Executive Summary
Conducting Early Morning Covey Call Point Counts
Standard Operating Procedure

The following guidelines have been developed to assist individuals interested in conducting early morning covey call point counts to estimate northern bobwhite (*Colinus virginianus*) autumn 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. 1993). 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.
- Sampling design should use a random or stratified random placement of survey points whenever permitted.
- The effective listening radius under most conditions will be out to 500 meters 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) will 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 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 EARLY MORNING COVEY CALL POINT COUNTS

1. Prior to the survey make sure all points have been clearly marked (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 6 hours prior to the survey (> 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 between 5 minutes before sunrise and 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 filling out 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*

Guidelines for Estimating Autumn Abundance and Density of Northern Bobwhites

Determining autumn density of northern bobwhite populations is important to researchers and managers for estimating population responses to land management activities and experimental treatments. Recent research on early morning covey call counts has provided the information necessary to develop methods to index autumn covey abundance and estimate bobwhite density (Demaso et al. 1992, Wellendorf 2000, Seiler 2001, Hamrick 2002, Seiler et al. 2002, Wellendorf et al. 2004). The purpose of this guide is to provide biologists with the information needed to design and implement covey call surveys for the purpose of estimating autumn abundance of northern bobwhites on areas of interest.

Covey Calling Behavior

The covey call is a loud clear whistle, vocalized as “koi-lee”, often given by 1 or 2 bobwhite from a covey (Stoddard 1931, Stokes 1967). Often the call is given in early mornings, but can also be heard in the evenings before coveys go to roost or after a covey has been flushed. Most likely, early morning calling primarily functions to announce a coveys location to neighboring coveys. Coveys use these location cues to space themselves across the landscape, which reduces competition for food and cover and to call back individuals separated from the covey. In early mornings, a calling covey will stimulate nearby coveys to call making this the most consistent time to hear coveys in an area. In autumn, this call is given on a regular basis while coveys are forming and establishing their winter ranges.

There has been extensive research investigating the rate at which coveys broadcast early morning covey calls (Seiler et al. 2002, Wellendorf et al. 2004). This information was gathered by monitoring calling activities of hundreds of radiomarked coveys on multiple sites, years, and varying localized densities. The results between these 2 cited studies are similar and summarized in the information below. They also provide the basis for developing protocols for surveying covey abundance using covey calls.

The covey call rate is the proportion of coveys that broadcast early morning calls. The covey call rate gradually increases during late September remaining high in October and then declining after November. Overall, the highest most consistent call rates were observed during the last 2 weeks of October. Wellendorf (2000) reported an overall call rate of 0.77 for 5 sites and Seiler et al (2002) had a call rate of 0.96 for 2 sites during the last week of October. For most areas and years the optimal time to conduct covey call surveys will be during that time period. However, consider that seasonal timing of peak call rates can fluctuate somewhat regionally and annually. Southern states such as Florida and South Georgia have observed high call rates that extended into late November, whereas northern states such as Tennessee and Missouri had high call rates in late September and early October. Additionally, while not as clearly documented, we have observed annual shifts in the peak calling rate on the same sites. These shifts were generally correlated to the length of the nesting season and average date that most chicks hatch. A longer nesting season and a large hatch in late summer will tend to cause a later peak call rate, presumably because covey formation occurs later. In late November and December, call rates tend to decrease and become more variable from day to day. For most areas and years it is not recommended to conduct surveys after 1 December.

The majority of covey calling was concentrated in the twilight period at dawn. The average calling time was 25 minutes before sunrise, but this can fluctuate slightly (± 5 minutes) from day to day depending on weather conditions and time of year. The light intensity for this period is about the time you can clearly read the numbers on a watch. Typically, coveys within an area called simultaneously with the majority of calling happening within a few minutes. After this initial surge, calling gradually ceased. Some radiomarked coveys called additional times after this initial calling period, but it was sporadic and unpredictable. On average, coveys would give about 30 calls during a morning calling period with the number of calls given tending to increase seasonally and peak during periods with the greatest call rate. This calling intensity provided the majority of observers ample opportunity to detect and locate a calling covey.

The most important measured factor in determining if a radiomarked covey called was the number of additional coveys heard calling within the vicinity of the radiomarked covey. As the number of calling coveys increased the probability of a radiomarked covey calling also increased. This density dependent relationship between the number of calling coveys and the call rate is very important when planning covey call surveys (see below). Weather was only a minor factor affecting covey calling, except during dramatic changes in barometric pressure, cloud cover, and wind. On mornings, when a cold front was encroaching characterized with 100% cloud cover and strong winds, few coveys called. The percentage of coveys calling and the number of calls per covey was highest on clear (cloud cover < 10%), calm (wind < 1.61 km/hr) mornings with stable to increasing barometric pressure. For best results surveys should be limited to be only conducted during similar weather conditions.

Predicting the Call Rate

Wellendorf et al. (2004) developed a call rate predictive model from covey call observations of radiomarked coveys. This model will estimate the covey call rate for an observation point considering the following explanatory variables: number of calling coveys recorded, barometric pressure change, percent cloud cover, and wind speed. The following model is a logistic regression model used to calculate a posterior probability of a covey calling or the call rate within the auditory range of a survey point.

CALL RATE =
[exp(-0.228 + (0.348*covey count) + (3.27*{ 0700bp-0100bp}) + (-0.002*cloud%) + (-0.092*wind km/hr)] ÷
[1 + [exp(-0.228 + (0.348*covey count) + (3.27*{0700bp – 0100bp}) + (-0.002*cloud%) + (-0.092*wind km/hr)]]

In the model, the barometric pressure (inches/Hg) change from 0100 to 0700 is used rather than raw barometric pressure readings to standardize over different areas. Get both observations from the same weather station. So, if 0100 bp = 30.10 in/Hg and 0700 bp = 30.12 in/Hg, then the value used would be: 30.12 – 30.10 = 0.02. Typically, barometric pressure change will range between –0.05 and 0.05. If you are getting values consistently higher than this you may consider getting your barometric pressure data from another source.

Estimate the cloud cover to within 10%. Wind should be an estimate of the ground speed (km/hr). Don't use weather station data. Most wind speeds are between 0–4.8 km/hr (0–3 mph). Below (Table 1) is a ground wind speed estimate guide from the breeding bird survey. Overall, cloud and wind are minor factors affecting calling rates except at extreme levels. How to incorporate the call rate model predictions with the survey count will be covered in later sections of this document.

OBSERVER TRAINING

Early morning covey call surveys, as with any survey effort, it is important to minimize variation among the data collected by different observers. Experience is the best way to minimize observer variation. However, it can take years before a group of observers can become very proficient. The following list of recommendations is to assist new observers with increasing their proficiency. It is important that all observers are clear on what the covey call whistle sounds like and how the whistle sound can change with topography and vegetation. Covey call recordings can be played before going to the field for the first time. However, the best option is to conduct practice surveys as a group. Missouri Department of Conservation recommends a minimum of 3 practice surveys for observers. During practice surveys observers should become familiar to the initial flurry of calling, differentiating coveys from one another, plotting covey locations on a map (if used), recording calling times (if multiple observer surveys are used), and estimating general distances (detailed later). The advantage of conducting practice surveys as a group is confusing observations can be discussed and a consensus on how to resolve them can be obtained.

On TTRS, we have noticed new observers having confusion with a couple of survey scenarios. First, when multiple quail within the same covey are calling new observers will count them as 2 coveys instead of 1. As a general rule, any calling within a 30 m diameter area should be considered from 1 covey. This will also account for the occasional times when a covey was broken apart before daybreak causing a large amount of calling by multiple individuals. If the number of calling coveys is unclear it is always best to be conservative on the count. Another problem for new observers is multiple calling events for the same covey. Coveys will give an initial burst of calling, be silent for a few minutes and then start calling a few minutes later. New observers will sometimes confuse this as a new covey. Recording covey locations on a map and call start times should help to minimize this problem. Often, new observers feel overwhelmed when the flurry of covey calling starts, especially on higher density areas (>8 coveys/point). To minimize the confusion have observers divide the survey area into compartments completing the data recording for each section and then rotating to face the next. This will have to be done quickly however to be effective, surveying each compartment multiple times before calling has ceased.

SURVEY DESIGN CONSIDERATIONS

Covey call surveys have many positive aspects. They require monitoring for only a short time in the mornings. The degree of access needed and disturbance to an area are low and very few supplies are needed. Before any surveys can begin the objectives of the study need to be clearly stated and a clear idea of what level of precision is needed to meet the objectives. Some general knowledge of covey abundance of the area prior to the survey would be beneficial in determining the types of feasible surveys. When measuring covey abundance, as with most animal sampling, the level of certainty for estimates tends to decrease at lower population levels and some survey types may not be statistically feasible. There are 3 degrees of surveys to consider and they vary by level of precision, these include: a simple presence/absence survey, a measure of relative abundance, and density estimation. Each type of survey is a modification of a point count type survey and each has specific advantages/disadvantages, which are detailed within this document.

Sampling Design

Determining how survey points are allocated across the area of interest can sometimes be difficult. Most vertebrate monitoring texts (Thompson et. al 1998, Bibby et al. 2000) support the use of random placement of survey points. On homogeneous landscapes, such as grasslands or open pine woodlands, this sampling strategy works well and should be used whenever possible. However, designing surveys on heterogeneous habitats can be more difficult to accomplish, which unfortunately is most landscapes in the Southeast. The problem becomes in determining how different habitats relate to autumn covey abundance and how to stratify sampling to account for these habitat differences. For instance, some habitat types are considered unusable by coveys but are part of the larger overall study area. An example would be large hardwood bottoms or closed-canopied pine plantations. If sampling mornings or personnel were limited a recommendation would be exclude these areas from point counts in order to concentrate sampling on areas where coveys would be more likely located. However, when drawing inferences from data gathered it should be clearly stated that these areas were excluded from sampling. The more difficult decision is determining how to allocate survey resources for areas with marginal habitats and limited numbers of coveys. Habitats considered even marginally usable by quail should be included in sampling area. Most sampling protocols recommend stratifying random points so the proportion of area surveyed is approximating in proportion to the amount of each habitat classification. On some landscapes were habitats are highly fragmented and/or access may be limited another option would be to establish as many potential survey points as possible and then randomly select from this pool of points. While this is not a truly random point selection it may be the only realistic option on a working landscape.

Agricultural landscapes can create additional sampling problems. Before point locations are selected the harvest status of different crops needs to be determined for the time of the survey. For instance, in North Carolina, during mid-October point count surveys the majority of corn had been harvested and radiomarked coveys moved to periphery habitats around the cornfields while other radiomarked coveys remained in standing soybean fields (S. Wellendorf, unpublished data). Therefore, surveying a buffer of acceptable habitat around areas of interest (e.g., field and bobwhite buffer) is important to estimate bobwhite response.

The amount of the overall study area that needs to be covered in the sample should be at a minimum 15% with an optimal coverage of between 30% and 50%. If the projected quail abundance is low the amount of coverage area should be increased to improve the number of coveys detected. One advantage of covey call point counts is the large area covered by a single point so attaining sampling coverage goals is usually attainable.

Point Spacing and Selection

There are some factors to be considered when spacing covey call point counts on a survey area. Previous research has shown that the estimated listening radius for experienced observers is 500 m (1640.5 feet, 547 yards, 0.31 miles). This listening radius should work for most places, but may vary on areas with rough terrain or dense cover. On TTRS, an open pine woodland, observers only detected 3% of calling coveys beyond 500 m. In order to maintain independence among points they should be spaced at least 1000 meters (0.62 miles, 3281 feet) apart from one another (Figure 1). This recommendation was determined on forested land with a rolling topography. On open range land or agricultural land spacing may have to be increased if it appears coveys are being documented from adjacent points. Adequately spacing points will maximize the survey area potential and avoid problems associated with double counting same coveys.

Choose point locations that are a good vantage point for hearing whenever possible. For instance, placing observers in low spots on the landscape, such as in drains, will greatly reduce their ability to hear coveys. Be prepared to slightly change survey point locations if the topography is not suited to listening. Make observers aware of potential factors such as dense vegetation or topography that may affect their ability to hear. Points should also be placed to minimize disturbance by observers on their way to the point. There are advantages to placing points along roads and paths because of their accessibility, however consider that inference from the count data will only to areas around the roads/paths. If points are placed off roads points should be well marked for the observer going to the point.

Pre Sampling Observations

For the best estimates conduct surveys when the calling rate is at its seasonal peak. It is important to survey during the peak calling to minimize variability in the calling rate and in turn in your abundance estimates. Prior to conducting actual surveys consider conducting pilot observations on a subset of areas to determine when covey calling peaks. To do so, survey a small subset of points beginning in early September about 2 times per week until an increase in calling activity is noted. Both the number of calling coveys and the duration of calling events noticeably increase during the peak of calling.

Point Resampling

The goal is to get the best count of calling coveys for a survey point. If the count seems low because surveys were conducted on marginal weather mornings or before peak seasonal calling then resampling should be considered. It is hard to quantify a poor calling morning for a particular point, but typically an observer familiar with an area will notice the morning calling period is very short, few calls are given by each covey, and the calling intensity by a covey is lower than usual. Deciding to resample a point can be subjective and could potentially effect the survey outcome. If possible, plan on resampling points and taking the highest counts, or only conduct surveys on the best survey mornings.

Morning of the Survey

On the morning of the survey, arrive at the listening point 45 minutes before sunrise. Be as quiet as possible traveling to the survey point and while waiting for the calling to begin. Have the datasheet/map ready and orientated for when the coveys begin calling. See the procedure guide sheet for detailed instructions on collecting and filling out the data field sheet (See Figure 3 for an example). Stay until 10 minutes before sunrise or until you are convinced that no new coveys are calling.

Point Count Survey Maps

Having a map of the point area is extremely helpful for discerning between different coveys and estimating their distance. If Arcview or ArcGIS is available there are multiple options for background coverages, such as DRG's, DOQQ's, or GPS delineated landcovers, The "bulls-eye" field sheet (*04coveycountfieldsheet.pdf*) was created as a map document template (*04coveycountfieldsheet.mxd*) and can be opened in ArcGIS. Once the template is opened in the layout window of ArcGIS the view scale (in data frame properties) needs to be set to 1 inch = 133 meters, which will set the view to the same scale as the ring sizes in the template. In the layout window the view can then be moved to align the "bulls-eye" on top of the point location. Other options to produce maps could be a photocopy of an aerial photo or an enlarged copy of a 1:24,000 USGS topographic map (0.82 inches = 500 m,). If no mapping media is available a blank "bulls-eye" field sheet attached with document will also be helpful in recording and discerning calling coveys.

MEASURING ABUNDANCE

Relative Abundance Surveys

Early morning covey call surveys are typically used as a general measure of relative abundance (typically referred to as an index). Abundance surveys are often used because of straightforward assumptions, a simple sampling design, and they do not have the restrictive assumptions or complicated detection functions associated with more precise density estimators. The main assumption of index counts is that the proportion of the population of interest is detected at a consistent rate over space and time, such that if the covey call count increases it is assumed the underlying covey density has also increased at a similar rate. This assumption is likely violated because the proportion of coveys calling changes over time and space. Therefore, the use of raw covey call counts to index abundance is not recommended. The covey count index can be improved by adjusting the raw covey counts at each point by a predicted covey calling rate estimated from the equation provided. Thus we advocate the use of adjusting each index covey call point count by the predicted call rate.

Early morning covey call count indices can be most effective on areas with approximate autumn bobwhite densities ranging between 1 quail/10 acres (1 covey/120 acres) and 2 quail/acre (1 covey/6 acres). This would similar to hearing on average between 0.5 and 16 coveys per point. The call rate model was developed on areas within this range of covey density. Adjusting point counts on areas with densities less than this can be problematic since predicted call rate could be vastly different than the actual call rate. If over half of the point counts are on average hearing no coveys than the only option may be to conduct presence/absence surveys (described below).

Survey point adjustment example

As stated earlier it is important adjust each point count by a predicted call rate before summarizing or analyzing the data. This adjustment will compensate for differences in the detection probabilities among points. The following is an example of the results from a point count. If an observer heard 4 calling coveys during the point count with weather variables measured as 0.01 six hour barometric pressure change, 10% cloud cover, and wind speed 1.0 km/hr, the estimated call rate based on the CALLRATE model would be:

$$\text{call rate} = \exp[-0.228 + 0.348(4) + 3.27(0.01) + -0.002(10) + -0.092(1.0)] \div$$
$$[1 + \exp[-0.228 + 0.348(5) + 3.270(0.01) + -0.002(10) + -0.092(1.0)]]$$
$$= 0.74.$$

The point count of 4 calling coveys would then be adjusted by dividing it by the calling probability, 0.74, to calculate a value of 5.4. This value would then be used in the data analysis.

Measuring Annual Differences

If the interest is comparing quail abundance changes over years then there are different options for surveys. If there are enough observers the best option is to survey all established points on a single morning. If possible, repeat surveys over multiple mornings. Then use the highest covey count for each point to be used in your overall yearly average. If observers are limited, survey as many points as possible on a morning and then survey new points if subsequent mornings are available. When the surveys are completed each covey count should be adjusted by the call rate using the call rate model. Using the adjusted counts an overall site average could be calculated for the year. This value can then be compared to values from upcoming years. See figure 2 for an example of summarizing point count data over years. For the best year to year comparisons conduct surveys the same way every year.

Measuring Site Differences

If the objective is to compare covey abundance among areas for the same year, such as where different treatments have been applied, points from each treatment area should be surveyed on each morning. Even though covey counts are adjusted by a call rate to minimize differences in the call rate probability a balanced survey design will minimize any immeasurable day-to-day variation that might affect the comparison between sites. For instance, if there are 4 treatment areas and 5 survey points on each treatment area at least 4 observers are needed for each survey morning (1 observer for each treatment area). Given the goal to measure population differences between treatments all points should be sampled at least once before resampling points again.

Presence/Absence Surveys

Early morning covey call counts in its simplest form can be used to determine presence/absence of coveys within the point survey area. On areas with extremely low autumn densities (< 1 quail/25 acres or 1 covey/300 acres) this may be the only realistic survey technique. Most density estimating techniques and other more robust abundance estimating techniques tend to fail in their estimates when detections are low, such as when quail densities are low. Presence/Absence surveys are not restricted by unattainable assumptions making them a viable option. On these low density areas the call rate can be extremely variable from day to day and the previously stated call rate model is unable to accurately estimate call rates on these areas. On these areas the call rate is hard to predict because there are such few calling coveys within an area to stimulate other coveys to call. It is not recommended to attempt to estimate a call rate on these areas. The idea (assumption) is that coveys within the point count survey area will call on some mornings irregardless of little or no calling from nearby coveys.

One option for presence/absence surveys on low density areas is to attempt to stimulate coveys to call by broadcasting tape recordings of the covey call. The use of a game caller and call tape may increase the likelihood of detecting a covey from a survey point. To be most effective, covey call recordings should be played at 25 minutes before sunrise or during the time when coveys would naturally call. Play the tape for 10-second intervals 3 or 4 times, pausing10 seconds between sessions to listen for coveys calling back to the broadcast. Commercially made game callers (Johnny Stewart etc…) work well, but you could use just about any battery operated tape player. However, we have observed that the louder the broadcast the better the response. If covey call tapes are used to stimulate calling it would be advisable that it be used on all points of interest. If sampling is to take place over many years and the game caller is used in the initial surveys then it should be used over all years of the study.

The purpose of presence/absence surveys is to cover as much area as possible and determine how many survey points have coveys detected. With this objective in mind, place as many independent survey points as possible in the area of interest. The objective would be to survey as many different points as possible. If additional resources are available resampling points with no detections is recommended to verify the absence of coveys. As with any covey call surveys conduct surveys under the best possible seasonal and weather conditions.

To summarize the data simply determine the proportion of points where coveys were detected calling. This is a very simple design, but gives you the basis for comparing observations from year to year for an area. Caughley (1977) suggested that the presence/absence index can be useful in monitoring a population when a species occurs on less than 20% of the survey points. Once species occurrence increases over 0.60 the ability for presence/absence survey to index density greatly decreases, since the relationship between the presence/absence index and the actual density often times is not linear (Thompson et al. 1998). The problem with this survey design is limited inference on population trends through time. Assuming there is an increase in the population through time this method will only document the increase in the spatial distribution of additional coveys and not the change in covey numbers within points where coveys are already detected. One option is to report presence/absence index data until at least 60% of points have recorded calling coveys for at least 2 years. After that has been completed, consider switching to a relative abundance index survey.

DENSITY ESTIMATION—Distance Sampling

Distance sampling combines point counts with an observer detection function. The premise of this method is that the ability of an observer to detect calling coveys decreases as the distance of coveys increases from the point, which can be modeled with a decreasing function. Distance sampling procedures have been extensively researched (Buckland 1993) and have been routinely used for songbird surveys (Rosenstock et. al 2002).

The use of distance sampling to estimate autumn covey density is a relatively new technique. Only preliminary testing has begun on the accuracy of the density estimates. Initial research documented legitimate density estimates for areas with autumn densities of ~ 1 quail/acre, with a range of 4-12 coveys heard per point. The use of distance sampling on lower density areas will have to be further tested before its use can be advocated. Preliminary research by Smith and Burger (unpublished data) on lower density areas in rural Georgia had reasonable detection functions with good model fit as long as an adequate number of points were surveyed. It becomes difficult to estimate a detection function when there is a limited number of distance observations collected. Buckland et al. (1993) recommend 75-100 observations be collected before a distance detection function can be estimated.

On areas were it is not possible to collect the minimum number of observations for estimating the distance detection function we still recommended that distance information be collected while conducting abundance index point counts. Then, at some future date, these data can be applied to a global detection function created using data from other areas to estimate density for their study areas. This would be okay as long as the landscape physiognomy is similar to the area the detection function was developed (i.e., the research has no reason to expect detections over distance would be different). As distance sampling techniques described herein are field-tested, data from multiple areas could be combined to develop detection functions for individual regions, such as BCR's.

Distance Sampling Assumptions

Covey call point counts are a good candidate for using distance sampling because of a strong potential to meet core assumptions, which are: (1) 100% detection of calling coveys at the vicinity of the survey point, (2) calling coveys are detected before evasive movements, and (3) distances to calling coveys are accurate and consistent among observers. The first 2 assumptions are relatively easy to meet. We have observed coveys calling very near to an observer as long as observer arrives at the point early (~45-50 minutes before sunrise) and remains quiet before calling begins. Coveys call before leaving their roost site minimizing the effect of evasive movements before detection. The final assumption is more problematic. It can be difficult to estimate the distance to a calling covey. Adequate observer training of observers is a must in order to meet this assumption, which will be covered in a following section.

Survey Design

Survey design for distance sampling would follow similar protocols of other point count surveys.

Observer Training

Additional observer training may be needed to ensure distances to calling coveys are accurately estimated and consistent among observers. First, observers should be assessed in their ability to estimate distance. There are many options to assist with this. Observers could pace out to different distances to get a "feel" for the size of a survey plot. If a long straight road is available markers could be set out at designated distances. The main objective is to get observers accustomed to estimating distances. A detailed map is extremely valuable in assisting with estimating distance, by referencing obvious landcover features (agricultural fields, roads, etc…) or topography. Another option is to provide a laser range finder to novice observers to assist with their distance estimation. If group practice surveys are used have observers compare distance estimates to help correct any problems.

Data Collection

To assist with estimating distances calling coveys can be placed into distance categories. Rosenstock et al. (2002) recommended wider categories for distance bands to help offset decreased accuracy in distance estimation by observers. Preliminary covey call survey research used the following distance categories: 0-100 m, 100-250 m, 250-500 m, and >500 m. However model fit was marginal, which presumably from a low number of categories. Buckland et al. (1993) recommend a minimum of 4-5 distance categories for estimating a detection function. The problem with covey call surveys is the limited ability for observers to locate calling coveys in the correct distance category and the difficultly increases as the number of categories increase. Another option for covey call surveys would be to have 4 categories: 0-50, 0-100 m, 100-250 m, 250-500 m, and >500 m (Figure 3). The additional group was added near to the observer where distance estimation accuracy should be highest. In preliminary covey call survey analyses, model fit was improved by adding this additional group (Wellendorf and Palmer). If distance categories are used, then assumption (3) would be observers accurately record calling coveys in the correct distance category.

Using Program Distance (version 3.5 or 4.1)

Program DISTANCE was developed to assist with calculating a detection function, estimating density, and associated variances. The DISTANCE home page and location of the program download are at: http://www.ruwpa.st-and.ac.uk/distance/. This website is an excellent resource for assistance with Version 3.5 and 4.1. There few differences between each version in the data input and data analysis modules. Version 4.1 has additional modules with a GIS and data simulation component. Make sure to read the install instructions carefully. Some additional Microsoft service packs may have to be installed before the program will run.

Project Setup

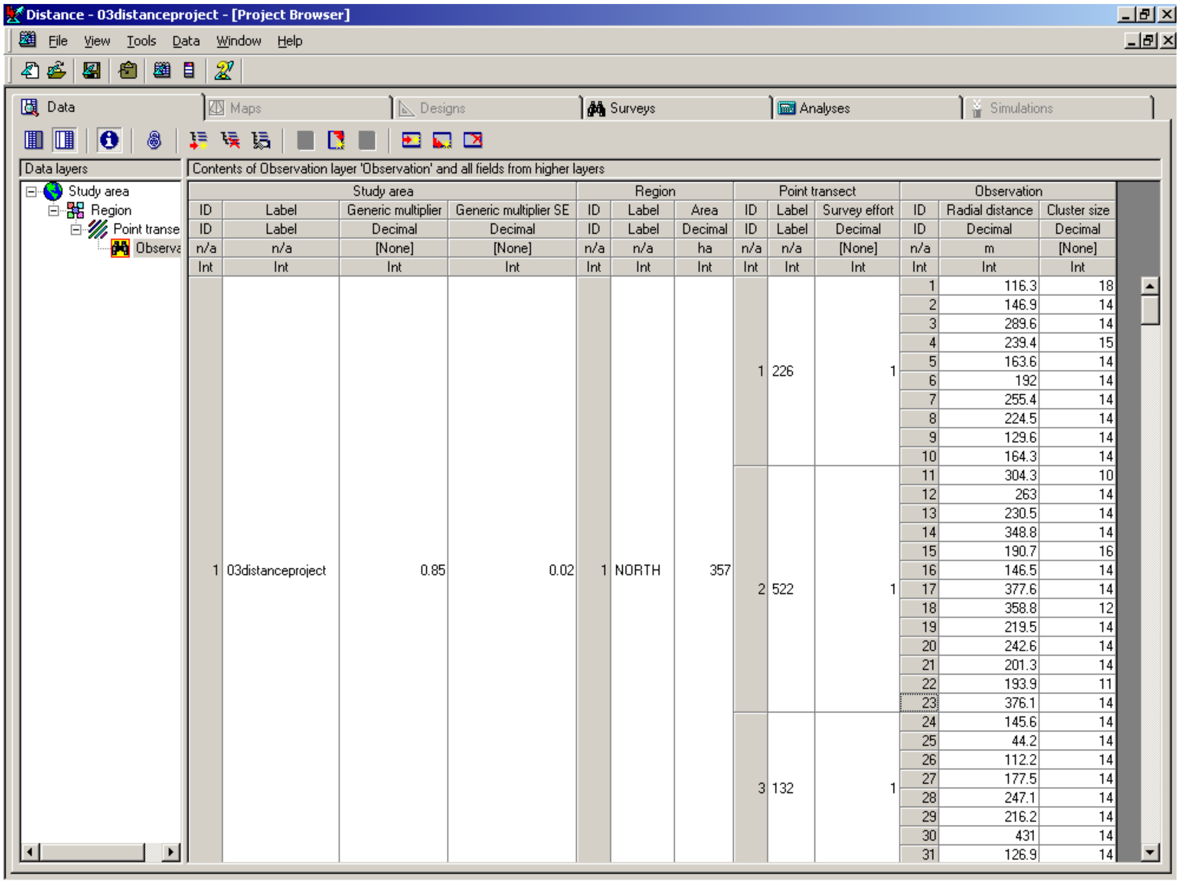
Project setup is extremely easy using the project setup wizard. Selection options will be: analysis of existing data, point transect, and whether observations are of clustered objects (coveys) or single objects. If population density is the interested statistic (quail/acre) then covey size will have to be estimated and clustered observations selected. Single object observations would be used for estimated covey density only. Typically, the sampling fraction should be set to 1 unless portions of the point transects were intentionally not sampled. Continue going through the wizard steps selecting desired measurement units. On the multiplier window select other for a general multiplier. This will allow for the adjustment of the density by an overall predicted call rate. After this move on to the data import window.

Data Input

It is much easier to enter and organize data in some other spreadsheet program such as Excel or Access as long as you can export as a delimited text file (tab or comma). The columns that must be included are study area name, the region or stratum name, stratum area, point label, radial distance, and cluster observations (covey size). Every cell must be filled for cluster observations or the program will not run. A covey average can be used for any missing cells. Use midpoint distances if distance categories are used. An example of the data would be:

Study Area	Stratum	Stratum Area	Point ID	Radial Distance	
03Florida	North Site	1000	1	75	
03Florida	North Site	1000	1	175	
03Florida	North Site	1000	1	175	
03Florida	North Site	1000	1	175	
03Florida	North Site	1000	1	375	
03Florida	North Site	1000	2	175	
.	.	.	.	.	
.	.	.	.	.	
.	.	.	.	.	
03Florida	SouthSite	1000	1	25	
03Florida	SouthSite	1000	1	75	
03Florida	SouthSite	1000	1	75	
03Florida	SouthSite	1000	1	175	
.	.	.	.	.	
.	.	.	.	.	
.	.	.	.	.	. . .

Here is an example of the program data interface:

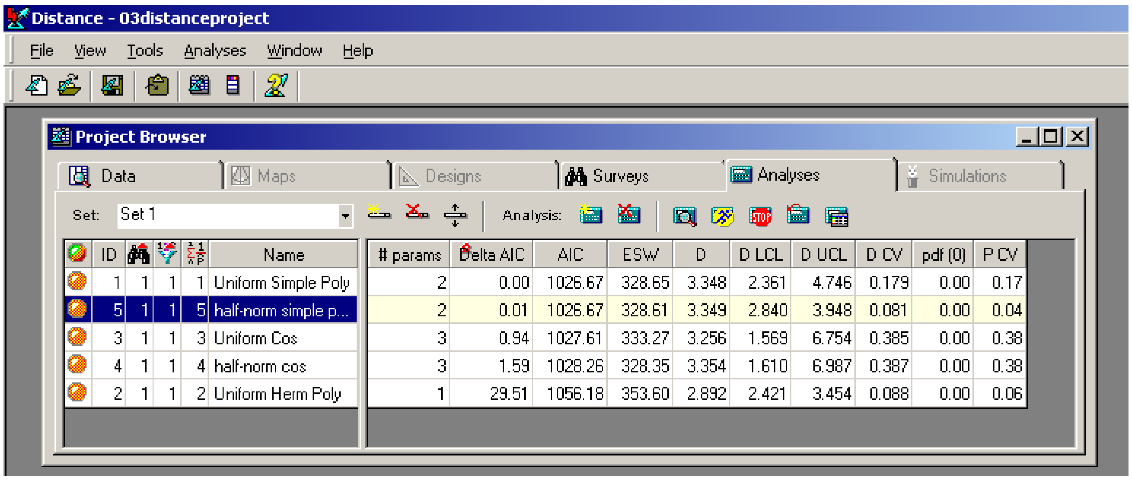


General Multiplier

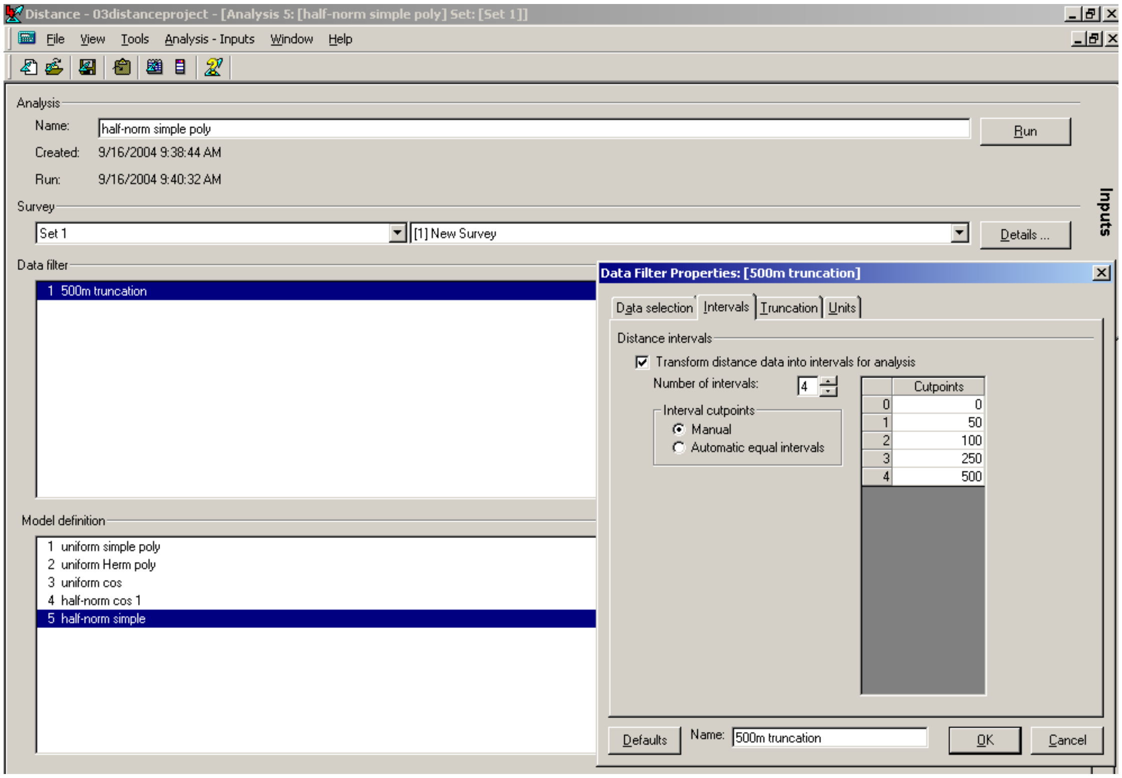
The current 2 versions of DISTANCE (3.5 or 4.1) are unable to apply a call rate to the point transect. The only way to adjust for the call rate is to apply an overall call rate average from predicted call rates of each point count, which is applied at the study area level as a general multiplier. After the data has successfully imported into DISTANCE open the data browser to the observation level and insert the overall average call rate and SE in the specified columns. This adjustment can be applied to the global and regional density estimates. The general multiplier should be used for both covey and population density estimates.

Data Analysis

Data analysis section allows for the input and comparison of different detection models and model selection uses an AIC approach. The initial data analysis window outlines the results from the different models that have been run and sorts them by the delta AIC values.

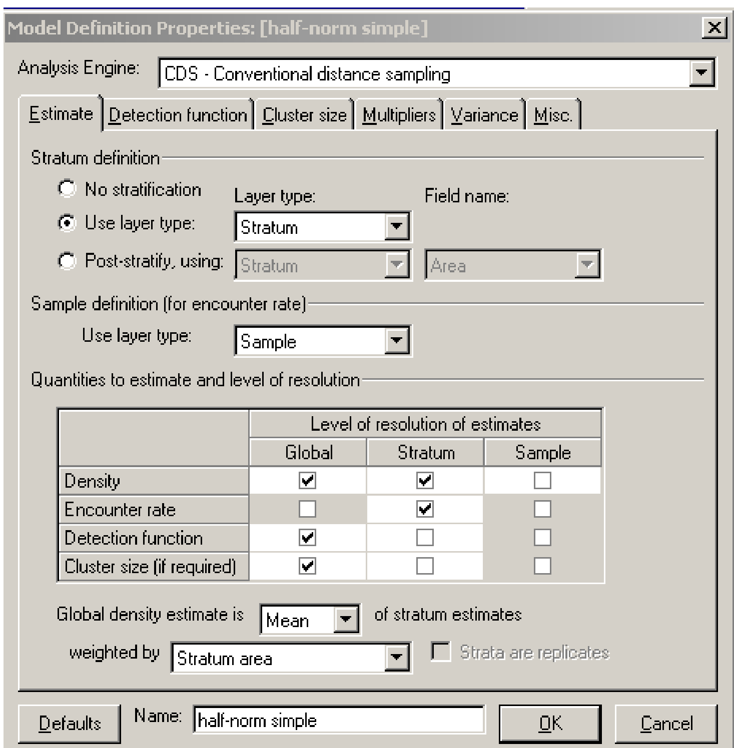


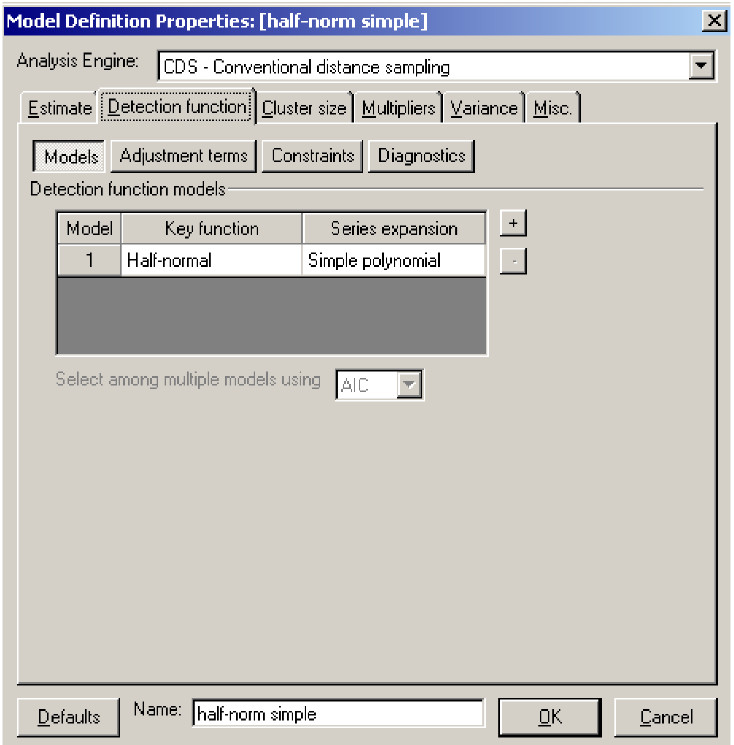
Models can be set up by opening the model details window, which is divided into 3 sections including input, log, and results. The input tab has the data filter and model definition section used to set up desired parameters. In the data filter section specific records can be queried, grouping intervals are set, and the right truncation levels specified. Right truncation discards observations beyond a specified distance (500 m in the covey example), which tends to improve model fit for the smaller distance categories. If the data is grouped right truncation is not a major issue. If categories are not used Buckland et al (1993) recommends discarding 5-10% of the farthest observations. Once the data filter parameters are set for a group of models it should not be changed. If changes are made all model summary statistics are lost and models will have to be rerun. The program will default right truncation value to the maximum distance interval entered.



The next step is to set the model definition parameters. The first tab assists with setting the level to calculate density estimates and the detection function. The detection function can be based on the global set of data or developed at the stratum level. In many instances a global detection function will have to estimated due to the lack of samples at the stratum level and to improve model fit. The next tab defines which key function and series expansion will be used in the detection function. The key function provides the general "shape" of the distance histogram and the series expansion provides flexibility in the key function by adding additional parameters to improve model fit (Buckland et al. 1993) There are 3 key functions offered for point transects including uniform, half-normal, and hazard rate. There are also 3 series expansion choices: cosine, simple polynomial, and Hermite polynomial. The model adjustment terms within the series expansion can be automatically selected by program DISTANCE or manually entered, which is important if a predetermined detection function is used. It would be advantageous to read additional resources on distance sampling key functions such as in, Buckland et al. (1993)(pp. 150) and Williams et al. (2001) (pp. 280).

Additional parameters to set in the model definition window include covey size, the multiplier, and variance estimation. If covey size (cluster size) is included select the option to use mean observed covey size in the analysis instead of the size-biased regression option, which is the default. The next tab details the multiplier options. Make sure the correct operator is used for the call rate (/). The variance tab will determine if the variance is determined empirically or by bootstrapping procedures, which is outlined in Buckland et al. (1993).





There are no clear guidelines for developing a set of models to be used in the analysis. Once the data filter has been set for an analysis model development can begin. The simplest recommendation is to develop all combinations of key functions and series expansions and select the model with the lowest AIC values and adequate model fit. Buckland et al. (1993) recommends plotting a histogram of the distance categories to narrow the model selection. However, it can be difficult to "eyeball" potentially adequate models. Typically, there will be measurable differences in model selection among key functions with only minor differences among series expansions within a key function.

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Table 1. General estimates of wind speed.

(km/hr) (use in the formula)	mph	Indicators wind speed
< 1.61	< 1	Smoke rises vertically
1.61 to 4.83	1 to 3	Wind direction shown by smoke drift
6.44 to 11.27	4 to 7	Leaves, small twigs in constant motion; light flag extended; consider not conducting survey
12.87 to 19.31	8 to 12	Raises dust and loose paper; small branches are moved; ***do not conduct survey***

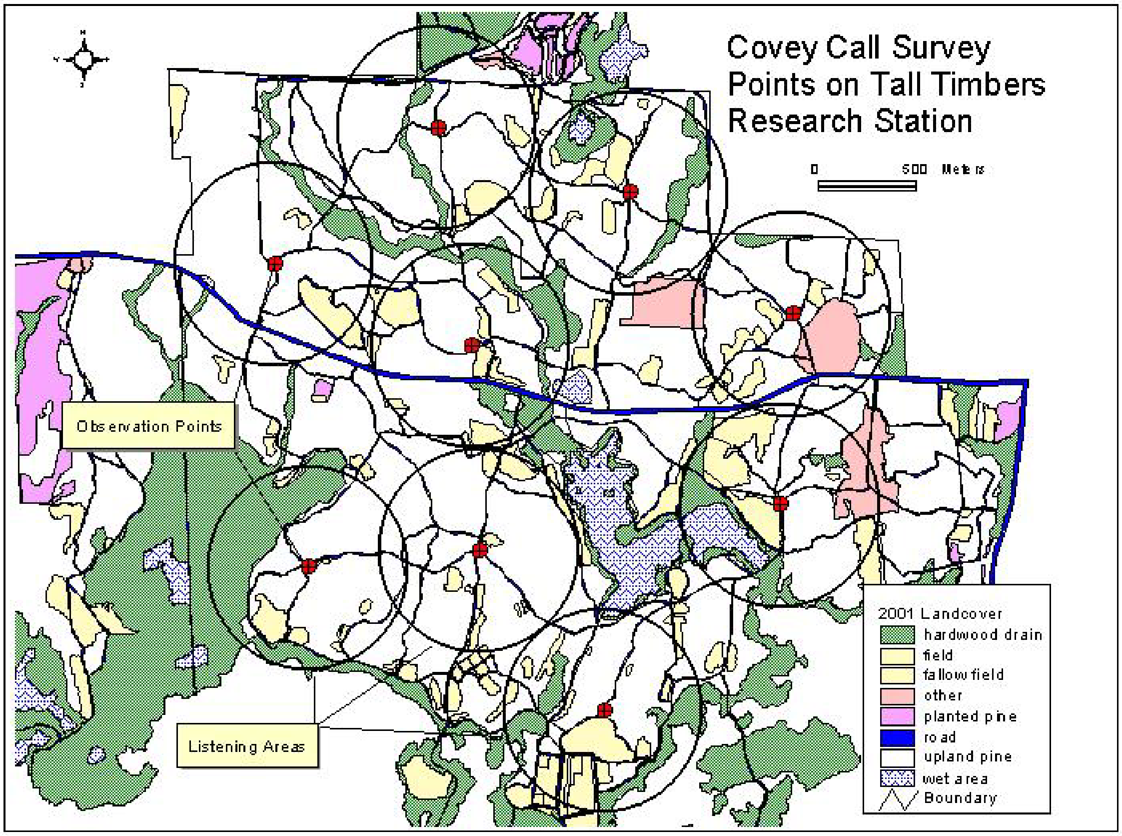

Figure 1. An example of observation point spacing with their associated 500 meter radius listening areas on Tall Timbers Research Station. Points should be spaced at least 1000 meters (0.62 miles) to minimize double counting of calling coveys by more than one observer.

Figure 2. An example of a study area with 5 survey points surveyed twice a year for 2 years. Within a year, the highest count for each point was used for the overall yearly average. To calculate the call rate the following values were used: 0 BP change, 0% cloud cover, and 0 km/hr wind. For this example there was a 36% increase from year to year.

YEAR 1

Survey Date	10/15/2001	10/22/2001			
Point ID	Covey Count	Covey Count	Count Used	Call Rate	Adjusted Covey Count
1	0	1	1	0.53	1.89
2	2	2	2	0.61	3.25
3	3	2	3	0.69	4.33
4	6	6	6	0.87	6.93
5	1	1	1	0.53	1.89
				Average	3.66
				SE	0.94

YEAR 2

Survey Date	10/18/2002	10/25/2002			
Point ID	Covey Count	Covey Count	Count Used	Call Rate	Adjusted Covey Count
1	2	2	2	0.61	3.25
2	4	3	4	0.76	5.25
3	4	6	6	0.87	6.93
4	8	8	8	0.93	8.62
5	3	3	3	0.69	4.33
				Average	5.68
				SE	0.95

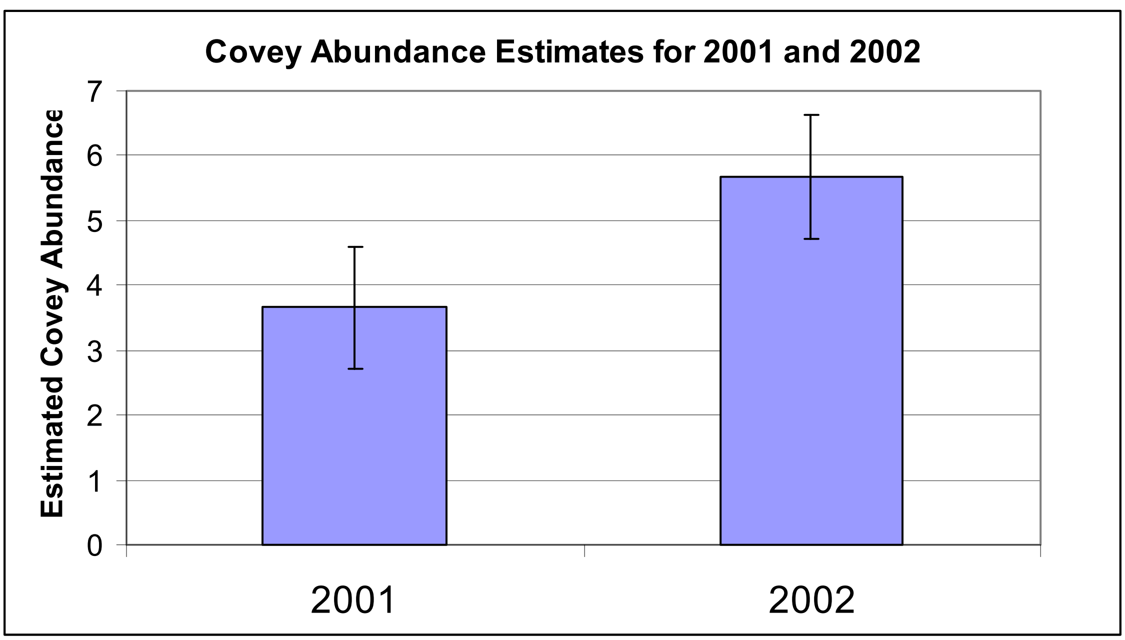

Figure 3. An example of a completed covey call field sheet.