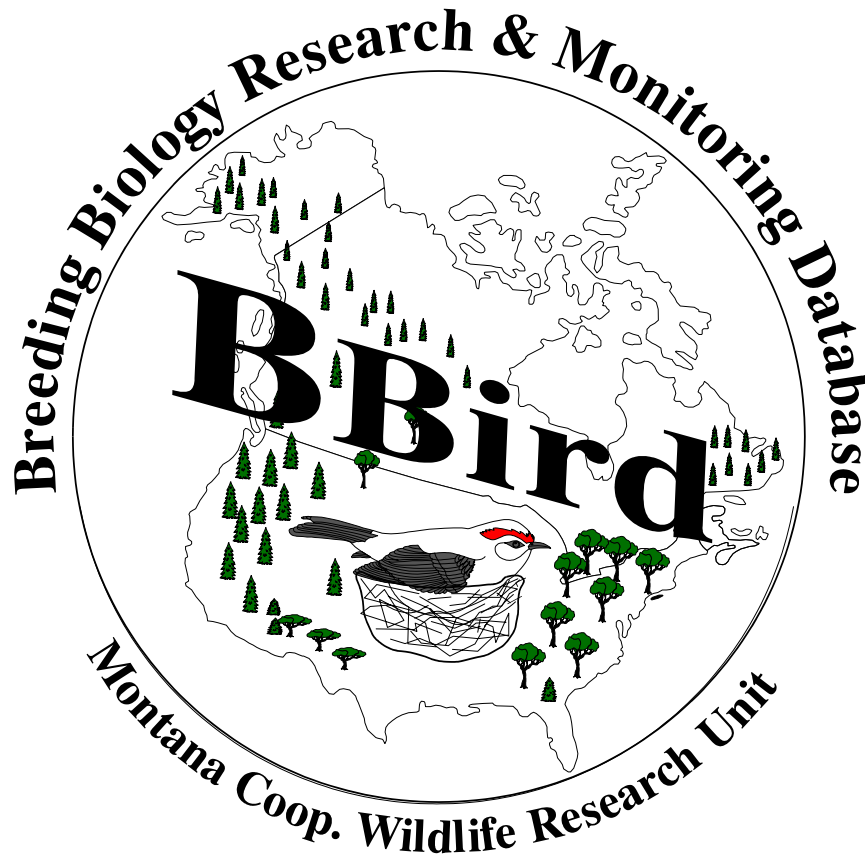


BBIRD

FIELD PROTOCOL



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Abstract: The Breeding Biology Research and Monitoring Database (BBIRD) program is a national, cooperative program that provides standardized field methodologies for studies of nesting success in birds. BBIRD monitors nesting success, productivity, and habitat of nongame birds by finding and monitoring nests at sites across North America. Studies at each local site are administered by independent investigators to maintain high data quality. Point counts are used to index population size at plots. Standardized vegetation sampling is conducted at nest sites, the locations at which point counts are conducted, and where individual investigators deem useful at “non-use” sites that are paired with locations of actual nests. Data from all sites are merged annually and maintained in a central database to allow overview analyses of national trends and patterns across sites. BBIRD field protocols provide detailed instructions to potential investigators for initiating BBIRD sites and maintaining standardized data collection nationally. Ultimately, BBIRD will enable scientists to identify relative population health and habitat requirements for a wide range of species, and examine responses to land conversion processes and global change.

Key Words: breeding productivity, clutch size, habitat measurements, monitoring, nesting success, nongame birds.

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OVERVIEW

Conservation of biological diversity depends on identification and preservation of habitat conditions that sustain healthy populations of coexisting species. Healthy populations are those in which reproduction is sufficient to maintain population size. Breeding biology information is needed to estimate population health and predict vulnerability of species to habitat changes, but such information is lacking for most species. BBIRD monitors breeding productivity and habitat conditions of nongame birds using standardized sampling protocols across local microclimatic gradients, differing land management regimes, and broad geographical regions to allow: 1) identification of species' breeding habitat requirements, 2) assessment of current population health based on breeding productivity for a wide range of species throughout their breeding ranges, 3) early detection of population problems or benefits arising from land management programs, habitat change/fragmentation, or global warming, and 4) projection of species vulnerability to habitat disturbance and global climate change.

NEEDS ADDRESSED

Habitat conversion, land management, and possibly global climate changes are causing loss or change in available habitats. Monitoring programs based solely on censusing may only detect population problems long after they occur; unhealthy populations can be maintained by immigration from healthy populations, causing some population problems to go undetected for years. Thus, presence of a species as detected by censusing may not reflect a population's health because censusing can not detect breeding productivity problems resulting from problematic nest predation, parasitism, or disturbance.

Habitat suitability and breeding population health are best assayed by breeding productivity. Such information is critical because conservation of biodiversity requires preservation of the habitat conditions necessary for sustaining breeding productivity at levels that maintain healthy populations. Moreover, knowledge of habitat requirements allows prediction of species responses to habitat changes, differing land management programs, and global climate change, further aiding management efforts. Finally, detection of declining productivity within populations allows early implementation of management responses. Despite these critical needs, breeding productivity is not widely monitored currently. Furthermore, the specific habitat features and range of habitat conditions needed to sustain breeding productivity of entire assemblages of coexisting species are unknown. A broad-scale research and monitoring program for breeding productivity and habitat requirements of entire communities of coexisting species is needed and such data are best gathered by collaborative partnerships among independent investigators spread over a broad geographic area.

The BBIRD program was initiated to address the above needs. The program identifies habitat conditions affecting breeding productivity and population health of species throughout their geographic ranges. BBIRD also allows monitoring of changes in breeding productivity, population sizes, and availability of microhabitats used by species to provide sensitive indicators of habitat change or global warming. The program is based on partnerships and data-sharing among researchers that use standardized sampling protocols. This allows comparisons of nesting

productivity and associated habitat across broad geographic regions to assess the breadth of environmental problems and provide data for implementing management responses. More than 25,000 nests were located and monitored in the first five years of the program.

Nongame birds are particularly appropriate for monitoring environmental health. 1) Breeding Bird Surveys suggest that populations of many nongame bird species are declining. 2) Bird species differ in environmental requirements and tolerances and thus form sensitive indicators of environmental health. 3) Breeding productivity is more easily monitored for birds than for any other group of vertebrate taxa. 4) Results under this program can be compared with larger regional patterns provided by other censusing programs. 5) Federal agencies have a responsibility to conserve bird populations under the Mitchell Amendment and National Forest Management Act. 6) Nongame birds are in the public eye. A 1985 survey revealed 46% of the U.S. population over 16 years of age (82.5 million people) purchase food for wild birds.

OBJECTIVES

- 1) Monitor breeding productivity and associated habitat to determine status of population health and to provide an early warning signal of population problems.
- 2) Provide baseline data on breeding productivity of species in healthy environments.
- 3) Identify unhealthy habitats and conditions.
- 4) Develop models of habitat needs for healthy populations of coexisting species.
- 5) Use models to assess suitability of habitat conditions for sustaining bird diversity under varying land management and disturbance regimes.
- 6) Examine microhabitat use, distributional, and demographic responses to climate differences in time and space to project long-term responses to global climate change.
- 7) Use information to implement management solutions to maximize probability of arresting problems early and prior to their becoming irreversible or cost-prohibitive.

GENERAL APPROACH

BBIRD replicates intensive local studies at sites across North America. Each site includes randomly-located replicate plots, the size and number of which vary depending on local objectives and productivity of the habitat. Nests of all or focal bird species found within each plot are located and monitored to provide data on breeding productivity of coexisting species. Nest searching and monitoring protocols follow methods outlined in Martin and Geupel (1993). Vegetation sampling is similar to methods described by Martin and Roper (1988) and Martin (1993) with some modifications (detailed sampling methods are outlined in this publication). Point counts are used to index general differences in population size in space and time. There are two types of

BBIRD sites, funded and volunteer. Funded sites follow this protocol completely. Volunteer participants obtain their own funding and use BBIRD protocols to the extent possible. The minimum requirement for participation in the program by volunteers is data on nesting productivity and sources of nesting mortality. However, measurement of vegetation associated with nest sites is also a critical element and is strongly encouraged. Point counts are included whenever possible to provide population trend information.

ORGANIZATION, STATUS, AND PUBLICATION RIGHTS

BBIRD is organized through the Division of Cooperative Research of the National Biological Survey, but depends on partnerships with other agencies. Studies at each local site are administered by an independent principal investigator to maintain high data quality. This facilitates rapid identification and publication of important results at individual local sites. Data collection began in 1992. Over 25,000 nests were monitored in 21 states and Puerto Rico from 1992-1996. Studies in more sites are needed and are being added to expand coverage and scope of inference. Data from all sites are merged and maintained in a central repository at the Montana Cooperative Wildlife Research Unit to allow overview analyses of trends and patterns across sites and to allow individual investigators to query the database to compare their results with other sites. All groups participating in the effort and providing data can request any portions of the shared data set for analyses. Requests will be fulfilled provided they do not conflict with goals and objectives of investigators supplying the data. Any requests for data gathered within 5 years of the request will be checked with individual investigators to ensure first rights of publication. When the majority of data being used in an analysis are from a single investigator's site, that investigator will be expected to be invited to serve as a coauthor on the publication. All publications resulting from this program should acknowledge BBIRD and send 2 reprints to the central site (Montana).

PRODUCT DEVELOPMENT

BBIRD will identify population health and habitat requirements for a wide range of species. Continued work over the long-term (15-20 years) and continued program expansion will allow more complete examination of habitat requirements and responses to land conversion processes and climate changes. These data can also be used to potentially tie in with other GIS programs and other monitoring programs to refine products of these programs.

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ORGANIZATION OF THIS PROTOCOL

This protocol is organized into a series of sections that each represent a different task associated with running a BBIRD site. These descriptions of tasks are organized in roughly the same order as you would encounter them in the course of setting up a BBIRD study site, collecting data in the field, and summarizing the data at the end of the field season. The tasks are organized in the following order:

- 1) Data collection forms — forms for recording data in the field should be prepared before the field season begins, in order to provide a standardized way of keeping records. See page 9.
- 2) Establishing the study plots to use. See page 10.
- 3) Finding new nests — which data to record while searching for a suspected nest or immediately upon finding a new nest. See page 12.
- 4) Monitoring nests — information to record each time you re-check a nest. See page 17.
- 5) After a nest fledges or fails — condensing the information from nest monitoring into a summary of the monitoring effort and fate of the nest. See page 24.
- 6) Describing location of the nest — measuring variables that describe placement and concealment of nests, done after activity at the nest has completed. These measurements should be taken at the same time that vegetation is measured around a nest. See page 30.
- 7) Describing vegetation on your study plots — systematic measurements of vegetation both in the immediate vicinity of nests, and at locations across study plots in order to describe habitat choices of birds, and to provide a description of the type of habitat on study plots. These measurements are generally taken at the end of a field season, when nest-related activities have slowed down. See page 34.
- 8) Measuring densities of adult birds — description of using point counts to provide an index of the densities of breeding birds on study plots. This activity is conducted in parallel with nest finding and monitoring. See page 45.
- 9) Recording meteorological information — recording information useful for relating nesting success to climatic variation. This activity is conducted in parallel with nest finding and monitoring. See page 48.

METHODS

REQUIRED DATA SHEETS

Before field work begins, several data sheets will have to be prepared. There are examples of some data sheets included in this manual. Other sample data sheets can be found on the BBIRD WWW site at <http://pica.wru.umd.edu/bbird/> as Wordperfect 6.1 for Windows files. We use the following data sheets in the field at the Arizona Mogollon Rim BBIRD site:

- 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 pages 12 and 17.
- 2) Nest vegetation forms — 8 ½ X 11" sheets used to record measurements of vegetation around nests and at locations used to describe the vegetation on study plots. See pages 30 and 34.
- 3) Point-centered quarter vegetation forms — 8 ½ X 11" sheets that are used to record additional vegetation data on plots used to characterize the vegetation on study plots. See page 38.
- 4) Point count forms — 8 ½ X 11" sheets used to record numbers of adult birds on point count censuses. See page 45.
- 5) Weather forms — an 8 ½ X 11" form that is used to record daily weather summaries. See page 48.

ESTABLISHMENT OF NEST SEARCH PLOTS

Number and Size of Plots per Site

Each geographic location and habitat condition or type where an independent study is being conducted will be referred to as a **SITE**. At each site, a sufficient number of nest plots should be established to find at least 20 nests per treatment/habitat type each year, for each of the most locally common species. In eastern hardwood forest this is typically about eight 35—50 ha plots, while in more productive (e.g., western riparian) sites, four 10—20 ha sites might be sufficient. Estimates of nesting success based on fewer than 20 nests may not be reliable (Hensler and Nichols 1981). When setting up a new BBIRD site, location of plots must be identified using a random or stratified random selection process, although constrained sampling may be used to control for aspect, slope, distance to roads, or other similar effects. Great caution must be exercised in terms of multiple objectives. Incorporation of additional treatments (fragments, land management programs, grazing, etc.) can fragment sample sizes. Additional objectives should be addressed by **adding** nest plots rather than by fragmenting the sample.

There are few specific requirements for plot size and number, but the following guidelines should be followed when determining the size and number of plots:

- 1) Nest plots should be a minimum of 200 x 200 m (4 ha) in size because point count survey locations (page 45) need to be completely nested within the area searched for nests (survey points should be at least 100 m from the edge of the nest search plot). Small plots are attractive because a larger geographic area can be sampled but search efficiency declines as travel time increases between plots.
- 2) Large numbers of nests can be found in a big plot and search efficiency increases up to a point, but the number of plots that can be searched and monitored drops rapidly as plot size increases. The percentage of nests found also declines in large plots, so there is a trade-off between search efficiency and search intensity. The potential for site-specific bias increases when only a few plots are sampled, reducing the power of inference to areas beyond the plots. It can also be difficult to fit large plots into a single habitat type. Moreover, when plots represent treatments (i.e. grazed vs. ungrazed plots), a sufficient number of plots are necessary to get within and between treatment variance estimates.

Choosing Plots

Plots must be chosen using a random-selection procedure so that inferences can be made to the entire site from the data collected. However, stratifying your site with respect to important features can improve precision. Obviously habitat type has a strong effect on the bird community, but within a general habitat type (e.g., Ponderosa pine) there are many other factors that influence habitat suitability. For example, aspect and proximity to roads or other anthropogenic factors can also influence species composition, density, and productivity. Before selecting plots, give careful thought to factors that might influence bird productivity in your area. Prior to actual choice of plot locations, your randomization scheme should be approved by BBIRD staff. In general, plots should be oriented to maximize local heterogeneity within the plot by running the long

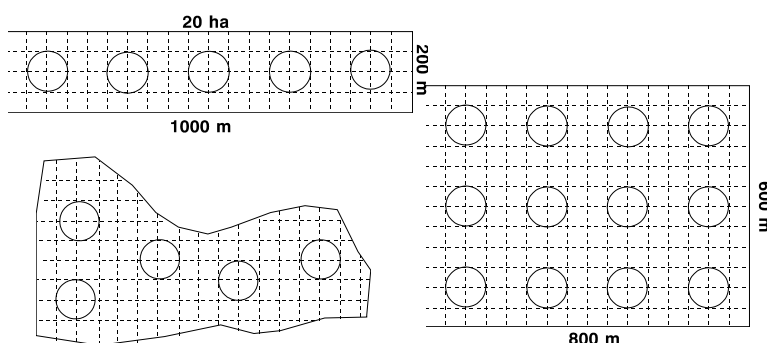
axis of each plot perpendicular to any obvious habitat gradient. This will minimize variance among plots.

Also, try to the extent possible to spatially separate the plots from each other, in order that the plots can be treated as independent sampling units. Separate plots cannot share a common boundary.

Plot Shape

Plots can be of any shape, but the borders should be well defined so the area searched for nests can be accurately determined. Plots should be large enough to fit bird survey points (50 m fixed radius plots) completely within the area searched for nests (see page 45). Survey points should be separated by 200m and all points should be at least 100 m from the edge of the plot (minimum plots width = 200 m; see figure, below).

FIGURE: PLOT SHAPES AND LOCATIONS OF POINT COUNTS



Marking Plots

Permanent markers should be established at 50 m intervals in a grid system to provide reference points for relocating nests; you may want to add additional markers between the 50 m marks if vegetation is dense and distant markers difficult to see. Permanent grid markers are hereafter referred to as **stations**. Station markers are used as field references for relocating nests, but are also used as reference points for calculating nest locations as UTM coordinates for use with GIS systems. All cooperators should try and gain the use of a GPS (Global Positioning System) unit to accurately locate their plots. (We do have limited access to some GPS units — contact Tom Martin if you need a unit.) The GPS units we have access to have a minimum error ranges of +/- 10 meters. This is great for locating plots within a larger geographic area but is not sufficient to accurately locate stations within a plot. We suggest GPS units should be used to locate 1 station on each plot: UTM locations of all other stations can then be calculated from distance and compass bearings from the measured point. Nest locations can be calculated in a similar way using distance and bearings from known station locations. Please note that station locations, and hence nest locations, will only be as accurate as the survey work used to establish stations in the first place. With good survey work, extrapolating from one GPS location per plot will result in more internally accurate locations than locating each station with the GPS unit.

It is important that stations be well marked, and that they survive between years. If possible, all stations should be permanently marked with wooden or metal stakes. Be sure to get permission from the appropriate landowners or agencies before establishing these permanent markers.

FINDING NEW NESTS

Plots should be searched for new nests every 2 days. This protocol will not describe the basic techniques used for finding nests; Martin and Geupel (1993) provides information on these techniques. When a new nest is found, the first priority is to insure that the nest can be found again. Ideally, a nest's location can be described using a distance and compass bearing from one of the stakes used to mark the study plot, coupled with some obvious local landmarks (e.g. distinctively shaped live tree or snag, fallen log). **Do not use flagging to mark nests unless absolutely necessary!** Always place flagging as far from the nest as possible (20 m or more if possible). In dense vegetation, 20 m may be too far to be useful for relocating the nest. Use your own judgment in placing flagging, but remember, predators can learn to associate flagging with nests. We suggest you have assistants label any flagging used to mark nests with year, species, and bearing and distance to nest. Flagging should be removed at the end of each field season. Record location information on a nest card immediately after finding a nest.

There will be occasions on which you are reasonably certain that there is a nest in the vicinity, but you have not been able to find the nest on that day. On these occasions, we have found it useful to fill out preliminary and unofficial information on a nest card: a description of the probable area of a nest. Additionally, search effort on your unsuccessful attempt to find the nest should also be recorded (see next section).

Once you have completed recording all of the information required in this section of the protocol, treat the new nest as you would any other nest, and follow the instructions for routine monitoring of nests found under **MONITORING NESTS** (page 17).

Filling Out The Nest Card

After you have ascertained how to describe the location of a new nest, the next step is to record on a nest card this description and initial information regarding the nest. We have assistants keep 2 sets of nest record cards for all of the nests that they monitor: field cards, which are updated while nest searching and monitoring, and a duplicate set of cards that remains at the field camp and is updated **daily**. The cards that we use in Arizona are color-coded in order to avoid confusing the two sets. Only assign a nest identification number and fill out the duplicate nest cards for nests that you are absolutely certain are active!

In the description of methods that follows, we have coded the individual data items to indicate their purpose. **UNDERLINED VARIABLES IN LARGE BOLD LETTERS** are included in the BBIRD database. The variable codes in parentheses after each variable are the **exact** names that should be used in data files contributed to the national database. *Underlined Variables in italics and mixed case* are needed to determine nest fate and/or provide useful information. *Italicized variables* are not reported directly to the central data repository but some are needed to calculate BBIRD reporting variables. In the figure below we show a sample nest card:

FIGURE: BASIC NEST DATA — FRONT OF NEST CARD

NID:	Nest ID:		Species:		Plot:				
Station:	Dir. Stn.>Nst.: °	Dist. Stn.>Nst.: m	Owner:		Order:				
Obs.:	Attempt:	Year:			Obs.:	Date:	Sex:		
Location Description:					TL:	BL:	TR:	BR:	
					Notes:				
								
					Obs.:	Date:	Sex:		
Location Description:					TL:	BL:	TR:	BR:	
					Notes:				
								
					Obs.:	Date:	Sex:		
Substr. 1:	Nst. Ht.(m):	# Srch. tries:	Srch. Meth.	Time (min)	# Parent visits	Search rad (m)	Nest Fate	Su re	Pr ob
Substr. 2:	Substr. Ht (m):						Success /Fail		
Conceal 1:	Dist. from stem (cm):						# Fledged		
Conceal 2:	Dist. from fol. edge (cm):						Predated?		
	Orient: °						Deserted?		
Fail Cause: human weather cowbird predation other:							# CB Fledged		

The first information to record is that which is required to re-locate a nest, as well as identify the species of bird and the person who found the nest. This information should be recorded while you are in the vicinity of the nest:

YEAR (YR) — 2 digit number for year (e.g. 94).

SPECIES (SPECIES) — bird species. We use 4-letter codes from the Fish & Wildlife Service Bird Banding Lab for reporting data to national database, but **have field assistants use the entire species name on the nest cards to eliminate confusion and errors**. Note that recognizable forms within a species have their own codes (e.g., Myrtle and Audubon's Warblers). Codes can be obtained as a dBase file as part of the DOS banding data entry program used by the Fish & Wildlife Service, available on the World Wide Web at the following web browser address: <ftp://www.im.nbs.gov/pub/software/band-ops/band-ops.exe>

OBSERVER (OBS) - person or persons that found the nest (first 2 initials followed by last name e.g., TEMartin).

NEST ID# (NST_ID) — unique, individual nest ID number or code. This can be assigned in the field or after the field season (in AZ we use the last 2 digits of the year, the observer's 3 initials, and a sequential number that represents the order in which that observer found that nest in that year,

e.g. 96TEM28 is the 28th nest that TEM found in 1996). Please choose a system for **NEST ID#** that will uniquely identify one specific nest in a given study area! Only assign a **NEST ID#** for nests that you are absolutely certain exist.

NEST ATTEMPT# (ATTEMPT) — the number of nests attempted in a season by an individual pair, up to and including the current attempt. If you do not know which attempt in a season this nest is for a pair, leave **ATTEMPT** blank. A new card should be filled out for each nest attempt.

PLOT (PLOT) — unique plot identification code (Number or letter codes are fine. Keep them short).

STATION (STN) — **STATION** is an identifier used to indicate location within a plot. Nests found outside of plot boundaries should be monitored and assistants should record OFFPLOT for the station for these nests to indicate that they were outside plot boundaries.

DIRECTION: STATION TO NEST (DIRSTN_D) — direction from station to nest in degrees.

DISTANCE: STATION TO NEST (DSTSTN_M) — distance from station to nest in meters.

Location description — give a complete description. Include bearing and distance from STN to nest or other landmark; sketching a detailed map works well for refinding nests, especially when nests occur in high densities or a nest is far from a station marker. Someone else should be able to find the nest from your description. Example: From STN #1, go 50m, 233° up slope to 27cm DBH snag in center of group of 3. Nest under bark on east side, 7m up.

Estimated nest height - useful for relocating the nest if height is not measured on finding.

The next step in keeping records is to describe the process that led you to find the nest. BBIRD is compiling this information in order to gain an idea of whether parental behavior or nest concealment affect the success of nests. I.e. if it took you a long time to locate a nest, it might indicate that such a nest would also be difficult for a predator to locate. We will compare success and vegetative characteristics of nests found by techniques that should be relatively unaffected by nest concealment (parents behavior leads us to the nest) and those extremely likely to be affected by nest concealment (chance observation of a nest). We will also use measures of **Parental Elusiveness** gathered at each nest visit (see page 20) in the same manner. We are also recording additional measures of search effort in Arizona (search time, systematic search radius, # of parent visits, and # of previous attempts to find the nest). These variables are not required but may turn out to be useful measures of nest concealment. Here is the information that you should record each time you have attempted to search for a nest:

adult you narrow the nest location to an area 1 meter in radius. You then systematically search the area for the nest). If parent behavior gets you within approximately 50 cm of the nest then the nest is considered to have been located by purely behavioral cues. However, use your own judgement when deciding whether systematic searching was part of the nest location process. The 50 cm cut-off is intended as a guideline and may be too large an area in some cases, and too small in others. For example, considerable searching may be necessary to find the exact position of a nest located in a thick shrub, even after localizing with 50 cm.

Non-behavioral cue (NBC) — a non-behavioral cue suggests a nest is nearby. The nest is then located by systematic searching or waiting for parents. Example: you notice fresh wood chips on the ground near a group of trees. You then locate the nest by searching nearby snags. Another example of a non-behavioral cue would be bird droppings on the ground or leaves under a nest. NOTE: if you were systematically searching under trees for wood chips then **SS** would be the first method recorded, followed by **NBC**, then **SS** or **PB** depending on the cues you used.

Luck (L) — came across a nest by chance without actively searching for it or seeing parental cues.

Previous year (PY) — found nest based on knowledge of nest location from previous year.

Young behavior (YB) — young's behavior led observer to nest. For example, noisy or begging young often can lead you to find nests of cavity nesting birds.

SEARCH EFFORT VARIABLES (not required) — the following are variables used to quantify search effort:

Time (STIME1 — STIME5) - record the time in minutes spent searching for the nest within each cue type (when applicable). If using parental cues, only record time parents are present, not the time spent waiting for them to return to the nest. Don't record a search time if you use systematic searching as the first step in nest location, but do record time spent systematically searching if **PB**, **NBC**, or **F** were the first step in nest location.

#Parent visits (NPARVIS1 — NPARVIS5) - for parent behavioral cues only - record the number of parent visits to the nest during an attempt to locate the nest using parental behavior. Record a separate value for each **PB** search method line you fill out.

Search radius (SRAD1_M — SRAD5_M) - record a search radius in meters for systematic searches initiated by some other cue (**PB**, **F**, **NBC**). For searches initiated by **PB** or **F** record a search radius if it is necessary to systematically search an area larger than a 50 cm radius circle around the nest.

of Previous attempts to find the nest (NTRIES) - number of previous days you have spent time trying to find this nest.

MONITORING NESTS

Active nests must be checked for fate every 3—4 days, and ideally every other day. The longer the interval between checks the more difficult it is to determine the fate of the nest. See Martin and Geupel (1993) for more information on monitoring nests. The information from routine monitoring of nests is used to determine nest fate, productivity, causes of failure and to calculate variables needed for Mayfield nesting success estimates. New participants should request examples of nest cards to help understand the importance of good data reporting. An entire nest visit record line should be filled in each time a nest is visited, even if no activity is observed. Record the number of eggs or young at each visit if you count them even if the number has not changed since the last visit. It is critical to check nests often and to record detailed descriptions of **everything** you see during each visit.

There are several guidelines that should be followed, in order to minimize disturbance of nests while still providing comprehensive information about a nest and its fate.

Nest Check Guidelines

- 1) Check nests from a distance whenever possible, and don't disturb the birds unless a transition from one stage of nesting to the next is expected. Don't go more than 8 days without actually checking nest contents.
- 2) Check nests more frequently (every 2 days) when transitions (onset of INCUBATION, HATCH, FLEDGING) are expected or when you don't have enough data to estimate when hatch or fledging might occur. The tighter your visits bracket these events the better the data.
- 3) Don't disturb birds during building or early in egg-laying because they may abandon.
- 4) Keep careful track of the stage of your nests. Use a table of clutch sizes, and incubation and nestling periods to estimate when incubation, hatch, and fledging may occur so you can plan when more frequent nest visits are needed.
- 5) Avoid creating dead end paths when checking nests. Approach the nest along one route and leave by another. This makes it more difficult for predators to determine exact nest locations from watching your activity or following scent trails.
- 6) Never go near an active nest if predators are nearby or watching you.

Determining Nesting Stage — Useful Cues

Even if you cannot see the contents of a nest, there are still many useful cues that can be used to determine the stage of the nest in the nesting cycle. Be particularly conscious of evidence of nest building or egg-laying and do not approach nests at these times. The following are particularly useful information:

- 1) Adults with building material — This almost certainly indicates that birds are still building their nest. Be careful not to get too close to the nest during building — the birds may abandon.
- 2) Mate-feeding — males of some open- and cavity-nesting species will feed the female on the nest during egg laying, incubation, and early brood rearing. A parent going to a nest with food may actually be feeding its mate, not nestlings. Be careful in interpreting feeding when you only observed one parent. Don't jump to conclusions, simply write down what you see. It is particularly difficult to recognize mate-feeding as opposed to nestling feeding in cavity-nesters. Pairs of many species will exchange contact calls during mate-feeding. Sometimes you can see an adult stick its head out of a cavity to get the food. Note: adults will occasionally enter the nest hole to mate feed and nestlings will also stick their heads out for food late in the nestling period.
- 3) Fecal Sacs — parents will carry fecal sacs away from the nest during the early and middle parts of the nestling period.
- 4) Feeding Young — in cavity-nesters, parents will go into the cavity to feed the young until the end of the brood-rearing period. A parent feeding from outside early in brood-rearing is often an indication that the other parent is in the cavity. Always record whether parents are feeding from the inside or outside of cavities and give a best guess as to whether the one accepting food is an adult or young and **why** you guess that.
- 5) Noisy Babies — Young of many species are very noisy, especially late in the nestling period (e.g. woodpeckers, sapsuckers, orioles). This can be useful in finding nests, and in ageing the young. Listen carefully for noise from nests and record distance at which it is audible. Once noise has been heard, record lack of noise as well.

Filling Out The Nest Card

As in the previous section, **UNDERLINED VARIABLES IN LARGE BOLD LETTERS** are included in the BBIRD database. The variable codes in parentheses after each variable are the **exact** names that should be used in data files contributed to the national database. Underlined Variables in italics and mixed case are needed to determine nest fate and/or provide useful information. *Italicized variables* are not reported directly to

the central data repository but some are needed to calculate BBIRD reporting variables. In Arizona we reserve most of the space on the backs of our nest cards for recording information from visits to nests:

FIGURE: NEST VISIT INFORMATION (TOP BACK OF NEST CARD)

NID:			Nest ID:					Species:						Plot:	COMMENTS	
Mo.	Day	Time	Min @ Nest	Observer	Stage	Nest cont. seen	# Egg	# Yng.	Elusive	Adult Loc.	Adult activity	Min age yng.	Max Age yng.	# CB egg		# CB Yng.

At each nest visit the date and time of day are recorded. Then the following information is written on the field nest card:

#Eggs — record a value here only when the nest contents are actually viewed.

All nests within 6 m of the ground should be checked by eye or with a mirror pole once during incubation (early is best). Two sections of half inch PVC with a shaving mirror or automobile rear-view mirror on top make a good nest monitoring pole for higher nests. Use binoculars to look at the mirror to check the nest. A short section of larger diameter PVC pipe or a pipe connector fitting can be glued to the end of one of the PVC poles to act as a sleeve that will connect the 2 poles when in use. Extendable light bulb replacement and paint poles can be found at some hardware stores, and window washer poles are very good for high nests. Nest checking poles are a pain to carry around in the field, so given an option, field assistants will tend to forget to use them. Having multiple poles and pushing assistants to get the data will improve your results. The number of eggs is reported once in the BBIRD database as **CLUTCH SIZE (CS)** or **NON-FINAL CLUTCH SIZE (NFCS)**.

#Yng — number of hatchlings in the nest. Record a number only when actually counted. Check once soon after hatch to get egg hatching success, and once 2-3 days before expected fledging date to get an estimate of number fledged. The closer your check is to fledging the better the estimate of number fledged, but be careful of force fledging by getting too close. Early fledging may reduce survival. Try to check from a distance, particularly late in the nestling period. These data are used to determine **NUMBER FLEDGED (NFLDG)** which is reported in the BBIRD database.

Elusiveness of parents — How the adult acts around the nest before becoming disturbed. Rate the conspicuousness or elusiveness of the parent around the nest (within a 10 m radius). We are trying to determine if we are just

finding nests of the obvious birds, and if nest success differs between obvious and elusive birds. Rate the elusiveness of the more conspicuous parent that is actively involved in the primary activity of that stage of the nest. For example, only females incubate in most passerines, so record female elusiveness during incubation. Both male and female feed the young in most species, so rate the elusiveness of whichever parent is more conspicuous during the nestling period. Report elusiveness only when you are not close to (i.e. within roughly 10 meters of) the nest, and when you are not actively following adults. *Elusiveness of parents* is a measure of how skittish parent birds are under circumstances in which a potential nest predator (you) has **not** obviously found a nest, but parental behavior could lead to the nest being detected. The following are the codes used:

TABLE: ELUSIVENESS CODES

1	Extremely shy and elusive. Would not approach the nest with you nearby or was able to go to and from the nest without being observed.
2	Somewhat shy or elusive.
3	Somewhat conspicuous
4	Very conspicuous. Unconcerned or oblivious to your presence. Went to the nest with you standing nearby

Minutes at the nest — number of minutes you spent observing the nest. If no activity is observed at the nest, minutes spent observing is critically important in deciding whether the nest is still active. Parents are sometimes away from an active nest for long periods of time. It is sometimes necessary to spend 30 minutes or more to get a good idea of whether or not the nest is active. Seeing no activity after 30 minutes of observation is much stronger evidence that the nest is no longer active than a 5 minute observation. You don't always have time for a 30 minute observation but we need to know how long you did watch.

Comments — Comments are critically important, particularly when it's impossible to check nest contents directly. These data are not reported to the central data repository, but are essential to the determination of nest fate and days under observation. The following is a list of useful things that should be recorded:

- 1) *Nest active/failed* — If no activity is observed at a nest, record how much effort you put in watching the nest (Watched 3 times for 5 minutes each: no activity). When no activity is observed at a nest, check it again in 2 days. Nest status is particularly difficult to determine at cavity nests. Very little activity occurs at some cavity nests during incubation. If no

activity is seen for 6 days, sit and observe the nest from a long distance for 30 minutes. Incubating birds will often sit on a nest for 30 minute periods and, consequently, 5 minute nest checks are not reliable for determining status. As a last resort, you can try banging on the tree with a stick. Banging on the tree during incubation will flush some cavity-nesters, but will just cause others to sit tight on their nests.. **NOTE:** banging on the tree is not a substitute for sitting and watching the nest. Bang on the tree only as a last resort after watching the nest for at least 10 minutes. **WARNING:** banging on old snags can bring down dead branches — BE CAREFUL.

- 2) Stage of nesting (**BLDG**, **LAYing**, **INCubation**, **NESTLing**) — Record the nesting stage whenever you have some idea of the stage. If you are not 100% sure of the stage then include a "?" after the stage. **MOST IMPORTANTLY**, always include the cues you based your determination on. These notes are extremely important for determining fate of the nest and changes in nesting stage, especially for cavity and canopy nests. See Parent Activity section for behavior cues. Be sure to record events such as hatching (young just hatched, egg shells still present). If the nest is in the building stage, record an estimated percent completion and/or the size of the nesting material being used — birds tend to bring finer material late in the building stage.
- 3) Age of young. — Describe: size, extent of feather development, and eye closure. (Example: chicks nickel sized, no feathers, eyes closed). If you know or can estimate chick age include that, but describe the babies anyway so we can develop aging guidelines for each species. Record noise levels for woodpecker young (distance from nest tree that noise is audible, and a subjective description: QUIET, NOISY, VERY NOISY etc.).
- 4) Parent activity — can be used to determine whether the nest is active and its stage in nesting. **Record parent activity even if you know nesting stage from checks of nest contents.** Behaviors of known-stage parents are useful in determining behaviors associated with each stage of nesting. Include the sex and number of parents you observed, and what they were doing. Always record observations of **building material**, **food**, and **fecal sacs**. Don't record "incubating" unless you are certain that a bird is sitting on eggs. If a bird is sitting on the nest and you don't flush her off to confirm eggs, you should record "sitting on nest" rather than "incubating". Birds will often sit on nests that have already hatched, even

- late in the nestling stage. Sometimes birds will even sit on nests for short periods during laying. Also, for cavity-nesters, note whether parents are feeding from the inside or outside of cavities, and if they go in, record how long they stay inside.
- 5) When a nesting attempt terminates (fails or succeeds) record the circumstances and any relevant observations. Check for shell fragments, holes in the nest, torn up nests etc.. If you are trying to distinguish predation from fledging, look for fecal droppings on the edge of the nest or on the ground under the nest, and flattening of the nest edge caused by chicks perching there before fledging. Always look for fledglings in the area to try to confirm fledging.
 - 6) Cowbird parasitism — Look carefully for cowbird eggs when you check nests. Cowbird eggs are mottled brown, about 20 mm long, and quite rounded. Look for eggs that are different from the rest. Cowbird chicks sometimes hatch before the host's eggs, and are often much larger than host chicks. Cowbirds will remove host eggs from the nest. Cowbirds will also lay eggs late in the incubation stage. Late Cowbird eggs usually don't hatch because the host stops incubating after its eggs hatch. Look for cowbird eggs under nestlings in frequently parasitized species. When cowbirds are present take careful notes on the number and fate of cowbird eggs/chicks and host eggs/chicks **on each visit**.

The Last Nest Visit

It is important insofar as possible to determine the fates of nests. Without this information, we cannot obtain accurate estimates of failure rates of nests, information that is essential for extrapolating to population-level consequences for the species being studied.

When a nest fails or fledges, immediately fill in the nest fate area of the card (see figure, below). Include both your own best estimate of what occurred, **and detailed notes on the physical/behavioral evidence you used to come to your conclusion**. Write on the card when you are sure of nest fate (observed some definitive cue) or if it is your best estimate. Fill in the spaces for number of Brown-headed Cowbird (BHCO) eggs, eggs hatched, and chicks fledged. **Pay particular attention to writing notes about cause of failure or evidence for fledging**. Determining whether or not a nest actually fledged young is difficult. In the absence of other cues, we assume chicks fledged successfully if the median date between the last nest check during which the nest was active and the final nest check when the nest was empty was within 2 days of predicted fledging date. If the nest is abandoned with eggs or chicks still in the nest, or the nest fell out of its tree, then be sure to comment on weather during the period since the last check (rain, cold weather, wind storms that could cause failure). Even if the weather was good, record this fact so the person making the final determination of nest fate can be sure you considered weather as a factor.

SUMMARIZING INFORMATION ON NEST FATES

After a nest has either fledged its young or failed it is necessary to condense the information from the nest visits into a summary that is useful for determining reproductive success of the nest, as well as provide population-level statistics such as daily mortality rates for a given species. In Arizona we conduct most of this summary work at the end of the field season.

After a nest is known to have fledged its offspring or failed, you may wish to prominently mark the exact location of the nest with flagging tape, labeled with the **NST_ID#**. This eases relocation of nests later in the season when field crews return to measure vegetation at and around nests (see pages 30 and 34). We have also found it useful to mark completed nests when using a global positioning system (GPS) unit to determine the exact locations of all nests on a study plot.

After The Field Season

After the field season, it is necessary to go over all of the information on the nest cards and determine several pieces of summary information that are needed by BBIRD. The following are the variables derived from data on nest visits. These are the actual nesting productivity variables that are reported to the BBIRD central data repository. Data should be reported on a nest by nest basis (one line in the database for each nest).

INITIATION DATE (INIT) — date that first egg laid

CLUTCH SIZE (CS) — the final number of eggs laid by the natal female in her nest. Record this only when the final number is known exactly. Otherwise leave **CS** blank, and record information in variable **NFCS**.

NON-FINAL CLUTCH SIZE (NFCS) — record clutch size information here, only if the final number of eggs could not be ascertained. Record a number in **NFCS** instead of **CS** when: 1) nests were found after hatching and you could use the number of nestings to estimate the minimum possible clutch size, 2) number of eggs was known on last nest check, but nest was subsequently depredated or abandoned and the adults may not have been finished laying on the previous check, or 3) observer could never confirm final clutch size and could only state that "at least # eggs in nest". If a group of fledglings are seen near the nest or actually fledging from the nest, this is not sufficient data to record a number for **NFCS**, unless you are certain that the observer saw ALL the fledglings. **CS** and **NFCS** are mutually exclusive. If you record a value for **CS**, then **NFCS** must be left blank, and vice versa.

NUMBER FLEDGED (NFLDG) — This variable is not recorded on the nest card, but is determined prior to data entry based on information recorded on nest card. During data entry, record the number of fledglings when number of young was counted in nest during second half of nestling period, or when a minimum number of fledglings were seen outside of

nest. If an observer saw exact number of nestlings in first half only, leave **NFLDG** blank. If the observer saw fledglings then record the number of fledglings seen even if this number is less than the number of nestlings observed in first half. If nestlings were not observed during second half of nestling period and no fledglings were seen in area, leave this variable blank even if observer is certain that nest was successful.

EXACT NUMBER FLEDGED (EXNFLDG) — This variable is also not recorded on nest card. During data entry, code this variable as 1 when **NFLDG** represents an exact number, not an estimate. Code as 1 when the **exact** number of nestlings in nest was known within 2 days of fledging, otherwise leave blank.

LAYING SUCCESS (NSUCEGG) — success at completing egg laying; see nest fate codes on page 27.

INCUBATION SUCCESS (NSUCINC) — success at completing incubation; see nest fate codes on page 27. If nests failed during egg laying, this variable should be left blank.

NESTLING SUCCESS (NSUCNSTL) — success at completing nestling rearing; see nest fate codes on page 27. If the nest failed during laying or incubation, this variable should be left blank.

FINAL SUCCESS (NFINALSUC) — final outcome of nest, see fate codes on page 27. This code should mirror the code for the period in which the nest failed.

NUMBER DAYS UNDER OBSERVATION, LAYING (NOBEGG)

NUMBER DAYS UNDER OBSERVATION, INCUBATION (NOBINC)

NUMBER DAYS UNDER OBSERVATION, NESTLING REARING (NOBNSTL)

NUMBER DAYS UNDER OBSERVATION, STAGE UNKNOWN (NOBTOT) — number of days under observation that could not be assigned to a specific nesting stage. Leave blank if all observation days have been assigned to **NOBEGG**, **NOBINC**, and **NOBNSTL**.

EXACT INITIATION DATE (PRECINIT) — precision with which initiation date of egg laying is known. Code as **1** when date known exactly (first egg appeared between two reliable visits which were only 2 days apart); code **2** when date is derived from any reliably estimated period switch (e.g. **INIT** back calculated from known hatching date); code **3** when **INIT** was estimated from poor nest card information; code **4** used only for lower levels of stacked nests (e.g., Yellow Warbler nests parasitized by Brown-headed Cowbirds, and subsequently built over).

EXACT LAYING PERIOD (PRECLAY) — code as **1** when the number of days under observation during egg laying reflects the exact length of the egg laying period (you identified the day the first egg was laid and the day the last egg was laid). Code as **2** when your data span the entire nesting stage, but the exact transition days between the stages are unknown. If data cannot be coded as **1** or **2**, leave these variables blank.

EXACT INCUBATION PERIOD (PRECINC) — code as **1** when the number of days under observation during incubation reflects the exact length of the incubation period (you identified the first day of incubation and the hatch date). Code as either **2** or leave blank according to the same criteria as for **EXACT LAYING PERIOD**.

EXACT NESTLING PERIOD (PRECNSTL) — code as **1** when the number of days under observation during the nestling period reflects the exact length of the nestling period (you identified the hatch date and the fledging date). Code as either **2** or leave blank according to the same criteria for **EXACT LAYING PERIOD**.

NUMBER OF COWBIRD EGGS LAID (CEGGLAY)

DATE OF FIRST BHCO EGG APPEARANCE (CEGGDATE)

NUMBER OF COWBIRDS HATCHED (CEGGTCH)

NUMBER OF COWBIRDS FLEDGED (CFLDG)

FATE OF COWBIRDS (CNFATE) — the cowbird equivalent of **NFINAL**SUC. See page 27 for codes.

TIMING OF COWBIRD FATE (CFATETIM) — timing of cowbirds' fate, relative to host young (**1** = before host offspring, **2** = same time as host offspring, **3** = after host offspring)

NUMBER DAYS UNDER OBSERVATION, COWBIRDS (COBS) — total observation days for cowbirds (may be longer than for host young if these die before fledging).

EXACT COWBIRD INITIATION (PRECEGGD) — precision with which cowbird egg laying date was estimated. Use same codes as for **PRECINIT**, above.

EXACT COWBIRD CLUTCH SIZE (PRECEGGL) — precision with which number of cowbird eggs in nest is known. Codes as **1** when eggs seen clearly in incubation, code as **2** when eggs only seen in egg laying, codes as **3** only cowbird nestlings seen, or code as **4** when only fledgling cowbirds seen with host parents. All codes other than **1** indicate that **CEGGLAY** is a minimum estimate.

EXACT NUMBER COWBIRDS HATCHED (PRECEGGH) — precision with which number of number of cowbird hatchlings known. Code as **1** when the number of cowbird eggs to hatch is clearly known, or the number of cowbird eggs and number of cowbird fledglings is equal; codes as **2** when the last count of the number of cowbird eggs was made during egg laying and the number of fledgling cowbirds is known; code as **3** when the only count of cowbirds is during the nestling stage; code as **4** when the only count of cowbirds is after fledging.

EXACT NUMBER COWBIRD FLEDGLINGS (PRECFLDG) — precision with which number of cowbird fledglings is known. Code of **1** is the same as for **EXNFLDG**, code **2** if nestling cowbirds seen more than 2 days before fledging, code as **3** if only cowbird eggs counted but fledglings seen, code as **4** when only the number of fledglings was

counted.

PARENTAL ELUSIVENESS (ELUSIVE) — How the adult acts around the nest before becoming disturbed. The value of **ELUSIVE** that you report is the average value of all visits combined (to the nearest 0.1).

Nest Fate Codes

The variables **SUCLAY**, **SUCEGG**, **SUCNSTL**, **FINALSUC**, and **CFATE** are given numeric codes which allow data analysts to quickly sort through the BBIRD database and determine causes of failure of nests. These codes are in the form of decimal numbers, in which the integer portion places a nest into one of several broad classes, and the decimal portion of the code indicates in more detail what caused the fate. **NOTE:** the way in which we code fates has changed from previous years; see **APPENDIX C** for a list of the translations from old to new fate codes. In the table below “prefix” will be used to refer to the integer number that describes the general class of fates, and “suffix” will refer to the decimal place modifier of the general fate class. Here are the new BBIRD fate codes:

TABLE: FATE CODES FOR NESTING SUCCESS

Prefix	Definition of Prefix	Allowable Suffixes	Definition of Suffix
1	Nest successfully completed stage of reproductive cycle		
		0	No modifiers allowed
2	Nest failed during stage of nesting cycle due to any other cause except cowbird parasitism.		
		0	Cause unknown
		1	Abandoned before eggs were laid — use only when certain no eggs were laid. Do not use this nest when calculating Mayfield failure rates of nests.
		2	Abandoned after first egg laid — use only when certain that at least one egg was laid.
		3	Depredated
		4	Failed due to adult mortality — a strong possibility when nest abandoned for no apparent reason late in incubation or nestling rearing.
		5	Failed due to research activities — any nest failure directly attributable to research work

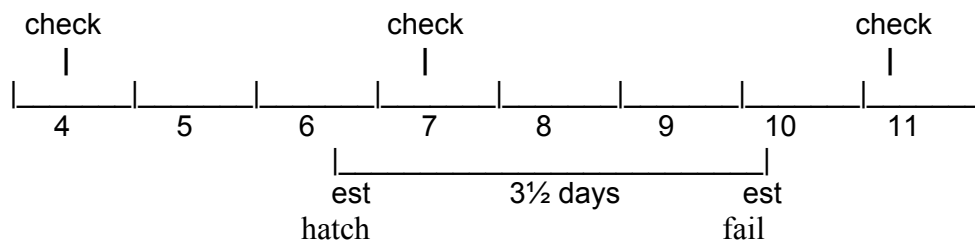
Prefix	Definition of Prefix	Allowable Suffixes	Definition of Suffix
		6	Failed due to weather (e.g. wind, hail, high winds)
		7	Failed due to Acts of God (e.g. nest tree falling down, moose laying down on nest, nest tree struck by lightning, floods)
3	Brood parasitism caused failure — use for fates of host young in any case of parasitism, unless natal young successful		
		0	Either natal or parasite eggs abandoned by natal parents
		1	Natal young failed, but parasite young survived longer (whether or not parasites fledged)
		2	Fate of natal offspring unknown, but parasite offspring definitely survived longer (regardless of whether they fledged)
4	Status unknown — these nests are not used in Mayfield estimates		
		0	Nest found, but never observed occupied or active (i.e. old or previously abandoned)
		1	Nest occupied, but information not sufficient to determine fate
		2	Nest occupied, but monitoring discontinued

Calculating Days Under Observation And Initiation Date

Complete information on nesting chronology is rare, so we frequently have to estimate the number of days that a nest was under observation at each stage of the nesting period. Here are some rules to follow:

- 1) Incubation starts when the last egg is laid (i.e. the last day of egg laying should be counted as the first day of incubation and **NOT** as a day of egg laying). I.e., the number of days in the laying period will generally be one less than the clutch size.
- 2) The nestling period starts when the first egg hatches
- 3) The day you find a nest is the first day under observation or the day the first egg is laid if the nest is found during building (estimates of percent nest completion are useful to estimate when the first egg should be laid).
- 4) In general, we use the mid-point between nest visits to estimate when critical events in the nesting cycle occurred (e.g., nest stage transitions,

fledging, or failure). Examples: If a nest was being incubated on 6/4, and eggs had hatched by the next check on 6/7; estimated hatch date would be midnight on 6/5 (see figure, below). Assume that the nest is checked again on 6/11 and it has been depredated. Estimated failure time would be noon on 6/9, and days under observation during the nestling period would be 3.5 days. Estimate days under observation to the nearest half day. When nest visits are several days apart, the mid-point between visits can be a very inaccurate estimate of when an event occurred. The range of possible days can sometimes be narrowed by using data on age of the young, and/or normal lengths of the incubation and nestling periods from the literature.



- 5) Use data from the literature for species-specific clutch size and lengths of the incubation and laying periods. Substitute your own values for these parameters once you have accumulated enough data for reliable estimates. Use average species clutch size to estimate initiation date when the nest is found during the nestling period and you don't have a clutch size estimate.
- 6) Assume 1 egg laid per day for estimating initiation date.
- 7) When a nest found during incubation fails before hatch, there are no definitive cues that can be used to place the nest within the incubation period. We will use the following method to estimate the first day of incubation in these cases. First day of incubation is calculated as:

$$\text{1ST DAY INCUBATION} = \text{DATE FOUND} - ((\text{INC. PERIOD} - \text{DAYS UNDER OBS.}) / 2)$$

Where:

DATE FOUND = Julian date on which the nest was found

INC. PERIOD = average incubation period of the species

DAYS UNDER OBS. = # of days nest was under observation while active (See calculating days under observation)

DESCRIBING THE NEST'S LOCATION

After a nest is no longer active, it is also time to gather the information needed

to provide an idea of the types of habitat chosen by species, and the consequences of particular habitat choices to the likelihood that nests succeeded in producing offspring. This process can be divided into 2 components: 1) gathering information on the location of the nest itself, and 2) describing the vegetation in the immediate area around the nest. Both of these activities should be conducted at the same time. We have found it convenient to conduct the vegetation work at the end of the field season, after most nesting has stopped, because vegetation measurement is a very labor intensive activity. Marking of nests immediately after they have ended activity allows faster location of nests later in the field season, when crews are conducting vegetation measurement work. This section only describes the information that must be gathered in order to describe placement of nests. The measures used to describe the vegetation around nests are covered in the next section (page 34), which deals with all vegetation measurements.

The following variables are all measured in order to provide information on geographical location or nests, placement of nests, and their concealment:

STATE (STATE) — the 2 letter postal service codes for state.

SITE (SITE) — a unique name that will distinguish each individual study within a **STATE**.

TREATMENT (TRTMT) — a short verbal description of the treatment experienced by a nest in studies that are comparing nesting in different types of habitats (e.g., fragmented vs. unfragmented, old growth vs. second growth). Code as “NONE” if your study is not designed to contrast specific treatments/conditions.

LATITUDE (LAT_D, LAT_MIN, LAT_SEC) — optional GPS measurement of nest’s latitude, derived from GPS measurements.

LONGITUDE (LONG_D, LONG_MIN, LONG_SEC) — optional GPS measurement of nest’s longitude, derived from GPS measurements.

UTM COORDINATES (LAT_M) — optional nest coordinates on UTM grid system, as measured with a GPS unit. Provide only UTM or latitude/longitude, not both.

ELEVATION (ELEV_M) — optional, a measurement of elevation in meters from GPS measurements.

NEST TYPE (NSTTYPE) — a variable that describes whether the subsequent nest and vegetation record belongs to a nest (code **NSTTYPE** as 1 for all nests).

NEST HEIGHT (NSTHT_M) — Measured nest height in meters. **Do not estimate this value.** Use any reliable technique (clinometer, meter stick, etc..)

Note: write in 0 (zero) for ground nests.

Clinometer Use — field assistants are easily confused by clinometers. When using Sunto Clinometers with both percent and degree scales, be sure to specify one method of getting heights or your data will be unreliable. We have assistants use the percent scale, and record the percent and baseline with labels for both the angle (%) and baseline

distance (e.g. 134° x 15m). If assistants record heights in this format you have a better chance of catching mistakes while in the field (i.e. confusion between degrees and percents often can be caught because percentages are usually over 80% and degrees are usually less than 80°), or of subsequently correcting errors.

PLANT SPECIES (NSTSUBS1 and NSTSUBS2) — plant species the nest is in. Use alphanumeric codes from PLANTS database (contact J. Scott Peterson, National Plants Data Collection Center, Baton Rouge, LA, 800-384-8732, a16speterson@attmail.com). Other codes include **ROCK, LOG, ROOT**. For ground nests record the most important feature within 30 cm of the nest (usually a plant, but occasionally rocks, logs, etc.). Use GRASS if nest is under grass tussock of unidentified species. Contact BBIRD staff for coding problem substrates. If nothing clearly important to concealment of the nest is within 30 cm, record **INOPEN**. Leave **NSTSUBS2** blank, unless there is more than one different substrate supporting of the nest.

OBJECTS CONCEALING NEST (NSTCNCL1 and NSTCNCL2) — the plant species or other substrates that are primarily responsible for concealing the nest. Use the same codes as for **NSTSUBS1**. Leave **NSTCNCL2** blank if only one type of substrate conceals the nest.

PLANT HEIGHT (NSBSHT_M) — Measured height in meters of plant or other substrate recorded under **PLANT SPECIES**.

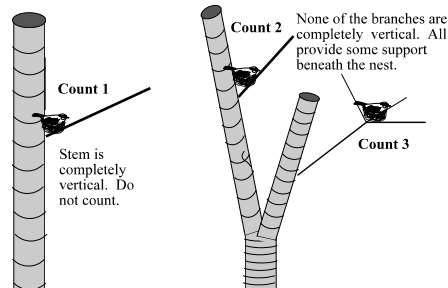
PLANT HEALTH/NEST LOCATION (HEALTH) — tree health and location of nest within dying trees (**L**=live; **PD**—**NL**=partly dead, nest in live portion; **PD**—**ND**=partly dead, nest in dead portion; **D**=dead).

DBH (DBH_CM) — Measured Diameter (cm) at Breast Height of **PLANT SPECIES**.

NEST ORIENTATION (ORIENT_D) — Orientation of the nest relative to the substrate (**PLANT SPECIES**) in degrees. For open nesters, stand at the central stem, face the nest and take a compass reading. For plants with no central stem, use the center point of the plant as a reference point. Orientation for ground nests is the direction the nest cup is tilted towards, or the direction that an adult would take to leave the nest for nests that have thick overhead or side cover. If an open nest is in the exact center of the plant and has no orientation, then have field assistants write in "999" here to make it clear they didn't just forget to record the data (do not put 0 for no orientation). For cavity-nesters, take a compass reading in the direction that the bird would be looking if it were looking straight out the nest hole.

#SUPPORT BRANCHES (NSPBRNCH) — Number of branches supporting an above ground nest. This includes both twigs and larger branches. Only branches that are at least partially under the nest, or that the nest is woven into should be counted. Don't count vertical trunks that may provide lateral support. If a branch or stem is completely vertical it

should probably not be counted. If a stem adjacent to the nest is not completely vertical then some portion is probably under the nest, and it should be counted (see examples in figure, below).



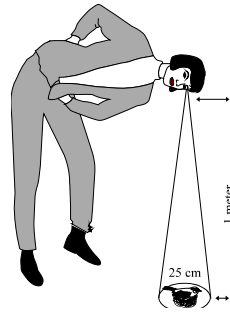
DIAMETER OF SUPPORT BRANCHES (DSPBR_CM) — Average diameter of supporting branches or twigs in cm. For high canopy nests, you can estimate **DSPBR_CM** by judging the sizes of branches relative to the widths of your own fingers.

DISTANCE FROM STEM (DSTEM_CM) — Distance from the central axis of the plant to the center of the nest in cm. If the plant has no single central stem then select a central axis that represents the center of the plant. If the nest is on the ground, then record a distance to the object listed under **PLANT SPECIES** if it is less than 30 cm from the nest. Leave blank if nest is more than 30 cm from a plant (e.g. **NSTSUBS = INOPEN, LOG**, etc..).

DISTANCE OF NEST FROM FOLIAGE EDGE (DCEDG_CM) — Record the horizontal distance from the nest to the nearest outer edge of the foliage (horizontal distance at the same height as the nest). Note that the outer edge of foliage can actually be in a different plant or species in areas of thick vegetation. Record zero (0) for cavity nests and nests attached to the trunks of trees at a level below the nest tree's canopy.

% OVERHEAD COVER (OVR CVR) —

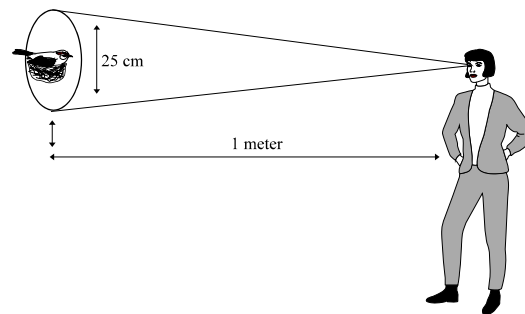
Overhead cover for low nests. Amount of the nest obscured by vegetation from 1m over the nest looking down. Imagine a 25 cm diameter circle (at the nest), 1 meter high vertical cone from your eye to the nest (see figure to right). Estimate % cover of the circle in this cone.



% SIDE COVER (SC1 —

SC4) - Side cover for low nests. Percent of nest obscured by vegetation from 1 meter N, S, E, W of nest at nest height. Record for nests above your head when a reasonable estimate is possible, otherwise ignore. No data are better than bad data. Imagine a 25 cm diameter circle (at the nest), 1 meter long cone extending back from the nest to your eye (see figure, right). Four values should be

reported to the BBIRD data repository for each nest.



MEASURING VEGETATION

We have established methods for sampling vegetation in forest, shrub, and grassland habitats. Exact methods differ somewhat between habitats. The current protocol describes only measurements in forest and shrub communities; at the time of writing (winter, 1997) grassland vegetation measurements are described in a supplemental protocol which will be incorporated into the main protocol in the future. Differences in sampling protocol among habitats will be noted, below. We use a modified version of the James and Shugart (1970) method for sampling vegetation in forest and shrub systems. Basic to this protocol is setting up circular plots in which to measure vegetation.

In this section, we first describe some of the techniques used to measure vegetation. Then we outline the data collected at all vegetation plots (both nest sites and sites used to systematically describe vegetation on a plot), organizing the data into 1) measurements taken at the nest, 2) measurements taken within 5 m plots (see below), and 3) measurements taken within 11.3 m plots (see below).

Locations Where Vegetation Should Be Measured

There are 3 types of locations where vegetation plots have to be established, and vegetation measured:

- 1) OPEN and CAVITY NESTS - 5- and 11.3-m radius plots centered on nests for all nests known to have contained eggs.
- 2) SYSTEMATIC DESCRIPTION OF VEGETATION ON PLOTS - A series of points in a grid system should be established to sample vegetation at the plot level. For sites that are doing bird point counts, the plot vegetation points should be centered on the survey points. Four pairs of 5- and 11.3 m vegetation plots should be done at each plot vegetation point. See next section for more details.
- 3) VEGETATION ON NESTS WITHOUT EGGS - Use your own judgment on whether or not to measure vegetation at nests that failed before laying or with unknown fate (status unknown/nest not occupied). If your nest numbers are low for the species in question then go ahead and take vegetation measurements. Don't bother with vegetation on these "status unknown" nests if sample sizes are large enough (e.g. if you already have 30 or more vegetation descriptions for a given species within the year)..

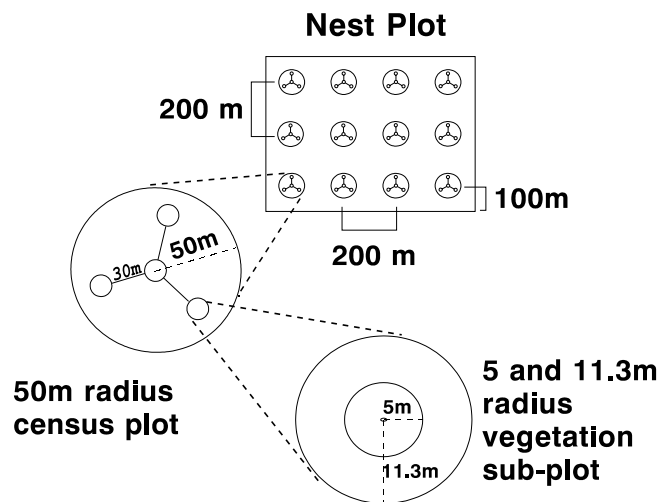
Previous versions of the BBIRD protocol specified that vegetation plots also be established at paired locations for each nest for which vegetation was measured. These paired, "non-use" vegetation plots were intended to be used in order to determine whether birds were selectively placing nests in certain habitats, after any effect due to tree (or other substrate) type of nest had been eliminated. At the fall 1996 BBIRD meeting it was decided that continued measurement of vegetation at these paired, non-use, sites was not consistently providing us with the desired information. Hence, measurement of non-use plots has been discontinued as a required part of the BBIRD protocol. However, if researchers at an individual site can see the use of such data for their individual projects, we encourage them

to continue measuring vegetation at these locations.

Spatial Arrangement of Systematic Sampling Plots

A stratified random sample of vegetation on nest search plots should be conducted every 3 years, except in early successional habitat in which vegetation should be measured more frequently. Instead of conducting a single large survey every third year, you should conduct vegetation measurements on 1/3 of the locations each year in a rotating fashion. For sites in which you will be conducting point counts, plot vegetation points will be established at each survey point. This gives both a measure of plot vegetation and allows us to tie point count data to the vegetative characteristics of the 50 m radius survey plot. Studies that are not doing point counts should establish a series of plot vegetation sampling points spaced 200 m apart, and 100 m from the edge of the plot (as described for survey point establishment). At each location, four separate vegetation plots should be done (see figure, below). The first plot will be located at the sampling location itself, and the remaining three will be located at 120 degrees from each other around the central location (the direction of the first outer subpoint should be random). The center of outer plots should be located 30 m from the center plot. **Location of each of the four subpoints should be permanently marked with stakes to allow measurement of the same vegetation sampling plots in future years.** Both 5 and 11.3 m vegetation plots should be done at each of the 4 subpoints as described for nest.

FIGURE: SPATIAL ARRANGEMENT OF SYSTEMATIC VEGETATION PLOTS



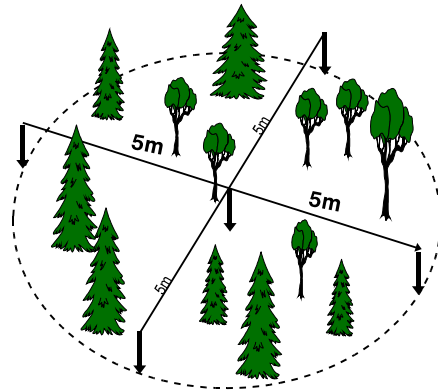
Setting Up An Individual Vegetation Plot

At most study sites, two sizes of circular plots are established: 1) a plot of 5 meter radius that is used to count shrub and sapling stems and measure ground cover, and

2) an 11.3 m radius plot that is used to count the stems of trees. The 5 m plot is nested within and centered on the same point as the 11.3 m plot.

Plots should be divided into quadrants to facilitate stem counting (see figure, below). Use a central tent stake attached to four 5 m long ropes to mark the center of the plot and divide the area into 4 quadrants; the ends of the ropes can be attached to the ground with stakes or tied off on vegetation. Using compass bearings is a convenient way to establish the quadrates in areas with little or no topography. However, on slopes you may find it simpler to orient one axis downslope along the plot's aspect, and the other axis parallel to the slope. For cavity nesters, having two arms of rope extent at 45° angles on either side of the cavity's orientation is convenient. Count stems in each quadrant separately. Setting up ropes and stakes takes little time but improves accuracy and efficiency.

FIGURE: 5 METER VEGETATION PLOT



Exceptions To Rules For Plot Size: Smaller Plots in Dense Habitat

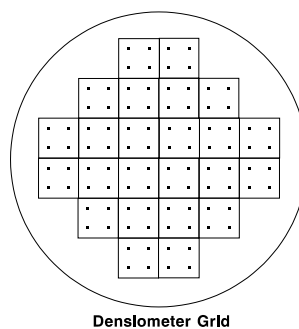
Counting stems in the 5 m radius circle is extremely time consuming in some shrubby habitats. In **thick, open canopy, shrub habitats** dominated by very large numbers of small stems it is permissible to reduce the size of the 5 m circle to 1 m for **stems ≤ 2.5 cm in size**. Continue to count 2.5 - 8 cm DBH stems in the 5 m circle. Do not use 1 m plots in closed canopy forest habitats. Be cautious in deciding to go to 1 m plots. Small plots may not adequately sample heterogeneous habitats. Stick with larger plots if 1 m plots do not appear to be representative of the 5 m plot. As a rule of thumb you should probably stick with 5 m plots unless you are getting more than 100 stems per 5 m quadrant. **Be sure to record whether stems were counted in a 1- or 5-m plot.**

In areas where blackberry or trailing vines form very dense impenetrable clumps with numerous vertical and horizontal stems, estimate percent of the ground covered by such patches instead of counting stems. **This should be done in the 5 m radius circle, not a 1 m circle.** For blackberry species that form single stem plants that can be counted discretely, continue to count stems. Use the guidelines in the previous section to decide whether it is permissible to use 1 m plots to sample single stem blackberry species.

Reading the densiometer

Densiometers are used to measure forest cover. The densiometer is a convex mirror with a grid etched into it (obtained from Robert E. Lemmon, Forest Densiometers, 5733 SE Cornell Drive, Bartlesville, OK 74006; (918)-333-2830 or Forestry Suppliers. We use the convex model). There are 24 squares in the mirror. Imagine 4 uniformly spaced dots in each square of the grid, as illustrated (see figure, below), and count either the number of dots covered by vegetation OR the number not covered by vegetation. When percent canopy cover is high, it is easier to count dots not covered and subtract the total from 96. When canopy cover is low, it is quicker to count covered dots and record that number. Always record **number of dots covered, not** number uncovered. **Do not** break the squares into 4 imaginary squares and try to decide if each one has greater or less than 50% cover. The 4 squares within a square method introduces bias because individuals tend to decide close calls more frequently in one direction than another. Deciding whether or not an imaginary dot is covered is a simple objective decision, and is less susceptible to bias. Avoid counting trunks as cover when possible, particularly when they make up a substantial portion of the cover. Step away from the trunk if necessary. Dot numbers should be converted to percent canopy cover ($\# \text{dots covered} / 96 * 100$) for reporting purposes, but field assistants should not do these conversions in the field.

FIGURE: DIAGRAM OF DENSIOMETER SURFACE



Densiometer Grid

Measurements Made At From The Center Of Vegetation Plots

The following measures are taken while standing at the center of the plot (nest, point count marker, or grid marker). Note that these measures are divided into two groups. The first group of measurements are taken at all types of plots (nest, and systematic vegetation). **However, the second group of measurements is only taken at plots used to systematically describe the vegetation on study plots.** First, the following variables are measured at all vegetation plots:

NEST TYPE (NSTTYPE)—a variable that describes whether the subsequent nest and vegetation record belongs to a nest (code **NSTTYPE** as 1), a non-use plot (code as 2), or a systematic/point count vegetation plot (code as 3).

AVERAGE TOP CANOPY HEIGHT (TOPCAN_M) — Choose a point in the canopy that represents the average height of the top of the canopy within 11.3 m of the center of the plot (i.e. ignore lone trees that emerge above the main canopy when taking this measure). Measure the height of this point with a clinometer.

TOTAL CANOPY (CANCOV) — Percent total canopy closure measured with a densiometer. Stand at/under the nest and take 4 densiometer readings, turning 90° between readings. Measure both **CANCOV** and **HCANOPY** (below) at the same time, for each of the four directions. **CANCOV** is intended to measure total canopy cover, including sub-canopy cover.

HIGH CANOPY (HCANOPY) — Percent total canopy cover above 5 m in height. This measure is intended to measure the upper canopy, not lower canopy layers. Stand at/under the nest and take 4 densiometer readings, turning 90° between readings. This measure can be difficult if there is a lot of low vegetation. We want an estimate of high canopy cover so try the following methods to avoid low vegetation:

- 1) Step away from the nest to a more open area that is representative of the high canopy above the nest.
- 2) If there is relatively little low vegetation you can sometimes ignore it when counting densiometer dots covered and uncovered.
- 3) If low cover is too continuous for a good densiometer reading then make an ocular estimate of cover above 5 m.

DOMINANT PLANT SPECIES IN CANOPY (CDOMSP1) — alphanumeric code (from PLANTS database; USDA 1994) of plant species that dominates the high canopy. Species' dominance is determined by eye. Record species that account for at least 40% of the high canopy **present**. Leave blank if no single plant species represents $\geq 40\%$ of the high canopy present.

PERCENT OF DOMINANT CANOPY SPECIES (CDOMSP1P) — percent of high canopy present that is occupied by **CDOMSP1**.

CO-DOMINANT PLANT SPECIES IN CANOPY (CDOMSP2) — alphanumeric code (from PLANTS database; USDA 1994) of plant species that co-dominates the high canopy. Use this variable when there are 2 plant species that each represent $\geq 40\%$ of the high canopy present. Leave blank if there is not a second plant species that represents $\geq 40\%$ of the high canopy that is present.

PERCENT OF CO-DOMINANT CANOPY SPECIES (CDOMSP2P) — percent of high canopy occupied by **CDOMSP2**.

This next set of measurements are taken at all plots, **except vegetation plots at nests**. These measures are all based on the point-centered quarter method of estimating densities of plants (e.g., Mueller-Dombois and Ellenberg 1974). For these measurements, stand at the center of the plot, and locate the nearest live tree, live shrub, or snag (dead tree)

within each of the quarters of the circle surrounding you. It is convenient to divide the circle into quadrates along the cardinal compass directions. Within each quadrate, record the following information:

SPECIES, CLOSEST SHRUB (PQShSp#) — where # is a number from 1—4 that represents identifies the quadrate

DISTANCE TO SHRUB (PQShDst#) — the distance (in meters) from the center of the plot to the shrub

HEIGHT OF SHRUB (PQShHt#) — height (in meters) of selected shrub

MAXIMUM SHRUB WIDTH (PQShWd#) — maximum width (in meters) of selected shrub

WIDTH PERPENDICULAR TO MAXIMUM (PQShPWd#) — width of the shrub measured at a right angle to the maximum width

SPECIES OF NEAREST TREE (PQTrSs#) — 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

HEIGHT OF CLOSEST TREE (PQTrHt#) — height (in meters) of closest tree in quadrate # to the center of the plot

DIAMETER AT BREAST HEIGHT, CLOSEST TREE (PQTrDBH#) — diameter at breast height (in centimeters) of closest tree in quadrate # to the center of the plot

AVERAGE CROWN WIDTH, CLOSEST TREE (PQTrCrn#) — average width (in meters) of crown of closest tree in quadrate # to the center of the plot

CANOPY COVER, CLOSEST TREE (PQTrCan#) — canopy cover (from densiometer) under closest tree in quadrate # to the center of the plot

DISTANCE, CLOSEST SNAG (PQSnagD#) — distance (in meters) from center of quadrate to the closest snag with ≥ 12 cm dbh in quadrate #. Leave this and all subsequent measure of snag # blank if there is no snag present within 25 meters

HEIGHT OF CLOSEST SNAG (PQSnngHt#) — height (in meters) of closest snag to center of plot in quadrate #

AVERAGE CROWN WIDTH, CLOSEST SNAG (PQSnngCr#) — average width (in meters) of crown of snag closest to center of plot in quadrate #

DIAMETER BREAST HEIGHT, CLOSEST SNAG (PQSnDBH#) — diameter at breast height (in centimeters) of the closest snag in quadrate # to the center of the plot.

CANOPY COVER, CLOSEST SNAG (PQSnCan#) — canopy cover (from densiometer) under the closest snag in quadrate #

Measurements Taken Within The Small (5 Meter) Plot

The following are the measurements to be taken within the 5 meter radius plots. All measurements are taken for all vegetation plots. One measurement taken is a count of the numbers of stems of shrubs that exist within the plot circle. Stems of all saplings and shrubs should be counted by species within each 5 m plot at 10 cm above the ground. The number of stems of each species should be counted for each of two size classes (<2.5 cm diameter or >2.5 cm diameter). We make no distinction in the data between shrubs and saplings, but different criteria must be used to place shrubs (often having no main stem) and saplings (often having a single, main stem) in one of the two size classes into which we place shrubs. Separate counts are made of the number of stems of each species of shrub/sapling within the plot. Please note: growth form and size class **DO NOT** constitute 4 different categories. We are **only** categorizing stems as small or large, **NOT** as single stem small, multiple stem large, etc.. Counts the numbers of stems that fit any of these criteria:

No single central stem at which DBH can be measured:

Small Size Class: < 2.5 cm stem diameter at 10 cm above ground

Large Size Class: > 2.5 cm stem diameter at 10 cm above ground

With a single central stem

Small Size Class: < 2.5 cm dbh, or less than 1.4 m tall

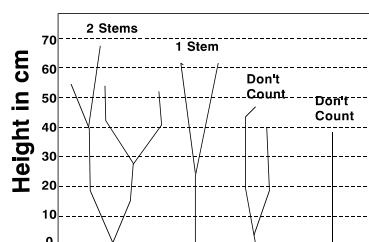
Large Size Class: 2.5 - 8.0 cm dbh

Many plant species break into multiple stems fairly close to the ground. In these situations, it is reasonable to assume that birds respond to stem densities rather than individual plant numbers. Therefore, we count vertical stems, not individual plants.

FIGURE: RULES FOR STEM COUNTS

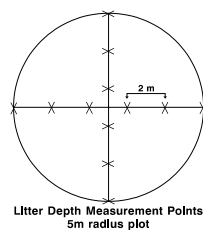
Rules for counting stems:

- 1) Don't count plants/stems less than 50 cm (i.e. approximately knee height) high.
- 2) Count the number of vertical stems at 10 cm above the ground (ankle level), i.e if a stem branches above 10 cm then it is counted as 1 (see figure, below)



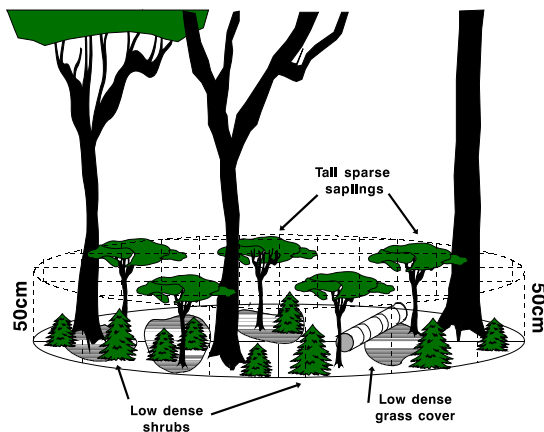
In each of the 5m plots we also measure the depth of organic litter, using a stake or other tool (meter stick, ruler) to dig a small hole down to where individual leaf parts are no longer visible (leaf veins usually decompose last). We are interested in the depth of leaf litter and partially decomposed organic matter that accumulates on top of the mineral soil. Litter depth is measured at 2 m intervals along the ropes that mark the 5 m plots; marking the locations for litter measurements on the ropes will aid consistency. If any of these 12 points land on a log or a rock, move the meter stick slightly to a location where you are actually measuring litter depth.

FIGURE: LOCATIONS FOR LITTER DEPTH MEASUREMENTS



The final class of vegetation measurements made within the 5 meter plots are estimates of ground cover, of several types. For each of the 4 quadrants in the 5 m plot, make an ocular estimate of: the percent of the ground covered by green vegetation from 50 cm above ground, to ground level. For each class of vegetation (shrub, grass, fern etc.), estimate a percent value **independent** of all other vegetation types (i.e. as if other vegetation types were absent). Vegetative cover categories can sum to more than 100% because of vertical stratification of plant layers. However, no **single** category of vegetative cover should be greater than the value for ALL GREEN COVER, **GCGRN**.

FIGURE: GROUND COVER MEASUREMENTS



Ground cover measurements in the 5 m vegetation plot. Notice that there are two types of ground cover that affect cover estimation rules: tall sparse cover that can overlap with low cover types, and low dense cover that cannot overlap with other low cover types (see figure to left). Percent cover in high and low cover types can sum to more than 100%, but low cover types (low grass, bare ground, moss, low dense shrub, leaf litter, logs, etc.) alone must sum to 100%. Total green cover can be more than 100%.

The following are the variables to be measured within each 5 meter plot:

PLOT ASPECT (ASPECT_D) — The direction the 5 m plot faces in degrees.

From the top of the 5 m plot face downhill and take a compass reading in degrees. For cavity nests also measure aspect at 5 m uphill from nest (**not** at top of 11.3 m circle).

SLOPE (SLOPE_D) — Measure the slope across the 5 m plot from the bottom to the top of the plot in degrees (LEFT HAND SCALE OF CLINOMETER). For cavity nests also measure slope across a 5 m radius circle centered on the nest tree (**not** across the 11.3 m circle). Measuring at eye-level aiming at a target also at eye-height the simplest way of taking this measurement.

LITTER DEPTH (LITTR_MM) — Organic litter depth (in mm) should be measured across the center of the plot parallel and perpendicular to the slope of the plot. Measures should be made at 12 points as shown in the figure, above. **LITTR_MM** is the average of these 12 measurements. We are measuring litter depth, **not** percent of ground covered by litter. **Note** if you are in an area covered in water, leave **LITTR_MM** blank, and do not record litter depth as zero: there is litter...just not at the surface.

RADIUS, SMALL PLOT (VGSRADM) — radius (in meters) of the small vegetation plot. This will generally be 5 meters.

SHRUB/SAPLING SPECIES (VGSP#) — species code for the #th (e.g., **VGSP1**, **VGSP2**, etc.) species of shrub encountered in the 5 meter plot. Species do not have to be placed in any specific order

NUMBER OF SMALL SHRUB STEMS (VSTM#CL1) — the number of small (<2.5 cm diameter) diameter stems of species # found within the plot circle

NUMBER OF SMALL SHRUB STEMS (VSTM#CL2) — the number of large (2.5 — 8 cm diameter) diameter stems of species # found within the plot circle

Use as many **VGSP#**, **VSTM#CL1**, and **VSTM#CL2** as required for the species of shrubs encountered. Rare species can be pooled into the group “OTHER”.

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

% GRASS COVER (GCNGRASS) — percentage of ground covered by grasses below 50 cm in height. This variable is new, as in previous years cover from sedges and grasses were lumped into the variable **GCGRASS**.

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

% SHRUB COVER (GCSHRUB) — percentage of ground covered by woody perennial plants that are below 50 cm tall.

% 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) — percentage of ground covered by broad-leaved non-woody plants below 50 cm height.

% 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 50cm 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 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 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 EXAMPLE

% MARSH VEGETATION (GCMARSH) — percentage of ground covered by marsh vegetation (vegetation undifferentiated by species or type that is growing in water). If sedges are **not** reported separate of other marsh vegetation (in **GCSEDGE**), then leave **GCSEDGE** blank instead of reporting a 0 cover for sedge.

Measurements Taken Within Larger (11.3 Meter) Vegetation Plots

The 11.3 meter radius plots are used to count the numbers of trees near the center of the vegetation plot. Live trees are separated into the size classes given in the table, below. Separate counts should be made for each species of tree in the plot. Snags (dead trees) taller than 1.4 m and >12 cm DBH should be combined in a single category (don't separate snags by species for BBIRD data). Some cavity-nesting species will nest in trees smaller than 12 cm DBH. If you have species nesting in snags of <12 cm DBH then don't ignore small snags. Create an additional size class for snags smaller than 12 cm DBH. **If for your own work you want to separate snags into a greater number of size classes, please make 12cm dbh the boundary between two of your size classes so that we can easily combine the data in the BBIRD database.**

TABLE: TREE SIZE CLASSES

Live Trees (measure each species separately)	Small trees: 8 — 23 cm dbh Medium trees: 23 — 38 cm dbh Large trees: >38 cm dbh
Snags (combine all species)	Small snags: < 12 cm dbh and > 1.4 m tall Medium snags: > 12 cm dbf and > 1.4 m tall

The following are the variables recorded for each of the large diameter plots:

RADIUS, LARGE PLOT (TSRADM) — radius (in meters) of the plot used to count numbers of tree stems. This will almost exclusively be 11.3 m

TREE SPECIES (TREESP#) — species code for the #th species of tree encountered on the large vegetation plot. There is no specific order in which tree species must be presented

NUMBER OF SMALL TREE STEMS (TSTM#CL1) — number of live stems of <8 cm DBH, of species # within the large vegetation plot

NUMBER OF SMALL/MEDIUM STEMS (TSTM#CL2) — number of live stems of 8 — 23 cm DBH, of species # within the large vegetation plot

NUMBER OF MEDIUM/LARGE STEMS (TSTM#CL3) — number of live stems of 23 — 38 cm DBH, of species # within the large vegetation plot

NUMBER OF LARGE STEMS (TSTM#CL4) — number of live stems of >38 cm DBH, of species # within the large vegetation plot

Use as many TREESP#, TSTM#CL1, TSTM#CL2, TSTM#CL3, and TSTM#CL4 as required for all species of trees in the plot. Rare species can be pooled into the category “OTHER”.

NUMBER OF SMALL SNAGS (M11SNAG1) — number of snags (all species combined) less than 12 cm dbh

NUMBER OF LARGE SNAGS (M11SNAG2) — number of snags (all species combined) greater than 12 cm dbh

POINT COUNT METHODS

Birds should be surveyed using 10-minute point counts located 200 m apart. Point counts should be 50 m fixed-radius to allow comparability among widely different habitat types and to maximize the probability that bird counts reflect vegetation measured at the point (Petit et al., in press). However, all birds detected beyond 50 m should also be recorded to allow total detection of species. Record male, female, or unknown for each individual bird detected. Distinguish between birds inside and outside of the 50 m radius circle. Points should be established using permanent markers (stakes) and these points should be totally contained within the plot (center of survey plots should be 100 m from the edge of the nest search plot). Data will be reported on a point by point basis, which will allow use of differing nest search plot sizes. However, to maximize comparability, 12 points should be established in each nest plot when possible.

Timing of Point Counts

Surveys should be conducted 3 times per season. Try to fit all 3 replicates in as short a period of time as possible (i.e. 30 days). The starting point and path among points should differ for each of the three counts to minimize effects of visitation path on time of surveying. Counts should begin no earlier than half an hour before sunrise. Base actual starting and ending times on bird activity in your area. We will adopt BBS weather guidelines for conducting surveys and recording weather conditions as cited below.

Weather

Follow BBS Weather Guidelines. To be comparable, surveys must be conducted under satisfactory weather conditions: good visibility, little or no precipitation, light winds. Occasional light drizzle or a very brief shower may not affect bird activity, but fog, steady drizzle, or prolonged rain should be avoided. Except in those prairie states where winds normally exceed Beaufort 3, counts preferably should be made on mornings when the wind is less than 8 m.p.h., and not taken if the wind exceeds 12 m.p.h. If you can walk faster than the wind is blowing, wind conditions are very satisfactory.

Data Recorded on Point Counts

The following information is recorded once for each point count:

PLOT (PLOT) — the name of the plot in which the point count is being conducted.

PLOT RADIUS (Radius_m) — the radius in meters of the point count circles used (record once for each point count).

DATE (DATE) — date upon which the point count was conducted in the format: *first digit* = month, *second and third digit* = day (e.g. May 7, 1997 would be recorded as 507).

REPLICATE NUMBER (REPNO) — number 1—3 depending on whether this is the first, second, or third point count for the season.

OBSERVER (OBS) — person conducting the point counts (2 initials + last

name, e.g., TEMARTIN).

TEMPERATURE (TEMP_C) — temperature in degrees Celsius at the time of the point count.

SKY CONDITIONS CODES (SKY) - Record one of the following Weather

Bureau codes:

TABLE: SKY CONDITION CODES

0	clear sky, few clouds
1	Partly cloudy (scattered) or variable sky
2	Cloudy (broken) or overcast
3	Rain
4	Fog or smoke
5	Fog or smoke
7	Snow
8	Showers (intermittent rain)

WIND SPEED CODES (WIND) - Enter Beaufort Numbers not m.p.h.:

TABLE: BEAUFORT WIND CODES

Beaufort Number	Wind Speed (miles/hour)	Indicators of Wind Speed
0	less than 1	smoke rises vertically
1	1 to 3	wind direction shown by smoke drift
2	4 to 7	wind felt on face; leaves rustle
3	8 to 12	leaves, small twigs in constant motion; light flag extended
4	13 to 18	raises dust and loose paper; small branches are moved
5	19 to 24	small trees in leaf sway; crested wavelets on inland waters

At each stop on the point count survey the following information is recorded:

TIME (TIME) — time to the nearest minute recorded as military time (e.g., 6:09AM = 0609h).

SPECIES (SPP#) — the 4 letter Bird Banding Lab species code for the #th bird species/recognizable sub-species detected. # is an integer number from 1 to the total number of species encountered at a point.

NUMBER MALES IN COUNT CIRCLE (M#NUMI) — number of males of species # found within the count circle.

NUMBER MALES OUTSIDE COUNT CIRCLE (M#NUMO) — number of males of species # found outside the count circle.

NUMBER FEMALES IN COUNT CIRCLE (F#NUMI) — number of females of species # found within the count circle.

NUMBER FEMALES OUTSIDE COUNT CIRCLE (F#NUMO) — number of females of species # found outside the count circle.

NUMBER UNKNOWN SEX IN COUNT CIRCLE (U#NUMI) — number of birds of unknown sex of species # found within the count circle.

NUMBER UNKNOWN SEX OUTSIDE COUNT CIRCLE (U#NUMO) — number of birds of unknown sex of species # found outside the count circle.

Use as many **SPP#**, **M#NUMI**, **M#NUMO**, **F#NUMI**, **F#NUMO**, **U#NUMI**, and **U#NUMO** as required for the number of species encountered at each point.

GENERAL WEATHER REPORTING

All cooperators should obtain daily and monthly weather data summaries from the NOAA weather station(s) nearest to their plots. In addition, a simple weather station should be set up near the plots. We need on-plot weather station(s) to determine if nearby NOAA weather stations are providing data generally representative of the study sites, and to document local weather deviations from NOAA sites. Use your own judgement in deciding on the number of weather stations you need to establish. One will probably be sufficient for most people but studies with widely dispersed plots may need more than one. For each weather station record the following:

STATE (STATE) — 2 letter state code.

SITE (SITE) — the study site's name.

PLOT (PLOT) — the name of the individual plot for which meteorological information is being recorded. List as "ALL_PLOTS", if there is only a single weather record for the entire study site.

YEAR (YR) — year as the 2 digit number.

The following data should be recorded at approximately noon on each day:

DATE (DATE) — 3 digit number, with month represented by the first digit, and day of the month as the last 2 digits.

MAXIMUM TEMPERATURE (MAXT_C) — maximum temperature in degrees Celsius for the previous 24 hours.

MINIMUM TEMPERATURE (MINT_C) — minimum temperature in degrees Celsius for the previous 24 hours.

PRECIPITATION (RAIN_MM) — precipitation in mm of rain during the previous 24 hours.

WIND SPEED (WIND) — the Beaufort wind code (see page 46) at noon on **DATE**.

SKY CONDITIONS (SKY) — the sky code (see page 46) at noon on **DATE**.

CITED LITERATURE

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- USDA. 1994. *PLANTS: Alphabetical Listing Report.* National Plant Data Collection Center, USDA Soil Conservation Service, Baton Rouge, LA.

APPENDIX A

The following is a list of BBIRD variable names that should be used in data files contributed to the national database. Everyone should use these **EXACT** variable names and order to facilitate merging data from all BBIRD sites. Further explanation of each variable is outlined in the BBIRD Field Protocols. Capitalize all text variables. We would like to have BBIRD data submitted in 4 separate units: 1) nesting success, productivity, and nest site vegetation variables, including vegetation data from non-use sites plots; 2) point count response data; 3) vegetation data from random/point count; and 4) daily weather data.

A computer program is now available to facilitate entry and formatting of BBIRD data. For information about this computer program please see the BBIRD web site at <http://pica.wru.umt.edu/bbird/>, or contact BBIRD staff. **PLEASE NOTE** that the format and variable names described below do not completely conform to the variables names used in the data entry program. The reason for this deviation is that the data entry program stores information in a format that, although very efficient with respect to space used, is composed of a series of nested and inter-linked tables in a relational database. The format described below has had to translate these nested tables into a single, “flat field” table format.

If you are having trouble interpreting any of the variables, please contact BBIRD staff.

NAMES USED NEST SITE AND NEST VEGETATION DATA

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)
- Nstype** — 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
- Health** — tree health and location of nest within dying trees (**L** = live; **PD** = partly dead; **PDNL** = partly dead, nest in live portion; **PDND** = partly dead, nest in dead portion; **D** = dead)
- Orient_d** — nest orientation in degrees (corrected for declination)
- Nspbrnch** — number of supporting branches for nest, excluding trunk
- Dspbr_cm** — average diameter of supporting branches in cm
- Dstem_cm** — distance of nest from central stem in cm
- 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).
- Exnflgd** — 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 page 25 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
- Precegggh** — 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)
- PreCegg** — precision code for **Ceggdate**

- Dbh_cm** — diameter of primary nest substrate (**Nstsubs1**) at breast height in cm
- Ovrco** — 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 - % 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
- Topcan_m** — average top canopy height in meters
- Hcanopy** — percent high (above 5m) canopy cover (based on 4 densiometer readings)
- Cancov** — percent total canopy cover (based on 4 densiometer readings)
- Cdomsp1** — alphanumeric code (from PLANTS database) of plant species that dominates the high canopy
- Cdomsp1p** — percent of high canopy occupied by **Cdomsp1**
- Cdomsp2** — alphanumeric code (from PLANTS database) of second plant species that co-dominates the high canopy
- Cdomsp2p** — percent of high canopy occupied by **Cdomsp2**

M11snag1 — total number of snags within the 11.3m radius vegetation plot with dbh < 12 cm (all species pooled)

M11snag2 — total number of snags within the 11.3 meter radius vegetation plot with dbh > 12 cm (all species pooled)

Fmeth1 — method initially used to find nest (**PB, F, SS, NBC, or L**)

Stime1 — search time under **Fmeth1** (in min)

Nparvis1 — number of parental visits observed under **Fmeth1**

Srad1_m — radius of area searched under **Fmeth1** (in m)

Fmeth2 — second method used to find nest, leave blank if you used only 1

Stime2 — search time under **Fmeth2** (in min)

Nparvis2 — number of parental visits observed under **Fmeth2**

Srad2_m — radius of area searched under **Fmeth2** (in m)

Fmeth3 — third method used to find nest, leave blank if <3

Stime3 — search time under **Fmeth3** (in min)

Nparvis3 — number of parental visits observed under **Fmeth3**

Srad3_m — radius of area searched under **Fmeth3** (in m)

Fmeth4 — fourth method used to find nest, leave blank if <4

Stime4 — search time under **Fmeth4** (in min)

Nparvis4 — number of parental visits observed under **Fmeth4**

Srad4_m — radius of area searched under **Fmeth4** (in m)

Fmeth5 — fifth method used to find nest, leave blank if <5

Stime5 — search time under **Fmeth5** (in min)

Nparvis5 — number of parental visits observed under **Fmeth5**

Srad5_m — radius of area searched under **Fmeth5** (in m)

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

VStm1C11 — number of stems of **Vgsp1** within the small radius plot with dbh <2.5 cm

VStm1C12 — number of stems of **Vgsp1** within the small radius plot with dbh 2.5-8 cm

Vgsp2 — alphanumeric code (from PLANTS database) for second plant species within the 5m radius vegetation plot

VStm2C11 — number of stems of **Vgsp2** within the small radius plot with dbh <2.5 cm

VStm2C12 — number of stems of **Vgsp2** within the small radius plot with dbh 2.5-8 cm

Vgsp# —

VStm#C11 —

VStm#C12 —

(use as many sets of **Vgsp#**, **VStm#C11**, and **VStm#C12** variables as you have plant species in the 5m radius vegetation plot, pooling rare or uncommon species into “OTHER”)

TSRadM — radius of large vegetation plot in meters (11.3 m for most BBIRD sites)

TreeSp1 — alphanumeric code (from PLANTS database) for first tree species within the 11.3m radius vegetation plot (tree species can be ordered arbitrarily)

- TStm1CI1** — number of **live** stems of **TREESP1** within the large radius plot with dbh 8— 23cm
- TStm1CI2** —number of **live** stems of **TREESP1** within the large radius plot with dbh 23— 38cm
- TStm1CI3** —number of **live** stems of **TREESP1** within the large radius plot with dbh >38cm
- TreeSp2** — alphanumeric code (from PLANTS database) for second tree species encountered within the larger radius vegetation plot
- TStm2CI1** —number of **live** stems of **TREESP2** within the large radius plot with dbh 8— 23cm
- TStm2CI2** —number of **live** stems of **TREESP2** within the large radius plot with dbh 23— 38cm
- TStm2CI3** —number of **live** stems of **TREESP2** within the large radius plot with dbh >38cm
- TreeSp#** —
- TStm#CI1** —
- TStm#CI2** —
- TStm#CI3** —
- (use as many sets of **TreeSp#**, **TStm#CI1**, **TStm#CI2**, and **TStm#CI3** variables as you have tree species in the larger radius vegetation plot, but pooling rare or uncommon species into OTHER)

NAMES USED 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 are 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)

NAMES USED FOR PLOT/POINT COUNT VEGETATION DATA

Nst_ID — this variable should be used even when there isn't a nest on your vegetation plot. Use the same **Nst_ID** for each of the four vegetation plots measured at a point count station, so that the data from these four plots can be associated with each other during data analysis. Likewise, if you are doing non-use vegetation plots, give the **Nst_ID** for the non-use plot the same name as the **Nst_ID** of its paired nest.

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)

Point — location code within plots

Subplot — vegetation subplot number (1-4) within the 50m radius census point (conduct vegetation measurements at 4 plots within each census point; **Subplot** = 1 should correspond to the subplot in the center of the point)

Date — date vegetation plot was measured (first digit = month, next two digits = day of month: 5/07/94 = 507)

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

Topcan_m — average top canopy height in meters

Hcanopy — percent high (above 5m) canopy cover (based on 4 densiometer readings)

Cancov — percent total canopy cover (based on 4 densiometer readings)

Cdomsp1 — alphanumeric code (from PLANTS database) of plant species that dominates the high canopy

Cdomsp1p — percent of high canopy occupied by **Cdomsp1**

Cdomsp2 — alphanumeric code (from PLANTS database) of second plant species that co-dominates the high canopy

Cdomsp2p — percent of high canopy occupied by **Cdomsp2**

M11snag1 — total number of snags within the 11.3m radius vegetation plot with dbh < 12 cm (all species pooled)

M11snag2 — total number of snags within the 11.3 meter radius vegetation plot with dbh > 12 cm (all species pooled)

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

VStm1CI1 — number of stems of **Vgsp1** within the small radius plot with dbh <2.5 cm

VStm1CI2 — number of stems of **Vgsp1** within the small radius plot with dbh 2.5-8 cm

Vgsp2 — alphanumeric code (from PLANTS database) for second plant species within the 5m radius vegetation plot

VStm2CI1 — number of stems of **Vgsp2** within the small radius plot with dbh <2.5 cm

VStm2CI2 — number of stems of **Vgsp2** within the small radius plot with dbh 2.5-8 cm

Vgsp# —
VStm#CI1 —
VStm#CI2 —

(use as many sets of **Vgsp#**, **VStm#CI1**, and **VStm#CI2** variables as you have plant species in the 5m radius vegetation plot, pooling rare or uncommon species into “OTHER”)

TSRadM — radius of large vegetation plot in meters (11.3 m for most BBIRD sites)
TreeSp1 — alphanumeric code (from PLANTS database) for first tree species within the 11.3m radius vegetation plot (tree species can be ordered arbitrarily)
TStm1CI1 — number of **live** stems of **TREESP1** within the large radius plot with dbh 8— 23cm
TStm1CI2 — number of **live** stems of **TREESP1** within the large radius plot with dbh 23— 38cm
TStm1CI3 — number of **live** stems of **TREESP1** within the large radius plot with dbh >38cm
TreeSp2 — alphanumeric code (from PLANTS database) for second tree species encountered within the larger radius vegetation plot
TStm2CI1 — number of **live** stems of **TREESP2** within the large radius plot with dbh 8— 23cm
TStm2CI2 — number of **live** stems of **TREESP2** within the large radius plot with dbh 23— 38cm
TStm2CI3 — number of **live** stems of **TREESP2** within the large radius plot with dbh >38cm

TreeSp# —
TStm#CI1 —
TStm#CI2 —
TStm#CI3 —

(use as many sets of **TreeSp#**, **TStm#CI1**, **TStm#CI2**, and **TStm#CI3** variables as you have tree species in the larger radius vegetation plot, but pooling rare or uncommon species into OTHER)

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 quadrat
- PQShHt3** — height (in meters) of selected shrub in third quadrat
- PQShWd3** — maximum width (in meters) of selected shrub in third quadrat
- PQShPWd3** — width (in meters) of shrub perpendicular to the width measurement in **PQShWd3**
- PQShSp4** — species code for nearest shrub in fourth quadrat from center of vegetation plot
- PQShDst4** — distance (in meters) from center of vegetation plot to nearest shrub in fourth quadrat
- PQShHt4** — height (in meters) of selected shrub in fourth quadrat
- PQShWd4** — maximum width (in meters) of selected shrub in fourth quadrat
- PQShPWd4** — width (in meters) of shrub perpendicular to the width measurement in **PQShWd4**
- PQTrSp1** — species code for nearest tree in first quadrat 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 quadrat
- PQTrHt1** — height (in meters) of selected tree in first quadrat
- PQTrCan1** — canopy cover (from densiometer) under selected tree in first quadrat
- PQTrDBH1** — diameter at breast height (in centimeters) of selected tree in first quadrat
- PQTrCrn1** — average width (in meters) of crown of selected tree in first quadrat
- PQTrSp2** — species code for nearest tree in second quadrat 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 quadrat
- PQTrHt2** — height (in meters) of selected tree in first quadrat
- PQTrCan2** — canopy cover (from densiometer) under selected tree in second quadrat
- PQTrDBH2** — diameter at breast height (in centimeters) of selected tree in second quadrat
- PQTrCrn2** — average width (in meters) of crown of selected tree in second quadrat
- 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

quadrate

PQTrCrn3 — average width (in meters) of crown of selected tree in third quadrate

PQTrSp4 — species code for nearest tree in fourth quadrate 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 quadrate

PQTrHt4 — height (in meters) of selected tree in fourth quadrate

PQTrCan4 — canopy cover (from densiometer) under selected tree in fourth quadrate

PQTrDBH4 — diameter at breast height (in centimeters) of selected tree in fourth quadrate

PQTrCrn4 — average width (in meters) of crown of selected tree in fourth quadrate

PQSnagD1 — distance from center of vegetation plot to the first snag ≥ 12 cm dbh in the first quadrate. Leave this and all subsequent measures of snags in quadrate 1 blank if there is no snag present within 25 m of the center of the vegetation plot

PQSnngHt1 — height (in meters) of selected snag in first quadrate

PQSnCan1 — canopy cover (from densiometer) under selected snag in first quadrate

PQSnDBH1 — diameter at breast height of the snag within the first quadrate

PQSnngCr1 — average width (in meters) of crown of selected snag in the first quadrate

PQSnagD2 — distance from center of vegetation plot to the first snag ≥ 12 cm dbh in the second quadrate. Leave this and all subsequent measures of snags in quadrate 1 blank if there is no snag present within 25 m of the center of the vegetation plot

PQSnngHt2 — height (in meters) of selected snag in second quadrate

PQSnCan2 — canopy cover (from densiometer) under selected snag in second quadrate

PQSnDBH2 — diameter at breast height of the snag within the second quadrate

PQSnngCr12 — average width (in meters) of crown of selected snag in the second quadrate

PQSnagD3 — distance from center of vegetation plot to the first snag ≥ 12 cm dbh in the third quadrate. Leave this and all subsequent measures of snags in quadrate 1 blank if there is no snag present within 25 m of the center of the vegetation plot

PQSnngHt3 — height (in meters) of selected snag in first quadrate

PQSnCan3 — canopy cover (from densiometer) under selected snag in third quadrate

PQSnDBH3 — diameter at breast height of the snag within the first quadrate

PQSnngCr13 — average width (in meters) of crown of selected snag in the third quadrate

PQSnagD4 — distance from center of vegetation plot to the first snag ≥ 12 cm dbh in the fourth quadrate. Leave this and all subsequent measures of snags in quadrate 1 blank if there is no snag present within 25 m of the center of the vegetation plot

PQSnngHt4 — height (in meters) of selected snag in fourth quadrate

PQSnCan4 — canopy cover (from densiometer) under selected snag in fourth quadrate

PQSnDBH4 — diameter at breast height of the snag within the fourth quadrate

PQSnngCr14 — average width (in meters) of crown of selected snag in the fourth

quadrate

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**

APPENDIX B

Names of some variables were changed from earlier editions of the protocol to the current version. Below is a list of the variables that were added or changed. The reasons for changes were to make the names of variables more closely reflect the actual data being recorded. The major constraint was that variable names could only be 8 characters long, as most, in order to maintain compatibility with some database programs.

NEW VARIABLE NAMES	COMMENT/OLD NAME
Lat_d, Lat_min, Lat_sec, Long_d, Long_m, Long_sec, Lat_m, Elev_m	All are new variables provided for BBIRD sites that GPS the locations of all nests.
NSucegg, NSucinc, NSucnstl, NFinalsuc, Cnfate	New versions of pre-existing fate code variables (see APPENDIX C).
Nobtot	New variable required to fully tally numbers of observation days of nests.
Precinit	New precision code for initiation dates.
Cobs	New observation days code for Cowbirds.
Preceggd, Precegg1, PreceggH, Precfldg	New precision codes for cowbird-related nest variables.
Gcsedge, Gcbrush, Gcmoss, Gccactus, Gewater, Gcmarsh, Gcrock	New categories of ground cover.
VgSRadM	Formerly called PLTRAD_M .
VgSp#, TreeSp#	Formerly SPP#M5 . and SPP#M11 respectively.
VStm#C11, VStm#C12	Formerly S#M50 and S#M51 respectively.
TSRadM	New variable allowing variable radii in tree stem count plots.
TStm#C11, TStm#C12, TStm#C13	Formerly S#M112 , S#M113 , and S#M114 respectively.

NEW VARIABLE NAMES	COMMENT/OLD NAME
PQShSp#, PQShDst#, PQShHt#, PQShWd#, PQShPWd#	New variables for point-centered quarter sampling of shrubs.
PQTrSp#, PQTrDst#, PQTrHt#, PQTrDBH#, PQTrCrn#, PQTrCan#	New variables for point-centered quarter sampling of live trees.
PQSnagD#, PQSngHt#, PQSngCr#, PQSnDBH#, PQSnCan#	New variables for point-centered quarter sampling of snags.
M#NumI, M#NumO, F#NumI, F#NumO, U#NumI, U#NumO	For point counts, replace SEX# , NUM# , and NUM1B

APPENDIX C

The numeric codes used to describe nest fate were changed from previous editions of the protocol to the current edition. The table below provides a conversion from old fate codes to the newer codes. The reason for the change was that some BBIRD sites required additional codes, resulting in a proliferation of integer codes, the order of which reflected in no logical way the biological similarities of the fates. The new **integer.decimal** format allows similar fates to be grouped together based on the integer component of the codes, while allowing a series of sub-categories in the decimal component.

Old BBIRD Fate Code	New BBIRD Fate Code
1	1.0
2	2.3
3	4.0
4	4.1
5	2.7
6	2.2
7	2.4
8	2.1
9	3.0
9	3.1
9	3.2
10	2.6
11	2.0
12	2.5
13	4.2