CVS-EEP Protocol for Recording Vegetation

All Levels of Plot Sampling

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1. Introduction

This document is intended primarily for individuals who are new to vegetation sampling for the Carolina Vegetation Survey (CVS, http://cvs.bio.unc.edu) or the North Carolina Ecosystem Enhancement Program (EEP, http://www.nceep.net). It also serves as a reference to current procedures for all workers collecting plot-based data using the CVS-EEP protocol. In addition, this document should be helpful for individuals who wish to interpret data collected for these programs or wish to apply our protocol for other programs. Definitions and explanations should also clarify changes for those familiar with earlier versions of our protocol.

We hope that this guide will facilitate your recording of vegetation plots, and perhaps even help you appreciate more deeply the vegetation that you have the opportunity to observe.

2. Vegetation Plots, Protocols, and Data

2.1: What is a plot?

The ***plot*** is the fundamental record of plant community composition. A plot is a bounded area of land, within which the vegetation and environment are documented. The CVS protocol defines plots as consisting of one or more 100-m^2 ***modules***. While a module typically has a standard shape of 10×10 m, varying the number, shape, and arrangement of modules allows flexible plot design enabling a common methodology to be applied to a broad diversity of vegetation types.

The scientific method requires that measurements be as unbiased as possible, and that they be repeatable. Plots should be designed to achieve both of these objectives; in particular, different people should be able to inventory the same plot and produce similar data. The bounded nature of plots reduces error and bias, as otherwise individual plants might be subjectively included or ignored. Because even with plots, bias can be hard to avoid, care should be taken to locate and record the plot objectively.

2.2: Choice of protocol level

There are many different goals in recording vegetation, and both time and resources for collecting plot data are extremely variable. To provide appropriate flexibility in project design we support five distinct types of vegetation plot records, which we refer to as ***levels*** in recognition of the increasing level of detail and complexity across the sequence. The lower levels require less detail and fewer types of information about both vegetation and environment, and thus are generally sampled with less time and effort.

- **Level 1: Planted stem inventory plots.** Level 1 plots are applicable only for restoration areas with planted woody stems. The primary purpose is to determine the pattern of installation of plant material with respect to species, spacing, and density, and to monitor the survival and growth of those installed plants. Level 1 plots are one module in size.
- **Level 2: Total woody stem inventory plots.** Level 2 plots also are designed specifically for restoration areas and represent a superset of information collected for Level 1 plots. In these plots planted woody stems are recorded exactly as for Level 1, but in addition all woody stems resulting from natural regeneration are recorded by size class using separate datasheets. These plots allow an accurate and rapid assessment of the overall trajectory of woody-plant restoration and regeneration on a site. Level 2 plots are one module in size.
- **Level 3: Community occurrence plots.** Level 3 plots are used to document the overall abundance and vertical distribution of leaf area cover of the more common species in a plot. Cover is estimated for all plant species exceeding a specified lower level (typically 5% cover); species present but with cover lower than the cut-off may be ignored. The information collected meets the Ecological Society of America (ESA) guidelines and Federal Geographic Data Committee (FGDC) standards for plots used to classify vegetation to an association within the U.S. National Vegetation Classification (NVC). The information can also be used to assess vegetation successional status as well as the presence and abundance of undesirable taxa such as invasive exotics. Additional environmental data are collected in Level 3 plots. Optionally, woody stem data required for Level 2 plots (tallies of planted and/or natural woody stems) may be collected for Level 3 plots to allow more accurate assessment of the rate and direction of succession. Level 3 plots are one module in size.
- **Level 4: Community classification plots.** Level 4 plots are similar to Level 3 plots, except that cover values are determined for *all* plant species occurring on the plot, and additional environmental data are collected. As is the case for Level 3 plots, it is optional whether to tally woody stems. These plots conform to the requirements for "classification plots" as defined by the ESA Guidelines and FGDC standards, which are plots of sufficient detail and quality to be used in development and refinement of the NVC. The primary purpose for collecting Level 4 plots is to facilitate rigorous documentation of vegetation composition. An experienced field botanist is required to ensure collection of a complete list of species occurring in the plot. Level 4 plots are one or more modules in size.
- **Level 5: Community classification and structure plots.** Level 5 plots require all the information collected for Level 4 plots, plus additional information on the spatial structure of the vegetation within the plot. Woody stem data remain optional, but are strongly recommended. The primary purpose of Level 5 plots is to facilitate rigorous research and assessment of vegetation composition and structure. Level 5 plots are one or more modules in size.

2.3: Data collection and forms

Field data forms are available for each of the plot levels, as are additional instructions and training aids. Visit http://cvs.bio.unc.edu to obtain forms or additional information.

2.4: Project identification

Each project should have a unique project identifier that ensures that plots will be properly associated with project metadata (information about the project data). There are two sources of unique project identifiers within our data network. For projects contracted by **EEP**, **EEP** assigns project identifiers including both a ***unique project label*** and an official ***project name*** (which may not be unique). To request a unique project label from **EEP**, contact them via their website (http://www.nceep.net). **CVS** assigns ***project numbers*** directly on an as-needed basis for projects independent of **EEP**; to request a **CVS** project number send email to cvs@unc.edu.

2.5: Plot numbering

Plots must be uniquely identified within a project. This is typically done with a couplet consisting of a team number and a plot number. Each field team is assigned a team number unique within the project; where only one team is involved this defaults to 1. Each team within a project will label each plot with a unique number. Normally a team will be assigned an ***initial plot number*** and will number plots sequentially starting with that number. Please be sure to write all plot identifiers (project-team-plot) on every datasheet you fill out. It's very easy to forget this simple activity, but if you forget it can be difficult or impossible to assign these identifiers later. The plot leader is responsible for ensuring that full plot identification is recorded on all datasheets and other samples (e.g., unknown plants, soils) collected in the plots.

2.6: Data management and data submission

CVS has developed a data entry tool within Microsoft Access that allows data entry in computer forms that mimic the datasheets used for the various protocol levels. Quality-control checks are automatically performed to ensure that data entry has been accurate and that field workers did not record logically inconsistent data. Once this process is complete, the Access database may be sent to CVS for inclusion in the central archive database. Instructions for submitting data to CVS may be found within the data entry tool itself (see Main Menu | Options). This data entry tool may be downloaded from http://cvs.bio.unc.edu.

3. Level 1-2 Vegetation Plots

3.1: Project information

3.1.1: Project planning

Project planning is a critical step and includes making decisions about such issues as how many plots to sample, the sampling methodologies to use, how and where plots should be located, what types of stands within certain areas should be targeted, and the level of expertise required of the sampling team. Long-term goals must be balanced with short-term availability of resources and logistics to achieve a successful project. The outcome of the planning process is presented in the Mitigation Plan, which must be reviewed by EEP personnel.

3.1.2: Timing of sampling for EEP projects

For newly constructed EEP projects, ***Vegetation Baseline Data*** (VBD) must be submitted ***within 60 days*** of the EEP/State Construction Office walk-through. To prevent unreasonably short time spans between the collection of VBD and the first collection of ***Year 1 Vegetation Monitoring Data*** (Y1-VMD), all Y1-VMD must be collected during the month of September. The second and all subsequent years of VMD must be collected between June 1 and September 31, unless a different schedule has been approved by the EEP.

3.1.3: Determining the number of required plots for EEP projects

The number of required plots must be calculated separately for each mitigation category: stream enhancement, stream restoration, and wetland mitigation. The data entry tool can aid in calculating the necessary number of plots (see Main Menu | Planning).

3.2: Plot location and placement

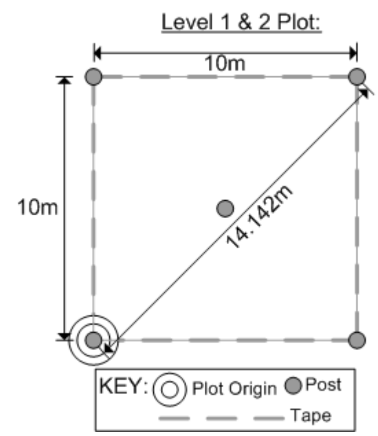
3.2.1: Location selection

Project directors will provide direction as to how to select a stand within which to place a plot or plots. Stands are selected based on available vegetation, project goals, needs of land owners, representativeness of overall vegetation of an area, and sometimes more subjective criteria. Once a stand is selected, the plot or plots should be placed within the stand to minimize effects of the borders of the stand (roads, trails, different vegetation), or other forms of heterogeneity.

Definition
A ***stand*** is "a spatially continuous unit of vegetation with uniform composition, structure, and environmental conditions" (Jennings et al. 2006).

3.2.2: Plot layout and marking

For Levels 1, 2 and 3, we require that plots be 100 m², which is generally accomplished by a 10×10 m square. Other shapes, such as a 5×20 m rectangle, are acceptable if the area for restoration follows a path that does not allow 10 m in width, or if planting zones or topography can be better represented within such a rectangle. You should measure the diagonal of the plot to ensure that the corners are square (the diagonal for a 10×10 m plot is 14.142 m, and for a 5×20 m plot is 20.616 m). Both 10×10 m (illustrated at right) and 5×20 m (not illustrated) plots can be laid out easily using two standard fiberglass tapes. A 50-m tape can serve to delineate the perimeter of a plot of either configuration, and a shorter tape (30 m is a common length) can be used to measure the diagonal distance.



Temporary marking is required but should be minimal. The amount of flagging can be adjusted according to several factors, such as the amount of detail on your map and project location (low in urban parkland versus higher in a remote rural location). Regardless, being discreet will reduce the amount of trampling in the plot. Ideally, the markers will be unnoticeable to the public, but easily recognized by staff with the use of a monitoring plan view sheet.

The corners of each plot must be marked with 12" or greater sections of ½" diameter galvanized steel ***conduit*** driven in the ground, with 4"- 6" exposed. If necessary, larger metal conduit stakes may be used provided no more than 6" of length is exposed. Each stake must be discreetly marked with flagging. Rebar may be used instead of conduit, but only if the rebar is capped with plastic caps to improve visibility and reduce risk of personal injury. The use of PVC is *not acceptable*, and all material except the conduit must be removed upon closeout of the project. An optional additional stake may be placed at the plot center when measuring the diagonal so as to facilitate plot relocation (7.071 m from a corner for 10×10 m plots). If rock or other obstructions prevent a conduit from being driven at a required location, the stake should be displaced along the X or Y axis, and the X-Y coordinates of the displaced stakes should be noted on the plot datasheet. Where 5×20 m plots are used, we recommend that additional stakes be placed at the mid-points of the 20-m sides.

3.3: Woody stem data

3.3.1: Planted woody stems

For Level 1 and 2 plots, newly installed woody plants are inventoried and measured for the purpose of tracking growth and survival. Since plot sampling occurs days or even a few weeks after planting, it is sometimes difficult to determine which stems were planted. A stem is ***considered planted if there is positive confirmation or strong evidence*** (e.g., obvious live-stake, collar, burlap bits), otherwise it is considered natural (a volunteer). Only the largest stem on each individual plant is measured, which is why we refer to these as "planted stems."

The species of each planted stem is recorded, along with its X and Y coordinates relative to the plot origin. A ***source*** code is used to identify where the stem came from (Tr for Transplanted from elsewhere within the project boundary, L for Live stake, B for Ball and burlap, P for Pot, Tu for Tubling, R for bare Root, and M for

Mechanically planted with a mechanical tree planter). If the source of the stem cannot be determined, U for Unknown should be used as a source value.

For planted woody stems ***less than 1.37 meters*** in height, two dimensions are measured, the ***height*** (in centimeters) of the longest stem and the ***ddh*** (Diameter at one Decimeter Height above the ground surface, measured in millimeters) of the thickest stem. Calipers (preferably plastic to avoid damage to the stem) should be used to measure the ddh. The abbreviation "ddh" is lowercase to help keep it distinct from DBH, which is described below. ***Height*** refers to the ***length of the woody (perennial) stem*** rather than the height above the ground, which is an important distinction when measuring bent or leaning stems. This also means that height is not measured to the tip of the tallest leaf, but rather the terminal bud of the longest woody stem.

For planted woody stems ***between 1.37 and 2.5 meters*** in height, height and ddh are measured, as described above, and in addition stem ***DBH*** (Diameter at Breast Height, measured in centimeters at a height of 1.37 m above the ground) is also recorded. We recommend use of either a Biltmore stick or a DBH tape (metric units).

For plants in ***excess of 2.5 meters*** in height, DBH is still measured, but ddh is no longer recorded. Height is also recorded and although still measured in cm, the required precision need only be to the nearest decimeter. For planted stems that reach ***4m in height***, the required precision drops to a half-meter.

Live stakes are treated somewhat differently from other planted material in that no ddh is recorded. As with other planted material, the height is measured from the base to the end of the longest stem, even if the longest stem is lying along the ground and must be lifted up for the height measurement. DBH is measured if the stem is tall enough (1.37 m).

Required Measurements				
Plant Height/Type	**ddh (mm)**	**Height (cm)**	**Height Precision**	**DBH (cm)**
<1.37 m tall	yes	yes	cm	no
1.37-2.5 m tall	yes	yes	cm	yes
2.5-4 m tall	no	yes	dm	yes
>4m tall	no	yes	0.5 m	yes
Live stake	no	yes	as above	if tall enough

Height, ddh, and DBH should all be measured by truncating to whole number units, ***not by rounding***. Thus, ddhs of 2.3 mm and 2.9 mm would both be reported as 2 mm. Truncation of measurements to the specified precision apply to all measurements including X and Y coordinates. This is analogous to the way one indicates one's age, saying "I am 20 years old" from the day one turns 20 until the day one turns 21, but never rounding up to the nearest year.

A ***vigor*** code is required for each whole plant. For this purpose use the scale 4=excellent, 3=good, 2=fair, 1=unlikely to survive one year, 0=dead, M=missing. A damage comment may be included for plants with a vigor of 4 or 3, and is required for any plants with a vigor less than 3. A recommended set of ***damage*** categories is provided, though additional categories may be added as needed. The recommended list of damage types includes Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown.

Vigor Code Definitions	
4, excellent	No more than minor tissue damage to leafy material exists and a generally normal amount of foliage is present.
3, good	Minor damage to both leaf material and bark tissue exists or moderately less than a normal amount of foliage is present.
2, fair	More than minor damage to leaf material and/or bark tissue exists.
1, unlikely to survive yr	Significant damage to leaf and/or bark tissue that is likely to lead to mortality or resprout.
0, dead	The entire plant appears to be dead.
M, missing	Neither the living plant nor any remains could be found.

3.3.1.1: Planted woody stems datasheet (for VBD)

Planted Woody Stem Data: CVS Levels 1 & 2

Leader: Smith　Project: E615　Team: 1　Plot: 13　Date: JUN /13 /2006　Page 1 of 1

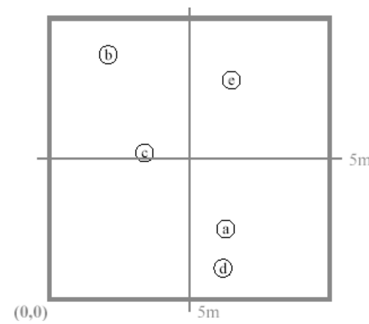
Species Name	Source	Coordinates X (m)	Coordinates Y (m)	ddh (mm)	Height (cm)	DBH (cm)	Vigor	Damage
Ulmus alata	C	6.3	2.5	1	23	---	3	---
Cornus amomum	LS	2.1	8.7	2	34	---	4	---
Salix nigra	LS	3.4	5.2	5	81	---	4	---
Salix nigra	LS	6.2	1.1	3	41	---	4	---
Lirio. tulip.	C	6.5	7.8	---	290	2	4	---

This datasheet is used to record new stems planted on a plot, as described above.

3.3.1.2: Monitoring planted woody stems datasheet (for VMD)

Plot: E6-01-0013

ID	Species		X	Y	Last Year's Data ddh	Last Year's Data Height	Last Year's Data DBH	This Year's Data ddh (mm)	Height (cm)	DBH (cm)	Vigor	Respr	Damage	Notes
1	Ulmus alata	ⓐ	6.3	2.5	1	23					0	☐	BEAV	
2	Cornus amomum	ⓑ	2.1	8.7	2	34					M	☐		
3	Salix nigra	ⓒ	3.4	5.2	5	81		2	62		4	☑	HURR	
4	Salix nigra	ⓓ	6.2	1.1	3	41		4	57		2	☐	DEER	
5	Liriodendron tulipifera	ⓔ	6.5	7.8		290	2		350	4	4	☐	---	Y=7.2



If the plot was previously sampled, each plant on the datasheet should be located in the field, using its species, X-Y coordinates, and approximate size. For these plants, measurements of size, vigor, and damage are needed, and errors in species and location (if error is >20 cm) should be noted. If the measurements of height and diameter have decreased because the plant has died back and ***resprouted*** from its base, you are now measuring the resprouted shoot instead of the original stem. In such a case, you should check the resprout box to explain the decrease in size.

This datasheet, generated from the database using the previous year's monitoring data, is used in collection of Vegetation Monitoring Data (VMD) in years after that of initial plot establishment. Corrections in location or species should be indicated in the notes field. Planted stems that may have been missed in previous years should be added. Circled letters are used in a map on the monitoring datasheet that shows the location of all the stems in the plot.

3.3.2: Natural woody stems (levels 2-3)

The intent of recording natural stems is to assess the overall recovery and compositional trajectory (successional trend) of the plot. A tally is made for the number of stems in each size class (height and DBH classes) for each species found. One stem can only be assigned to one cell on the datasheet. Stems that are quite small (and most likely ephemeral) are ignored because they are often too numerous to count and/or too small to locate; for this reason, no stems less than 10 cm in height are recorded. It is also possible to set larger minimum stem sizes to satisfy various project monitoring objectives; the ***height cut-off for stems*** can be set to 10 cm (default), 50 cm, 100 cm, or 137 cm. The reason for selecting a height cut-off other than 10cm must be recording on the datasheet in the "Explanation of cut-off and subsampling" field. Stems reaching the elected cut-off but shorter than 1.37 m are recorded in ***height classes***: 10-50 cm, 50-100 cm, and 100-137 cm. All stems at least 1.37 m in height (breast height) are assigned to DBH (Diameter at Breast Height) classes. The ***DBH classes*** (in cm) are:

0-1, 1-2.5, 2.5-5, 5-10, 10-15, 15-20, 20-25, 25-30, 30-35, and 35-40. Any stem equal to or greater than 40 cm DBH is recorded individually by diameter, truncated to the whole centimeter as described above.

A ***subsampling*** feature has been incorporated into the protocol to provide an alternative to counting numerous woody stems occurring at a consistent density throughout a given one are plot. If necessary, height and sapling size classes can be subsampled for individual species that are too abundant to be efficiently counted. Subsampling may be as low as 1% (1 m²) for extremely abundant species, or greater for species that can be represented better with larger subsamples, such as 20 or 50%. The percentage subsamples for height and sampling classes should be recorded in the "Sub-Seed" and "Sub-Sapl" columns, respectively. Record or draw the subsampled portion of the plot on the plot diagram on the Plot Datasheet so that the subsample can be repeated. A common and readily repeatable method for subsampling is to record a strip along one of more sides of the plot. For example, two 1m strips along opposite sides of a 10×10 m plot provide a convenient method for taking a 20% subsample. If any subsampling other than 100% was used, ***the reason for and method of subsampling*** should be recorded in the "Explain subsampling" on the Natural Woody Stem Data Form.

Two cautions about subsampling. First, the actual number of stems counted should be recorded on the datasheets, ***never an extrapolated estimate*** of the total number of stems. Secondly, subsampling is only permissible for natural woody stems, ***not planted woody stems***.

An efficient and compact tallying method is shown below, though the particular order of each dot and line is not important. This tallying method is shown at the bottom of the Natural Woody Stem Datasheet for reference.

Tally Method						
	= 1	= 2	= 3	= 4	= 5	= 6
	= 7	= 8	= 9	= 10	= 11	= 12, etc.

3.3.2.1: Natural woody stems datasheet

Natural Woody Stem Data: CVS Levels 2 & 3

Leader: Smith Project: E615 Team: 1 Plot: 13 Date: JUN / 13 / 2006 Ares (=100m²): 1 Page 1 of 1

Height Cut-Off for Stems (all stems shorter than this height are ignored and not tallied): ☑ 10cm ☐ 50cm ☐ 100cm ☐ 137cm

Species Name	☑ c	Mod*	Seedlings — Height Classes: Sub-Seed	10 cm-50 cm	50 cm-100 cm	100 cm-137 cm	Saplings — DBH: Sub-Sapl	0-1 cm	1-2.5 cm	Trees — DBH: 2.5-	5-	10-	15-	20-	25-	30-	35-	≥40 (write dbh)
Carya cordiformis				3	0	1												
Quercus alba				1	0	0												
Ulmus americana				0	0	2												
Pinus echinata															1			
Toxicodendron radicans								2										
Acer rubrum			50	25	8													

Note that for simplicity of representation, the tallying method described above is not shown in this diagram. The "**c**" checkbox column should be checked if a specimen was **c**ollected for later identification. Mod (Module) is only filled out for Level 3 plots and higher.

4. Level 3-5 Vegetation Plots

4.1: Plot layout

4.1.1: The modular approach

The CVS protocol provides for flexibility in size and shape of plot, type and amount of data collected, and commitment of researcher time, while retaining a requirement for collection of specific core data that assure comparability across all plots. The key to this flexibility is a modular approach to plot layout, wherein all measurements are made in plots comprised of one or more 10×10 m modules (100 m^2 or 1 “are” = 0.01 hectare).

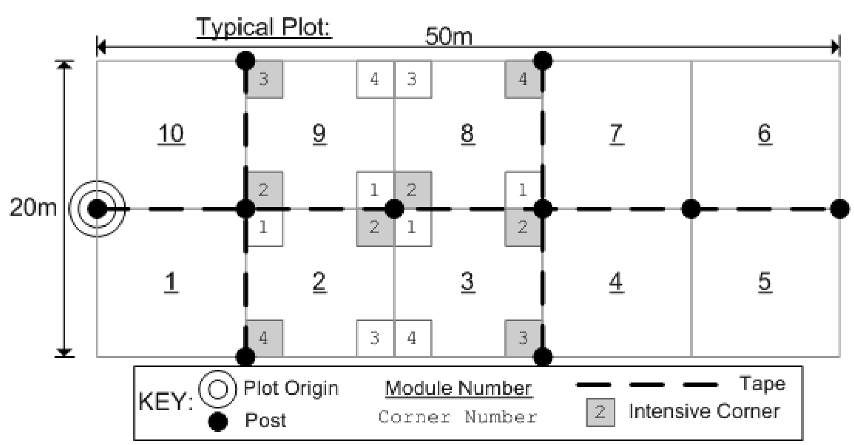
The module size and shape were chosen to provide a convenient building block for larger plots and because a body of data already exists for plots of some multiple of this size. In effect, the methodology defines most spatial heterogeneity in vegetation at scales below 10×10 m as within-community pattern.

Two types of modules are recognized, intensive and residual. The intensive modules are inventoried separately and may (in Level 5 inventories) have additional information collected about the presence of species in nested subplots. Residual modules are not inventoried separately and are aggregated to provide a supplemental record of vegetation in the portion of the plot not contained in intensive modules.

The flexibility of the CVS protocol stems primarily from flexibility as to the number of modules included in a plot and the information recorded for each. Numerous configurations are possible. In situations where a standard plot configuration would not fit or would be inadequate or heterogeneous, investigators are encouraged to modify plot layout so as to obtain a representative portrayal of homogeneous vegetation. However, regardless of configuration, cover estimates by cover classes for vascular plants are collected separately for intensive modules. In Level 3 plots, cover data are typically collected only for those species reaching at least 5% cover in at least one intensive module or in the residual modules. In Level 4-5 plots, cover data are collected for all species. Collection of woody stem data is optional for Level 3-5 plots. For restoration plots, researchers may wish to continue collecting data on planted woody stems, using the protocols developed for use in Level 1-2 plots. Data on natural woody stems may also be collected in Level 3-5 plots. For Level 3 plots, natural woody stems are tallied using the protocol developed for Level 2 plots. For Level 4-5 plots, tallies are recorded for woody species by diameter classes for all woody plant stems (including vines) that reach breast height (1.37 m).

4.1.2: Standard configurations

Although numerous implementations of the protocol are possible, three standard measurement modes are most often employed, here referred to as Levels 3, 4, and 5. These provide the user with flexibility in both the kind of data obtained and in the commitment of time and effort. A CVS plot may consist of any number of modules. Although a single module is possible and often appropriate for rapid assessment purposes, it is usually insufficient for obtaining an adequate representation of most woody vegetation. Mueller-Dombois and Ellenberg (1974) recommended an area of 200-500 m^2 for forest vegetation, and we have found that even this area is often too small for an adequate representation of composition in large-stature, species-rich forests. The widespread use of 0.1 ha (20×50 m) plots in a variety of forested vegetation types and the consequent availability of substantial comparative vegetation data at this scale led to the adoption of this plot size and shape as a standard CVS configuration.



In determining plot size, thought should also be given to the size of the dominant plants and how large a plot is required to achieve an adequate sample of the those dominants. Typically, a forest or woodland requires 10 modules to adequately sample the composition of the tree layer, whereas for low-stature vegetation such as grasslands a single module can suffice, and for dense shrublands 1-2 modules not only suffices but often is all that is physically possible. For most vegetation types 10 modules is sufficient size to capture vegetation structure and adequately characterize species composition and cover. In addition, comparison among plots is facilitated if all are the same size. However, stands of marked heterogeneity are often best sampled with plots containing a small number of modules to assure within plot homogeneity. Moreover, limitation on available time or physical difficulty of moving within a stand can be strong inducements for limiting plot size to only one or a few modules.

The principal limitations of Level 3 inventory are that composition, structure, and diversity are assessed at a single spatial scale (the full 100-m^2 module) and only for the more abundant species. Level 4 inventory involves all species, but composition, structure, and diversity are still assessed at a single spatial scale. Level 5 inventory fully exploits the potential of the CVS protocol for recording vegetation at multiple scales. With Level 5, species presence is determined for a $\log_{10}$ series of nested subplots (a "nest") established in one or more (typically two) corners of the 100-m^2 module(s). The number of subplots in a nest is referred to as the depth of the nest, where a depth of 1 indicates presence recorded only for the 100-m^2 plot, and a depth of 5 indicates presence recorded in a subplot of 0.01 m^2 (10×10 cm). The depth of sampling for a project must be determined by the individual researcher, but depth 5 (smallest plot = 0.01 m^2) has been adopted for most CVS projects. Use of Level 5 sampling can substantially add to the time and effort required collect to data, but this is dependent on the number of series of nested plots per module and the depth to which they are recorded.

4.1.3: Plot establishment

Good plot layout helps to avoid misrepresenting the vegetation. With our modular approach to plots, the user can easily change plot shape and size to reflect smaller stands, or stands that run in narrow strips (e.g., along a stream). Before establishing a plot, you should spend a few minutes becoming familiar with a stand so that you understand local heterogeneity and what areas are representative of the entire stand.

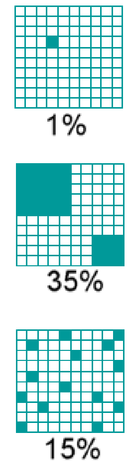
The standard plot consists of a 5 by 2 array of 10 modules (1000 m^2, 0.1 hectare), and a block of four intensive modules (in a 2×2 array) is typically selected for complete floristic analysis at the module level (see the diagram to the right).

To start a plot, you need to ***mark the boundaries*** so that you will know which plants are inside and outside the plot. You begin setting up a plot by selecting a point, called the ***plot origin*** and running a tape measure along ***the plot centerline*** to span the length of the plot. To keep the line straight, it is helpful for one person to extend the tape from the plot origin and another person to sight along the tape, correcting its path when it inevitably veers to one side. Once established, the center line position should be permanently marked with conduit every 10 m including both ends of the tape, resulting in six conduit stakes for the center line of a standard 10-module plot.

Once the centerline is marked for a standard 10-module (0.1 ha) plot, we establish the edges and outer corners of the block of four intensive modules with perpendicular tapes. Usually 30-m tapes are stretched 10 m perpendicular from the center line at the 10-m and 30-m marks and the outer corners are each fixed with a chaining pin. The tape is then extended an additional 10 m in the opposite direction from the center line to establish the other two outer corners, and the tapes are bent around the corners and brought together to join at the 30 m marks to assure that the two perpendicular lines are parallel and have square corners (this last step is not illustrated in the above diagram). Conduit stakes (posts) are then placed at the four outside corners, defining the locations of the outer nests of subplots collected in the intensive modules. Location of the nested subplots as a series with a common outside corner congruent with the module corner assures that each subplot is permanently and accurately marked for relocation and resampling. The far outside corners of the 20×50 m plot are generally marked with temporary flagging. For special circumstances, other plot configurations are permissible. However, we urge, wherever possible, establishment of four contiguous intensive modules, even where the plot shape must vary, or where there is insufficient space for a full ten modules.

Modules are numbered in counter-clockwise order starting in the lower left. If fewer than 10 modules are used, the counter clockwise numbering scheme is retained. The configuration and module numbering scheme should be shown on the plot datasheet diagram. In contrast, corners of the modules are numbered in a clockwise fashion: for an observer standing in a module and facing the center tape, corner 1 would be in front of the observer to the left, corner 2 in front of the observer to the right, and so forth (again, see the above illustration).

Although there is no one correct way to collect plot data, some techniques have proven particularly efficient. The most common approach is for a team to split into two groups after the plot in laid out. One (or more) team member(s) enters a few key items on the plot sheet and then starts recording presence and cover of species, starting with the intensive modules. Meanwhile, the other team member(s) records the sizes and species of the saplings and trees (generically called stems). Whichever person(s) finishes first starts to collect soils, other environmental data, and additional information needed for the plot sheet. If the cover or stems are particularly difficult and only two team members are available, they may achieve better efficiency through collaboration.



4.2: Species list and cover values

4.2.1: Cover data

Cover is defined as the percentage of the ground that is covered by the vertical projection of the aboveground material (leaves, branches, etc.) for a particular species. One way of thinking of this would be to ignore all but one species, then estimate what percent of the ground would be shaded with the sun directly overhead. We record ***canopy cover*** (as opposed to foliar cover) where the tiny gaps in the canopy are considered filled when estimating cover. The canopy of a plant, if reasonably continuous in outline, is considered completely continuous. However, if there are *significant gaps* within an individual canopy, it is *not* considered continuous. Cover ignores the vertical distribution of leaves and includes all leaves from those crawling along the ground to those in a very tall overhead canopy. Note that because species overlap one another, the sum of the covers across all species may exceed 100%, even though no single species can exceed 100%. The graphic to the right illustrates a few examples of cover, showing that cover may be dispersed or concentrated. (See *§4.2.5:* Vertical strata for information on recording where cover is portioned into vertical strata.)

4.2.2: Cover classes

Humans can relatively readily perceive differences in cover (or absence of cover) in terms of doublings of area, but much more poorly along a linear scale. For example, we can perceive the difference between 5 and 10% cover much more readily than the difference between 55 and 60% cover. For this reason, among others, species cover values are typically recorded by classes along a roughly logarithmic scale. The CVS cover scale ranges from 1 to 10, and experience shows that when estimates are replicated across observers, the different observations are typically within one scale unit of each other.

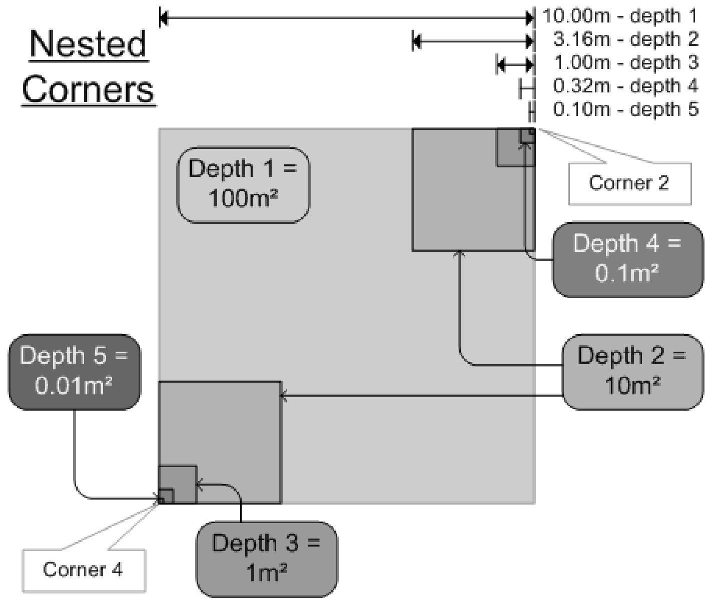
Carolina Vegetation Survey Cover Classes			
1	Trace (<0.1%)	**6**	10-25%
2	0-1%	**7**	25-50%
3	1-2%	**8**	50-75%
4	2-5%	**9**	75-95%
5	5-10%	**10**	95-100%

CVS uses a cover scale that is largely compatible with other cover scales (see examples in Jennings et al. 2004). We assign a number to each scale unit (called a cover code) listed in the adjacent table. "Trace" (1) is defined as one or a very few individuals with a very small amount of cover (<0.1%). For assigning values it is helpful to note that 1 square meter in a 10×10 m module is equivalent to 1%. Thus, when viewing all vegetation that covers a particular module (including that which is not rooted in the plot), one can attempt to mentally sum the cover and see if it exceeds 1 square meter, or 2, 5, 10, etc. Team members often make estimates and others chime in agreement or disagreement about the amount of cover for a module. Advanced users will note that the CVS scale has more classes than the classical Braun-Blanquet scale widely used by the European community, but that the class boundaries are defined so that the CVS scale can be collapsed easily into the Braun-Blanquet scale if necessary.

4.2.3: Nested subplots (level 5)

We establish nested subplots in each intensively sampled module to measure species presence across different spatial scales. ***Presence*** is defined as being rooted in the module, with at least part of an individual plant's stem emerging from the ground (or water if applicable) within the plot boundaries.

The standard 0.1-ha plot has 2 nested corners in each of the four intensive modules, as shown in the adjacent figure. When a smaller number of modules is collected, it is not uncommon to collect nested occurrence for all four corners.



For a nested corner we typically use a series of 5 nested boxes (subplots) to record presence at different spatial scales, increasing in size on a $\log_{10}$ scale from 10×10 cm to the full 10×10 m module, though a different depth of nesting can be selected. We start with the smallest box and if a species is found it is given a presence value of 5 (found in the 5th largest box size). If a species occurs in the depth-5 box, it is also known to occur in the other 4 nested boxes because the depth-5 box is entirely contained by the other boxes. Similarly, a species found in the 1×1 m box receives a presence value of 3 (and is thus known to be present also at the 1 and 2 depths). Note that the depth-1 box (the full 10×10 m module) is the same for all corners. If a species is not present in the module, but is ***overhanging*** such that it has cover in the module, the presence value is recorded as 0.

To record data for nested subplots, start with the smallest 10×10 cm box in the corner of a module, recording any species with a presence value of 5. Move sequentially through each larger-size box of that corner, marking additional species with the presence value for that box in which it was first observed (i.e., record the highest possible value, which simultaneously indicates presence at all larger scales). If more than one corner is sampled, then move to the next corner, starting at the smallest box and working up as before. Note that because the full module (depth 1) is the same for all corners, it is most efficient to complete the intensive corners to depth 2 before doing a systematic search for additional species at depth 1. After presence has been recorded for all the intensive corners and the module as a whole, cover is estimated for each species observed in the module.

4.2.4: "R" module

The modules not sampled intensively are called "R" (Residual) Modules and are treated differently. Only species that are ***not found in the intensive modules*** are recorded for the residual modules. For these species, cover values are estimated for the entire plot. When woody stems are recorded (see below), R Modules are lumped into one aggregate with no distinction being made between the individual R Modules. In the diagram in *§4.1.3: Plot establishment*, modules 1, 4, 5, 6, 7, and 10 are combined to form a single, aggregate R Module for the typical 10-module plot.

4.2.5: Vertical strata

Cover by Strata is employed to clarify the size and potential reproductive status of plant species within the plot. Without such detail, it would be hard to know whether a plot with a cover class value of 7 (25-50%) for a species like red maple had that cover entirely as seedlings, entirely as mature trees in the canopy, or spread across both. CVS recognizes five standard strata, using the first letter of each as an abbreviation. ***Tree*** refers to tall stems, generally in excess of 5 m, though a lower limit can be specified on the plot sheet. ***Shrub*** refers to woody plants below the trees and above the herbs (typically 0.5-5 m). ***Herb*** captures everything on or just above the ground, including all herbaceous plants and the smaller woody seedlings (typically 0-0.5 m). ***Floating*** applies to plants (rooted in the sediment or not) with upper parts floating on top of water such as water lilies. ***Aquatic*** refers to plants rooted beneath water with most of their photosynthetic surface area underwater.

Plants rooted underwater that emerge out of the water and contribute most of their cover above water should be placed in the tree, shrub, or herb stratum based on their height.

Each stratum used on the plot must be defined according to its approximate height boundaries, as this varies according to the height of the vegetation. Additionally, the total cover of all species within the stratum must be estimated, giving an idea of how open or dense the stratum is. The total cover estimate is a percent between 0 and 100. It is not a cover class, nor is it the sum of the cover percent of each species.

Example of describing strata by growth forms (ESA Guidelines - Jennings et al. 2004)	
Stratum	**Possible General Growth Forms in Stratum**
Tree (generally > 5 m)	Tree (overstory), Shrub*, Liana, Epiphyte
Shrub (generally 0.5 – 5 m)	Tree (sapling), Shrub, Liana, Epiphyte
Herb (Field)	Herb, Dwarf-shrub**, Tree (seedling***)
Floating	Floating
Aquatic (Submerged)	Submerged

*Very tall shrubs are sometimes included in the tree stratum.
**Can also include seedlings of shrubs, i.e. all shrubs less than <0.5 m.
***Tree seedlings are often defined as up to 1.4 m height or as < 2.5 cm DBH by many forest survey methods, in which case they would span the shrub and herb strata.

4.2.6: Cover datasheet

Levels 3 and 4 have datasheets with columns for cover by strata, species names, and cover codes in each Module:

Cover Data: CVS Levels 3 & 4

Leader: Jones Project: 75 Team: 1 Plot: 1341 Date: JUN/02/2008 Ares: 10

Strata — Column headers are module numbers, with cover codes below:

T	S	H	(F)	(A)	Species Name	c	2	9	R			
2	3	1			Carya cordiformis		4	6				
2	2	2			Toxicodendron radicans		2	2				
		2			Carex sp.	\		2				
		1			Panax quinquefolius				1			

Level 5 expands the above to include columns for presence values in corners of each module:

Cover Data: CVS Level 5

Leader: Jones Project: 75 Team: 1 Plot: 1341 Date: JUN/02/2008 Depth (1-5): 5 Ares: 10

Strata — Column headers are couplets of module and corner numbers, under which presence values and cover codes are entered (see lists at bottom of page)

T	S	H	(F)	(A)	Species Name	c	2	2	2	3	9	2	9	4	R	R			
2	3	1			Carya cordiformis		5	4	1		2	6	1						
2	2	2			Toxicodendron radicans		1	2	3		3	2	3						
		2			Carex sp.	\					2	2							
		1			Panax quinquefolius										1	1			

The header row consists of couplets of module number and corner number. All corners that are sampled within a module must be adjacent to one another on the datasheet. The data consist of a couplet of presence value and cover code. Only one cover value is needed per module, with the consequence that if two corners are collected per intensive module, every fourth column will be blank. The R (Residual) Module has a header of "R" for the module as well as "R" for the corner. Presence in the R Module should always be 1 or 0 (if overhanging), and cover is assigned based on cover for the entire plot, rather than just the R Module. In the above example, module 2 has corners 2 and 3 sampled, and module 9 has corners 2 and 4 sampled. For module two, the first species has a presence of 5 (present in 10×10 cm box) in corner 2 and 1 (present in full module) in corner 3 as well as a cover code of 4 (2-5%).

4.3: Tree stems (optional, levels 3-5)

Researchers working in restoration sites may wish to continue monitoring planted woody stems, if present, when performing inventories in Level 3-5 plots. The procedures and data forms already described for Level 1-2 plots are to be followed. The current data form for tracking planted woody stems was developed for single-module plots of the type used in Levels 1-2. If planted woody stems are to be monitored in multi-module plots used in Levels 3-5, then a separate data form (carefully annotated as to module number) should be used for monitoring of planted woody stems in each module.

Natural woody stems are tallied by module and species, using size classes. Each intensive module should be tallied separately, as should the "R" (Residual) Module representing the aggregate of all modules except the intensive modules. Thus, for a standard 10-module plot, there will be five sequential species lists on the datasheets corresponding to the four intensive modules and the R module. Because plot size can vary and thus the number of modules embedded in the R category is initially undefined, ***it is essential to record the total plot area in ares (100-m^2 modules)*** at the top of the datasheet.

For Level 3 plots, both height and DBH classes may be used for tallying natural woody stems (see Level 2 for details), though for community occurrence assessment the minimum height is often set at 1.37 m, thereby eliminating use of the height classes. Level 4 and 5 plots do not include tally of stems shorter than breast height, but allow some advanced features described below. As with Level 2 sampling, all stems at least 1.37 m in height (breast height) are assigned to DBH (Diameter at Breast Height) classes using a Biltmore stick or DBH tape to determine diameter. The ***DBH classes*** (in cm) are: 0-1, 1-2.5, 2.5-5, 5-10, 10-15, 15-20, 20-25, 25-30, 30-35, and 35-40. Any stem equal to or greater than 40 cm DBH is recorded individually by diameter. DBH values of at least 40 cm are not rounded to the nearest whole number, but instead are truncated so as to record the largest whole number that is less than or equal to the measured DBH (e.g., 44.0 cm, 44.5 cm, and 44.9 cm are all recorded as 44 cm).

An efficient and compact tallying method is shown below, though the particular order of each dot and line is not important:

Tally Method	= 1	= 2	= 3	= 4	= 5	= 6
	= 7	= 8	= 9	= 10	= 11	= 12, etc.

For plots with stems densely packed, it is useful to have one person (the caller) measure stem sizes and call the sizes out to a second person (the recorder), who records the species and tallies the sizes. The second person can often help keep track of which stems have already been tallied and which ones have not, or even serve as a movable and intelligent marking post to aid the caller in keeping track of progress through the plot. It is recommended that the tree team (if separate) consult with the team that is recording species cover values to make sure that species are identified in a consistent manner, according to the same taxonomic standard.

4.3.1: Subsampling (optional)

Level 3-5 inventory allows for optional subsampling and supersampling of woody stems. Subsampling (sampling only a portion of the plot, for example 25% or 50%) is often helpful if there is a large number of stems (especially small stems, e.g. >50 per module), where only a portion of the plot is needed to give a good representation of the numbers, sizes, and species of stems. Supersampling (sampling a larger area than the plot itself; e.g. 150 or 200%) may be useful if stems are scattered to a degree that the plot appears too small to give a good idea about the overall composition of the stand. Typically, subsampling and supersampling are achieved by measuring a distance other than the standard 10 m from the centerline, say only 1 m for a 10% sample in a vine tangle, and 20 m for a 200% sample in an open woodland. For each case where you use a subsample or a supersample, ***be sure to record*** it in the appropriate blanks on the datasheet, as failing to do so can cause large errors in estimates of stem density.

For Levels 4 and 5, it is possible to designate that all saplings (stems 0-2.5 cm DBH) and/or all trees (stems >2.5 cm DBH) have been subsampled or supersampled by indicating the percentage sample in the blanks at the top of the datasheet ("Plot Sapling Subsample %", "Plot Tree Subsample %"). However, these "universal" subsampling determinations can be overridden for individual species in sapling and/or tree size classes by noting the alternative subsample percentages in the appropriate spaces on the tree stem data form (see below).

Often, subsampling (or supersampling, from here on used interchangeably) is only needed for certain species. For example, in a rhododendron thicket, the rhododendrons might be subsampled, while a full sample is obtained for the trees. Similarly, in a longleaf pine savanna a supersample might be needed for the pines, while a normal sample is retained for all other taxa. With Level 3 plots ***subsampling can be designated by species*** for either or both of the Seedling and Sapling size classes (indicate the percent in the SubSeed and/or SubSapl columns). For Levels 4 and 5, subsampling can be by designated species for both the sapling and tree classes (indicate the percent in the SubSapl and SubTree columns). Note that subsampling by species can be specific to a particular module. All of these decisions are based on an effort to get an accurate representation of the vegetation that exists on the plot with a reasonable amount of effort. Subsampling should be used somewhat cautiously, certainly not serendipitously, as the best approach is usually a 100% sample. It should be noted that subsampling should never be used to artificially exclude or include particular (perhaps large or rare) species or stems. The decision should be made based on the overall vegetation and a desire to reflect that in the data with a realistic expenditure of effort.

Please note that the actual number of stems counted should be recorded on the datasheets, ***never an extrapolated estimate*** of the total number of stems. If any subsampling other than 100% was used, ***the reason for and method of subsampling*** should be recorded in the "Explain subsampling" on the Natural Woody Stem Data Form.

4.3.2: Natural woody stem datasheets

Plots at Level 3 use the same datasheet as Level 2 for natural stems (see *§3.3.2.1: Natural woody stems*). Level 4 and 5 stems are recorded on this datasheet:

Natural Woody Stem Data: CVS Levels 4 & 5

Leader: Jones Project: 75 Team: 1 Plot: 1341 Date: 02 / JUN / 2008 Ares: 10 Plot Sapling Subsample %: 100 Plot Tree Subsample %: 100 Page of

				SAPLINGS — DBH			TREES — DBH								
Species Name	☑ c	Mod	Sub Sapl	0-1 cm	1-2.5 cm	Sub Tree	2.5-	5-	10-	15-	20-	25-	30-	35-	≥40 (write dbh)
Carya cordiformis		2		2	0		1			1					
Quercus alba		2		1	1				2						42
Toxicodendron radicans		2	33	12	5										
Pinus echinata		2									2			1	
Querus alba		9		1				2							
Toxicodendron radicans		9	33	25	3			1							

The "Sub Sapl" values of 33 here indicate that a 33% subsample was used when sampling *Toxicodendron radicans* saplings. The tally method illustrated above is not pictured in this datasheet.

5. Additional Data

5.1: Taxonomic standard (required)

Taxonomy (the recognition and identification of particular classes of plants such as families, genera, species, subspecies, and varieties) is one of the most difficult aspects of collecting plot data. In addition to the difficulty associated with recognizing small and/or sterile specimens, we are confronted with the problem that not all authorities will agree about which name to apply to a particular plant species or how those species should be defined. This difficulty is increased when considering authorities or data that span many decades. To reduce the ambiguity associated with application of scientific names, we require that you report the taxonomic standard or authority you used to identify the species on your plot. This way we can tell the difference, for example, between *Carya ovata* (northern shagbark hickory) as used in Radford et al. (1968) and Weakley (2006), and *Carya ovata* (shagbark hickory, including southern shagbark hickory of Radford et al.) as used in the *Flora of North America* (Stone 1997).

In our region, there are several manuals and floras often used to identify species, the most commonly used and authoritative for the region-specific are Radford et al. (1968) and Weakley (various dates, e.g. 01-Jan-2006). The project director may specify which taxonomic standard you should use. In the absence of other instruction, we strongly recommend that you follow Weakley (01-Jan-2006, or subsequent versions). Note that ***you must include dates*** with your taxonomic reference, as different versions at different dates will indicate slightly different criteria for identifying plants. For Weakley ***indicate the exact date*** of your version, as multiple versions exist for each year (the current version of Weakley may be downloaded freely from http://herbarium.unc.edu/flora.htm). If some species you have encountered are absent from the authority you follow (as for example, some exotic cultivated species that are not treated in Weakley), or if you disagree with your authority for a particular taxon, please provide a separate note indicating the exceptions to your primary taxonomic authority.

5.2: Document location (required)

Locations should be reported as precisely as possible with either latitude and longitude or UTM coordinates. Some projects may allow use of other coordinate systems, such as state plane, as determined by the project director. The ***type of coordinate system*** should be recorded, as well as the ***units*** used (e.g., degrees, degrees and minutes, meters, feet). With UTM coordinates, care should be taken to report the UTM zone. In either case, the ***datum*** should be reported. We recommend that coordinates be reported in decimal degrees of latitude and longitude using the NAD83 or WGS84 datum.

GPS (Global Positioning Systems) devices are very helpful for accurately mapping plot locations, especially in remote areas. The many details about GPS units cannot all be covered here, but it is important to be familiar with your particular GPS unit and to know how to ensure that the accuracy settings are reliable for a reading. Ideally, the location of the plot origin would be where the GPS receiver collects its data points, but it may be better to move slightly to find an opening in the canopy, or get a better satellite reading. In any case, record on the plot datasheet where the GPS unit was located using X and Y coordinates relative to the plot origin. GPS records or surveyed locations converted to geocoordinates are required for Levels 1 and 2 inventory.

For Levels 3-5, if a GPS device is not available, the plot may be mapped based on ***topographic maps***. Because many plots are located far from any permanent references (e.g., roads, buildings) that can be viewed on a map, it is often somewhat difficult to precisely determine where a plot is on a map. The team leader (or someone gifted in reading and remembering terrain) should attempt to mark the plot location on an accurate map as soon as possible after the plot is sampled. Accuracy for such a method may be between 50 and 500 m, depending on the context.

Because not all geocoordinates are calculated with the same precision, ***location accuracy estimates*** are required. GPS units can give estimates for their accuracy (sometimes to be taken with a grain of salt), and some idea of uncertainty can lead to an accuracy assessment if mapping a plot manually. Inexpensive, hand-held GPS units often deliver accuracy on the order of 10 m or better.

Location Accuracy
The plot origin has a 95% or greater probability of being within this many meters of the reported location. (VegBank 2006)

Location information can be are somewhat sensitive. If there are rare species that may be prone to illegal harvesting (e.g., orchids, ginseng), the plot location may be flagged for ***data confidentiality*** and its location "fuzzed" in public releases of the data to mask its precise whereabouts. This is available for Levels 4-5. If you feel confidentiality is needed, or a land owner requests such confidentiality, it should be indicated on the datasheets. Consult your project director if you are uncertain whether a location should be confidential.

For EEP plots, Levels 1-3, the ***reach*** should be recorded for each plot to reflect the new EEP emphasis on stratification of monitoring plots by reach. Each unique reach label and extent must be consistent with those established in the final version the EEP Mitigation Plan (Table 1). Copies of the final Mitigation Plan for each project are typically included as part of the monitoring contract scope package and are also available upon request from EEP. Ideally, each plot occurs in a single reach, but in the event a plot spans ***multiple reaches***, the plot should be assigned to the reach in which the larger portion of the plot occurs. If the plot is evenly divided into two reaches, the upstream reach should be recorded. Reach may be ignored for non-EEP applications.

5.3: Classification (optional, levels 3-5)

Many ecologists recognize ***ecological communities.*** Community types (or associations in the US NVC) are typically defined on the basis of a characteristic range of species composition, diagnostic species occurrence, habitat conditions, and physiognomy (Jennings et al. 2004). Common objectives in collecting plot data include documenting the occurrence of a particular community type, or revision of a standard set of community types to better reflect the vegetation of the study region. The most commonly used vegetation classification in the U.S. is the U.S. National Vegetation Classification (NVC) maintained on behalf of the federal government (FGDC Vegetation Subcommittee) by NatureServe (see http://www.natureserve.org/explorer/servlet/NatureServe?init=Ecol).

Ecologists ***classify*** vegetation to a community type in a particular classification system, or in cases where there is ambiguity, to more than one community type. Fit and Confidence associated with classification provide useful modifiers or caveats to the classification of plots. ***Fit*** (5=excellent, 4=good, 3=fair, 2=wrong-but-understandable, and 1=absolutely-wrong) is used to illustrate how well a particular community concept matches a vegetation of a plot. It has nothing to do with certainty. ***Confidence*** (high, medium, low) is a statement about how sure the classifier is about the identification (i.e., assignment of the plot to the community type) he or she is asserting. Thus, one may be highly confident that a plot has excellent fit to a community, or highly confident that the plot has a low fit to the community. Conversely, it is also possible for low confidence that a plot fits well or low confidence that a plot doesn't fit well. Low confidence generally means that something isn't clear to the classifier, either about the plot or the community definition, or both.

5.4: Photographs

For Level 1 and 2 plots, one photograph is required for each plot, generally taken from the plot origin toward the diagonally opposite corner. It is desirable to take photographs before tape measures have been removed from the plot as these serve to clarify the portion of the photograph relative to the plot. Any identification of photos, such as whose camera, which image, or what film roll and frame, should be marked on the plot datasheet. Now that digital cameras are common and media generally large, you may want to simply take a photo of the plot cover sheet before taking photos of the plot (like beginning a scene in a movie) as this should help identifying which photos belong with which plot. Please note the location and bearing of photos (with numbers) on the plot datasheet. For Levels 3-5, photographs are strongly encouraged, but not required.

5.5: Site environment data

5.5.1: Soil depths (optional, levels 4-5)

Soil depth readings are taken adjacent to each corner of each intensively sampled module, 1 m removed from the corner in both the X and Y dimensions (see plot datasheet for a diagram). Use a pointed steel Soil Probe roughly 90-120 cm long (record the probe length), and push it into the ground until it hits the impermeable layer (you can't push it any further). The distance of the probe underground at this point (not including leaf litter) is the soil depth for that corner of the module. Typically soil depths are recorded for study sites in Piedmont and Mountain regions, but are considered of generally less value in Coastal Plain study areas.

5.5.2: Soil samples (optional, levels 4-5)

Soil samples from the A horizon (here defined as the top 10 cm of soil, after removal of the surficial litter and humus layers, if any) should be taken from a representative location near the center of each intensive module. Each sample should be about the size of a grapefruit (technically, 200-g dry weight) and should be stored in a plastic bag labeled on both sides with the team, plot, module, and horizon. ***Mark the bag twice*** so that if one label becomes illegible, the sample identity can be reconstructed more easily. Mark on the datasheet where the soil samples came from (roughly). In addition, we generally elect a location to sample the B horizon (roughly 50 cm deep in the soil) at a representative location near the point between the intersection of the four intensive modules. A ***soil augur*** is typically used to collect the deep samples. Care should be taken not to injure oneself while pulling stubborn deep soil samples from the ground; it's easier to injure your back this way than it might seem.

5.5.3: McNab indices (optional, levels 4-5)

McNab indices (McNab 1989, 1993) give us an idea about a plot's topographic position in the landscape (Landform Index) and its local shape (Terrain Shape Index). There are eight measurements taken for each of Landform Index (LFI) and Terrain Shape Index (TSI) using a device that measures inclinations such as a ***clinometer***. These angles are first observed facing the downslope direction of the aspect, and then at 45-degree intervals to capture the entire panorama. LFI is the angle from the plot to the horizon. If foliage is dense or the weather foggy, LFI can be tough to measure—just do the best you can. TSI is based on the angles formed by local slopes. Often, it is easiest to measure the angle from the recorder's eye to the eye of a person standing about 10 m away (it's tough to read a clinometer that is flat on the ground).

5.5.4: Disturbances (optional, levels 4-5)

We record evidence of disturbance in categories based on what caused the disturbance. We have several standard broad categories (human, natural, fire, clear-cut, animal, and other), but more detailed categories may also be used (see *§8. Definitions and Abbreviations*). Each category should be assigned a somewhat subjective severity (None, Low, Medium, High), along with an estimate for how long ago the disturbance took place, what percent of the plot was affected, and a description of the disturbance (or evidence thereof).

5.5.5: Earth surface & ground cover percents (optional, levels 4-5)

Earth surface is the underlying material of a plot (which may or may not be exposed) and is generally mineral in composition and somewhat immobile. The earth surface categories are histosol (i.e., organic soil), mineral soil/sediment, gravel/cobble, boulder, and bedrock. We envision the entire plot to rest on some form of non-overlapping earth surface material, meaning the various categories must add to 100%. In situations where earth surface categories do overlap, only the uppermost material should be counted.

- HISTOSOL: wet soils comprised of significant amounts of organic matter and are poorly drained, e.g. peat, muck
- MINERAL SOIL/SEDIMENT: below the F (Fermentation) and H (Humus) layers
- GRAVEL/COBBLE: rocks with their largest diameters ranging from roughly 2 mm to 250 mm (1/16th in.-10 in.)
- BOULDER: rocks with their largest diameters exceeding roughly 250 mm (10 in.)

Ground cover categories are mostly organic material and are perhaps somewhat more easily moved than earth surface materials. Ground cover categories often overlap one another; hence we allow each ground cover category to range from 0 to 100%, with no requirement about the sum of all categories. The ground cover categories are coarse woody debris, fine woody debris, leaf litter, duff, lichen/bryophytes, and water. We have one additional "other" category if your plot has some other significant ground cover that isn't in this standard list. Please provide the name of your custom category as well as its cover percent.

- COARSE WOODY DEBRIS: standing dead trees (snags), fallen trees, rotting roots
- FINE WOODY DEBRIS: smaller than coarse woody debris, generally less than 5 cm in diameter
- LEAF LITTER: the L horizon
- DUFF: consists of the F (Fermentation) and H (Humus) layers

Please note that for all earth surface and ground cover percents, we estimate percent directly. ***We do not use cover classes*** as we do for estimating cover of particular species.

6. Equipment

This equipment list is designed to be exhaustive for Level 5 plots. Some of this equipment (marked with *) may not be necessary for lower level plots.

6.1: Required field gear

(**+** = only for Levels 1-2, ***** = only for Levels 3-5)

- field pack (with a large open compartment)
- taxonomic manual or flora
- measuring tapes: one 50-m tape, two 30-m tapes (only one of the 30-m tapes for Levels 1 and 2)
- chaining pins (steel arrows), usually 8
- * pin flags
- flagging tape
- stakes for permanent plot marking (electrical conduit only). Allow 6 for Levels 1 and 2, and up to 10 for Levels 3-5.
- mallet or hammer
- diameter tape (metric units)
- Biltmore stick (metric units)
- * meter sticks: 2
- clipboards: two, at least one aluminum with storage compartments (one for Levels 1 and 2)
- datasheets
- sampling instructions
- maps
- pencils and extra lead
- * trowel or other digging tool for soil samples
- * soil auger
- * soil depth probe
- * soil collection bags
- plant collection bags
- permanent marking pen (for soil and plant bags)
- compass
- clinometer (sometimes on compass)
- GPS or survey equipment
- + caliper for ddh (preferably plastic)
- digital camera

6.2: Personal gear

- hand lens
- water
- lunch
- duct tape (has many uses, but gets used mainly for tick/chigger protection)
- additional/alternate flora
- emergency items: small first aid kit, small flashlight, matches
- comfort items: t.p., insect repellent, sunscreen, hat, long-sleeved shirt, rain gear

6.3: Optional/occasional field gear (levels 3-5)

- altimeter
- increment corer
- straws for holding cores
- tree height measuring device
- metal detector (for plot stake relocation)
- binoculars
- 100 m tape
- walkie-talkie or cell phone for communication with other teams (cell phone coverage may not exist in many areas sampled)

6.4: Base-camp/home lab equipment (levels 3-5)

- plant press
- library of floras
- dissecting scope
- National Vegetation Classification

7. Safety

Safety for the people sampling plots is a high priority. A broad range of hazards could cause harm to participants, but these are best mitigated with good preparation and precaution. The particular hazards vary depending on location, but large and/or common possible hazards include motor vehicle collisions en route, arthropods (e.g., ticks, bees, wasps, ants, chiggers), exposure to heat and sun, wildlife encounters (e.g., bears, snakes), contact with poison ivy, steep terrain, storms, lightning, open water, flying golf balls, whistle pig burrows, and other outdoor hazards. Appropriate clothing should be worn, generally including long pants, layers when in cold weather that may get warmer, and a good hat to protect from the sun. Insect repellent and sun screen may be desirable. The equipment should be treated with care, as some items are sharp and digging and pulling can strain your back. You should always ***bring ample water*** into the field with you.

8. Definitions and Abbreviations

8.1: Field definitions

An online version of definitions may be found at http://cvs.bio.unc.edu/ref/ which may be helpful if downloaded to a mobile device for reference in the field.

8.1.1: Disturbance types (optional, levels 4-5)

Follows 2008 ESA Guidelines.
The type of disturbance being reported. * indicates a more general type of disturbance.

- *Animal, general
- Avalanche and snow
- Cryoturbation
- Cultivation
- Erosion
- Fire suppression
- Fire, canopy
- *Fire, general
- Fire, ground
- Floods
- Grazing, domestic stock
- Grazing, native ungulates
- Herbicide or chemical
- Herbivory, invertebrate
- Herbivory, vertebrates
- *Human, general
- Hydrologic alteration
- Ice
- Mass movements (landslides)
- Mowing
- *Natural, general
- Plant disease
- Roads and vehicular traffic
- Salt spray
- Tides
- Timber harvest, clearcut
- *Timber harvest, general
- Timber harvest, selective
- Trampling and trails
- Wind event
- Wind, chronic
- *Other disturbances
- *Unknown

8.1.2: Hydrologic regime (optional, levels 3-5)

Modified from Grossman et al 1998.
A description of frequency and duration of flooding.

- UPLAND: Not a wetland. Very rarely flooded.
- INTERMITTENTLY/SEASONALLY SATURATED: Dry at least once per year. Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season.
- PERMANENTLY/SEMIPERMANENTLY SATURATED: Dry less than once per year. Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season. Equivalent to Cowardin's Saturated modifier.
- OCCASIONALLY FLOODED: Surface water can be present for brief periods during growing season, but not in most years. Often characterizes flood-plain upper terraces.
- TEMPORARILY FLOODED: Surface water present for brief periods during growing season, but water table usually lies well below soil surface. Often characterizes flood-plain levees and lower terraces. Equivalent to Cowardin's Temporary modifier.
- INTERMITTENTLY FLOODED : Substrate is usually exposed, but surface water can be present for variable periods without detectable seasonal periodicity. Inundation is not predictable to a given season and is dependent upon highly localized rain storms. This modifier was developed for use in the arid West for water regimes of Playa lakes, intermittent streams, and dry washes but can be used in other parts of the U.S. where appropriate. This modifier can be applied to both wetland and non-wetland situations. Equivalent to Cowardin's Intermittently Flooded modifier.
- SEMIPERMANENTLY FLOODED (exposed <1/year): Surface water persists throughout the growing season in most years. Land surface is normally saturated when water level drops below soil surface. Includes Cowardin's Intermittently Exposed and Semipermanently Flooded modifiers.
- PERMANENTLY FLOODED: Water covers the land surface at all times of the year in all years. Equivalent to Cowardin's "permanently flooded".
- TIDALLY FLOODED - DAILY: Salt water covers the land surface at all times of the year in all years. This modifier applies only to permanently flooded area irregularly flooded by fresh tidal water. Equivalent to Cowardin's "permanently flooded/tidal".
- TIDALLY FLOODED - MONTHLY: Flooded by the alternate rise and fall of the surface of oceans, seas, and the bays, rivers, etc. connected to them, caused by the attraction of the moon and sun.
- TIDALLY FLOODED - IRREGULAR (wind, storms): Flooded by the alternate rise and fall of the surface of oceans, seas, and the bays, rivers, etc. connected to them, caused by the back-up of water caused by unfavorable winds.
- UNKNOWN: The hydrologic regime cannot be determined from the available information.

8.1.3: Landform (optional, levels 3-5)

Region specific subset of list in Grossman et al 1998.
A recognizable physical feature on the surface of the earth, often including consideration of the natural cause of its formation. The following list contains suggestions but alternative terms may be used:

- Active slope
- Alluvial fan
- Alluvial flat
- Alluvial plain
- Backswamp
- Bar
- Basin
- Beach
- Bluff
- Braided channel or stream
- Cliff
- Crest
- Delta
- Dome
- Dune
- Escarpment
- Flat
- Flood-plain
- Gorge
- Hill
- Hummock
- Knob
- Levee

- Mountain
- Oxbow
- Plain
- Ravine
- Ridge
- Saddle
- Shoulder
- Sinkhole
- Spit
- Splay
- Swale
- Terrace
- Valley

8.1.4: Physiognomy (optional, levels 4-5)

Follows 1997 FGDC Vegetation Classification Standard.
The physical structure of the dominant vegetation.

- FOREST: Trees with their crowns overlapping (generally forming 60-100% cover).
- WOODLAND: Open stands of trees with crowns not usually touching (generally forming 25-60% cover). Canopy tree cover may be less than 25% in cases where it exceeds shrub, dwarf-shrub, herb, and nonvascular cover, respectively.
- SHRUBLAND: Shrubs generally greater than 0.5 m tall with individuals or clumps overlapping to not touching (generally forming more than 25% cover, trees generally less than 25% cover). Shrub cover may be less than 25% where it exceeds tree, dwarf-shrub, herb, and nonvascular cover, respectively. Vegetation dominated by woody vines is generally treated in this class.
- DWARF- SHRUBLAND: Low-growing shrubs usually under 0.5 m tall. Individuals or clumps overlapping to not touching (generally forming more than 25% cover, trees and tall shrubs generally less than 25% cover). Dwarfshrub cover may be less than 25% where it exceeds tree, shrub, herb, and nonvascular cover, respectively.
- HERBACEOUS: Herbs (graminoids, forbs, and ferns) dominant (generally forming at least 25% cover, trees, shrubs, and dwarf-shrubs generally with less than 25% cover). Herb cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and nonvascular cover, respectively.
- NONVASCULAR: Nonvascular cover (bryophytes, non-crustose lichens, and algae) dominant (generally forming at least 25% cover). Nonvascular cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and herb cover, respectively.
- SPARSE VEGETATION: Abiotic substrate features dominant. Vegetation is scattered to nearly absent and generally restricted to areas of concentrated resources (total vegetation cover is typically less than 25% and greater than 1%).
- BARREN VEGETATION: Vegetation almost absent, typically less than 1%.

8.1.5: Rock type (optional, levels 3-5)

Follows 1997 US FGDC Soil Geographic Data Standards. For definitions see NRCS 2002.
Geology is normally broken into this field and surficial deposits. Rock type refers to the type of underlying rock. Its values conform to the lithic types in the FGDC Soil Geographic Data Standards, September 1997.

- aa
- acidic-ash
- andesite
- andesitic-ash
- arkose
- basalt
- basaltic-ash
- basic-ash
- chalk
- charcoal
- chert
- cinders
- coal
- conglomerate, calcareous
- conglomerate, noncalcareous
- conglomerate, unspecified
- diorite
- dolostone
- ejecta-ash
- gabbro
- glauconite
- gneiss
- gneiss-acidic
- gneiss-basic
- granite
- graywacke
- gypsum
- hornfels
- igneous, acid
- igneous, basic
- igneous, coarse crystal
- igneous, fine crystal
- igneous, intermediate
- igneous, ultrabasic
- igneous, unspecified
- interbedded sedimentary
- limestone, arenaceous
- limestone, argillaceous
- limestone, cherty
- limestone, phosphatic
- limestone, unspecified
- limestone-sandstone
- limestone-sandstone-shale
- limestone-shale
- limestone-siltstone
- marble
- marl
- metaconglomerate
- metamorphic, unspecified
- mixed
- mixed calcareous
- mixed igneous-metamorphic
- mixed igneous-metamorphic-sedimentary
- mixed igneous-sedimentary
- mixed metamorphic-sedimentary
- mixed noncalcareous
- obsidian
- pahoehoe
- phyllite
- pumice
- pyroclastic, unspecified
- quartzite
- rhyolite
- sandstone, calcareous
- sandstone, noncalcareous
- sandstone, unspecified
- sandstone-shale
- sandstone-siltstone
- schist, acidic
- schist, basic
- schist, unspecified
- scoria
- sedimentary, unspecified
- serpentinite
- shale, acid
- shale, calcareous
- shale, clayey
- shale, noncalcareous
- shale, unspecified
- shale-siltstone
- siltstone, calcareous
- siltstone, noncalcareous
- siltstone, unspecified
- slate
- tuff breccia
- tuff, acidic
- tuff, basic
- tuff, unspecified
- volcanic bombs
- volcanic breccia, acidic
- volcanic breccia, basic
- volcanic breccia, unspecified
- wood
- other
- no rock visible

8.1.6: Salinity (optional, levels 3-5)

Follows Grossman et al 1998.
How saline is the water, if plot is flooded?

- SALTWATER: >30 ppt
- BRACKISH: 0.5-30 ppt
- FRESHWATER: < 0.5 ppt

8.1.7: Soil drainage (optional)

Follows the 1997 US FGDC Soil Geographic Data Standard. Definitions follow Grossman et al 1998. Identifies the natural drainage conditions of the soil and refers to the frequency and duration of wet periods. The soil drainage classes are defined in terms of (1) actual moisture content (in excess of field moisture capacity) and (2) the extent of the period during which excess water is present in the plant-root zone. This could affect hydrology, but shouldn't be confused with it.

- EXCESSIVELY DRAINED: Soils are free from any evidence of gleying throughout the profile. These soils are commonly very coarse textured (e.g., >35% volume of particles > 2 mm in size) or soils on very steep slopes. Sometimes described as "very rapidly drained."
- SOMEWHAT EXCESSIVELY DRAINED: The soil moisture content seldom exceeds field capacity in any horizon except immediately after water addition. Soils are free from any evidence of gleying throughout the profile. Rapidly drained soils are commonly coarse textured or soils on steep slopes. Sometimes described as "rapidly drained."
- WELL DRAINED: The soil moisture content does not normally exceed field capacity in any horizon (except possibly the C) for a significant part of the year. Soils are usually free from mottling in the upper 3 feet (1 m), but may be mottled below this depth. B horizons, if present, are reddish, brownish, or yellowish.
- MODERATELY WELL DRAINED: The soil moisture in excess of field capacity remains for a small but significant period of the year. Soils are commonly mottled (chroma < 2) in the lower B and C horizons or below a depth of 2 feet (0.6 m). The Ae horizon, if present, may be faintly mottled in fine-textured soils and in medium-textured soils that have a slowly permeable layer below the solum. In grassland soils the B and C horizons may be only faintly mottled and the A horizon may be relatively thick and dark.
- SOMEWHAT POORLY DRAINED: The soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year. Soils are commonly mottled in the B and C horizons; the Ae horizon, if present, may be mottled. The matrix generally has a lower chroma than in the well-drained soil on similar parent material. Sometimes described as "imperfectly drained."
- POORLY DRAINED: The soil moisture in excess of field capacity remains in all horizons for a large part of the year. The soils are usually very strongly gleyed (low chroma colors, such as gray, bluish, or gray-green). Except in high-chroma parent materials the B, if present, and upper C horizons usually have matrix colors of low chroma. Faint mottling may occur throughout.
- VERY POORLY DRAINED: Free water remains at or within 12 inches of the surface most of the year. The soils are usually very strongly gleyed. Subsurface horizons usually are of low chroma and yellowish to bluish hues. Mottling may be present but at depth in the profile. Very poorly drained soils usually have a mucky or peaty surface horizon.
- IMPERMEABLE SURFACE: Soils do not permit water absorption (e.g., hard-packed clay, concrete).

8.1.8 Soil Texture (optional, levels 3-5)

Follows the 1997 US FGDC Soil Geographic Data Standard.

Texture Group	General Term	Texture Class	Texture Subclass (enter on datasheet)
Sandy soils	Coarse-textured	Sands	Coarse Sand
			Sand
			Fine Sand
			Very Fine Sand
			Sands, unspecified subclass
		Loamy Sands	Loamy Coarse Sand
			Loamy Sand
			Loamy Fine Sand
			Loamy Very Fine Sand
			Loamy Sands, unspecified subclass
Loamy soils	Moderately coarse-textured	Sandy Loams	Coarse Sandy Loam
			Sandy Loam
			Fine Sandy Loam
	Medium-textured		Very Fine Sandy Loam
			Sandy Loams, unspecified subclass
		Loam	Loam
		Silt Loam	Silt Loam
		Silt	Silt
	Moderately fine-textured	Sandy Clay Loam	Sandy Clay Loam
		Clay Loam	Clay Loam
		Silty Clay Loam	Silty Clay Loam
Clayey soils	Fine-textured	Sandy Clay	Sandy Clay
		Silty Clay	Silty Clay
		Clay	Clay

8.1.9: Surficial deposits (optional, levels 3-5)

Modified from 2008 ESA Guidelines.

Geology is broken into this field and rock type. Surficial deposits represent the parent material that are the geologic or organic precursors to the soil. They may either have been deposited by geologic (wind, ice, gravity or water) or biologic (organic) activity, or formed in place more-or-less directly from rocks and minerals below.

- Aeolian Deposits: Aeolian sand flats and cover sands
- Aeolian Deposits: Dunes
- Aeolian Deposits: Loess deposits
- Aeolian Deposits: Volcanic Ash
- Alluvial Deposits: Alluvial Fan
- Alluvial Deposits: Deltas
- Alluvial Deposits: Floodplain
- Chemical Deposits: Evaporites and Precipitates
- Glacial Deposits: Bedrock and till
- Glacial Deposits: Deltaic deposits
- Glacial Deposits: Glaciofluvial
- Glacial Deposits: Glaciolacustrine
- Glacial Deposits: Glaciomarine
- Glacial Deposits: Moraine
- Glacial Deposits: Till
- Glacial Deposits: Undifferentiated glacial deposit
- Lacustrine Deposits: Coarse sediments
- Lacustrine Deposits: Fine-grained sediments
- Lacustrine Deposits: Unconsolidated Sediments
- Marine Deposits: Coarse sediments
- Marine Deposits: Fine-grained sediments
- Marine Deposits: Unconsolidated Sediments
- Organic Deposits: Muck
- Organic Deposits: Peat
- Residual Material: Bedrock
- Residual Material: Deeply Weathered Rock
- Residual Material: Disintegrated Rock
- Slope and Modified Deposits: Colluvial
- Slope and Modified Deposits: Solifluction, landslide
- Slope and Modified Deposits: Talus and scree slopes
- Variable
- Other

8.1.10: Taxonomic accuracy & effort level (encouraged, levels 4-5)

From VegBank 2006.

There are three fields for taxonomic accuracy where you rate your team's ability in identifying vascular, bryophytes, and lichens. If you didn't include nonvascular species in your plot, you should select "not sampled" for bryophytes and lichens.

- HIGH: at least 85% of all taxa were identified to species level; search was thorough.
- MODERATE: between 70% and 85% of all taxa were identified to species level; search was thorough.
- LOW: less than 70% of all taxa were identified to species level; or, the search was not very thorough.
- NOT SAMPLED: taxa in this category were not sampled at all (this value is NOT allowed for the vascular category).

Additionally, there is a field for effort level, which is a subjective measure for you to specify how much effort you were able to put into the plot sampling. Many plots are sampled somewhat quickly and are still extremely valuable. The effort level values are Very Thorough, Accurate, and Hurried.

8.1.11: Topographic position (optional, levels 3-5)

Follows Grossman et al 1998.

The position of the plot on land surface.

- INTERFLUVE: (crest, summit, ridge): linear top of ridge, hill, or mountain; the elevated area between two fluves (drainageways) that sheds water to the drainageways.
- HIGH SLOPE: (shoulder slope, upper slope, convex creep slope): geomorphic component that forms the uppermost inclined surface at the top of a slope. Comprises the transition zone from backslope to summit. Surface is dominantly convex in profile and erosional in origin.
- HIGH LEVEL (mesa): level top of plateau
- MIDSLOPE (transportational midslope, middle slope): intermediate slope position
- BACKSLOPE (dipslope): subset of midslopes which are steep, linear, and may include cliff segments (fall faces).
- STEP IN SLOPE (ledge, terracette): nearly level shelf interrupting a steep slope, rock wall, or cliff face.
- LOWSLOPE (lower slope, foot slope, colluvial footslope): inner gently inclined surface at the base of a slope. Surface profile is generally concave and a transition between midslope or backslope, and toe slope.
- TOESLOPE (alluvial toeslope): outermost gently inclined surface at base of a slope. In profile, commonly gentle and linear and characterized by alluvial deposition.
- LOW LEVEL (terrace): valley floor or shoreline representing the former position of an alluvial plain, lake, or shore.
- CHANNEL WALL (bank): sloping side of a channel.
- CHANNEL BED (narrow valley bottom, gully arroyo): bed of single or braided watercourse commonly barren of vegetation and formed of modern alluvium.
- BASIN FLOOR (depression): nearly level to gently sloping, bottom surface of a basin.

8.2: Definition of terms

Vegetation Baseline Data (VBD): vegetation data collected on a new plot with new plants installed. Must be collected according to the *CVS-EEP Monitoring Protocol* and submitted according to the "NC EEP Mitigation Plan Draft Outline." Sometimes referred to as "Vegetation As-Built."

Vegetation Monitoring Data (VMD): vegetation data collected on a plot that was previously sampled and planted. Often, a year is indicated with this term (such as Y1-VMD for year 1) to indicate the number of years elapsed after collection of the baseline data. VMD must be collected according to the *CVS-EEP Monitoring Protocol* and submitted according to the "NC EEP Mitigation Plan Draft Outline."

8.3: Acronyms

CVS: Carolina Vegetation Survey. This organization plans and conducts research events to sample the natural vegetation of the Carolinas. It also hosts and manages data for their group, as well as similar data for the area. See http://cvs.bio.unc.edu

CWD: Coarse Woody Debris. Standing dead trees (snags), fallen trees, and rotting roots, generally at least 5 cm in diameter. See also FWD.

DBH: Diameter at Breast Height. The diameter of a tree (usually measured in centimeters) at "breast height," which is 1.37 m above the ground.

ddh: diameter at decimeter height. The diameter of a woody stem (usually measured in millimeters) at 10 centimeters above where it emerges from the ground. This is usually measured on small trees that are less than 2.5 m tall.

EEP: Ecosystem Enhancement Program. A North Carolina Program which works to "restore, enhance, preserve and protect the functions associated with wetlands, streams and riparian areas... throughout North Carolina." http://www.nceep.net

ESA: Ecological Society of America. This organization provides guidelines for documenting vegetation that this manual follows for inventory Levels 3-5 http://www.esa.org, http://www.esa.org/vegweb

FGDC: Federal Geographic Data Committee is "an interagency committee that promotes the coordinated development, use, sharing, and dissemination of geospatial data on a national basis." FGDC standards for vegetation sampling provide the basis for inventory Levels 3-5, and in large part derive the ESA guidelines. Some of our soils values derive from FGDC standards. http://www.fgdc.gov

FWD: Fine Woody Debris. Includes dead woody material on the ground that is smaller than Coarse Woody Debris, generally less than 5 cm in diameter. See also CWD.

GPS: Global Positioning System. A system of satellites orbiting the earth and transmitting radio signals that can be interpreted by a receiver on the ground to calculate its geocoordinates (latitude and longitude).

LFI: LandForm Index. One of the two types of measurements for the McNab indices (McNab 1993). A set of eight readings which measure the angle from a point to the horizon. See also TSI.

NVC: National Vegetation Classification of the U.S. The most commonly used vegetation classification in the U.S. Maintained on behalf of the federal government (FGDC Vegetation Subcommittee) by NatureServe (http://natureserve.org).

NWS: Natural Woody Stems. Used to identify the datasheets where stems are tallied according to height and/or DBH classes. See also PWS.

PWS: Planted Woody Stems. Used to identify the datasheet where planted stems are measured individually. See also NWS.

TSI: Terrain Shape Index. One of the two types of measurements for the McNab indices (McNab 1989). A set of eight readings that measure the local shape of the land (for about a 10 m radius from the observer). See also LFI.

VBD: Vegetation Baseline Data. The first sampling of a plot which includes newly planted vegetation. Part of the EEP protocol in restoring vegetation. See also VMD.

VMD: Vegetation Monitoring Data. Sampling of plots that have been previously planted and sampled. Used to determine the success of a restoration effort over a period of years. May be preceded by "Y1" or "Y2" to indicate the year of monitoring after baseline data were collected. Part of the EEP protocol in restoring vegetation. See also VBD.

Y1-VMD, Y#-VMD: see VMD.

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