nearby field without buffers, ***on the same morning*** to avoid bias arising from temporal variation in covey calling rates.
- Further instructions for the morning of survey are listed on the field sheet guidelines.
- A call rate should be calculated for each point survey. See the guidebook for the formula.
- Program DISTANCE (version 3.5 or 4.1) can be used to estimate covey density at the local (stratum) and regional (global) level. The average predicted call rate will be included as a general multiplier.
- Between 75-100 observations are recommended to adequately estimate the detection function. Calling data, pooled over states will be used to estimate BCR or region-specific detection functions which can then be back-applied to state-level detections to generate state-specific density estimates.
- Additional details on using program DISTANCE are in the guidebook.

Procedure for Early Morning Fall Covey Call Point Counts

1. Make sure all points have been clearly marked prior to the survey (flagging, pole, location coordinates) and observers understand directions to the point.

2. Have maps and field sheets ready for observers. In ArcGIS, the field sheet can overlay a coverage of the survey area. For the ArcGIS template open the file: *04coveycountfieldsheet.mxd*

3. Do not conduct the survey if there are high winds (> 6.5 km/hr), cloud cover (>75% cloud cover), rain, or a dramatic drop in barometric pressure (> 0.05 in/Hg).

4. All observers should arrive at the point at 45 minutes before sunrise and remain at the survey point until all covey calling has ceased, approximately 5 minutes before sunrise. Disturbance should be kept to a minimum while at the point.

5. Before calling begins, orient the field sheet/map in the appropriate direction and be prepared to record data.

6. Record each calling covey once on the field sheet by placing a unique number in the appropriate location and distance category from the survey point.

7. During the calling period rotate to face all cardinal directions to assist in hearing coveys from all directions.

8. Use mapped covey locations to determine if subsequent calling coveys have already been detected. Add new coveys only if it is possible to verify they are unique. It is better to be conservative in the count of calling coveys.

9. At the end of the survey visually estimate cloud cover and measure or estimate wind speed (use an anemometer if available). Count the total number of calling coveys and the number of coveys for each distance category. Complete the datasheet. After returning to the office collect barometric pressure (in/Hg) observations for 1 am and 7 am to calculate the change. This information will be used for calculating the predicted call rate.

For the field sheet open the file: *04coveycountfieldsheet.pdf*

Breeding Season Call Counts

Breeding season call counts should be conducted using the same contracts, fields, and points used during the fall covey counts.

- Prior to conducting breeding season cock counts, observers should receive training that consists of a minimum of 3 mornings of monitoring male calling activity.
- Surveys should be conducted during the daily and seasonal peak periods of calling activity (Hansen and Guthery 2001). This generally occurs between sunrise and 1 hour after sunrise during the period from the last week of May to the 2nd week of July. Daily and seasonal phenology should be locally determined using pilot monitoring starting in late May.
- Replicate sampling of individual points (3 mornings/point) will reduce effects of daily and seasonal variation in calling activity.
- The effective listening radius under most conditions will be out to 400 m from the survey point. This may be greater in open, flat landscapes. Adjacent survey points should be spaced at least 1000 m apart to ensure independence.
- When possible, survey paired sites, such as a field with buffers and nearby field without buffers, ***on the same morning*** to avoid bias arising from temporal variation in covey calling rates.
- Program DISTANCE (version 3.5 or 4.1) will be used to estimate calling male density at the local (stratum) and regional (global) level.
- Between 75-100 observations are recommended to adequately estimate an observer detection function. If sample sizes are too low, existing detection functions can be used.
- Additional details on using program DISTANCE are in the guidebook.

Procedure for Breeding Season Calling Male Point Counts

1. Make sure all points have been clearly marked prior to the survey (flagging, pole, location coordinates) and observers understand directions to the point.

2. Have maps and field sheets ready for observers. In ArcGIS, the field sheet can overlay a coverage of the survey area. For the ArcGIS template open the file: *04coveycountfieldsheet.mxd*

3. Do not conduct the survey if there are high winds (> 6.5 km/hr), cloud cover (>75% cloud cover), rain, or a dramatic drop in barometric pressure (> 0.05 in/Hg).

4. Multiple points/per morning can be surveyed by a single observer as long as observers complete counts within 2 hour after sunrise.

5. All observers should arrive at the first point of the morning approximately 15 minutes before sunrise. Disturbance should be kept to a minimum while at the point.

6. Before calling begins orient the field sheet/map in the appropriate direction and be prepared to record data.

7. Call counts will consist a 5-minute observation period in which the number of calling males detected will be recorded within each of 5 distance bands (0-50, 50 – 100, 100 – 250, 250 – 500, > 500).

8. Record each calling male once on the field sheet by placing a unique number in the appropriate location and distance category from the survey point.

9. During the calling period, rotate to face all cardinal directions to assist in hearing calling males from all directions.

10. Use mapped bird locations to determine if subsequent calling birds have already been detected. Add new birds only if it is possible to verify they are unique.

11. At the end of the survey visually estimate cloud cover and measure or estimate wind speed (use an anemometer if available). Count the total number of calling males and the number of males for each distance category. Complete the datasheet. After returning to the office collect barometric pressure (in/Hg) observations for 1 am and 7 am to calculate the change. This information will be used for calculating the predicted call rate.

PROCEDURE FOR SONG BIRDS:

1. After the 5-minute bobwhite point count is completed, conduct a 10-minute songbird count, recording number of individuals and distance for each of the 8 select songbirds identified for regional monitoring (Dickcissel, Indigo Bunting, Common Yellowthroat, Eastern/Western Meadowlark, Grasshopper Sparrow, Song Sparrow, Eastern Bluebird, Loggerhead Shrike).

2. Do not conduct the count during high winds or heavy rains. Counts should not be conducted if it is raining hard or if wind strength on the Beaufort Scale is a sustained 4 or greater. If these conditions are encountered, cancel the sampling for the day and reschedule.

3. Orient the songbird bull's-eye data sheet to a fixed direction, record the wind and sky conditions, temperature, date, time, and observer. Concentric circles on the data sheet indicate distances of 0-25 m, 25-50 m, and 50-100 m ***(note this is a different distance band width than for bobwhite counts).***

4. Use a pocket timer or watch to keep track of time.

5. Record each bird seen or heard with the appropriate species codes [Appendix C in Hamel et al. (1996)]. Count family groups of juveniles with a single adult as a single bird.

6. Mark birds on the data sheet in the appropriate distance band and approximate spatial location. Use standard coding symbols included on the data sheet to aid in separating individuals [4 letter species alpha codes can be found in Appendix C of Hamel et al. (1996)].

7. Record data for different time intervals (0-3 minutes, 4-5 minutes, and 6-10 minutes) of the count in different ways. Some people like to use different color pens; alternatively, detections can be underlined or double underlined to indicate the different time periods. Be sure to record a legend of the chosen coding scheme on the data sheet for future reference.

8. Holding the sheet in a fixed position, spend part of the time facing in each of the cardinal directions in order to better detect birds.

9. Mark each bird once, using the mapped locations to judge whether subsequent songs are from new or already recorded individuals. All birds greater than 100 m from point center are recorded outside of the 100-m band; likewise, flyovers are recorded at the bottom of the page. The recorded distance should be the horizontal distance between the location a bird was first detected and the plot center. For species that occur in flocks, record the flock (e.g., species) and flock size in the appropriate distance band. There is no need to record each bird in a flock individually.

10. At the end of 10 minutes, stop recording bird observations. Do not record any new birds seen or heard after the 10 minutes have passed.

11. Record the latitude and longitude coordinates from the GPS unit and mark the location.

Field-level Monitoring Protocol of Vegetative Cover

We need to develop a monitoring protocol to minimally or at least qualitatively document extant vegetation conditions. Some of the items to be documented include:

Contract width/actual width
Contracted cover.
Is contracted cover established?
Harvested, hayed, or grazed by livestock
Used as turn rows, roads, storage of crops or equipment
Percentage in trees and shrubs (not to exceed 10%)
Presence of noxious weeds

Table 1. Distribution of CP33 acres by state sorted by acreage allocation, estimated number of contracts, estimated number of fields, cumulative acres of total CP33 allocation, cumulative % of total allocation, and cumulative % of allocation to states with 95% of total allocation.

State	Acres	Est. No. Cont.	Est. No. Flds	Cumulative Acres	%Total	Cumulative %	% of 235700
Illinois	20000	2500	10000	20000	0.08	0.08	0.085
Indiana	20000	2500	10000	40000	0.08	0.16	0.085
Iowa	20000	2500	10000	60000	0.08	0.24	0.085
Kansas	20000	2500	10000	80000	0.08	0.32	0.085
Missouri	20000	2500	10000	100000	0.08	0.4	0.085
Texas	20000	2500	10000	120000	0.08	0.48	0.085
Ohio	14200	1775	7100	134200	0.0568	0.5368	0.060
Arkansas	12000	1500	6000	146200	0.048	0.5848	0.051
NorthCarolina	11300	1412.5	5650	157500	0.0452	0.63	0.048
Oklahoma	9500	1187.5	4750	167000	0.038	0.668	0.040
Mississippi	9400	1175	4700	176400	0.0376	0.7056	0.040
Tennessee	9300	1162.5	4650	185700	0.0372	0.7428	0.039
Kentucky	9000	1125	4500	194700	0.036	0.7788	0.038
Louisiana	8900	1112.5	4450	203600	0.0356	0.8144	0.038
Georgia	8600	1075	4300	212200	0.0344	0.8488	0.036
Alabama	6100	762.5	3050	218300	0.0244	0.8732	0.026
Nebraska	6000	750	3000	224300	0.024	0.8972	0.025
SouthCarolina	5000	625	2500	229300	0.02	0.9172	0.021
Virginia	3600	450	1800	232900	0.0144	0.9316	0.015
Florida	2800	350	1400	235700	0.0112	0.9428	0.012
Michigan	2400	300	1200	238100	0.0096	0.9524	
Pennsylvania	2200	275	1100	240300	0.0088	0.9612	
Maryland	2100	262.5	1050	242400	0.0084	0.9696	
Wisconsin	1500	187.5	750	243900	0.006	0.9756	
Delaware	900	112.5	450	244800	0.0036	0.9792	
Colorado	600	75	300	245400	0.0024	0.9816	
NewJersey	600	75	300	246000	0.0024	0.984	
Connecticut	500	62.5	250	246500	0.002	0.986	
Maine	500	62.5	250	247000	0.002	0.988	
Minnesota	500	62.5	250	247500	0.002	0.99	
NewMexico	500	62.5	250	248000	0.002	0.992	
NewYork	500	62.5	250	248500	0.002	0.994	
RhodeIsland	500	62.5	250	249000	0.002	0.996	
SouthDakota	500	62.5	250	249500	0.002	0.998	
WestVirginia	500	62.5	250	250000	0.002	1	
Total	250000				1		

Table 2. Labor estimates based on fixed sampling level within each state at minimum sampling intensity.

All States Sample at the Minimum Level

					Fall Surveys			Spring Surveys			
State	**Acres**	**Est. No. Cont.**	**Est. No. Flds**	**Sample Size**	**Mandays**	**Bodies**	**Labor Cost**	**Mandays**	**Bodies**	**Labor Cost**	**Total Costs**
Illinois	20000	2500	10000	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Indiana	20000	2500	10000	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Iowa	20000	2500	10000	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Kansas	20000	2500	10000	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Missouri	20000	2500	10000	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Texas	20000	2500	10000	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Ohio	14200	1775	7100	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Arkansas	12000	1500	6000	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
NorthCarolina	11300	1413	5650	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Oklahoma	9500	1188	4750	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Mississippi	9400	1175	4700	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Tennessee	9300	1163	4650	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Kentucky	9000	1125	4500	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Louisiana	8900	1113	4450	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Georgia	8600	1075	4300	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Alabama	6100	763	3050	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Nebraska	6000	750	3000	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
SouthCarolina	5000	625	2500	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Virginia	3600	450	1800	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Florida	2800	350	1400	40	94	4	$7,050.00	20	1	$1,500.00	$8,550.00
Total				800	1880	94	$141,000.00	400	20	$30,000.00	$171,000.00

Table 3. Labor estimates based on proportional stratified sampling, proportional to acreage allocation.

Modified Stratified Proportional Sampling

					Fall Surveys			Spring Surveys			
State	**Acres**	**Est. No. Cont.**	**Est. No. Flds**	Sample Size	Mandays	Bodies	Labor Cost	Mandays	Bodies	Labor Cost	Total Costs
Illinois	20000	2500	10000	141	296.85	14	$22,263.41	70.71	4	$5,303.35	$27,566.76
Indiana	20000	2500	10000	141	296.85	14	$22,263.41	70.71	4	$5,303.35	$27,566.76
Iowa	20000	2500	10000	141	296.85	14	$22,263.41	70.71	4	$5,303.35	$27,566.76
Kansas	20000	2500	10000	141	296.85	14	$22,263.41	70.71	4	$5,303.35	$27,566.76
Missouri	20000	2500	10000	141	296.85	14	$22,263.41	70.71	4	$5,303.35	$27,566.76
Texas	20000	2500	10000	141	296.85	14	$22,263.41	70.71	4	$5,303.35	$27,566.76
Ohio	14200	1775	7100	100	214.82	10	$16,111.52	50.21	3	$3,765.38	$19,876.90
Arkansas	12000	1500	6000	85	183.71	8	$13,778.04	42.43	2	$3,182.01	$16,960.06
NorthCarolina	11300	1413	5650	80	173.81	8	$13,035.57	39.95	2	$2,996.39	$16,031.97
Oklahoma	9500	1188	4750	67	148.35	7	$11,126.37	33.59	2	$2,519.09	$13,645.46
Mississippi	9400	1175	4700	66	146.94	7	$11,020.30	33.23	2	$2,492.58	$13,512.88
Tennessee	9300	1163	4650	66	145.52	7	$10,914.23	32.88	2	$2,466.06	$13,380.29
Kentucky	9000	1125	4500	64	141.28	6	$10,596.03	31.82	2	$2,386.51	$12,982.54
Louisiana	8900	1113	4450	63	139.87	6	$10,489.97	31.47	2	$2,359.99	$12,849.96
Georgia	8600	1075	4300	61	135.62	6	$10,171.76	30.41	2	$2,280.44	$12,452.21
Alabama	6100	763	3050	43	100.27	4	$7,520.09	21.57	1	$1,617.52	$9,137.61
Nebraska	6000	750	3000	42	98.85	4	$7,414.02	21.21	1	$1,591.01	$9,005.03
SouthCarolina	5000	625	2500	40	94.00	4	$7,050.00	20.00	1	$1,500.00	$8,550.00
Virginia	3600	450	1800	40	94.00	4	$7,050.00	20.00	1	$1,500.00	$8,550.00
Florida	2800	350	1400	40	94.00	4	$7,050.00	20.00	1	$1,500.00	$8,550.00
Total				1706	3692.11	171	$276,908.36	853.0	42.65	$63,977.09	$340,885.45