Pulse Protocol and Field Guide

This guide to the Carolina Vegetation Survey Protocol is designed to familiarize folks new to Pulse with our field methods, and to provide a reference tool for those already familiar with the methods. Not all aspects of Pulse are the same from year to year. Make sure you check with the Organizers of a particular Pulse about oddities, which are bound to occur. Good luck, and happy Pulsing!

Where to find what I'm looking for

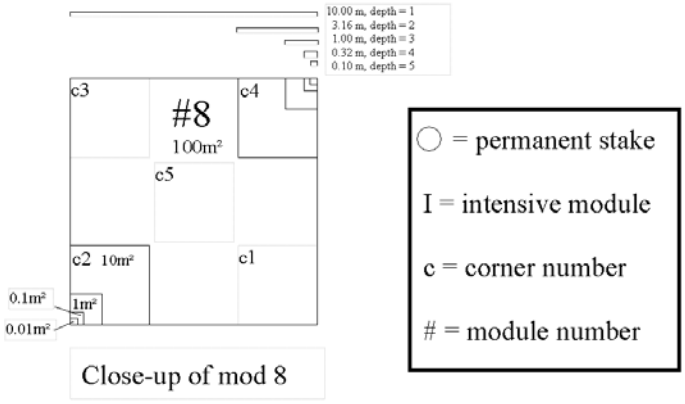
What is Pulse?

For those of you not familiar with the pulse events, each year the Carolina Vegetation Survey (a.k.a. The Gang of Seven) organizes a group effort to study intensively the vegetation of some natural area within North or South Carolina. All persons interested in vegetation and/or field botany are invited to participate for as many days as is convenient. Any level of experience is appropriate; the only requirement is that you bring your enthusiasm for field work.

The annual "pulse" of NCVS has become established as a special event for those interested in the natural history of the Carolinas. We sample a wide variety of natural communities in areas well known for their biological diversity. Many of these areas are not readily accessible without special arrangements with landowners/managers. This is an ideal way to see new and exciting areas, meet others interested in botany and ecology, and to share knowledge and experience. (Descriptions of past pulses have ranged from "Boot Camp for Botanists" to "Woodstock for Botanists.")

Now what?

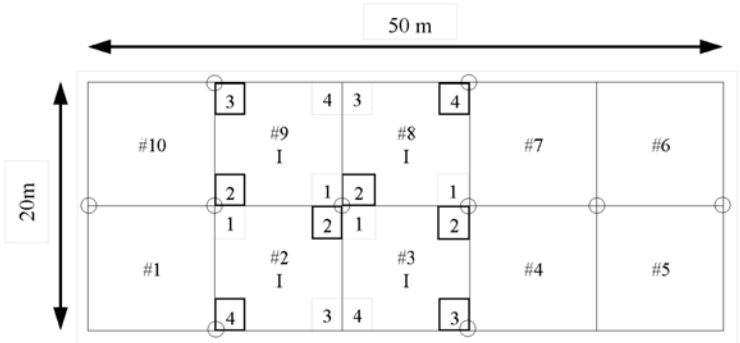
We want to record an accurate description of the vegetation and environment of each area we sample. Sites for plots are generally picked by team leaders (a.k.a. honchos) based on available vegetation, purpose of the pulse, the overall long-term needs of the project, the requirements of land owners, representativeness, interesting locations, serendipity, etc. Once a place for a plot is picked, it's time to get started.



Close-up of mod 8

Plot layout

Plots consist of ***modules***, which are simply 10m x 10m boxes of land. A typical plot is a 5 module x 2 module rectangle (50m x 20m), though any number of modules is permissible. Permanent metal stakes are used to mark plot and module boundaries. The ***centerline*** refers to the long axis line between modules 1-5 and 6-10. Usually 4 modules are sampled more closely and are called ***intensive modules***. Other modules are residual modules and will be discussed later. Each intensive module contains a series of nested boxes that allows analysis of vegetation at different spatial scales. The nested boxes are square and increase in area exponentially. The smallest is 10cm x 10cm, next 32cm x 32cm, then 1m x 1m, etc. The largest box is the actual 10m x 10m module.



A standard 50m x 20m plot

This brings us to an often misunderstood term for pulse: ***Depth***. Depth is the number of sizes of nested boxes that we are analyzing. Normally, 5 sizes are used (see diagram above), hence a depth of 5. If no nested boxes are used, the depth is 1 (because the module is the largest

box). These nested boxes originate in the corners of the modules. The modules are numbered counterclockwise, while the corners are numbered clockwise, such that corners 1 and 2 are interior corners. Normally, two corners are sampled in each intensive module; these have darker boxes around them in the diagram above. Notice that the 10m x 10m box for all corners of the module is the same box, which is the module itself.

Wherever possible, plots are permanently marked with metal stakes. The typical locations for stakes (shown by open circles in the figure above) include every 10 meters along the centerline, and at the outside corners of the intensive modules. Make certain a stake has been placed at the corners used for nested plots so as to facilitate possible future resampling.

Data Collected

Three kinds of data are collected on each plot: Presence/Cover data (a.k.a. Herb data), Tree data, and General Plot (=Cover Sheet) data. Each has its own data sheet.

Herb Data

Presence/Cover is recorded by species. ***Presence*** is defined as "the occurrence of a species within a quadrat [box], where the species must be 'rooted' in the quadrat." For the intensive modules, presence values are given based on the smallest nested box in which a species is present (rooted). For example, if a species is found in the smallest 10cm x 10cm box, it is given a presence value of 5 (found in the 5th depth box). If a species occurs in the depth 5 box, it also occurs in the other 4 depth boxes, because the depth 5 box is entirely contained by the other boxes. Similarly, a species found in the 1m x 1m box receives a presence value of 3. Note also that if a species is not present in the module, but is ***overhanging***, the presence value is 0.

Cover is the other value collected for each species with the herb data. Cover is defined as "the percentage of ground surface obscured by the vertical projection of all above ground parts of a given species onto that surface." If the sun were shining directly overhead, and only the species in question were present, the cover value would be the portion of ground not in sunlight. Since we can't measure this value to a high degree of accuracy, we use cover classes based on what the human eye can determine. The cover classes are based roughly on doubling percents, since we can more easily tell 5% from 10% than 75% from 80%. The cover classes are: trace=1; 0-1%=2; 1-2%=3; 2-5%=4; 5-10%=5; 10-25%=6; 25-50%=7; 50-75%=8; 75-95%=9; 95-100%=*. This also appears at the bottom of each herb sheet. Trace (Cover 1) differs from 0-1% (Cover 2) in that a trace of a species might be a solitary individual or very few, contributing extremely minimal cover.

Cover can also be thought about for different vertical strata. ***Cover by strata*** is estimated for each species, generally just once for the entire plot, but this can be done by individual module if the plot authors feel this appropriate. Cover by strata is similar to other cover values, with the difference that only a certain vertical stratum is considered, for example, 5m-10m above ground. Each team defines the height limits of the strata, according to the vegetation, broken into standard categories (emergent, canopy, understory, shrub, & field; in aquatic systems floating and submerged are also recognized). Definitions for cover by strata are explained more in the Cover Sheet Data section.

Herb Data Sheets

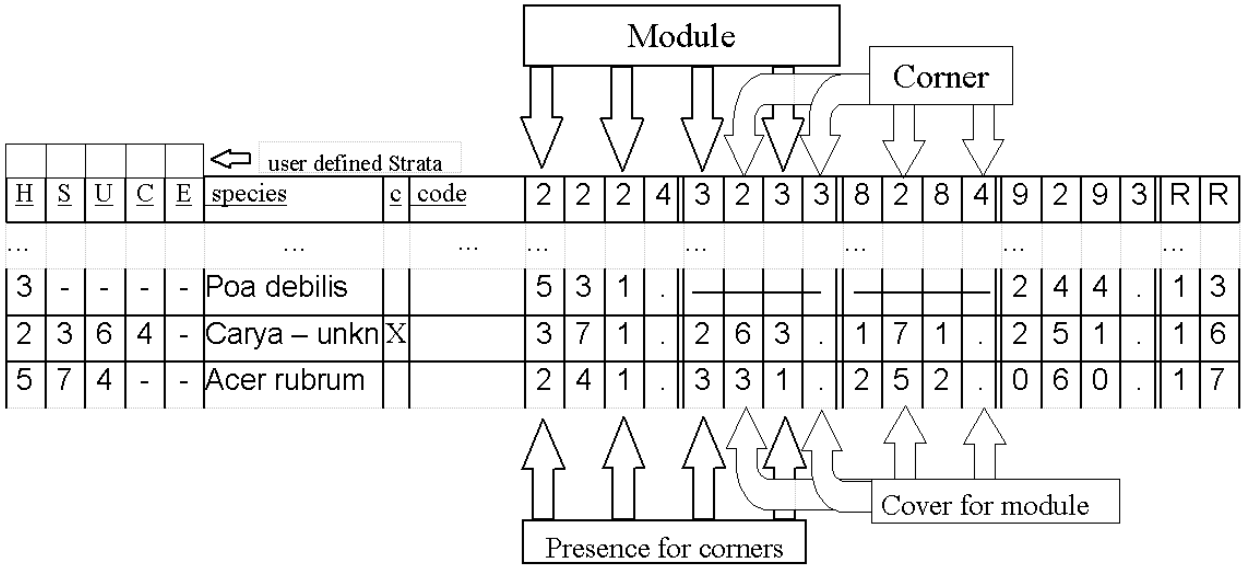
The first 5 columns are for cover by strata. Default categories are given for the most common strata. If different strata apply to the plot, these can be overridden with new strata categories in boxes above (user defined Strata).

Species is simply the scientific name of the species. As scientific names can be long, abbreviation can be used with caution. "c" column is to be checked when samples of a species are taken for later identification. Such samples are placed into a plastic collection bag, which is provided for each plot. The species column then describes the unidentified sample. Code is for later coding to specific standards for data entry and may be left blank in the field.

The presence/cover columns follow. Below, there is a standard plot example. The column headings must be entered by the team in the field and can vary according to the plot set-up. Headings consist of couplets labeled as the module number and then corner number, module again and so on. A module may have one or more corners sampled, up to a maximum of 5 where the fifth is centered. Note, corners can never be numbered higher than 5.

Presence values are entered for a corner in the first data column; cover in the second. Since cover applies to the whole module, only the first column to record cover for a species need be filled in. Redundant cover columns should be left blank, as shown in the example below (a "." is entered below to reserve the column). For modules where a species is not found, a straight line may be entered across the module, helping those in the field know that they have searched for a species and it is not present (see Poa debilis below).

There are two columns for *residual modules*. These are used to give presence and cover values for each species for the entire plot. If species are found in the residuals modules, but not the intensives, a new line is added for that species, and presence is either 1 or 0 (overhanging) and a cover value is given for the whole plot.



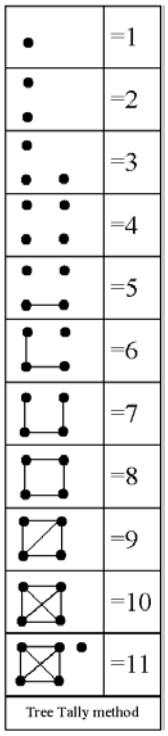
An example herb sheet. Only the underlined words are preprinted on the data sheets.

Woody Stem Data

Woody plants (trees, shrubs, woody lianas) are recorded on the Woody Stem Data Sheet. A tally is kept for every plant that *occurs* (is *rooted*) in the plot *and reaches breast height* (1.37m). As with the herb data, all stems within the same species are recorded on the same line. A separate tally is kept for each module, with the exception of the residual modules, which are lumped together as the "R" module. Thus, if the same species occurs in two different modules, two separate lines (one for each module) record the number of stems in each size class.

Large trees (40cm in dbh or more) are not tallied, but recorded individually, writing each dbh rounded to the nearest cm. These large individuals can vary significantly in basal area based on a difference of only a few centimeters making size classes less useful than for small stems.

Subsampling (and ***Supersampling***) can often be quite helpful in areas that are either quite dense or somewhat sparse in woody species. Often it is helpful to subsample saplings and trees differently as their densities can differ significantly. Here, ***saplings*** are defined as stems with dbh less than 2.5cm. ***Trees*** are considered all stems greater than 2.5cm in dbh. There are two ways to create altered sample size for each trees and saplings. First, one can create a plot subsample for either trees or saplings. That is, all saplings or trees of all species are subsampled at a certain percentage. Or, one can subsample only a particular species (i.e. Dog-hobble or *Rhododendron*). Subsampling is usually accomplished by measuring stems within a certain distance from the centerline (if 20% subsample, then only stems within 2m of the centerline are included.)



Woody Stem Data Sheets

Above the datasheet, there is a ***Plot Sapling Subsample*** and ***Plot Tree Subsample***, which show the subsampling for the entire plot (all species), unless indicated differently for a specific subsample (in data table). Species specific subsamples override plot specific subsamples, and all subsamples are viewed to be a percentage of the standard 10 m wide module.

Code is to be filled in later for database purposes and should be left blank. "C" is again to indicate that a sample of an individual was taken for later identification. Species is the scientific name. Mod is the module. SubSapl and SubTree are for species sub- and supersamples. The size classes are listed and total numbers of stems in each module are recorded below the appropriate size class. Notice the 40- size class has a dbh written for each stem. Here, numbers are written out, but tallies are kept in the field with a ten-point tally. The tally scheme appears to the right.

Plot Sapling Subsample:__50___ Plot Tree Subsample:_133__

					SAPLINGS			TREES								
Code	c	Species	Mod	Sub Sapl	0-1 cm	1-2.5 cm	Sub Tree	2.5-	5-	10-	15-	20-	25-	30-	35-	≥40 write dbh
	X	Carya -?	2	33	6	8	200	9	12	5	3	2		1		42,48
		Quercus alba	2		7	5		5	2						1	
		Quercus alba	3		3	2		1								87
		Parth. quinq.	R		2	1										

Cover Sheet Data

The Cover Sheet Data identifies where the plot is, what kind of plot it is, what irregularities exist, soil and environmental information, who worked on the plot, when, etc. It's very important to complete this page accurately if the rest of the data is to make any sense ecologically. *Asterisks indicate that definitions and/or values are in the Reference section.*

General Information

All kinds of identifying information about who, when and what. Appropriate role codes for participants are identified in Reference section.

Location

This identifies where the plot is (okay, that's pretty basic). But location refers not to the plot as a whole, but technically to the ***plot origin***, which is the "Zero Point," usually where the 50m tape starts. It's between module 10 and module 1 on the edge of the plot. If the plot has an irregular shape, it's important to note how the center line runs and where the plot origin is.

General (location) refers to the general area name, which is rather broad. More specific place names can be entered in the three blanks for ***Place Names***. County and state are self-explanatory. The ***USGS quad*** is generally known by leaders, but can be identified from the coordinates (GPS) or off a topo map. It's also very important to **mark the plot on a topo map** so that the coordinates can be checked. Especially in the mountains GPS signals can reflect off terrain and trees thereby introducing errors.

Ownership refers to the person, group, or organization that owns the land on which the plot lies. ***Confidentiality*** has three levels : Confidential (contractually to be kept confidential), Sensitive (may contain species or information that requires that the plot location not be made available to the general public), and Public (all may view these data). ***Source of location data*** simply refers to how you know where you are. Generally from a GPS or map, though perhaps something else.

The ***GPS location in plot*** is the X,Y coordinates of where the GPS data was taken in the plot. The origin is (0,0) and X increases along the centerline. Y increases toward modules 6-10 ("up") and decreases toward modules 1-5 ("down"). ***UTM zone*** tells which part of the Earth the UTM coordinates refer to; most of NC and all of SC are in Zone 17. The coast of NC and some Piedmont areas are in Zone 18 (72ºW-78ºW longitude). Check your GPS unit, which should tell you which zone you are in. (Not necessary if using Lat/Long Geocoordinates.)

Datum refers to the 2-Dimensional projection that approximates the surface of the earth. The most often used Datum for NCVS is NAD27 (on most USGS quadranges), though there is also the WGS-84, which is also quite common. There are others, which are less desirable for our purposes, but if you must use one, let us know which one it is so we can convert to a common reference grid.

UTM-E (or Longitude) tells us your E/W coordinates, usually read from a GPS or off a topo map, (once the plot is marked on a map). Similarly, UTM-N (or Latitude) tells us your N/S coordinates. Circle which one you are using, though it should be quite clear. ***Coordinate accuracy*** is simply the error (m radius from your coordinates) you think could be embedded in these coordinates; with GPS this is often around10m, whereas guesses from USGS quadrangles are more often in the 50-100m range..

There are two areas for coordinates, uncorrected and corrected. ***Uncorrected coordinates*** are simply read from a GPS in the field. ***Corrected coordinates*** are more accurate estimates of position based on a post-processed ***GPS file***, the name of which also should be recorded on the data sheet. Again, there is a place for corrected coordinates accuracy, also a meter radius.

If the plot lies in a region surveyed using the ***Township-Range-Section*** methodology, these can be recorded as ***T:, R:, S:***.

Map

The map is a rough template of a standard NCVS plot. If your plot differs in module number, configuration, size, shape, or anything else, please note this on the map by crossing out,

adding, or stretching the appropriate modules. You can also change the module numbers if fewer than 10 modules are sampled. (If a 2x3 module plot is done, the modules should be numbered 1-6 counterclockwise, not 1-3 and 8-10.) There is a separate map for plots consisting of only one module.

There is a key that gives symbols to represent different measurements on the plot. A box with an "M" in it shows where the McNab Indices were measured; a star shows where the GPS data was recorded on the plot; a circle with an arrow shows where photos were taken and along what azmuth, and darkened circles show where permanent posts were driven into the ground (stakes can't always be driven where they are supposed to be). Also remember to fill in the ***bearing of the center line***.

Plot Documentation

Various information about how the plot was sampled. ***Cover method*** should almost always be GOS (=Gang of Seven, which later became CVS and which is described in this document). If some other cover method must be used, enter it here. ***Plot size*** in terms of the number of modules (each generally one "are" in size) can be different for trees and herbs, if time constraints limit the team. The ***numbers of each intensive module*** must be recorded, not how many intensive modules were sampled. Depth is described in the herb section. Each ***photo*** taken should be documented.

Site Characteristics

Elevation, in meters or feet (do specify which), ***Slope***, ***Aspect*** should be recorded with a reasonable estimate for error. Here, you should also state whether you are using a magnetic or corrected compass. This applies to the bearing of the center line, as well. ***Topographic Position*** and ***Landform Type*** must be looked up in this Reference. ***Ground Cover Percentages*** should be entered and should generally add up to 100%. If ground cover should for some reason exceed 100%, note why. Also, if something other than the categories mentioned has ground cover, specify what it is (i.e. shell).

McNab Indices

McNab Indices give us an idea about how exposed a plot is. There are eight measurements taken for each of ***Landform Index (LFI)*** and ***Terrain Shape Index (TSI)*** using a device that measures inclinations called a clinometer. These are at the aspect, then at 45-degree intervals to capture the entire landscape. LFI is the angle from the plot to the horizon. If foliage is dense or the weather is 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 10m away (it's tough to read a clinometer that is flat on the ground).

Notes

Notes should be recorded by category. ***Disturbance Notes*** has severity to indicate how much of what types of disturbance, if any, affect the plot. ***Layout Notes*** are used to describe the oddities of plot layout and shape that should already be drawn on the map. ***Location Notes*** should be used to draw a map showing where the plot is and why this location was chosen. ***Vegetation notes*** describe the community. ***Additional notes*** are on the back for anything else.

Taxonomic standard used should be filled in (and agreed upon by the team). Any ***Community Classification*** done in the field should be entered in its appropriate box.

Cover by Strata

Cover by strata is recorded on the herb sheet for each species. The five default strata need not be used, only the ones that seem applicable to the plot. ***Height ranges*** for each stratum used are defined here. ***Total cover*** for each stratum should also be recorded; that is, the cover of all species combined, using the same cover classes as on the herb sheet. The general ***Canopy Height*** should also be recorded here, which is a value, not a range.

Soil

Soil Depths are to be taken at each corner of each intensive module. Depth should be measured 1m x 1m away from each module corner, or in other words, at the inner edge of the 1m x 1m box (depth 3). A Newell Soil Probe roughly 90 cm long should be used (record the exact ***probe length***), and it should be pushed into the ground until it hits the impermeable layer (i.e. 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. The standard modules and corners are supplied, but cross them out and supply your own if your corners are different.

Soil Samples from the A horizon (the first 10cm of soil) should be taken for each intensive module. Each sample should be about the size of a grapefruit and should be stored in a white soil bag that is properly labeled on both sides with the team, plot, module, and horizon. We record this twice so that if one is illegible (or incorrect) we have something to check it against. Mark on the diagram where the soil samples came from (roughly). In addition, we generally elect a place to sample the B horizon (roughly 50cm deep in the soil), which is usually near the point between the four intensive modules.

Please record any other observations about the soil type or ***soil series*** below the soil samples. Soil horizon descriptions can be helpful.

Reference

The following material is largely taken without modification from Grossman et al. 1998. (except Roles and Soil Sample – Modules)

Cowardin System:

If the system is a wetland, enter the name of the USFWS system that best describes it's hydrology and landform. Indicate "upland" if the system is not a wetland.

Drainage:

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. It is recognized that permeability, level of groundwater, and seepage are factors affecting moisture status. However, because these are not easily observed or measured in the field, they cannot be used generally as criteria of moisture status. It is further recognized that soil profile morphology, for example mottling, normally, but not always, reflects soil moisture status. Although soil morphology may be a valuable field indication of moisture status, it should not be the overriding criterion. Soil drainage classes cannot be based solely on the presence or absence of mottling. Topographic position and vegetation as well as soil morphology are useful field criteria for assessing soil moisture status.

RAPIDLY 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.

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, 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. 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.

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. 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.

Hydrologic Regime:

Assess the hydrologic regime of the plot using the descriptions below. Hydrological modifiers used to identify wetland units at the formation level (adapted from Cowardin et al. 1979).

SEMIPERMANENTLY FLOODED - 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.

SEASONALLY FLOODED - Surface water is present for extended periods during the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is very variable, extending from saturated to a water table well below the ground surface. Includes Cowardin's Seasonal, Seasonal-Saturated, and Seasonal-Well Drained modifiers.

SATURATED - Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season. Equivalent to Cowardin's Saturated modifier.

TEMPORARILY FLOODED - Surface water present for brief periods during growing season, but water table usually lies well below soil surface. Often characterizes flood-plain wetlands. 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.

IRREGULARLY FLOODED - Tidal water floods land surface less often than daily; the area must be flooded by tides at least once yearly as a result of extreme high spring tide plus wind plus flow.

IRREGULARLY EXPOSED - Land surface is exposed by tides less often than daily; the area from mean low tide to extreme low spring tide.

PERMANENTLY FLOODED - Water covers the land surface at all times of the year in all years. Equivalent to Cowardin's "permanently flooded".

PERMANENTLY FLOODED-TIDAL - 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 - 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 or by the back-up of water caused by unfavorable winds.

UNKNOWN - The water regime of the area is not known. The unit is simply described as "non-tidal wetland".

Landform Types:

ACTIVE SLOPE - (metastable slope) A mountain or hill slope that is responding to valley incision, and has detritus accumulated behind obstructions, indicating contemporary transport of slope alluvium. Slope gradients commonly exceed 45 percent.

ALLUVIAL CONE - The material washed down mountain and hill slopes by ephemeral streams and deposited at the mouth of gorges in the form of a moderately steep, conical mass descending equally in all directions from the point of issue.

ALLUVIAL FAN - A body of alluvium, with or without debris flow deposits, whose surface forms a segment of a cone that radiates downslope from the point where the stream emerges from a narrow valley onto a less sloping surface. Common longitudinal profiles are gently sloping and nearly linear. Source uplands range in relief and aerial extent from mountains and plateaus to gullied terrains on hill and piedmont slopes.

ALLUVIAL FLAT - A nearly level, graded, alluvial surface.

ALLUVIAL PLAIN - A flood plain or a low-gradient delta. It may be modern or relict.

ARROYO - (wash) The flat-floored channel or an ephemeral stream, commonly with very steep to vertical banks cut in alluvium.

BACKSWAMP - (valley flat) Extensive marshy, depressed areas of flood plains between the natural levee borders of channel belts and valley sides or terraces.

BAR - An elongated landform generated by waves and currents and usually running parallel to the shore, composed predominantly of unconsolidated sand, gravel, cobbles, or stones with water on two sides.

BASIN - A depressed area with no or limited surface outlet. Examples are closed depressions in a glacial till plain, lake basin, river basin, or fault-bordered intermontane structure such as the Bighorn Basin of Wyoming.

BEACH - The unconsolidated material that covers a gently sloping zone, typically with a concave profile, extending landward from the low-water line to the place where there is a definite change in material or physiographic form (such as a cliff) or to the line of permanent vegetation; the relatively thick and temporary accumulation of loose water-borne material (usually well-sorted sand and pebbles, accompanied by mud, cobbles, boulders, and smoothed rock and shell fragment) that is in active transit along, or deposited on the shore zone between the limits of low water and high water.

BLUFF - (a) A high bank or bold headland, with a broad, precipitous, sometimes rounded cliff face overlooking a plain or body of water, especially on the outside of a stream meander; (b) any cliff with a steep, broad face.

BRAIDED CHANNEL OR STREAM - (flood-plain landforms) A channel or stream with multiple channels that interweave as a result of repeated bifurcation and convergence of flow around interchannel bars, resembling in plan the strands of a complex braid. Braiding is generally confined to broad, shallow streams of low sinuosity, high bedload, non-cohesive bank material, and step gradient. At a given bank-full discharge, braided streams have steeper slopes and shallower, broader, and less stable channel cross sections than meandering streams.

CANYON - A long, deep, narrow, very steep-sided valley with high and precipitous walls in an area of high local relief.

CIRQUE - Semicircular, concave, bowl-like area with steep face primarily resulting from erosive activity of a mountain glacier.

CLIFF - Any high, very steep to perpendicular or overhanging face of rock or earth; a precipice.

CREST - (summit) The commonly linear top of a ridge, hill or mountain.

DELTA - A body of alluvium, nearly flat and fan-shaped, deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, usually a sea or lake.

DOME - A roughly symmetrical upfold, with bed dipping in all directions, more or less equally, from a point. A smoothly rounded landform or rock mass such as a rock-capped mountain summit, roughly resembling the dome of a building.

DRUMLIN - A low, smooth, elongated oval hill, mound, or ridge of compact glacial till that may or may not have a core of bedrock or stratified glacial drift. The longer axis is parallel to the general direction of glacier flow. Drumlins are products of streamline (laminar) flow of glaciers, which molded the subglacial floor through a combination of erosion and deposition.

DUNE - A mound, ridge, or hill of loose, windblown granular material (generally sand), either bare or covered with vegetation.

ESCARPMENT - (scarp) A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and produced by erosion or faulting. The term is more often applied to cliffs produced by differential erosion.

ESKER - A long, narrow sinuous, steep-sided ridge composed of irregularly stratified sand and gravel that was deposited by a subsurface stream flowing between ice walls, or in an ice tunnel of a retreating glacier, and was left behind when the ice melted.

FLAT - A general term for a level or nearly level surface or small area of land marked by little or no relief, eg. mud flat or valley flat.

FLOOD-PLAIN - (bottomland) The nearly level alluvial plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is usually a constructional landform built of sediment deposited during overflow and lateral migration of the stream.

GORGE - (a) A narrow, deep valley with nearly vertical rocky walls, enclosed by mountains, smaller than a canyon, and more steep-sided than a ravine; especially a restricted, steep-walled part of a canyon. (b) A narrow defile or passage between hills or mountains.

HILL - (foothills) A natural elevation of the land surface, rising as much as 300 m above the surrounding lowlands, usually of restricted summit area (relative to a tableland) and having a well-defined outline; hill slopes generally exceed 15%. The distinction between a hill and a mountain is often dependent on local usage.

HUMMOCK - A rounded or conical mound of knoll, hillock, or other small elevation. Also, a slight rise of ground above a level surface.

KAME - A moundlike hill of ice-contact glacial drift, composed chiefly of stratified sand and gravel.

KETTLE - A steep-sided bowl-shaped depression without surface drainage. It is in glacial drift deposits and believed to have formed by the melting of a large, detached block of stagnant ice buried in the glacial drift.

KNOB - (a) A rounded eminence, as a knoll, hillock, or small hill or mountain; especially a prominent or isolated hill with steep sides, commonly found in the southern United States. (b) A peak or other projection from the top of a hill or mountain. Also a boulder or group of boulders or an area of resistant rocks protruding from the side of a hill or mountain.

LEVEE - (floodwall, earth dike) An artificial or natural embankment built along the margin of a watercourse or an arm of the sea, to protect land from inundation or to confine streamflow to its channel.

MORAINE - A drift topography characterized by chaotic mounds and pits, generally randomly oriented, developed in superglacial drift by collapse and flow as the underlying stagnant ice melted. Slopes may be steep and unstable and there will be used and unused stream coursed and lake depressions interspersed with the morainic ridges. Consequently, there will be rapid or abrupt changes between materials of differing lithology.

MOUNTAIN - (hill) A natural elevation of the land surface, rising more than 300 m above surrounding lowlands, usually of restricted summit area (relative to a plateau), and generally having steep sides (greater than 25 percent slope) with or without considerable bare-rock surface. A mountain can occur as a single, isolated mass or in a group forming a chain or range. Mountains are primarily formed by deep-seated earth movements and/or volcanic action and secondarily by differential erosion.

OUTWASH PLAIN - (glacial outwash, kettles) An extensive lowland area of coarse textured, glaciofluvial material. An outwash plain is commonly smooth; where pitted, due to melt-out of incorporated ice masses, it is generally low in relief.

OXBOW - (meander belt, oxbow lake) A closely looping stream meander having an extreme curvature such that only a neck of land is left between the two parts of the stream. A term used in New England for the land enclosed, or partly enclosed, within an oxbow.

PINGO - A large frost mound; especially a relatively large conical mound of soil-covered ice (commonly 30 to 50 m high and up to 400 m in diameter) raised in part by hydrostatic pressure within and below the permafrost of Arctic regions, and of more than 1 year's duration.

PLAIN - (lowland, plateau) An extensive lowland area that ranges from level to gently sloping or undulating. A plain has few or no prominent hills or valleys, and usually occurs at low elevation with reference to surrounding areas (local relief generally less than 100m, although some, such as the Great Plains of the United States, are as much as 1000 to 1800 m above sea level.) Where dissected, remnants of a plain can form the local uplands.

PLATEAU - (mesa, plain) An extensive upland mass with a relatively flat summit area that is considerably elevated (more than 100m) above adjacent lowlands, and is separated from them on one or more sides by escarpments. A comparatively large part of a plateau surface is near summit level.

RAVINE - (gulch, draw) A small stream channel; narrow, steep-sided, and commonly V-shaped in cross section; and larger than a gully.

RIDGE - A long, narrow elevation of the land surface, usually sharp rested with steep sides and forming an extended upland between valleys. The term is used in areas of both hill and mountain relief.

SADDLE - A low point on a ridge or crestline, generally a divide (pass, col) between the heads of streams flowing in opposite directions.

SHOULDER - (hill slope) The geomorphic component that form the uppermost inclined surface at the top of a hillslope. It comprises the transition zone from backslope to summit of an upland. The surface is dominantly convex in profile and erosional in origin.

SINKHOLE - (doline) A closed depression formed either by solution of the surficial bedrock (e.g. limestone, gypsum, salt) or by collapse of underlying caves. Complexes of sinkholes in carbonate-rock terraces are the main components of karst topography.

SPIT - (a) A small point or low tongue or narrow embankment of land, commonly consisting of sand or gravel deposited by longshore drifting and having one end attached to the mainland and the other terminating in open water, usually the sea; a fingerlike extension of the beach. (b) A relatively long, narrow shoal or reef extending from the shore into a body of water.

SPLAY - A small alluvial fan or other outspread deposit formed where an overloaded stream breaks through a levee and deposits its material (often coarse-grained) on the flood plain.

SWALE - (a) A slight depression, sometimes swampy, in the midst of generally level land. (b) A shallow depression in an undulating ground moraine due to uneven glacial deposition. (c) A long, narrow, generally shallow, trough-like depression between two beach ridges, and aligned roughly parallel to the coastline.

TERRACE - A step-like surface, bordering a valley floor or shoreline, that represent the former position of an alluvial plain, or lake or sea shore. The term is usually applied to both the relatively flat summit surface (platform, tread),

cut or built by stream or wave action, and the steeper descending slope (scarp, riser), graded to a lower base level of erosion.

VALLEY - (basin) An elongate, relatively large, externally drained depression of the earth's surface that is primarily developed by stream erosion.

OTHER - Additional landforms may be added. Please specify and define.

Leaf phenology:

Select the value which best describes the leaf phenology of the dominant stratum.

EVERGREEN - Greater than 75% of the total woody cover is never without green foliage.

DECIDUOUS - Greater than 75% of the total woody cover sheds its foliage simultaneously in connection with the unfavorable season.

COLD DECIDUOUS - Unfavorable season mainly characterized by winter frost.

DROUGHT DECIDUOUS - Unfavorable season mainly characterized by drought, in most cases winter-drought. Foliage is shed regularly every year. Most trees with relatively thick, fissured bark.

MIXED EVERGREEN - DECIDUOUS - Evergreen and deciduous species generally contribute 25-75% of the total woody cover.

MIXED EVERGREEN - COLD DECIDUOUS - Evergreen and cold-deciduous species admixed.

MIXED EVERGREEN - DROUGHT DECIDUOUS - Evergreen and droughtdeciduous species admixed

PERENNIAL - Herbaceous vegetation composed of more than 50% perennial species.

ANNUAL - Herbaceous vegetation composed of more than 50% annual species.

Leaf type:

Select one value which best describes the leaf form of the dominant stratum.

BROAD-LEAF - Woody vegetation primarily broad-leaved (generally contribute to greater than 50% of the total woody cover).

NEEDLE-LEAF - Woody vegetation primarily needle-leaved (generally contribute to greater than 50% cover).

MICROPHYLLOUS - Woody cover primarily microphyllous.

GRAMINOID - Herbaceous vegetation composed of more than 50% graminoid/stipe leaf species

BROAD-LEAF-HERBACEOUS (FORB) - Herbaceous vegetation composed of more than 50% broad-leaf forb species.

PTERIDOPHTYE - Herbaceous vegetation composed of more than 50% species with frond or frond-like leaves.

Physiognomic class:

Select the value which best describes the physiognomy.

Definitions are modified from the 1973 UNESCO and 1984 Driscoll et al. Formation Classes and are defined by the relative percent cover of the tree, shrub, dwarfshrub, herbaceous, and nonvascular strata.

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 0%).

Roles:

Leader (LDR)
Assistant (AST)
Roving Taxonomist (RTX)
Others to be listed as appropriate

Salinity:

enter the salinity/halinity modifiers of the hydrologic regime using the scale below.

INLAND		COASTAL TIDAL
Saltwater	>30 ppt	Saltwater-tidal
Brackish	0.5-30 ppt	Brackish
No Equivalent	< 0.5 ppt	Freshwater

Soil Sample – Modules:

1-10 = Module Number
C = Composite (mixed soils from different places)
E = Elected (i.e. elected to represent plot; the usual strategy for the B horizon)
M = Middle of plot (similar to E)

Soil Texture:

Using the key below, assess average soil texture, Simplified key to soil texture (Brewer and McCann, 1982)

A1 Soil does not remain in a ball when squeezed ..... sand
A2 Soil remains in a ball when squeezed ..... B
B1 Squeeze the ball between your thumb and fore-finger, attempting to make a ribbon that you push up over your finger. Soil makes no ribbon ..... loamy sand
B2 Soil makes a ribbon; may be very short C
C1 Ribbon extends less than 1 inch before breaking ..... D
C2 Ribbon extends 1 inch or more before breaking ..... E
D1 Add excess water to small amount of soil; soil feels at least slightly gritty ..... loam or sandy loam
D2 Soil feels smooth ..... silt loam
E1 Soil makes a ribbon that breaks when 1-2 inches long; cracks if bent into a ring ..... F
E2 Soil makes a ribbon 2+ inches long; doesn't crack when bent into a ring ..... G
F1 Add excess water to small amount of soil; soil feels at least slightly gritty ..... sandy clay loam or clay loam
F2 Soil feels smooth ..... silty clay loam or silt
G1 Add excess water to a small amount of soil; soil feels at least slightly gritty ..... sandy clay or clay
G2 Soil feels smooth ..... silty clay

Topographic Position:

topographic position of the plot. NOTE a comprehensive list of topographic positions is being developed. The list below provides an example of the topographic positions that might be included.

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.

What's In My Bag?

Required field gear:

(* = sometimes shared by adjacent teams)
field pack (various military-type designs with a large open compartment are best)
measuring tapes: one 50m tape, two 30m tapes
chaining pins (steel arrows), usually 6
pin flags and flagging tape (hot pink or day-glo orange are good choices)
stakes for permanent plot marking (electrical conduit or rebar), 3 sets of 10
hammer
Biltmore stick
diameter tape
meter sticks: 2
clipboards: two, at least one aluminum with compartments
data sheets: 6 cover sheet; 10 tree sheets, 10 herb sheets
sampling instructions
maps
pencils
trowel or other digging tool for soil samples
* soil auger
* soil depth probe
soil collection bags (15)
plant collection bags (5 large clear plastic bags for plant specimens)
permanent marking pen (for soil and plant bags)
compass
clinometer (sometimes on compass)
* GPS

Personal gear:

flora (typically Radford et al 1968)
hand lens
camera & film (usually with 28mm lens)
water
lunch
duct tape (has many uses, but gets used mainly for tick/chigger protection)
emergency items: small first aid kit, small flashlight, matches
comfort items: t.p., insect repellent, sunscreen, hat, long-sleeve shirt, rain gear

Optional/occasional field gear:

altimeter
increment corer
straws for holding cores
tree height measuring device
metal detector (for plot stake relocation)
binoculars
100 m tape

Base-camp equipment:

plant press
library of floras
dissecting scope
National Vegetation Classification