

# **BBIRD Grassland Protocol**

1997 draft

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## OVERVIEW

This document describes the protocol used to measure vegetation from grassland BBIRD sites. This is the first year (1997) in which there has been a grassland vegetation protocol for BBIRD, and the exact protocol will probably change with use. As a result, we decided to keep the grassland component of the BBIRD protocol as an independent, supplemental document to the main BBIRD protocol at the present time. Our intent is to merge the grassland protocol with the main BBIRD protocol after a test year. If you have any comments or suggestions for improving the grassland protocol, please feel free to contact the BBIRD office.

Because the grassland BBIRD protocol is a supplement, you will not find explanations of all facets of BBIRD located in this document. In order to find information on monitoring nests, summarizing information on nesting success, and recording meteorological information, please see the main BBIRD protocol, which is available for downloading from the BBIRD web site at <http://pica.wru.umt.edu/bbird> in WordPerfect 6.1 or Microsoft Word 6 format. Also note that only a brief mention is made here of potential deviation in methods for point counts in grassland from the methods used in forested areas, so you will need to refer to the main protocol for information about point counts as well.

Although this supplement does not contain detailed information on all aspects of the BBIRD protocol, **APPENDIX A** does list all of the variables that are to be reported as part of running a BBIRD site. Use the appendix in concert with the main BBIRD protocol in order to determine which information you will have to collect when running a grassland BBIRD site.

This supplement has 4 sections, describing separate tasks that you will have to do before, and during fieldwork:

- 1) Creating data sheets — you will need a set of data sheets prepared before you go into the field. A possible list of data sheets is given on page 4.
- 2) Setting up your BBIRD study locations — where possible, actual study plots should be set up, similar to BBIRD sites in any other habitat. However, under some circumstances (e.g., very low densities of birds), the conventional study plot may have to be foregone. For information on dealing with these situations see page 5.
- 3) Measuring vegetation around nests, and at locations used to characterize study habitat. See page 6.
- 4) Point counts — conducting point counts or otherwise censusing birds in grassland areas may require different methods than in forested habitat. See page 20.

## **FORMS FOR RECORDING FIELD DATA**

Before going into the field, you will need to create a set of data sheets and cards on which to record the information that you will collect. Below, we suggest a series of data forms that are used for the different tasks performed during a field season. We have samples of these forms available on the BBIRD web site (<http://pica.wru.umt.edu/bbird>), on the **Software** page; these forms are downloadable in WordPerfect 6.1 format. Our suggested list of data forms is as follows:

- 1) Nest record cards — double-sided 4 X 6" cards used in the field to record information on nests and their contents. You may want to use a larger, 4 ½ X 8" card to record more information. See the main BBIRD protocol for description of the use of this form.
- 2) Grassland vegetation forms — 8 ½ X 11" sheets used to record measurements that describe nest site, and vegetation around nests and at locations used to characterize the vegetation on study plots. See the main BBIRD protocol for an explanation of the variables used to describe nest location. For a description of all other variables recorded on this form, see page 6.
- 3) Point count forms — 8 ½ X 11" sheets used to record numbers of adult birds on point count censuses. See the main BBIRD protocol for explanation of use of this form.
- 4) Weather forms — an 8 ½ X 11" form that is used to record daily weather summaries. See the main BBIRD protocol for an explanation of this form's use.

## **DEALING WITH LOW NEST DENSITIES**

If you are working in an area with very low densities of breeding birds, then setting up conventional, static study plots may not be an effective way of monitoring the breeding biology of populations of birds. If a system of study plots will not be able to provide you with a minimum of 20 nests/year for the commonest species in your system, then you will have to consider other forms of sampling.

If breeding birds are clumped in your system, then you should consider using some sort of adaptive sampling scheme (Thompson 1992), which involves an initial random or systematic exploration of your area, followed by concentration of effort in the immediate vicinity of any locations at which you detected birds. You could view adaptive sampling as making use of movable study plots, that are set up only in areas in which the study plots will contain birds.

If you know that certain features in your habitat are associated with a given species of bird, then you should actively search out areas of these types and concentrate your effort at these locations. This approach will probably require a different set of cues be used for each species of bird in your system.

If breeding birds are not clumped and you know of no obvious habitat cues for finding birds, then your alternative is to abandon any pretense of searching specific areas for nests, and instead cover an ever expanding area (within logistic feasibility) in search of breeding birds. Your best approach would be to systematically travel across very large areas of habitat in your study area, looking for any signs of territorial activity or nesting behaviour, and only at these locations expend effort looking for nests.

The danger in any of these non-plot methods of finding and monitoring nests is that the sample of nests that you find is a non-random sub-set of the nests of a given species in your area. Even if you can use adaptive sampling, or can use habitat features to define areas in which you should concentrate your work, please spend some time in systematically exploring other areas on your study site for additional birds. Always be conscious that you could be obtaining a biased and otherwise unrepresentative view of a species breeding biology by assuming that the easiest nests to find are typical of the population as a whole.

Also, when you are dealing with non-plot studies, you will still have to make systematic vegetation samples to describe the general habitat in which you are working. Make sure that these systematic samples cover the full area over which you are searching for nests. The distances between sampling points will have to be larger than if you were working on discrete study plots, but you should keep the objectives of your sampling the same: to describe the general distribution of vegetation on your study sites.

## MEASURING VEGETATION

This section is the main component of the BBIRD grassland protocol. Material is presented in a series of sections that describe the specialized tools required to take measurements, locations at which measurement should be taken, a list of the various measurements that should be taken along with the names to be used when reporting data to BBIRD, and a suggested procedure for collecting these data. Read and understand what the various measures are before you go into the field; the final section (see page 19) will help you organize the process of collecting all of this information in the field.

### TOOLS NEEDED

#### “Wiens Pole”

A “Wiens pole” is used to measure the vertical distribution and density of foliage; the name comes from John Wiens who used this device in his research in shrub-steppe bird communities (Wiens and Rotenberry 1981). A Wiens pole is nothing more than a cylindrical stick, one-quarter inch in diameter. This stick is marked at 10 cm intervals from its base (i.e. at 10 cm, 20 cm, 30 cm, 40 cm, and 50 cm).

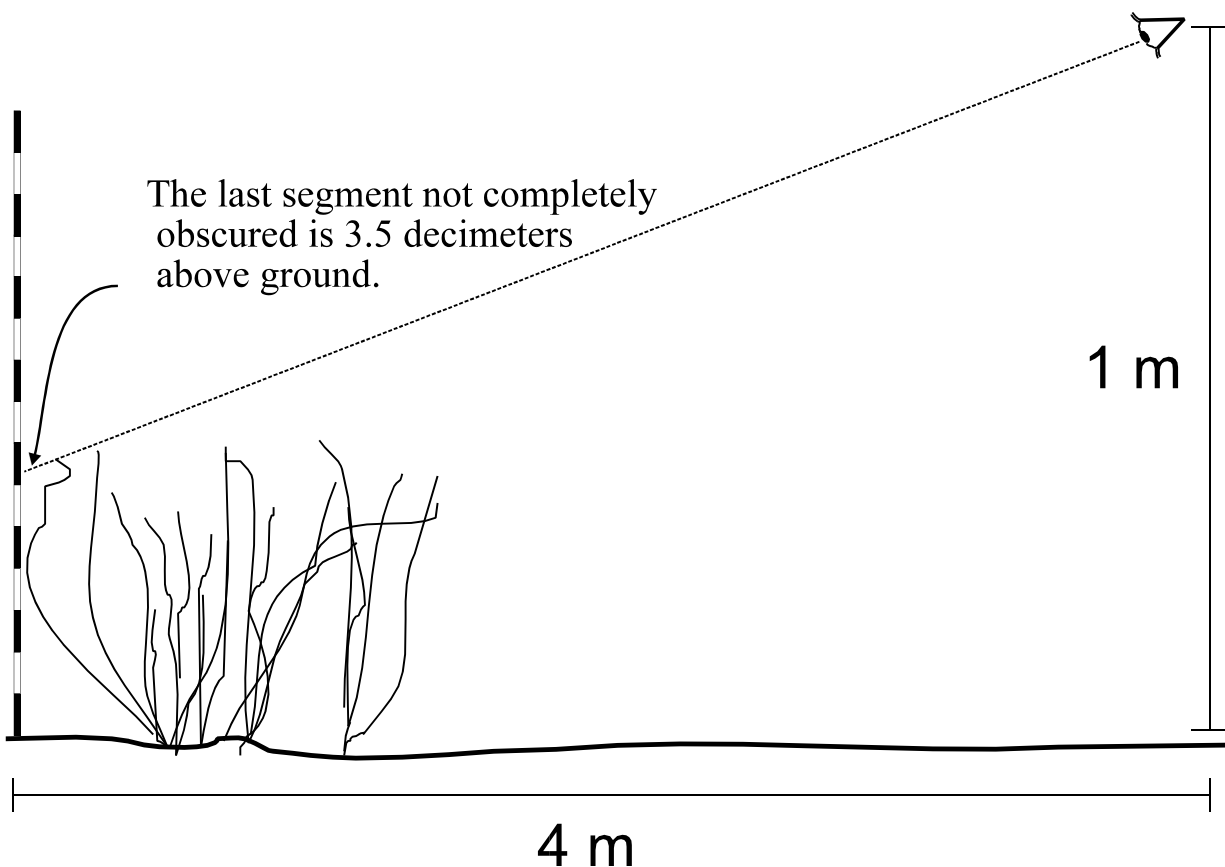
The pole is used by resting the base of this stick on the ground and holding it vertically. Then, within each of the five, 10 cm intervals, a count is made of the number of times that herbaceous vegetation touches the pole. If a single leaf or stem touches the pole several times, each of these contacts is counted as a separate contact. For BBIRD, we require that the number of contacts be counted separately for graminoids, and for other herbaceous plants.

For recording your data in the field, you may want to minimize the space needed on a data form by not using separate boxes for graminoids and other forbs. Instead, draw a diagonal line through each data box on the form, and record forbs above the diagonal and graminoids below the diagonal (a Point Reyes Bird Observatory trick).

#### “Robel Pole”

The Robel pole (Robel et al. 1970) is another stick, and the only requirement is that it be demarcated at half decimeter (i.e. 5 cm) intervals (painting intervals alternately black and white is one option). The pole is stood vertically at a location. An observer then moves 4 m away from the pole, and with eyes 1 m above the level of the ground, the observer notes the lowest interval on the pole that is not completely obscured by vegetation. This interval is recorded as the distance in decimeters from the ground to the bottom of the interval. Measurements with Robel poles are widely used to characterize vegetation around nests of birds (e.g., Kirsch et al 1978), and measure not only height of vegetation, but also an index of biomass (Robel et al. 1970).

FIGURE: TAKING MEASUREMENTS WITH A ROBEL POLE



The figure, above (not drawn to scale) shows a Robel pole, and the way in which readings are taken from the pole.

### Other Equipment

In addition to the above poles, you will need the following pieces of equipment:

- 1) compass (used to choose directions for dividing vegetation plots into quarters in order to aid measurement.
- 2) tent peg or other stake, with four, 5 m long ropes attached. One relatively rapid and convenient way of demarcating a plot is to place a tent peg at the plot's center, and run a rope in each of the four cardinal directions (north, east, south, and west) out from the center. These ropes both serve to divide the plot into quarters as well as indicate the outer boundary of the circular plot.
- 3) metric tape measure, for measuring grass height, shrub heights and widths, tree DBHs, and distance from the plot's center to closest trees and shrubs in point-centered quarter measurements.

## LOCATIONS FOR VEGETATION MEASUREMENTS

There are four classes of locations at which you should measure vegetation on grassland study sites:

- 1) At nests — after activity has ceased at a nest, use the nest as the center of a vegetation plot.
- 2) Non-use sites — a “non-use” site is a location at which there could have been a nest, with any non-use site paired with a nearly actual nest. The purpose of non-use plots is to determine if there is any feature of the habitat, **in addition to the actual nest site**, that contributes to birds’ decision of where to place nests. The procedure for choosing a non-use site is to walk about 35 m away from a nest and look for a substrate that closely matches the location of the actual nest. For example, if the nest is under a clump of grass, look for a clump of the same species of grass that is approximately the same size as the grass clump under which the nest is located. **You are trying to match only the nest bearing/covering structure**, and not the entire habitat. If you are working in a uniform habitat, the direction that you walk from the actual nest site should be random. However, if you are in habitat of variable structure, and this variation can at least partially be ascribed to topographical variation, travel away from the actual nest so that you are following the same slope/elevation on which the actual nest is found. For 1997 we have dropped non-use sites are part of the forest BBIRD vegetation protocol because several years of experience have indicated that we are gaining little information from non-use vegetation plots in forested habitats. However, because work in grasslands is a new component of BBIRD we are encouraging people to collect data from non-use plots in the next few field seasons.
- 3) Point count stations — if you are conducting point counts on your site (see **POINT COUNT** section on page 20 for conditions under which point counts may not be appropriate), then vegetation descriptions should be made at each station in the point count. Four separate vegetation points should be measured at each location, such as a point count, that is used to characterize the vegetation on a study site. These 4 vegetation plots are arranged as a central vegetation plot, with 3 plots surrounding the central one. If you are conducting point counts using BBIRD’s forest protocol (classifying birds as being either within 50 meters of the observer, or greater than 50 m away) then the 3 outside vegetation plots should be 30 meters from the central plot, at compass bearings 0°, 120°, and 240° from the central plot. If you are in habitat in which you can detect birds on point counts at very large distances (see **POINT COUNT** section on page 20), then the vegetation plots should try to characterize the vegetation at greater distances from the central vegetation plot. In such cases, place one outside vegetation plot at each of these distances from the center: 30 m, 60 m, and 90 m.

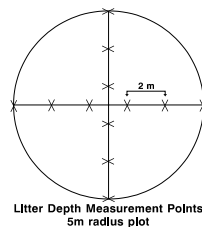
- 4) Other sites used to characterize vegetation — if you are using locations other than point counts to characterize vegetation on your study plot, then use the same spatial pattern of 4 separate plots outlined above, with the 3 outside plots all 30 m from the central plot.

When you are entering data from vegetation surveys at point counts or other locations for which you use 4 plots, present each vegetation point as a separate line of data in your data file. Data from the related plots should be cross-linked by using the same code in the variable “**NST\_ID**” in the database for all four of the plots.

## MEASURING LITTER DEPTH

The depths (in millimeters) of organic litter (dead, non- and partially-decomposed vegetation lying above the top of the soil) are measured in grassland in the same way that measurements are taken in the forest BBIRD protocol. Twelve measurements are taken, three in each cardinal direction from the center of the plot, at distances of 1 m, 3 m, and 5 m from the center. If one of your points lands on a rock or log, move your measurement location so that you are at a location that does have mineral soil on which litter could potentially rest; **do not** record a litter depth of zero simply because the location is a rock.

**FIGURE: LOCATIONS FOR LITTER DEPTH MEASUREMENTS**



Note that these are the same locations at which you will be taking measurements with your Robel pole. The data reported to BBIRD are in the variable:

**LITTER DEPTH (Littr\_mm)** — the average (in millimeters) of the 12 separate measurements of litter depth that are taken on your plot.

## MEASURING GROUND COVER

Ground cover is measured in order to characterize the types and amounts of material close to the ground (within 0.5 m of the ground) that could provide cover for nests. Ground cover is estimated as in the forest BBIRD protocol: a circle of 5 m radius is formed around the center of a plot, and this circle is divided into quarters. Within each quadrature, the total percentage of a cover type is estimated by eye, and the average of the 4 quadrates’ estimates is reported to BBIRD. **The**

**percentages can add up to more than 100%, in some circumstances.** If there is more than one layer of cover (e.g. a layer of litter and short grasses, with small shrubs above) these layers are treated separately. If there are obvious layers of ground cover, keep the total percentages within these layers adding up to 100%. The following are the categories of ground cover used in BBIRD:

**% ALL GREEN COVER (Gcgrn)** — percentage of ground covered by green vegetation that is below 50 cm in height

**% GRASS COVER (Gcgrass)** — percentage of ground covered by grasses below 50 cm in height.

**% SEDGE COVER (Gcsedge)** — percentage of ground covered by sedge that is below 50 cm in height.

**% SHRUB COVER (Gcshrub)** — below 50 cm.

**% BRUSH COVER (Gcbrush)** — percentage of ground covered by small dead woody vegetation (i.e. dead shrubs and bramble) less than 50 cm above the ground

**% FORB COVER (Gcforb)** — below 50 cm.

**% FERN COVER (Gcfern)** — below 50 cm.

**% MOSS COVER (Gcmoss)** — percentage of ground covered by moss

**% CACTUS COVER (Gccactus)** — percentage of ground covered by cactus that are less than 50 cm tall

**% LEAF LITTER COVER (Gcleaf)** — percent of ground covered by leaf litter. This value should be independent of taller, sparser vegetation (litter + tall sparse vegetation can sum to more than 100%), but is dependent on low dense vegetation (litter + low dense vegetation sum to 100% or less). Example: a plot with a layer of small shrubs/saplings covering 80% of the ground at 50 cm can have little plant cover at ground level so more than 20% of the ground could be leaf litter. However, a plot with 80% coverage of short, dense grass could have no more than 20% leaf litter cover.

**% DOWNED LOGS (Gclog)** — percent of ground covered by downed logs (logs >12 cm diameter). This value should be independent of taller, sparser vegetation (can sum to more than 100%), but dependent on low dense vegetation (sum to 100% or less). See **% LEAF LITTER COVER** example.

**% ROCK COVER (Gcrock)** — percentage of ground covered by rocks (mineral substrate, the pieces of which are larger than grapefruit sized). The distinction between **Gcrock** and **Gcbare** is that nests could potentially be hidden among rocks, but would have to be placed on the surface of bare ground.

**% BARE GROUND (Gcbare)** — percent open ground not covered by leaf litter. This value should be independent of taller, sparser vegetation, but dependent on low dense vegetation. See **% LEAF LITTER COVER** example.

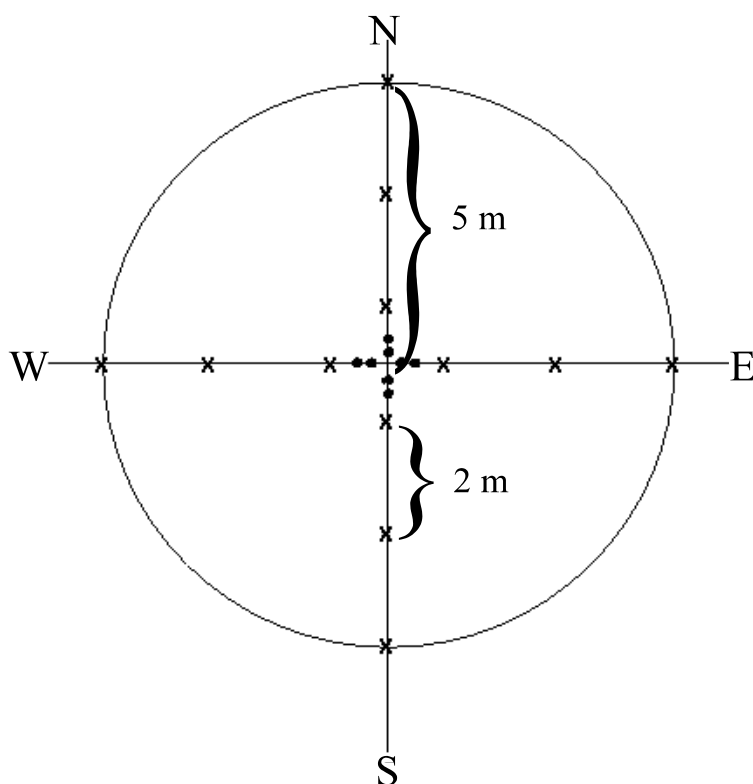
**% WATER COVER (Gcwater)** — percent of ground covered by standing water. This value should be independent of taller, sparser vegetation, but dependent on low dense vegetation. See **% LEAF LITTER COVER** example.

**% MARSH VEGETATION (Gcmarsh)** — percentage of ground covered by marsh vegetation (vegetation undifferentiated by species or type that is growing in water). This category excludes sedges, which are recorded in **Gcsedge**.

## MEASURING HERBACEOUS VEGETATION

Three separate measurements are made on herbaceous vegetation. All of these measurements are made along lines running along the four cardinal directions (i.e. north, south, east, and west) from the center of each vegetation plot. We will note below when measurements are made at the same distances from the center. In these case, it is most efficient to take the various types of measurements at the same time at one point, before moving onto the next location. The figure at left diagrams the locations within a 5 meter circle at which various measurements are taken. The "X"s mark locations at which four types of measurements are taken: maximum height of herbaceous vegetation, Robel pole measurements, Wiens pole measurements, and litter depth. Additionally,

Wiens pole measurements are also taken at locations denoted by the dots (at distances of 0.25 m, and 0.5 m from the center of the plot).



### Measuring Grass Height

The first type of measurement is maximum height (in meters) of herbaceous vegetation. Height is recorded at the following locations:

- 1) At the nest
- 2) 1 meter from the center of the plot, in each of the four cardinal directions
- 3) 3 meters from the center of the plot, in each of the four cardinal directions
- 4) 5 meters from the center

of the plot, in each of the four cardinal directions

Other types of measurements that are taken at the 1 m 3 m, and 5 m distances are Robel pole, Wiens pole, and litter depth.

The following variables are used to record information on height of herbaceous vegetation for BBIRD:

**HEIGHT OF HERBACEOUS VEGETATION AT NEST (GrHtNst)** — maximum

height (in meters) of herbaceous vegetation recorded at the nest/center of vegetation plot.

**HEIGHT NORTH 1 METER FROM NEST (GrHt1mN)** — maximum height of herbaceous vegetation 1 m north of nest/center of plot.

**HEIGHT EAST 1 METER FROM NEST (GrHt1mE)** — maximum height of herbaceous vegetation 1 m east of nest/center of plot.

**HEIGHT SOUTH 1 METER FROM NEST (GrHt1mS)** — maximum height of herbaceous vegetation 1 m south of nest/center of plot.

**HEIGHT WEST 1 METER FROM NEST (GrHt1mW)** — maximum height of herbaceous vegetation 1 m west of nest/center of plot.

**HEIGHT NORTH 3 METER FROM NEST (GrHt5mN)** — maximum height of herbaceous vegetation 3 m north of nest/center of plot.

**HEIGHT EAST 3 METER FROM NEST (GrHt5mE)** — maximum height of herbaceous vegetation 3 m east of nest/center of plot.

**HEIGHT SOUTH 3 METER FROM NEST (GrHt5mS)** — maximum height of herbaceous vegetation 3 m south of nest/center of plot.

**HEIGHT WEST 3 METER FROM NEST (GrHt5mW)** — maximum height of herbaceous vegetation 3 m west of nest/center of plot.

**HEIGHT NORTH 5 METER FROM NEST (GrHt10mN)** — maximum height of herbaceous vegetation 5 m north of nest/center of plot.

**HEIGHT EAST 5 METER FROM NEST (GrHt10mE)** — maximum height of herbaceous vegetation 5 m east of nest/center of plot.

**HEIGHT SOUTH 5 METER FROM NEST (GrHt10mS)** — maximum height of herbaceous vegetation 5 m south of nest/center of plot.

**HEIGHT WEST 5 METER FROM NEST (GrHt10mW)** — maximum height of herbaceous vegetation 5 m west of nest/center of plot.

## Measurements With Robel Pole

Measurements with the Robel pole are taken at the nest/plot center, 1 m, 3 m, and 5 m in each cardinal direction from the plot's center. A total of 16 measurements are taken. At the nest, four measurements are taken with the Robel, with the observer facing towards the plot's center from each of the four cardinal directions. At every location away from the plot's center a single measurement is taken. All measurements at locations other than the plot's center are taken facing towards the center of the plot. The nest, 1 m, 3 m and 5 m distances also are locations at which height of herbaceous vegetation is measured. The 1 m, 3 m, and 5 m distances are locations at which litter depth and Wiens pole measurements are made. The following are the data to be reported to BBIRD:

**ROBEL MEASUREMENT NORTH FROM PLOT CENTER (RobNstN)** — Robel pole measurement (in decimeters) with pole at the plot's center, and observer viewing the pole from the north.

**ROBEL MEASUREMENT EAST FROM PLOT CENTER (RobNstE)** — Robel pole measurement (in decimeters) with pole at the plot's center, and observer viewing the

pole from the east.

**ROBEL MEASUREMENT SOUTH FROM PLOT CENTER (RobNstS)** — Robel pole measurement (in decimeters) with pole at the plot's center, and observer viewing the pole from the south.

**ROBEL MEASUREMENT WEST FROM PLOT CENTER (RobNstW)** — Robel pole measurement (in decimeters) with pole at the plot's center, and observer viewing the pole from the west.

**ROBEL MEASURE, POLE 1 METER NORTH OF CENTER (Rob1mN)** — Robel pole measurement, with pole 1 meter north of plot's center, observer facing towards the center of the plot.

**ROBEL MEASURE, POLE 1 METER EAST OF CENTER (Rob1mE)** — Robel pole measurement, with pole 1 meter east of plot's center, observer facing towards the center of the plot.

**ROBEL MEASURE, POLE 1 METER SOUTH OF CENTER (Rob1mS)** — Robel pole measurement, with pole 1 meter south of plot's center, observer facing towards the center of the plot.

**ROBEL MEASURE, POLE 1 METER WEST OF CENTER (Rob1mW)** — Robel pole measurement, with pole 1 meter west of plot's center, observer facing towards the center of the plot.

**ROBEL MEASURE, POLE 3 METER NORTH OF CENTER (Rob3mN)** — Robel pole measurement, with pole 3 meter north of plot's center, observer facing towards the center of the plot.

**ROBEL MEASURE, POLE 3 METER EAST OF CENTER (Rob3mE)** — Robel pole measurement, with pole 3 meter east of plot's center, observer facing towards the center of the plot.

**ROBEL MEASURE, POLE 3 METER SOUTH OF CENTER (Rob3mS)** — Robel pole measurement, with pole 3 meter south of plot's center, observer facing towards the center of the plot.

**ROBEL MEASURE, POLE 3 METER WEST OF CENTER (Rob3mW)** — Robel pole measurement, with pole 3 meter west of plot's center, observer facing towards the center of the plot.

**ROBEL MEASURE, POLE 5 METER NORTH OF CENTER (Rob5mN)** — Robel pole measurement, with pole 5 meter north of plot's center, observer facing towards the center of the plot.

**ROBEL MEASURE, POLE 5 METER EAST OF CENTER (Rob5mE)** — Robel pole measurement, with pole 5 meter east of plot's center, observer facing towards the center of the plot.

**ROBEL MEASURE, POLE 5 METER SOUTH OF CENTER (Rob5mS)** — Robel pole measurement, with pole 5 meter south of plot's center, observer facing towards the center of the plot.

**ROBEL MEASURE, POLE 5 METER WEST OF CENTER (Rob5mW)** — Robel pole measurement, with pole 5 meter west of plot's center, observer facing towards the center of the plot.

## Measurements With The Wiens Pole

Measurements are made with the Wiens pole at distances of 0.25 m, 0.5 m, 1 m, 3 m, and 5 m from the center of each vegetation plot; at each distance, one measurement is made in each of the four cardinal directions. Separate counts are kept for the number of contacts of forbs and grasses with the pole. The result is that a total of 240 measurements are taken (5 distance × 4 directions × 6 height classes/plot × 2 plot growth forms). At distances of 1 m, 3 m and 5 m from the plot center, measurements are also made of litter depth, maximum height of herbaceous vegetation, and with Robel pole. The following are the variables reported to BBIRD (in the main BBIRD database, Wiens pole measurements are kept in a separate sub-table that is linked to the main table by a variable called **NID**, and each distance from the plot's center forms a separate line of data in the Wiens pole table. See the Appendix for a list of variable names to use if you are submitting your data to BBIRD as a single table, instead of using the BBIRD data entry software):

**PLANT GROWTH FORM (Stype)** — this is a coding variable, given either a “G” for grass, or “F” for forb, which tells whether the Wiens pole contacts are for either of these growth forms of plants.

**DISTANCE FROM PLOT CENTER (Distance)** — distance in meters from the center of the plot to the point of measurement. Distances used are: 0.25 m, 0.5 m, 1 m, 3 m, and 5 m.

**NUMBER CONTACTS, NORTH SAMPLE, LOWEST HEIGHT (N0)** — For a given **Distance** and **Stype** in the direction north from the center of the plot, the number of leaves that touch the Wiens pole at a level between 0 cm and 10 cm above ground level.

**NUMBER CONTACTS, EAST SAMPLE, LOWEST HEIGHT (E0)** — For a given **Distance** and **Stype** in the direction east from the center of the plot, the number of leaves that touch the Wiens pole at a level between 0 cm and 10 cm above ground level.

**NUMBER CONTACTS, SOUTH SAMPLE, LOWEST HEIGHT (S0)** — For a given **Distance** and **Stype** in the direction south from the center of the plot, the number of leaves that touch the Wiens pole at a level between 0 cm and 10 cm above ground level.

**NUMBER CONTACTS, WEST SAMPLE, LOWEST HEIGHT (W0)** — For a given **Distance** and **Stype** in the direction west from the center of the plot, the number of leaves that touch the Wiens pole at a level between 0 cm and 10 cm above ground level.

**NUMBER CONTACTS, NORTH SAMPLE, SECOND HEIGHT (N10)** — For a given **Distance** and **Stype** in the direction north from the center of the plot, the number of leaves that touch the Wiens pole at a level between 10 cm and 20 cm above ground level.

**NUMBER CONTACTS, EAST SAMPLE, LOWEST HEIGHT (E10)** — Same as **N10**, but to east of center of plot.

**NUMBER CONTACTS, SOUTH SAMPLE, LOWEST HEIGHT (S10)** — Same as **N10**, but to south of center of plot.

**NUMBER CONTACTS, WEST SAMPLE, LOWEST HEIGHT (W10)** — Same as **N10**,

but to west of center of plot.

**NUMBER CONTACTS, NORTH SAMPLE, THIRD HEIGHT (N20)** — For a given **Distance** and **Stype** in the direction north from the center of the plot, the number of leaves that touch the Wiens pole at a level between 20 cm and 30 cm above ground level.

**NUMBER CONTACTS, EAST SAMPLE, THIRD HEIGHT (E20)** — Same as **N20**, but to east of center of plot.

**NUMBER CONTACTS, SOUTH SAMPLE, THIRD HEIGHT (S20)** — Same as **N20**, but to south of center of plot.

**NUMBER CONTACTS, WEST SAMPLE, THIRD HEIGHT (W20)** — Same as **N20**, but to west of center of plot

**NUMBER CONTACTS, NORTH SAMPLE, FOURTH HEIGHT (N30)** — For a given **Distance** and **Stype** in the direction north from the center of the plot, the number of leaves that touch the Wiens pole at a level between 30 cm and 40 cm above ground level.

**NUMBER CONTACTS, EAST SAMPLE, FOURTH HEIGHT (E30)** — Same as **N30**, but to east of center of plot.

**NUMBER CONTACTS, SOUTH SAMPLE, FOURTH HEIGHT (S30)** — Same as **N30**, but to south of center of plot.

**NUMBER CONTACTS, WEST SAMPLE, FOURTH HEIGHT (W30)** — Same as **N30**, but to west of center of plot.

**NUMBER CONTACTS, NORTH SAMPLE, FIFTH HEIGHT (N40)** — For a given **Distance** and **Stype** in the direction north from the center of the plot, the number of leaves that touch the Wiens pole at a level between 40 cm and 50 cm above ground level.

**NUMBER CONTACTS, EAST SAMPLE, FIFTH HEIGHT (E40)** — Same as **N40**, but to east of center of plot.

**NUMBER CONTACTS, SOUTH SAMPLE, FIFTH HEIGHT (S40)** — Same as **N40**, but to south of center of plot.

**NUMBER CONTACTS, WEST SAMPLE, FIFTH HEIGHT (W40)** — Same as **N40**, but to west of center of plot.

**NUMBER CONTACTS, NORTH SAMPLE, TOP (N50)** — For a given **Distance** and **Stype** in the direction north from the center of the plot, the number of leaves that touch the Wiens pole at a level 50 cm and above ground.

**NUMBER CONTACTS, EAST SAMPLE, TOP (E50)** — Same as **N50**, but to east of center of plot.

**NUMBER CONTACTS, SOUTH SAMPLE, TOP (S50)** — Same as **N50**, but to south of center of plot.

**NUMBER CONTACTS, WEST SAMPLE, TOP (W50)** — Same as **N50**, but to west of center of plot.

While we realize that a substantial amount of data is gathered from measurements using Wiens poles, and that entry of these data into the computer is extremely time consuming, we strongly encourage people to enter all of the raw data when contributing data to BBIRD. However,

if for logistical reasons you are forced to only enter summary data into the computer summarize the data by **averaging** the number of contacts across the four cardinal directions for each height and distance from center of plot. This will give 72 pieces of data to enter. Arbitrarily **place these averages in the “north” data fields and leave all other fields blank** (i.e. do not fill other fields with zeros).

## MEASURING SHRUBS

Three separate measurements of shrubs are made on each grassland vegetation plot. The first of these is an estimate of the percentage of area within the plot that has a layer of shrub over top. This first measure tells us in general terms the ubiquity of shrub cover on the plot. Second is a count of the number of stems of each shrubs, giving indication of the thickness of shrubs. Third is a measure of density of individual shrub plants. Each of these classes of measurements is explained below.

### Shrub Cover

The percentage of a 5 m radius plot that has a layer of shrub covering it is estimated by eye for each vegetation plot. In order to aid measurement, divide the plot circle into quarters and estimate cover within each quarter separately. Average these values, and provide these average values to BBIRD for the central database. Estimate the percent covers of shrub for each species separately, as well as providing a total for all species combined. This measure differs from the **Gshrub** measure in ground cover estimation in that all shrubs regardless of height are included in this general shrub cover estimate, whereas **Gshrub** only measures the cover of shrubs that are less than 0.5 m high.

Shrub cover should be estimated at the same time that counts of shrub stems are made (see next section). Shrub cover and stem counts are most conveniently recorded together on data sheets.

### Stem Counts

Numbers of stems of shrubs are counted in the same manner as in the BBIRD forest protocol, with the exception of the way in which dead shrub stems are treated (see next paragraph). As with estimates of cover, stem counts are made within a circle of 5 m radius around the center of a plot. In order to simplify counting, the circle is divided into quarters, and stems counted within each quarter separately.. However, the sum, over the entire circle, is reported to BBIRD. The number of stems is counted at 10 cm above ground. Two size classes of stems (<2.5 cm diameter at breast height, and 2.5—8 cm DBH) are counted separately. Separate counts are kept for each species.

The one difference from the forest BBIRD protocol is that in grassland both live and dead shrub stems are counted (only live stems are counted in the forest BBIRD protocol). Keep separate counts of live and dead stems for each species of shrub, and record live and dead stems separately for each species when submitting your data to BBIRD. The following variables should be recorded for BBIRD:

**CIRCLE RADIUS, STEM COUNTS (VgSRadm)** — radius of small vegetation plot in meters. This will be 5 m; the variable is included for conformity with the main BBIRD database which allows for varying radii of circles if every dense vegetation is encountered.

**SHRUB SPECIES # (Vgsp#)** — alphanumeric code for the #th species of plant within the 5 m radius vegetation plot. Add “DEAD” or “D” to the start of the species name to signify dead stems for a given species.

**NUMBER SMALL STEMS, SPECIES # (VStm#C11)** — number of stems of Vgsp# within the plot with dbh <2.5 cm

**NUMBER OF LARGE STEMS, SPECIES # (VStm#C12)** — number of stems of Vgsp# within the plot with dbh 2.5-8 cm

**PERCENT COVER, SPECIES # (VgPerCv#)** — the percentage of the 5 m radius circle that has a layer of species Vgsp#. In addition to the species-specific cover estimates include a total cover for all species combined, under the species name “TOTAL”.

## Point-centered Quarter Measurements

While stem counts tell us something about the thickness of shrub vegetation on a site, we cannot use counts of stems by themselves to distinguish between the presence of a few, widely separated shrub plants each with a myriad of stems, or many shrubs each with few stems each. In addition to counts of stems, we need to get an estimate of the density of individual plants. We are doing this using point-centered quarter measurements (e.g. Mueller-Dombois and Ellenberg 1974), in which the observers starts at the nest (or center of a non-nest vegetation plot) and divides the area around themselves into quarters along the cardinal directions. Within each quadrante, the closest shrub is found, as long as that shrub is within 100 meters of the center of the plot. If the closest shrub is over 100 m away, then leave the shrub variables for this quadrante blank, and **do not** report a zero value. The following measurements are taken on that shrub:

**SPECIES, CLOSEST SHRUB (PQshsp#)** — where # is a number from 1 — 4 that identifies the quadrante

**DISTANCE TO SHRUB (PQSHDST#)** — the distance (in meters) from the center of the plot to the shrub, for the first shrub within 100 m of the plot’s center. Pacing large distances is an acceptable form of measurement for distances over 20 m. Leave blank if no shrub was found within 100 m in this quadrante.

**HEIGHT OF SHRUB (PQShHt#)** — height (in meters) of selected shrub. Leave blank if no shrub was found in this quadrante within 100 m.

**MAXIMUM SHRUB WIDTH (PQShWd#)** — maximum width (in meters) of selected shrub. Leave blank if no shrub was found within 100 m in this quadrante.

**WIDTH PERPENDICULAR TO MAXIMUM (PQSHPWD#)** — width of the shrub measured at a right angle to the maximum width. Leave blank if no shrub was found within 100 m in this quadrante.

## MEASURING TREES

If you are working in an area in which trees are extremely rare, you should measure every tree that is within 100 m of the center of a vegetation plot. However, if you are in a location in which you can find at least one tree within each of the 4 quadrates of a circle extending out from the center of the vegetation plot, then you should measure only the nearest tree within each quadrate, using the same point-centered quarter method described above for shrubs. Regardless of the number of trees measured, the following variables should be recorded for each tree:

**SPECIES OF NEAREST TREE (PQTRSP#)** — species code for closest live tree within the quadrate, where quadrates are indicated by the # (1 — 4) in the variable name

**DISTANCE TO CLOSEST TREE (PQTRDST#)** — distance (in meters) from the center of the plot (to the closest tree within a quadrate for point-centered quarter measurements)

**HEIGHT OF CLOSEST TREE (PQTrHt#)** — height (in meters) of the tree in quadrate # (measuring only the closest tree if doing point-centered quarter measurements)

**DIAMETER AT BREAST HEIGHT, CLOSEST TREE (PQTrDBH#)** — diameter at breast height (in centimeters) (measuring only the closest tree in quadrate # to the center of the plot if doing point-centered quarter measurements)

**AVERAGE CROWN WIDTH, CLOSEST TREE (PQTrCrn#)** — average width (in meters) of crown (only measure the closest tree in quadrate # to the center of the plot if conducting point-centered quarter measurements)

**CANOPY COVER, CLOSEST TREE (PQTrCan#)** — canopy cover (from densiometer) under tree (measure only under the closest tree in quadrate # to the center of the plot if doing point-centered quarter measurements)

## ORDER OF MEASUREMENT

In the sections above, we have presented all of the data on vegetation that are to be collected. These measurement were grouped by type, which is not the same order in which data should be gathered in the field. What follows is a suggested order in which to collect data. In suggesting this order, we have tried to minimize the amount of trampling that would cause the taking of one measure to flatten the vegetation needed to take other measurements. The following are the suggested steps in measuring vegetation:

- 1) find the center of the plot, and measure the height of the herbaceous vegetation at the point. Then place a stake at the plot's center, and run the 5 m long ropes out in the four cardinal directions.
- 2) at a distance of 10 m in one cardinal direction from the center, measure the maximum height of herbaceous vegetation. Pace out the final 5 m distance from the end of the rope.
- 3) move towards the center of the plot, and at 5 m distance from the center measure height

of herbaceous vegetation, litter depth, take a set of Wiens pole measurements, and finally make a measurement using your Robel pole.

- 4) move towards the plot's center again, and at 3 m from the center take another measure of litter depth, a set of Wiens pole measurements, and a Robel pole measurement.
- 5) again, move towards the plot's center, and 1 m from the center measure maximum height of herbaceous vegetation, litter depth, take a set of Wiens pole measurements, and a Robel pole measurement.
- 6) at 0.5 m from the plot's center, take a set of measurements with your Wiens pole.
- 7) at 0.25 m from the plot's center, take the final set of measurements with your Wiens pole.
- 8) repeat steps 2) — 7) in the other three cardinal directions
- 9) place your Robel pole in the center of the plot, and take measurements with the observer facing the pole from each of the four cardinal directions
- 10) standing at the center of the plot, estimate percentages of ground cover in the various categories, as well as percent cover of shrubs (by species, and total)
- 11) within each quarter of the circular plot, count the number of stems of shrubs (by species, keeping separate counts for live and dead stems)
- 12) in each quadrat, find the closest shrub to the plot's center, and take the point-centered quarter measurements for each of the four shrubs
- 13) take all measurements of live and dead trees (either measure every tree in vicinity, or only one per quadrat if trees are locally abundant)

## POINT COUNTS

You may be able to apply the point count census methods outlined in the BBIRD forest protocol directly to work on a grassland site. However, before doing so, you should conduct trial work in order to see if the forest BBIRD point counts are the most appropriate methods of obtaining an index of the density of breeding birds. There are two circumstances under which other methods may be appropriate:

- 1) if densities of birds are extremely low, point counts may be uninformative. In such circumstances other methods such as systematically walking across plots and mapping the locations from which birds flushed may be more useful.
- 2) if populations of birds are dense enough that conducting point counts is viable, then you should see if it is realistic to extend the range of distances over which birds are recorded. The forest BBIRD point counts record whether a bird is within 50 m of the observer, or greater than 50 m from the observer. However, the more open habitat may allow detection of birds at greater distances and it might be viable to increase the number of distance categories from which birds are recorded to: <50 m, 50 — 100 m, 100 — 150 m, and >150 m. If you do use a larger number of distance categories, please insure that one of the cut-off distances is 50 m, in order to allow your data to be easily and directly combined with data from other study sites.

Unless it is clear that point counts will provide no useful information, conducting point counts is preferable to any other method of censusing adult birds, because it will census data to be compared across the widest range of BBIRD sites due to the standardized methodology.

One final matter to note about point counts is that if you are using an extended range of distances in your point counts, you should also extend the distances over which your vegetation plots are measured at each point count station. Keep one of the four vegetation plots at the station itself, but array the 3 outer vegetation plots at distances of 30 m, 60 m, and 90 m from the center, instead of keeping all plots equidistant from the center. In relatively uniform habitat, having one plot at each distance will provide a reasonable representation of the habitat. Along vegetation gradients, this sampling design is not ideal. When such gradients are obvious to the field workers, align the plots across the gradient, in order to capture the maximum amount of variation along the gradient. I.e. keep the 4 plots located at the point count station, and 30 m, 60 m, and 90 m distance, but do not bother with maintaining a 120° separation in angles from the central plot: plots can be strung out in a line on one or both sides of the point count station.

## CITED LITERATURE

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## APPENDIX A

This appendix contains the complete list of variables measured for a grassland nest, or plot used to describe the vegetation on a study plot. We have included not just the grassland vegetation measurements, but all variables (i.e. nest success, point counts, and weather) that are required from a grassland study site. The variables are presented in the order in which they should appear when submitting data to BBIRD, and with the spelling (please pay attention to upper and lower case) that should be used when submitting data. Four separate lists of variables are presented in this appendix: 1) variables to be reported from a grassland bird's nest, 2) variables to be reported from plots used to systematically describe vegetation on a study area, 3) point count data, and 4) general weather data. For a detailed description of nesting success, point count, and weather data, please see the main BBIRD protocol.

We have a data entry program (running a Borland Paradox database) that places data into the format used by the national BBIRD database. See the BBIRD web site at <http://pica.wru.umd.edu/bbird/> for information on this program. Otherwise, contact BBIRD staff at the University of Montana before sending data in, in order to determine the most efficient format for providing data. The list of variable names in this appendix does not exactly conform to the names used in BBIRD's database. The list, below provides the names to be used in the case that data are submitted to BBIRD in some form other than the database program that we have developed.

**If you have any questions about interpretation of variables, please contact BBIRD staff.**

### VARIABLES MEASURED AT GRASSLAND BIRDS' NESTS

Each data record represents all data on one nest or one non-nest site, so every line of data should have an entry for each of the following variables:

**Nst\_ID** — unique number or code to identify each individual nest within each year (e.g. in AZ we use the observer's 3 initials followed by a number (TEM28) - the number represents the order in which that observer found that nest in that year)

**Species** — 4 letter AOU species identification code (check in the Bird Banding manual for these codes).

**Plot** — your plot designation code

**Site** - location within state. A unique name that will distinguish each site (individual study) within each state.

**State** — 2 letter code used by postal service (e.g. AZ)

**Yr** — 2 digit number for year (e.g. 94)

**Trtmt** — treatment by plot code, e.g. fragmented, unfragmented, grazed, ungrazed. Please use short verbal descriptions and not number codes.

**Obs** — person who found the nest (first 2 initials + last name, e.g. TEMARTIN)

**Nsttype** — nest plot (1), nonuse plot (2), systematic plot vegetation (3)

- Attempt** — nesting attempt number (1-5). If unknown, leave **Attempt** blank.
- Stn** — location code within plots
- Dirstn\_d** — direction from station to nest in degrees (corrected for declination).
- Dststn\_m** — distance from station to nest in meters.
- Lat\_m** — latitude location of nest in Universal Transverse Mercator format (optional, for those who use GPS units). Use either UTM format locations or latitudes and longitudes, not both.
- Lat\_d** — latitude in whole degrees (optional, for studies using GPS units). Supply locations in either latitude and longitude, or UTM (see below), not both.
- Lat\_min** — minutes of latitude (optional, for studies using GPS units)
- Lat\_sec** — seconds of latitude (optional, for studies using GPS units)
- Long\_m** — longitude location of nest in Universal Transverse Mercator format (optional, for those who use GPS units). Use either UTM format locations or latitudes and longitudes, not both.
- Long\_d** — longitude in whole degrees (optional, for studies using GPS units)
- Long\_min** — minutes of longitude (optional, for studies using GPS units)
- Long\_sec** — seconds of longitude (optional, for studies using GPS units)
- Elev\_m** — elevation of nest above sea level, in meters (optional, for studies using GPS units)
- Nstsubs1** — substrate type/plant species that nest is in or, for ground nests, that provides most cover for the nest (**INOPEN**, **ROCK**, **LOG**, or alphanumeric PLANT code from PLANTS database)
- Nstsubs2** — the second substrate/plant species that a nest is placed in. Leave this field blank unless there are actually 2 separate substrates for a nest
- Nstcncl1** — type of substrate or plant species that is primarily responsible for concealing the nest (use same types as used for **Nstsubs1**)
- Nstcncl2** — type of substrate or plant species that is second most important in concealing the nest (use only when applicable)
- Nstht\_m** — nest height in meters (to the nearest 0.1 meters)
- Nsbsht\_m** — height of **Nstsubs1**, the primary nest substrate, in meters (to the nearest 0.1 meters)
- Dcedg\_cm** — distance of the nest from nearest foliage edge (use for shrub- but not grass-supported nests)
- Orient\_d** — nest orientation in degrees (corrected for declination)
- Nspbrnch** — number of supporting branches for nest, excluding trunk (use for shrub- but not grass-supported nests)
- Dspbr\_cm** — average diameter of supporting branches in cm (use for shrub- but not grass-supported nests)
- Dstem\_cm** — distance of nest from central stem in cm (use for shrub- but not grass-supported nests)
- Ntries** — number of previous tries to find nest
- Cs** — confirmed final clutch size, leave blank if unknown. Mutually exclusive with **Nfcs** only **Cs** or **Nfcs** should be non-blank for a given nest.
- Nfcs** — non-final clutch size: final number of eggs in nest could not be confirmed due to

failure prior to clutch size being completed. Mutually exclusive with **Cs**.

**Nfldg** — number of young fledged (if nest successful).

**Exnfdg** — code as **1** when **Nfldg** represents an exact number, not an estimate. Otherwise, leave blank.

**Elusive** — parental elusiveness (code 1 — 4, 1 = most elusive, 4 = most conspicuous)

**Init** — nest initiation date: date when first egg was laid (first digit = month, next two digits = day of month; e.g. 5/07/95 = 507)

**Precinit** — precision with which nest initiation date is known (coded 1 — 4). See BBIRD field protocol for description of these codes

**NSucegg** — new (in 1997) decimal format code for whether a nest successfully survived to end of egg laying (see codes in BBIRD Field Protocol)

**NSucinc** — new (in 1997) decimal format code for whether a nest successfully survived to end of the incubation stage. Leave blank if nest failed during egg laying.

**NSucnstl** — new (in 1997) decimal format code for whether a nest successfully survived to end of the nestling stage (success at this stage means a nest fledged at least one young). Leave blank if nest failed during laying or incubation.

**NFinalsuc** — new (in 1997) decimal format code for final success code for the nest. This should match the success code for the last active stage (egg, inc, or nstl).

**Nobegg** — Number of days the nest was observed being active during egg-laying (to the nearest 0.5 days)

**Nobinc** — Number of days the nest was observed being active during incubation (to the nearest 0.5 days)

**Nobnstl** — Number of days the nest was observed being active during the nestling stage (to the nearest 0.5 days)

**Nobtot** — Number of days the nest was observed but stage was unknown. Use this only when **Nobegg**, **Nobinc**, and **Nobnstl** cannot account for all days of observation; otherwise leave blank

**Preclay** — precision in laying period: coded as **1**, **2**, or left blank. See the main BBIRD protocol for explanations of codes.

**Precinc** — precision in incubation period: code as for **Preclay**.

**Precnstl** — precision in nestling period: code as for **Preclay**.

**Cegglay** — number of cowbird eggs laid

**Precegg** — precision code for **Cegglay**

**Cegghtch** — number of cowbirds hatched

**Precegg** — precision code for **Cegghtch**

**Cfldg** — number of cowbirds fledged

**Precfldg** — precision code for **Cfldg**

**Cobs** — number of days cowbirds (eggs and nestlings) were under observation (may be longer than for host nestlings if these die due to parasitism of the nest)

**CNfate** — new (1997) decimal format code for overall success for cowbird nestlings in parasitized nests

**Cfatetim** — the timing of cowbird fate relative to the fate of genetic young (**1**=before genetic young, **2**=same time, **3**=after genetic young)

**Ceggdate** — date of first cowbird egg appearance (month and day, 5/07/95 = 507)

**PreCeggd** — precision code for **Ceggd**

**Dbh\_cm** — diameter of primary nest substrate (**Nstsubs1**) at breast height in cm

**Ovrcov** — overhead nest cover in percent (concealment of the nest by foliage above the nest looking down on it from a distance of 1 m)

**SC1** — side cover 1 is the % concealment of the nest from the side from each of four cardinal directions standing 1m from the nest and looking at the nest from nest level.

**SC2** — side cover 2

**SC3** — side cover 3

**SC4** — side cover 4

**Litr\_mm** — avg organic litter depth from 12 sample points within 5m plot (in mm)

**Gcgrn** — percent green cover - percent of ground within 5m plot covered by green vegetation below 50 cm

**Gcgrass** — percent grass/sedge cover below 50 cm. This is an old category, combining cover from grasses and sedges, **that is no longer in use**. **Gcgrass** has now been split into 2 separate variables: **Gcngrass**, and **Gcsedge**

**Gcngrass** — percentage of grass cover below 50 cm.

**Gcsedge** — percent sedge cover below 50 cm

**Gcforb** — percent forb cover below 50 cm

**Gcshrub** — percent shrub cover below 50 cm

**Gcfern** — percent fern cover below 50 cm

**Gcmoss** — percent moss cover below

**Gccactus** — percent cactus shorter than 50 cm in ground cover

**Gclog** — percent of ground covered by downed logs (logs > 12 cm diameter)

**Gewater** — percent of ground covered by standing water

**Gcbare** — percent of **open** ground not covered by leaf litter (gravel or smaller sized)

**Gcrock** — percent rocks (larger than grapefruit sized) in ground cover

**Gcleaf** — percent of ground covered by leaf litter

**Gcbrush** — percent brush (dead shrub and bramble) cover below 50 cm in height

**Gcmarsh** — percent of ground covered by marsh vegetation (vegetation, not differentiated by species or growth form, with its roots submerged under water, but stems and leaves above the water surface; **note** that sedge cover should be determined separately in **Gcsedge**).

**Aspect\_d** — direction (in degrees) that the 5m radius plot faces

**Slope\_d** — in degrees

**RobNstN** — Robel pole measure (in decimeters, to nearest 0.5 decimeter) taken with pole at the center of the vegetation plot and the observer to the north of the pole observing from 1 m above ground level.

**RobNstE** — Robel pole measure, pole at plot's center, observer to the east.

**RobNstS** — Robel pole measure, pole at plot's center, observer to the south.

**RobNstW** — Robel pole measure, pole at plot's center, observer to the west.

**Rob1mN** — Robel pole measure, pole 1 m north of plot's center, and observer facing towards the center of the plot

**Rob1mE** — Robel pole measure, plot 1 m east of the plot's center

- Rob1mS** — Robel pole measure, plot 1 m south of the plot's center
- Rob1mW** — Robel pole measure, plot 1 m west of the plot's center
- Rob3mN** — Robel pole 3 m north of plot's center, observer facing towards the center of the plot
- Rob3mE** — Robel pole measure, plot 3 m east of the plot's center
- Rob3mS** — Robel pole measure, plot 3 m south of the plot's center
- Rob3mW** — Robel pole measure, plot 3 m west of the plot's center
- Rob5mN** — Robel pole 5 m north of plot's center with observer facing center of the plot
- Rob5mE** — Robel pole measure, plot 5 m east of the plot's center
- Rob5mS** — Robel pole measure, plot 5 m south of the plot's center
- Rob5mW** — Robel pole measure, plot 5 m west of the plot's center
- GrHtNst** — maximum height of herbaceous vegetation (in meters) at the center of the vegetation plot
- GrHt1mN** — maximum height of herbaceous vegetation 1 m north of plot's center
- GrHt1mE** — maximum height of herbaceous vegetation 1 m east of plot's center
- GrHt1mS** — maximum height of herbaceous vegetation 1 m south of plot's center
- GrHt1mW** — maximum height of herbaceous vegetation 1 m west of plot's center
- GrHt3mN** — maximum height of herbaceous vegetation 3 m north of plot's center
- GrHt3mE** — maximum height of herbaceous vegetation 3 m east of plot's center
- GrHt3mS** — maximum height of herbaceous vegetation 3 m south of plot's center
- GrHt3mW** — maximum height of herbaceous vegetation 3 m west of plot's center
- GrHt5mN** — maximum height of herbaceous vegetation 5 m north of plot's center
- GrHt5mE** — maximum height of herbaceous vegetation 5 m east of plot's center
- GrHt5mS** — maximum height of herbaceous vegetation 5 m south of plot's center
- GrHt5mW** — maximum height of herbaceous vegetation 5 m west of plot's center
- N0\_1f** — Wiens pole measurement, pole 0.25 m north of the plot's center, counting number of forb contacts with the pole between ground level and 10 cm above ground
- N0\_1g** — same as **N0\_1f**, but counting contacts by graminoids
- E0\_1f** — same as **N0\_1f**, but Wiens pole 0.25 m east of plot's center
- E0\_1g** — same as **N0\_1g**, but Wiens pole 0.25 m east of plot's center
- S0\_1f** — same as **N0\_1f**, but Wiens pole 0.25 m south of plot's center
- S0\_1g** — same as **N0\_1g**, but Wiens pole 0.25 m south of plot's center
- W0\_1f** — same as **N0\_1f**, but Wiens pole 0.25 m west of plot's center
- W0\_1g** — same as **N0\_1g**, but Wiens pole 0.25 m west of plot's center
- N10\_1f, N10\_1g, E10\_1f, E10\_1g, S10\_1f, S10\_1g, W10\_1f, W10\_1g** — the same as the above 8 variables, except this set counts the number of contacts between 10 cm and 20 cm above ground level
- N20\_1f, N20\_1g, E20\_1f, E20\_1g, S20\_1f, S20\_1g, W20\_1f, W20\_1g** — the same as the first 8 Wiens pole variables, except this set counts the number of contacts between 20 cm and 30 cm above ground level
- N30\_1f, N30\_1g, E30\_1f, E30\_1g, S30\_1f, S30\_1g, W30\_1f, W30\_1g** — the same as the first 8 Wiens pole variables, except this set counts the number of contacts between 30 cm and 40 cm above ground level

**N40\_1f, N40\_1g, E40\_1f, E40\_1g, S40\_1f, S40\_1g, W40\_1f, W40\_1g** — the same as the first 8 Wiens pole variables, except this set counts the number of contacts between 40 cm and 50 cm above ground level

**N50\_1f, N50\_1g, E50\_1f, E50\_1g, S50\_1f, S50\_1g, W50\_1f, W50\_1g** — the same as the first 8 Wiens pole variables, except this set counts the number of contacts higher than 50 cm above ground level

This naming scheme for variables is continued with the numbers immediately after the underscore in each name indicating different distances from the plot's center: **1**=0.25 m from center, **2**=0.5 m, **3**=1 m, **4**=3 m, and **5**=5 m. E.g., the variable named **E40\_4g** would be the number of contacts of the Wiens pole by graminoids, when the Wiens pole is 3 m east of the center of the plot. There will be a total of 288 separate variables measured.

**VgSRadm** — radius of small vegetation plot in meters (5 m for most BBIRD sites)

**VgSp1** — alphanumeric code (from PLANTS database) for first plant species within the 5m radius vegetation plot

**VStm1Cl1** — number of stems of **Vgsp1** within the small radius plot with dbh <2.5 cm

**VStm1Cl2** — number of stems of **Vgsp1** within the small radius plot with dbh 2.5-8 cm

**VCov1** — percent cover within the 5 m plot for shrub species **Vgsp1**

**VgSp2** — alphanumeric code (from PLANTS database) for second plant species within the 5m radius vegetation plot

**VStm2Cl1** — number of stems of **Vgsp2** within the small radius plot with dbh <2.5 cm

**VStm2Cl2** — number of stems of **Vgsp2** within the small radius plot with dbh 2.5-8 cm

**VCov2** — percent cover within the 5 m plot for shrub species **Vgsp2**

**VgSp#** —

**VStm#Cl1** —

**VStm#Cl2** —

**VgPerCv#** — percent cover of within the 5 m radius circle for shrub species **Vgsp#**

(use as many sets of **Vgsp#**, **VStm#Cl1**, **VStm#Cl2**, and **VgPerCv#** variables as you have plant species in the 5m radius vegetation plot, pooling rare or uncommon species into "OTHER")

The following variables are measurements of shrubs taken using a point-centered quarter method for selecting targets for measurement. If there is no shrub within 100 meters of the center of your plot in a given quadrat, leave the data fields recorded for that quadrat blank.

**PQShSp1** — species code for nearest shrub in first quadrat from center of vegetation plot; used in point-centered quarter measurements of vegetation

**PQShDst1** — distance (in meters) from center of vegetation plot to nearest shrub in first quadrat

**PQShHt1** — height (in meters) of selected shrub in first quadrat

**PQShWd1** — maximum width (in meters) of selected shrub in first quadrat

**PQShPWd1** — width (in meters) of shrub perpendicular to the width measurement in **PQShWd1**

**PQShSp2** — species code for nearest shrub in second quadrat from center of vegetation plot

**PQShDst2** — distance (in meters) from center of vegetation plot to nearest shrub in second

quadrate

**PQShHt2** — height (in meters) of selected shrub in second quadrate

**PQShWd2** — maximum width (in meters) of selected shrub in second quadrate

**PQShPWd2** — width (in meters) of shrub perpendicular to the width measurement in **PQShWd2**

**PQShSp3** — species code for nearest shrub in third quadrate from center of vegetation plot

**PQShDst3** — distance (in meters) from center of vegetation plot to nearest shrub in third quadrate

**PQShHt3** — height (in meters) of selected shrub in third quadrate

**PQShWd3** — maximum width (in meters) of selected shrub in third quadrate

**PQShPWd3** — width (in meters) of shrub perpendicular to the width measurement in **PQShWd3**

**PQShSp4** — species code for nearest shrub in fourth quadrate from center of vegetation plot

**PQShDst4** — distance (in meters) from center of vegetation plot to nearest shrub in fourth quadrate

**PQShHt4** — height (in meters) of selected shrub in fourth quadrate

**PQShWd4** — maximum width (in meters) of selected shrub in fourth quadrate

**PQShPWd4** — width (in meters) of shrub perpendicular to the width measurement in **PQShWd4**

The following variables are all measured from trees using point-centered quarter measurements. If there is no tree within 100 meters of the center of your plot in a given quadrate, leave the fields of information for this quadrate blank. If there is not one tree per quadrate, measure the distance from all trees, regardless of quadrate, to the center of the plot. The **Quad#** variables will allow data analysts to determine whether data are suitable for point-centered quarter estimates of density (i.e. only a single tree measured from each quadrate).

**Quad1** — quadrate (arbitrarily numbered 1—4) from which the first record comes

**PQTrSp1** — species code for nearest tree in first quadrate from center of vegetation plot; used in point-centered quarter measurements of vegetation

**PQTrDst1** — distance (in meters) from center of vegetation plot to nearest tree in first quadrate

**PQTrHt1** — height (in meters) of selected tree in first quadrate

**PQTrCan1** — canopy cover (from densiometer) under selected tree in first quadrate

**PQTrDBH1** — diameter at breast height (in centimeters) of selected tree in first quadrate

**PQTrCrn1** — average width (in meters) of crown of selected tree in first quadrate

**Quad2** — quadrate (arbitrarily numbered 1—4) from which the second record comes

**PQTrSp2** — species code for nearest tree in second quadrate from center of vegetation plot; used in point-centered quarter measurements of vegetation

**PQTrDst2** — distance (in meters) from center of vegetation plot to nearest tree in second quadrate

**PQTrHt2** — height (in meters) of selected tree in first quadrate

**PQTrCan2** — canopy cover (from densiometer) under selected tree in second quadrate

**PQTrDBH2** — diameter at breast height (in centimeters) of selected tree in second quadrate

**PQTrCrn2** — average width (in meters) of crown of selected tree in second quadrate

- Quad3** — quadrat (arbitrarily numbered 1—4) from which the third record comes
- PQTrSp3** — species code for nearest tree in third quadrat from center of vegetation plot; used in point-centered quarter measurements of vegetation
- PQTrDst3** — distance (in meters) from center of vegetation plot to nearest tree in third quadrat
- PQTrHt3** — height (in meters) of selected tree in third quadrat
- PQTrCan3** — canopy cover (from densiometer) under selected tree in third quadrat
- PQTrDBH3** — diameter at breast height (in centimeters) of selected tree in third quadrat
- PQTrCrn3** — average width (in meters) of crown of selected tree in third quadrat
- Quad4** — quadrat (arbitrarily numbered 1—4) from which the fourth record comes
- PQTrSp4** — species code for nearest tree in fourth quadrat from center of vegetation plot; used in point-centered quarter measurements of vegetation
- PQTrDst4** — distance (in meters) from center of vegetation plot to nearest tree in fourth quadrat
- PQTrHt4** — height (in meters) of selected tree in fourth quadrat
- PQTrCan4** — canopy cover (from densiometer) under selected tree in fourth quadrat
- PQTrDBH4** — diameter at breast height (in centimeters) of selected tree in fourth quadrat
- PQTrCrn4** — average width (in meters) of crown of selected tree in fourth quadrat

## VARIABLES USED TO DESCRIBE VEGETATION

The following list includes all variables to be measured at locations that are being used to describe the vegetation on the study plot (e.g., locations of point counts). Note that even though there are no nests, the variable **Nst\_ID** is still used. For non-nest locations, **Nst\_ID** is needed in order to link together the 4 separate vegetation plots that are measured at each site at which vegetation is measured; the same **Nst\_ID** is given for all 4 vegetation plots from a single site. The list of variables is as follows:

- Nst\_ID** — unique number or code to identify each individual nest within each year (e.g. in AZ we use the observer's 3 initials followed by a number (TEM28) - the number represents the order in which that observer found that nest in that year)
- Plot** — your plot designation code
- Site** - location within state. A unique name that will distinguish each site (individual study) within each state.
- State** — 2 letter code used by postal service (e.g. AZ)
- Yr** — 2 digit number for year (e.g. 94)
- Trtmt** — treatment by plot code, e.g. fragmented, unfragmented, grazed, ungrazed. Please use short verbal descriptions and not number codes.
- Nsttype** — nest plot (1), nonuse plot (2), systematic plot vegetation (3)

- Stn** — location code within plots
- Dirstn\_d** — direction from station to nest in degrees (corrected for declination).
- Dststn\_m** — distance from station to nest in meters.
- Litr\_mm** — avg organic litter depth from 12 sample points within 5m plot (in mm)
- Gcgrn** — percent green cover - percent of ground within 5m plot covered by green vegetation below 50 cm
- Gcgrass** — percent grass/sedge cover below 50 cm. This is an old category, combining cover from grasses and sedges, **that is no longer in use**. **Gcgrass** has now been split into 2 separate variables: **Gcngrass**, and **Gcsedge**
- Gcngrass** — percentage of grass cover below 50 cm.
- Gcsedge** — percent sedge cover below 50 cm
- Gcforb** — percent forb cover below 50 cm
- Gcshrub** — percent shrub cover below 50 cm
- Gcfern** — percent fern cover below 50 cm
- Gcmoss** — percent moss cover below
- Gccactus** — percent cactus shorter than 50 cm in ground cover
- Gclog** — percent of ground covered by downed logs (logs > 12 cm diameter)
- Gcwater** — percent of ground covered by standing water
- Gcbare** — percent of **open** ground not covered by leaf litter (gravel or smaller sized)
- Gcrock** — percent rocks (larger than grapefruit sized) in ground cover
- Gcleaf** — percent of ground covered by leaf litter
- Gcbrush** — percent brush (dead shrub and bramble) cover below 50 cm in height
- Gcmarsh** — percent of ground covered by marsh vegetation (vegetation, not differentiated by species or growth form, with its roots submerged under water, but stems and leaves above the water surface; **note** that sedge cover should be determined separately in **Gcsedge**).
- Aspect\_d** — direction (in degrees) that the 5m radius plot faces
- Slope\_d** — in degrees
- RobNstN** — Robel pole measure (in decimeters, to nearest 0.5 decimeter) taken with pole at the center of the vegetation plot and the observer to the north of the pole observing from 1 m above ground level.
- RobNstE** — Robel pole measure, pole at plot's center, observer to the east.
- RobNstS** — Robel pole measure, pole at plot's center, observer to the south.
- RobNstW** — Robel pole measure, pole at plot's center, observer to the west.
- Rob1mN** — Robel pole measure, pole 1 m north of plot's center, and observer facing towards the center of the plot
- Rob1mE** — Robel pole measure, plot 1 m east of the plot's center
- Rob1mS** — Robel pole measure, plot 1 m south of the plot's center
- Rob1mW** — Robel pole measure, plot 1 m west of the plot's center
- Rob3mN** — Robel pole 3 m north of plot's center, observer facing towards the center of the plot
- Rob3mE** — Robel pole measure, plot 3 m east of the plot's center
- Rob3mS** — Robel pole measure, plot 3 m south of the plot's center
- Rob3mW** — Robel pole measure, plot 3 m west of the plot's center

- Rob5mN** — Robel pole 5 m north of plot's center with observer facing center of the plot  
**Rob5mE** — Robel pole measure, plot 5 m east of the plot's center  
**Rob5mS** — Robel pole measure, plot 5 m east of the plot's center  
**Rob5mW** — Robel pole measure, plot 5 m east of the plot's center  
**GrHtNst** — maximum height of herbaceous vegetation (in meters) at the center of the vegetation plot  
**GrHt1mN** — maximum height of herbaceous vegetation 1 m north of plot's center  
**GrHt1mE** — maximum height of herbaceous vegetation 1 m north of plot's center  
**GrHt1mS** — maximum height of herbaceous vegetation 1 m north of plot's center  
**GrHt1mW** — maximum height of herbaceous vegetation 1 m north of plot's center  
**GrHt3mN** — maximum height of herbaceous vegetation 3 m north of plot's center  
**GrHt3mE** — maximum height of herbaceous vegetation 3 m north of plot's center  
**GrHt3mS** — maximum height of herbaceous vegetation 3 m north of plot's center  
**GrHt3mW** — maximum height of herbaceous vegetation 3 m north of plot's center  
**GrHt5mN** — maximum height of herbaceous vegetation 5 m north of plot's center  
**GrHt5mE** — maximum height of herbaceous vegetation 5 m north of plot's center  
**GrHt5mS** — maximum height of herbaceous vegetation 5 m north of plot's center  
**GrHt5mW** — maximum height of herbaceous vegetation 5 m north of plot's center
- N0\_1f** — Wiens pole measurement, pole 0.25 m north of the plot's center, counting number of forb contacts with the pole between ground level and 10 cm above ground  
**N0\_1g** — same as **N0\_1f**, but counting contacts by graminoids  
**E0\_1f** — same as **N0\_1f**, but Wiens pole 0.25 m east of plot's center  
**E0\_1g** — same as **N0\_1g**, but Wiens pole 0.25 m east of plot's center  
**S0\_1f** — same as **N0\_1f**, but Wiens pole 0.25 m south of plot's center  
**S0\_1g** — same as **N0\_1g**, but Wiens pole 0.25 m south of plot's center  
**W0\_1f** — same as **N0\_1f**, but Wiens pole 0.25 m west of plot's center  
**W0\_1g** — same as **N0\_1g**, but Wiens pole 0.25 m west of plot's center  
**N10\_1f, N10\_1g, E10\_1f, E10\_1g, S10\_1f, S10\_1g, W10\_1f, W10\_1g** — the same as the above 8 variables, except this set counts the number of contacts between 10 cm and 20 cm above ground level  
**N20\_1f, N20\_1g, E20\_1f, E20\_1g, S20\_1f, S20\_1g, W20\_1f, W20\_1g** — the same as the first 8 Wiens pole variables, except this set counts the number of contacts between 20 cm and 30 cm above ground level  
**N30\_1f, N30\_1g, E30\_1f, E30\_1g, S30\_1f, S30\_1g, W30\_1f, W30\_1g** — the same as the first 8 Wiens pole variables, except this set counts the number of contacts between 30 cm and 40 cm above ground level  
**N40\_1f, N40\_1g, E40\_1f, E40\_1g, S40\_1f, S40\_1g, W40\_1f, W40\_1g** — the same as the first 8 Wiens pole variables, except this set counts the number of contacts between 40 cm and 50 cm above ground level  
**N50\_1f, N50\_1g, E50\_1f, E50\_1g, S50\_1f, S50\_1g, W50\_1f, W50\_1g** — the same as the first 8 Wiens pole variables, except this set counts the number of contacts higher than 50 cm above ground level

This naming scheme for variables is continued with the numbers immediately after the underscore

in each name indicating different distances from the plot's center: **1**=0.25 m from center, **2**=0.5 m, **3**=1 m, **4**=3 m, and **5**=5 m. E.g., the variable named **E40\_4g** would be the number of contacts of the Wiens pole by graminoids, when the Wiens pole is 3 m east of the center of the plot. There will be a total of 288 separate variables measured.

**VgSRadm** — radius of small vegetation plot in meters (5 m for most BBIRD sites)

**VgSp1** — alphanumeric code (from PLANTS database) for first plant species within the 5m radius vegetation plot

**VStm1Cl1** — number of stems of **Vgsp1** within the small radius plot with dbh <2.5 cm

**VStm1Cl2** — number of stems of **Vgsp1** within the small radius plot with dbh 2.5-8 cm

**VCov1** — percent cover within the 5 m plot for shrub species **Vgsp1**

**VgSp2** — alphanumeric code (from PLANTS database) for second plant species within the 5m radius vegetation plot

**VStm2Cl1** — number of stems of **Vgsp2** within the small radius plot with dbh <2.5 cm

**VStm2Cl2** — number of stems of **Vgsp2** within the small radius plot with dbh 2.5-8 cm

**VCov2** — percent cover within the 5 m plot for shrub species **Vgsp2**

**VgSp#** —

**VStm#Cl1** —

**VStm#Cl2** —

**VgPerCv#** — percent cover of within the 5 m radius circle for shrub species **Vgsp#**

(use as many sets of **Vgsp#**, **VStm#Cl1**, **VStm#Cl2**, and **VgPerCv#** variables as you have plant species in the 5m radius vegetation plot, pooling rare or uncommon species into "OTHER")

The following variables are measurements of shrubs taken using a point-centered quarter method for selecting targets for measurement. If there is no shrub within 100 meters of the center of your plot in a given quadrat, leave the data fields recorded for that quadrat blank.

**PQShSp1** — species code for nearest shrub in first quadrat from center of vegetation plot; used in point-centered quarter measurements of vegetation

**PQShDst1** — distance (in meters) from center of vegetation plot to nearest shrub in first quadrat

**PQShHt1** — height (in meters) of selected shrub in first quadrat

**PQShWd1** — maximum width (in meters) of selected shrub in first quadrat

**PQShPWd1** — width (in meters) of shrub perpendicular to the width measurement in **PQShWd1**

**PQShSp2** — species code for nearest shrub in second quadrat from center of vegetation plot

**PQShDst2** — distance (in meters) from center of vegetation plot to nearest shrub in second quadrat

**PQShHt2** — height (in meters) of selected shrub in second quadrat

**PQShWd2** — maximum width (in meters) of selected shrub in second quadrat

**PQShPWd2** — width (in meters) of shrub perpendicular to the width measurement in **PQShWd2**

**PQShSp3** — species code for nearest shrub in third quadrat from center of vegetation plot

**PQShDst3** — distance (in meters) from center of vegetation plot to nearest shrub in third

quadrate

**PQShHt3** — height (in meters) of selected shrub in third quadrate

**PQShWd3** — maximum width (in meters) of selected shrub in third quadrate

**PQShPWd3** — width (in meters) of shrub perpendicular to the width measurement in  
**PQShWd3**

**PQShSp4** — species code for nearest shrub in fourth quadrate from center of vegetation plot

**PQShDst4** — distance (in meters) from center of vegetation plot to nearest shrub in fourth  
quadrate

**PQShHt4** — height (in meters) of selected shrub in fourth quadrate

**PQShWd4** — maximum width (in meters) of selected shrub in fourth quadrate

**PQShPWd4** — width (in meters) of shrub perpendicular to the width measurement in  
**PQShWd4**

The following variables are all measured from trees using point-centered quarter measurements. If there is no tree within 100 meters of the center of your plot in a given quadrate, leave the fields of information for this quadrate blank. If there is not one tree per quadrate, measure the distance from all trees, regardless of quadrate, to the center of the plot. The **Quad#** variables will allow data analysts to determine whether data are suitable for point-centered quarter estimates of density (i.e. only a single tree measured from each quadrate).

**Quad1** — quadrate (arbitrarily numbered 1—4) from which the first record comes

**PQTrSp1** — species code for nearest tree in first quadrate from center of vegetation plot;  
used in point-centered quarter measurements of vegetation

**PQTrDst1** — distance (in meters) from center of vegetation plot to nearest tree in first  
quadrate

**PQTrHt1** — height (in meters) of selected tree in first quadrate

**PQTrCan1** — canopy cover (from densiometer) under selected tree in first quadrate

**PQTrDBH1** — diameter at breast height (in centimeters) of selected tree in first quadrate

**PQTrCrn1** — average width (in meters) of crown of selected tree in first quadrate

**Quad2** — quadrate (arbitrarily numbered 1—4) from which the second record comes

**PQTrSp2** — species code for nearest tree in second quadrate from center of vegetation plot;  
used in point-centered quarter measurements of vegetation

**PQTrDst2** — distance (in meters) from center of vegetation plot to nearest tree in second  
quadrate

**PQTrHt2** — height (in meters) of selected tree in first quadrate

**PQTrCan2** — canopy cover (from densiometer) under selected tree in second quadrate

**PQTrDBH2** — diameter at breast height (in centimeters) of selected tree in second quadrate

**PQTrCrn2** — average width (in meters) of crown of selected tree in second quadrate

**Quad3** — quadrate (arbitrarily numbered 1—4) from which the third record comes

**PQTrSp3** — species code for nearest tree in third quadrate from center of vegetation plot;  
used in point-centered quarter measurements of vegetation

**PQTrDst3** — distance (in meters) from center of vegetation plot to nearest tree in third  
quadrate

**PQTrHt3** — height (in meters) of selected tree in third quadrate

**PQTrCan3** — canopy cover (from densiometer) under selected tree in third quadrate

**PQTrDBH3** — diameter at breast height (in centimeters) of selected tree in third quadrat  
**PQTrCrn3** — average width (in meters) of crown of selected tree in third quadrat  
**Quad4** — quadrat (arbitrarily numbered 1—4) from which the fourth record comes  
**PQTrSp4** — species code for nearest tree in fourth quadrat from center of vegetation plot; used in point-centered quarter measurements of vegetation  
**PQTrDst4** — distance (in meters) from center of vegetation plot to nearest tree in fourth quadrat  
**PQTrHt4** — height (in meters) of selected tree in fourth quadrat  
**PQTrCan4** — canopy cover (from densiometer) under selected tree in fourth quadrat  
**PQTrDBH4** — diameter at breast height (in centimeters) of selected tree in fourth quadrat  
**PQTrCrn4** — average width (in meters) of crown of selected tree in fourth quadrat

## VARIABLES REPORTED FOR POINT COUNT RESPONSE DATA

**State**

**Site**

**Plot**

**Point** — census point number (e.g. 1-12 for each plot)

**Repno** — replicate number (e.g. 1-3 depending on whether data is from the first survey of the season, second, or third)

**Obs** — person conducting point count (2 initials + last name, e.g. TEMARTIN)

**Date** — date point count was conducted (first digit = month, next two digits = day of month: 5/07/94 = 507)

**Time** — 4 number military time (e.g. 7:08am = 0708)

**Yr** — year (2 digit number, e.g. 94)

**Sky** — sky code (0-8)

**Wind** — wind code (0-5)

**Temp\_C** — temperature (degrees C) at time of point count

**Radius\_m** — radius of point count circle used

**Spp1** — 4 letter AOU species identification code for bird species detected

**M1NumI** — number of males of **Spp1** found within the count circle

**M1NumO** — number of males of **Spp1** found outside the count circle

**F1NumI** — number of females of **Spp1** found within the count circle

**F1NumO** — number of females of **Spp1** found outside the count circle

**U1NumI** — number of birds of unknown sex of **Spp1** found within the count circle

**U1NumO** — number of birds of unknown sex of **Spp1** found outside the count circle

**Spp#** —

**M#NumI** —

**M#NumO** —

**F#NumI** —

**F#NumO** —

**U#NumI** —

**U#NumO** —

(use as many sets of **Spp#**, **M#NumI**, **M#NumO**, **F#NumI**, **F#NumO**, **U#NumI**, and **U#NumO** as are needed for all species counted at a given point)

## VARIABLE NAMES USED IN DAILY WEATHER DATA FILES

**Date** — (first digit = month, next two digits = day of month: 5/07/94 = 507)

**Yr** — year (2 numbers, e.g. 94)

**Plot**

**State**

**Site**

**MaxT\_C** — maximum temperature (degrees C) during the 24 hr **Date**

**MinT\_C** — minimum temperature (degrees C) during the 24 hr **Date**

**Rain\_mm** — rainfall during the 24 hr **Date** (in mm)

**Wind** — wind code (0-5) recorded at noon on that **Date**

**Sky** — sky code (0-8) recorded at noon on that **Date**