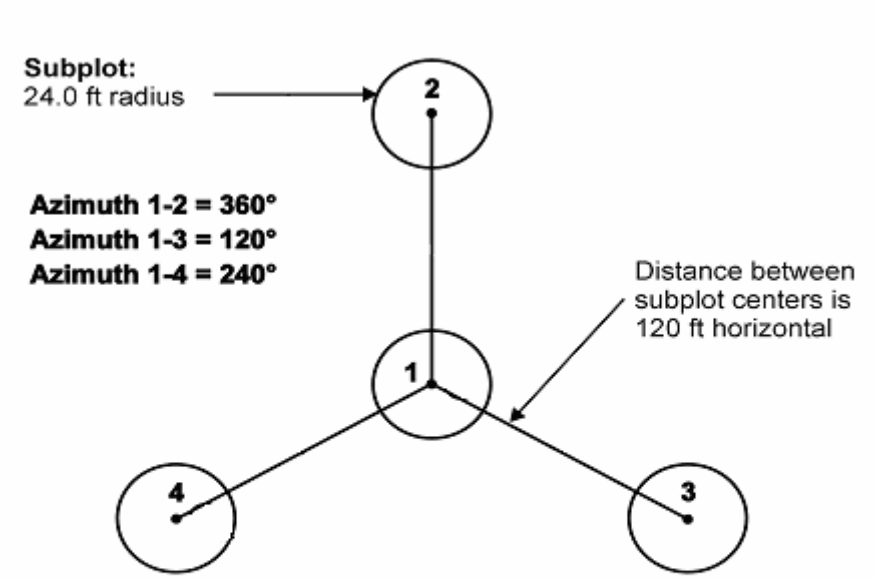
Section 13. Vegetation Diversity and Structure

Indicator regionally revised May 2004.



FIA plot diagram.

13.0 INTRODUCTION

The objectives of the Phase 3 (P3) Vegetation Indicator are to measure the type, relative abundance, and vertical position of all trees, shrubs, herbs, grasses, ferns and fern allies within each P3 plot. We use this information to assess forest ecosystem health in terms of diversity and rates of change of community structure for both native and non-native vascular plant species. While individual species can be important indicators of a site's potential productivity, economic value, and wildlife forage and shelter, changes in the composition and spatial arrangement of vascular plants in a forest may indicate the presence of chronic stresses such as discrete site degradation, climate change, and pollution. These stresses can lead to decline or local eradication of sensitive species, as well as increase and dominance of opportunistic species, such as many weedy non-native plants.

Vegetation diversity and structure data can also be used to classify P3 plots by locally defined plant communities or associations, allowing extrapolation of other forest health monitoring results to broader areas.

The accepted technique used by vegetation scientists to sample plant composition and diversity is to install nested plots of different sizes within a given plant community (Mueller-Dombois and Ellenberg 1974, Barbour and others 1987). Multi-scale sampling is necessary because different communities have different spatial patterns of species richness, so a single plot size is an arbitrary sample of species diversity. Sampling at two or more scales provides information about the structure of a plant community and distribution of individual species, which allows better comparison among communities (and forest types), allows us to estimate how many additional species might occur beyond our largest plot size (i.e., were "missed") (Stohlgren and others 1995), and allows us to measure change in composition over time.

Data will be collected by crew members who have been trained and certified in the Vegetation Indicator methods. These crew members are expected to have had previous botanical training; while we can provide some refresher training in local flora, the skills needed to be an effective field vegetation specialist are beyond the scope of what we can provide during a short training period at the beginning of the field season.

Crew members who are not certified in Vegetation Indicator methods may assist the field vegetation specialist by:

1. Sharing CONDITION CLASS number information
2. Assisting with DETAILED NONFOREST LAND USE descriptions
3. Laying out transects
4. Locating quadrat corners
5. Collecting unknown specimens
6. Entering data
7. Aiding in tree identification

13.1 SAMPLE DESIGN

Phase 3 sampling of vegetation is focused on accessible forest condition classes. If the total area of all accessible forest land condition classes is less than 100% on a subplot, vegetation measurements are done only on the portion that is in accessible forest land condition classes. Vegetation Indicator measurements are not done on portions of the plot that are NOT accessible forest land condition classes. Canopy cover estimates are only made for the area within accessible forest condition(s).

Vegetation Indicator data is collected on all four subplots of P3 plots, and summarized to the Plot level. Specific data are collected at the subplot level for total foliar height diversity and descriptions of ground cover. Species data are collected at the quadrat level (presence/absence only) and at the subplot level (total relative abundance and abundance by height layer).

The boundaries of the subplot are 24.0 feet, horizontal distance, from the subplot center. Total cover of all vegetation foliage in four height layers (0 – 2, >2 – 6,> 6 – 16, and >16 feet) is estimated on each subplot prior to recording species. Ground variable cover estimates are also recorded on the 24.0-foot radius subplot. These estimates are only made on the portion of the subplot that is in accessible forest land.

Species data for all vascular plants are collected on two plot sizes on each subplot: three 3.28 x 3.28 feet (1 m^2) "quadrats", and the 24.0-foot radius subplot (Figure 13-1). From subplot center, the quadrats are located on the right sides of lines at azimuths of 30^o, 150^o, and 270^o. Ideally, two corners of each quadrat are permanently marked at 15 and 18.3 feet (4.57 and 5.57m), horizontal distance, from the subplot center. (This will vary by region and land owner.) Each quadrat is assigned to the dominant condition class on the quadrat, and trampling is assessed. On the quadrats where the dominant condition class is accessible forest, species presence/absence data are collected for vascular plants rooted in the quadrat or with overhanging foliage or live material within 6 feet above the ground above the quadrat.

After the quadrats are assessed, a time-constrained search of all species on the subplot is conducted. Total canopy cover of each individual species is estimated, and then canopy cover within each of three height layers (0-6,> 6-16, and >16) are estimated on each subplot. There are no height limits for vegetation overhanging the subplot boundary; trees and shrubs that are rooted outside the subplot are included in the record if they overhang the subplot. Most species will have canopy cover in one layer only, in which case the total canopy cover and layer canopy cover will be the same. Species and canopy cover estimates are only made for the area of the subplot in accessible forest condition(s). Boundaries between multiple accessible forest conditions on a subplot are ignored during data collection.

Specimens of all measured plants that cannot be confidently identified to the species level are collected off-plot and submitted to herbaria for subsequent identification. Data are collected by certified vegetation specialists with regional knowledge to provide optimum field identification of plant species at each site.

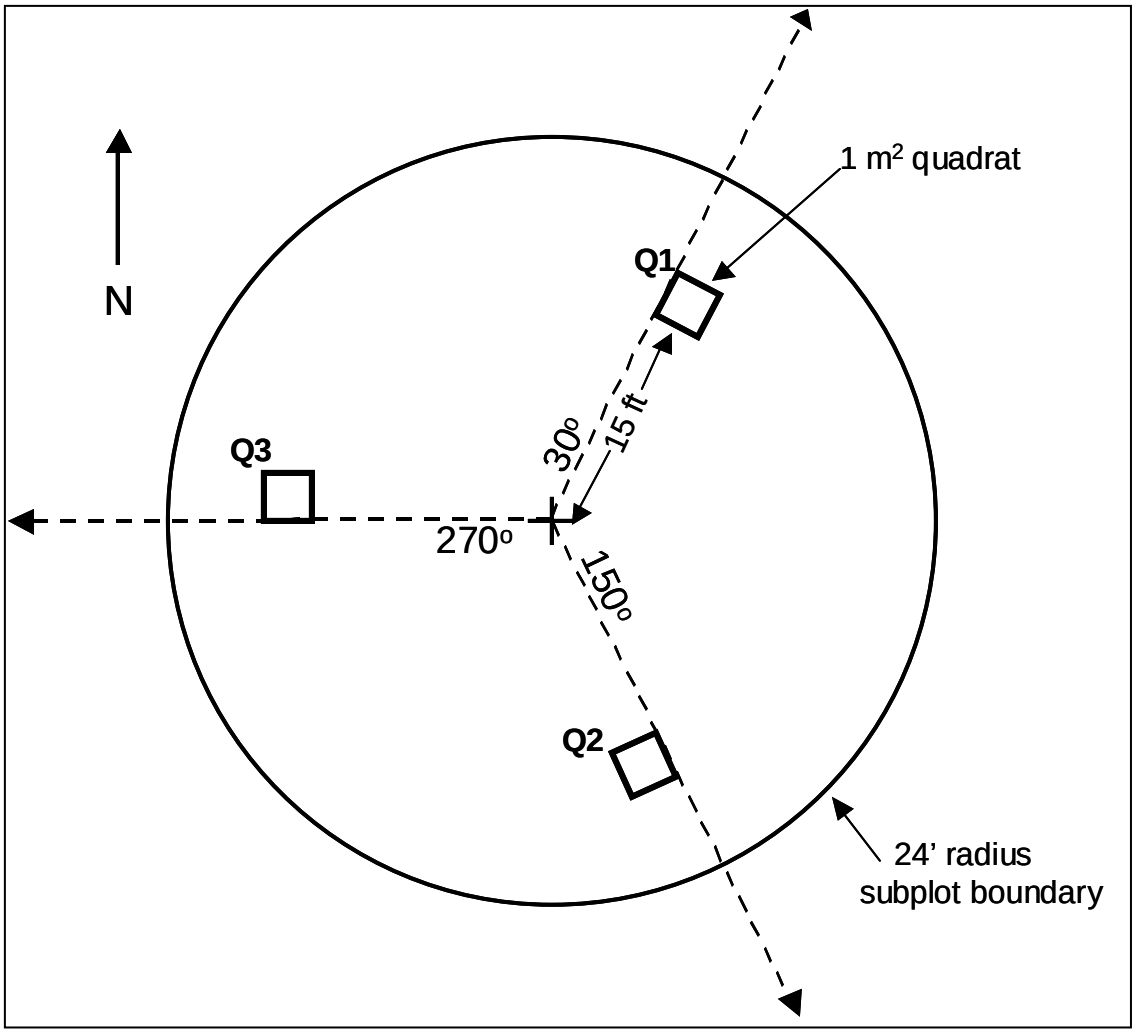


Figure 13-1. Layout of P3 subplot showing location of quadrats and subplot boundary

Quality assurance measurements should be made within 2 weeks of the original plot visit. At the time of next plot measurement cycle, plots should be revisited within 2 weeks of the calendar date of the previous measurement cycle, if at all possible.

13.2 SUGGESTED FIELD GEAR UNIQUE TO VEGETATION INDICATOR

- 1-gal plastic bags for unknown plant specimens
- 1-m^2 quadrat frame
- Permanent pins/stakes to mark quadrat where allowed, or temporary pin flags
- Carpenters ruler (for height measurements)
- Hand lens
- Pre-numbered labels for unknown plant specimens (provided)
- Envelopes for bulky fruits or nuts
- Local flora keys and species lists
- Digging tool
- Large boxes to store and ship samples

- Newspaper and cardboard
- Plant press
- Access to dissecting scope with illuminator
- Mailing instructions for samples (Region specific)
- Diskettes for sending unknown sample information to herbaria
- PLANTS code dictionary with cross-walk plant names to accepted codes

13.3 PLOT AND VISIT REFERENCE INFORMATION

13.3.1 STATE

Record the unique FIPS (Federal Information Processing Standard) code identifying the State where the plot center is located.

When collected: All plots currently having at least one accessible forest condition.
Field width: 2 digits
Tolerance: No errors
MQO: 99% of the time
Values: See Appendix 1 in the P2 field guide

13.3.2 COUNTY

Record the unique FIPS (Federal Information Processing Standard) code identifying the County where the plot center is located.

When collected: All plots currently having at least one accessible forest condition
Field width: 3 digits
Tolerance: No errors
MQO: 99% of the time
Values: See Appendix 1 in the P2 field guide

13.3.3 PLOT NUMBER

Record the identification number, unique within a county, parish, or borough (survey unit in AK), for each plot. If SAMPLE KIND = 3, the plot number will be assigned by the National Information Management System (NIMS).

When collected: All plots currently having at least one accessible forest condition
Field width: 4 digits
Tolerance: No errors
MQO: 99% of the time
Values: 0000(0) – 9999(9)

13.3.4 P3 HEXAGON NUMBER

Record the unique code assigned to each Phase 3 (former FHM) hexagon.

When collected: All plots currently having at least one accessible forest condition
Field width: 7 digits
Tolerance: No errors
MQO: 99% of the time
Values: 0000001 to 9999999

13.3.5 P3 PLOT NUMBER

Record the Phase 3 PLOT NUMBER that are used to identify individual plots within the same Phase 3 (former FHM) hexagon.

When collected: All plots currently having at least one accessible forest condition
Field width: 1 digit
Tolerance: No errors
MQO: 99% of the time
Values: 0 - 9

13.3.6 QA STATUS

Record the code corresponding to the type of vegetation measurement conducted.

When collected: All plots currently having at least one accessible forest condition
Field width: 1 digit
Tolerance: No errors
MQO: 99% of the time
Values:

1 Standard field production plot
2 Cold Check
3 Reference plot (off grid)
4 Training/Practice plot (off grid)
5 Botched Plot file (disregard during data processing)
6 Blind Check
7 Hot Check (production plot)

13.3.7 CREW TYPE

Record the code corresponding to the type of crew measuring the vegetation diversity and structure.

When collected: All plots currently having at least one accessible forest condition
Field width: 1 digit
Tolerance: No errors
MQO: 99% of the time
Values:

1 Regular field crew
2 QA crew (any QA crew member present collecting data)

13.3.8 SAMPLE KIND

Record sample kind.

When collected: All plots
Field width: 1 digit
Tolerance: No errors
MQO: 99% of the time
Values:

1 Initial plot establishment
2 Remeasure of previously established plot
3 Replacement plot

13.3.9 VEG VISIT DATE
Record the year, month, and day that the current plot visit was completed as follows:

13.3.9.1 YEAR
Record the year that the plot was completed.

When collected: All plots
Field width: 4 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: ≥ 2004

13.3.9.2 MONTH
Record the month that the plot was completed.

When collected: All plots
Field width: 2 digits
Tolerance: No errors
MQO: At least 99% of the time
Values:

January	01	May	05	September	09
February	02	June	06	October	10
March	03	July	07	November	11
April	04	August	08	December	12

13.3.9.3 DAY
Record the day of the month that the plot was completed.

When collected: All plots
Field width: 2 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: 01 to 31

13.3.10 VEGETATION SPECIALIST CREW NAME
Record the name of the crew member measuring vegetation diversity and structure.

When collected: All plots
Field width: 20 digits
Tolerance: No errors
MQO: 99% of the time
Values: *Lastname, firstname*

13.3.11 PLOT NOTES
Use these fields to record notes pertaining to the entire plot. If the notes apply only to a specific subplot or other specific aspect of the plot, then make that clear in the notes.

When collected: All plots
Field width: Unlimited alphanumeric character field
Tolerance: N/A
MQO: N/A
Values: English language words, phrases and numbers

13.4 SUBPLOT INFORMATION

13.4.1 SUBPLOT NUMBER

Record the code corresponding to the number of the subplot.

When collected: On all plots with at least one accessible forest condition
Field width: 1 digit
Tolerance: No errors
MQO: 99% of the time
Values:

1 Center subplot
2 North subplot
3 Southeast subplot
4 Southwest subplot

13.4.2 SUBPLOT STATUS

Record the code corresponding to how the subplot was sampled, and if not, why not.

When collected: Each subplot
Field width: 1 digit
Tolerance: No errors
MQO: 99% of the time
Values:

1 Sampled – at least one accessible forest land condition present
2 Sampled – no accessible forest land condition present on subplot
3 Nonsampled

13.4.3 SUBPLOT NONSAMPLED REASON

For subplots that cannot be sampled, and are wholly or partially within the FIA sampling population (U.S. boundary), record one of the following reasons. Codes 1-4 can be assigned to entire plots or portions of plots that are not sampled. Code 5 is assigned only when the entire plot is affected.

When collected: When Subplot Status=3.
Field width: 2 digits
Tolerance: No errors
MQO: 99% of the time
Values:

01 Outside U.S. boundary
02 Denied access area

03 Hazardous situation
04 Time Limitation
05 Lost data (office use only)
10 Other

13.4.4 PERCENT SUBPLOT AREA ACCESSIBLE FOREST LAND

Record the percent area of the subplot in an accessible forested condition.
When collected: When Subplot Status=1.
Field width: 3 digits
Tolerance: +/- 1 class based on the following canopy cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: 90 % of the time
Values: 001-100.

13.4.5 DETAILED NONFOREST LAND USE

Record the code corresponding to the NONFOREST land use of the portion of the subplot that is not forest. If more than one nonforest land use is present, record the code that best describes the land use occurring closet to subplot center.

When collected: SUBPLOT STATUS = 1, and PERCENT SUBPLOT AREA ACCESSIBLE FOREST LAND < 100%
Field width: 2 digits
Tolerance: No errors
MQO: 99% of the time
Values:

10 Agriculture
- 11 Cropland
- 12 Pasture
- 13 Idle farmland
- 14 Orchard
- 15 Christmas tree plantation

20 Rangeland
30 Developed
- 31 Cultural (business, residential, urban buildup)
- 32 Rights-of-way (improved roads, railway, power lines, canals
- 33 Recreation (parks, ski areas, golf courses, etc.)

40 Other (beach, desert, noncensus water, marsh, bog)

13.5 SUBPLOT TOTAL CANOPY COVER BY LAYER

Estimate the total canopy cover of the foliage of all vascular plants by layer above the ground surface within the accessible forested conditions on the subplot. A rapid canopy cover estimate is made, ignoring overlap among species. It may help to visualize canopy cover by collapsing each layer into a 2-dimension space and using the polygon method. Canopy cover is based on a vertically-projected polygon described by the outline of the foliage, ignoring any normal spaces occurring between the leaves of plants (Daubenmire 1959). If there is no foliage in a layer, enter 0% for that layer. Canopy cover estimates are only made for the area within accessible forest condition(s) and should not include foliage on non-forested portions of the subplot. However, record the percent cover on the forested portion as if the subplot was 100% accessible forest. That

is, if cover in a layer is about equal to a circle with a radius of 5.3 ft, enter 5%, as you would for a fully forested subplot, on any partially forested subplot.

13.5.1 SUBPLOT CANOPY COVER LAYER 1 (0 – 2 feet above ground)

Estimate the total canopy cover of the foliage of all vascular plants in Layer 1 within the accessible forested conditions on the subplot. A rapid canopy cover estimate is made, ignoring overlap among species.

When collected: All subplots where SUBPLOT STATUS = 1
Field width: 3 digits
Tolerance: +/- 1 class based on the following canopy cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: at least 90% of the time
Values: 000-100

13.5.2 SUBPLOT CANOPY COVER LAYER 2 (>2 – 6 ft)

Estimate the total canopy cover of the foliage of all vascular plants in Layer 2 within the accessible forested conditions on the subplot. A rapid canopy cover estimate is made, ignoring overlap among species.

When collected: All subplots where SUBPLOT STATUS = 1
Field width: 3 digits
Tolerance: +/- 1 class based on the following canopy cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: at least 90% of the time
Values: 000-100

13.5.3 SUBPLOT CANOPY COVER LAYER 3 (>6 – 16 ft)

Estimate the total canopy cover of the foliage of all vascular plants in Layer 3 surface within the accessible forested conditions on the subplot. A rapid canopy cover estimate is made, ignoring overlap among species.

When collected: All subplots where SUBPLOT STATUS = 1
Field width: 3 digits
Tolerance: +/- 1 class based on the following canopy cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: at least 90% of the time
Values: 000-100

13.5.4 SUBPLOT CANOPY COVER LAYER 4 (> 16 ft)

Estimate the total canopy cover of the foliage of all vascular plants in Layer 4 within the accessible forested conditions on the subplot. A rapid canopy cover estimate is made, ignoring overlap among species.

When collected: All subplots where SUBPLOT STATUS = 1
Field width: 3 digits
Tolerance: +/- 1 class based on the following canopy cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: at least 90% of the time
Values: 000-100

13.6 SUBPLOT GROUND VARIABLE RECORDS

Assess the cover of ground variables found on the accessible forest portion of the subplot. In areas with thick vegetation, you may opt to complete this section after you have collected the species data and have a better perspective on the ground cover. These describe things in contact with the ground surface and not occupied by tree boles or other vegetation basal area. Multiple ground variables often occur on a subplot. Items must be visible from above. For example, a large rock completely covered with moss would not be coded, but the moss would be. Estimate the cover of each ground variable. Cover is estimated to the nearest 1% for each ground variable. The sum of all ground variable covers must equal the percentage entered for variable 13.4.4 PERCENT SUBPLOT AREA ACCESSIBLE FOREST LAND, above.

13.6.1 PERCENT CRYPTOBIOTIC CRUST COVER

Record the PERCENT CRYPTOBIOTIC CRUST COVER in the subplot. Cryptobiotic crust is a layer of symbiotic lichens and algae on the soil surface (common in arid regions).

When collected: All sampled subplots with SUBPLOT STATUS = 1
Field width: 3 digits
Tolerance: +/- 1 class based on the following cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: at least 90% of the time
Values: 000-100

13.6.2 PERCENT LICHEN COVER

Record the PERCENT LICHEN COVER in the subplot.

When collected: All sampled subplots with SUBPLOT STATUS = 1
Field width: 3 digits
Tolerance: +/- 1 class based on the following cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: At least 90% of the time
Values: 000-100

13.6.3 PERCENT LITTER/DUFF COVER

Record the PERCENT LITTER/DUFF COVER in the subplot. This is a continuous layer of accumulated organic matter over forest mineral soil (e.g., scattered leaves over mineral soil is coded mineral soil).

When collected: All sampled subplots with SUBPLOT STATUS = 1
Field width: 3 digits
Tolerance: +/- 1 class based on the following cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: At least 90% of the time
Values: 000-100

13.6.4 PERCENT MINERAL SOIL COVER

Record the PERCENT MINERAL SOIL COVER in the subplot. This is physically weathered soil parent material that may or may not also be chemically and biologically altered.

When collected: All sampled subplots with SUBPLOT STATUS = 1
Field width: 3 digits
Tolerance: +/- 1 class based on the following cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: At least 90% of the time
Values: 000-100

13.6.5 PERCENT MOSS COVER

Record the PERCENT MOSS COVER in the subplot. If liverworts occur on the subplot, include them here with mosses.

When collected: All sampled subplots with SUBPLOT STATUS = 1
Field width: 3 digits
Tolerance: +/- 1 class based on the following cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: At least 90% of the time
Values: 000-100

13.6.6 PERCENT ROAD/TRAIL COVER

Record the PERCENT ROAD/TRAIL COVER in the portions of the subplot designated as accessible forest condition. Include any areas compacted and unvegetated from regular use by foot travel or small motorized vehicles.

When collected: All sampled subplots with SUBPLOT STATUS = 1
Field width: 3 digits
Tolerance: +/- 1 class based on the following cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: At least 90% of the time
Values: 000-100

13.6.7 PERCENT ROCK COVER

Record the PERCENT ROCK COVER in the subplot. Include any rocks, boulders, or accumulations of gravel (> 1/4 inch diameter) or pebbles

When collected: All sampled subplots with SUBPLOT STATUS = 1
Field width: 3 digits
Tolerance: +/- 1 class based on the following cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: At least 90% of the time
Values: 000-100

13.6.8 PERCENT STANDING WATER/FLOODED COVER

Record the PERCENT STANDING WATER/FLOODED COVER in the subplot. Include any ponding or flowing water that is not contained within banks.

When collected: All sampled subplots with SUBPLOT STATUS = 1
Field width: 3 digits
Tolerance: +/- 1 class based on the following cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: At least 90% of the time

Values: 000-100

13.6.9 PERCENT STREAM/LAKE COVER
Record the PERCENT STREAM/LAKE COVER in the subplot. Include any body of water contained within banks that is within a forested condition.

When collected: All sampled subplots with SUBPLOT STATUS = 1
Field width: 3 digits
Tolerance: +/- 1 class based on the following cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: At least 90% of the time
Values: 000-100

13.6.10 PERCENT TRASH/JUNK/OTHER COVER
Record the PERCENT TRASH/JUNK/OTHER COVER in the subplot.

When collected: All sampled subplots with SUBPLOT STATUS = 1
Field width: 3 digits
Tolerance: +/- 1 class based on the following cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: At least 90% of the time
Values: 000-100

13.6.11 PERCENT WOOD COVER
Record the PERCENT WOOD COVER in the subplot. Wood pieces included should average greater than 3 inches in diameter and be in contact with the ground; smaller pieces should be included in Litter/ Duff Cover. Stumps are included.

When collected: All sampled subplots with SUBPLOT STATUS = 1
Field width: 3 digits
Tolerance: +/- 1 class based on the following cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: At least 90% of the time
Values: 000-100

13.7 QUADRAT DATA

Place the quadrat frame to the right side of the transect line and make sure the corners are lined up with the permanent pins. Level the quadrat, if necessary, by propping up the quadrat corners. When a quadrat is located on a steep slope the vegetation specialist should be positioned next to or downhill from the quadrat to prevent sliding or falling into the quadrat. In areas of thick vegetation, quadrat sides should be slid through the vegetation. Quadrat frames can be made with hinging corners or detachable sections to improve maneuverability.

13.7.1 SUBPLOT NUMBER
Record the code corresponding to the number of the subplot.

When collected: All sampled subplots with SUBPLOT STATUS = 1
Field width: 1 digit
Tolerance: No errors

MQO: 99% of the time
Values:

1 Center subplot
2 North subplot
3 Southeast subplot
4 Southwest subplot

13.7.2 QUADRAT NUMBER

Record the code corresponding to the number of the quadrat.

When collected: Each quadrat
Field width: 1 digits
Tolerance: No errors
MQO: 99% of the time
Values:

1 Quadrat on 30^{o}
2 Quadrat on 150^{o}
3 Quadrat on 270^{o}

13.7.3 QUADRAT CONDITION CLASS

A CONDITION CLASS number is assigned to each quadrat. If the quadrat straddles a CONDITION CLASS boundary, assign the number for the CONDITION CLASS which occupies the greatest area in the quadrat. Use the CONDITION CLASS number assigned during plot mapping by the mensuration crew (FIA National Core Field Guide, Ver. 2.0, section 2.4.1).

When collected: Each Quadrat
Field width: 1 digit
Tolerance: No errors
MQO: 99% of the time
Values: 1-9

13.7.4 QUADRAT STATUS

Record the code corresponding to how the quadrat was sampled. If QUADRAT STATUS is 1 or 3, continue to enter data for the quadrat. If value entered is 2, 4, or 5, leave the remaining quadrat items blank.

When collected: Each quadrat
Field width: 1 digit
Tolerance: No errors
MQO: 99% of the time
Values:

1 Quadrat sampled (most of the quadrat is in an accessible forest condition)
2 Quadrat not sampled because most or all of it does not fall in an accessible forested condition class
3 Quadrat sampled, no vascular plants rooted in or overhanging within 6 feet

of the ground surface
4 Quadrat not sampled, hazard present on quadrat
5 Quadrat not sampled, other reason – enter in plot notes

13.7.5 TRAMPLING

A trampling code is assigned to each quadrat at the start of vegetation diversity measurements. Trampling is defined as damage to plants or disturbance of the ground layer by humans, livestock, or wildlife.

When collected: QUADRAT STATUS = 1 or 3
Field width: 1 digits
Tolerance: +/- one code
MQO: At least 90% of the time
Values:

1 Low: 0-10% of quadrat trampled: pristine to relatively undisturbed.
2 Moderate: 10-50% of quadrat trampled: trampling by animals or field crew
3 Heavy: >50% of quadrat trampled: hiking trail or heavily grazed.

13.8 QUADRAT SPECIES RECORDS

13.8.1 QUADRAT SPECIES

Record a code for each vascular plant species found rooted in or overhanging within 6 feet above the quadrat. Species codes must be the standardized codes in the Natural Resource Conservation Service (NRCS) PLANTS database January 2000 version. Identification to species only is expected. However, if subspecies information is known, enter the appropriate NRCS code. If a plant is not known to species, see rules below.

If a plant cannot be identified quickly and confidently, assign an unknown code, as described in rules below, to the measurement and collect a specimen away from the quadrat. As a rule of thumb: “if you have any doubts, collect it”.

If there are no live plants on the quadrat, enter the code 3 in QUADRAT STATUS.

When collected: QUADRAT STATUS = 1
Field width: 10 digits
Tolerance: No errors
MQO: 99% of the time
Values: see rules below:

KEY TO ASSIGNING SPECIES CODES, WHEN TO COLLECT:

1a. Plant is identified to species or subspecies……..…**Enter NRCS[1] Species Code**
1b. Plant is **NOT** identified to at least species……**2**

2a. Plant is locally sparse[2], **OR** has less than 1% canopy cover on subplot AND no mature foliage or reproductive parts present: **DO NOT COLLECT** and assign unknown code ……..……..**3**
2b. Plant **IS NOT** locally sparse: **COLLECT** and assign unknown code.....**4**

(Unknowns locally sparse OR has less than 1% canopy cover AND no mature foliage or reproductive parts present **DO NOT COLLECT**)
3a. Plant is known to genus……..**Enter NRCS genus code and number[3] as needed**
3b. Plant is know to Family……...**Enter UNFM[4] and NRCS family code and number as needed**
3c. Plant not known ……..……..**Enter NRCS general code and number as needed**

(Unknowns **NOT** locally sparse: **COLLECT!**)
4a. Plant known to genus……..
……..**Enter UN[5] and either a descriptive code[6] or NRCS genus code, and number as needed**

4b. Plant is known to family……..
……..…**Enter UNFM and either a descriptive code or NRCS family code, and number as needed**

4c. Plant not known to genus, or family……..……..
……**Enter UN and either a descriptive code or NRCS general code, and number as needed**

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[1]NRCS refers to the Natural Resource Conservation Service PLANTS database version downloaded January 2000. Species, genus, family and general codes from this version available from web site: http://socrates.lv-hrc.nevada.edu/fia/ia/IAWeb/Veg.htm

[2] "Locally sparse" is defined as 5 or less plants present in the entire plot (4 subplots) and immediate surrounding area.

[3] Add a sequential number when two different plant species occur which would have the same Genus, Family or general code. For example, if there are a number of 2FDA plants, you would list them as 2FDA, 2FDA2, 2FDA3, and so on if they are NOT collected. If specimens ARE collected, the codes used are UN2FDA, UN2FDA2, UN2FDA3, and so on. Descriptive text should be added on unknown spreadsheet and label when a specimen is collected, and to plot notes when not collected.

[4] A "UNFM" prefix identifies plant to Family; it may or may not represent a collected specimen, although if it was present with flower parts or fruits, and had canopy cover of 1 percent or greater on any subplot, it should have been collected. The "UNFM" prefix is needed to designate family level identification: there are many genus codes and family codes that are the same.

[5]"UN" prefix on a code signals data processors that this code represents a plant which was collected and may be identified in the future, and updates to the database will be required.

[6]When a plant is collected for identification, you may assign a descriptive name if it is easier to remember and use EXACTLY the same way when referring to the same plant species encountered elsewhere. The database will be updated with the plants' determined identity for all entries made by the VEG specialist crew who submitted the sample in a given season, so you must NOT use the same descriptive name for different species. In contrast, when generic (NRCS genus, family and general codes) unknowns are updated, they will be made on a plot by plot basis. For example, a species record is coded as UNCAREX3 on a plot is identified from a specimen collected on that plot. All UNCAREX3 records from that plot are updated with the identified species code, but specimens recorded as UNCAREX3 on a different plot are NOT updated with that code, unless a specimen collected on the different plot is identified to the same species.

13.9 SUBPLOT SPECIES RECORDS

After completing the three quadrats on a subplot the vegetation specialist does a search of the entire accessible forest condition area of the subplot, ignoring any condition class boundaries within the accessible forest. **Only** species rooted in or overhanging accessible forest condition(s) are included. The vegetation specialist records all species, searching for no more than an average of 45 minutes per subplot. Some vegetation specialists find they spend more time on the first subplot, but less time on other subplots because most plants have been identified and coded. Only emergent plants are recorded in wetland forest situations. Epiphytes (Spanish moss, ferns, orchids, mistletoes) are recorded as best as possible as seen from the ground level. Two types of canopy cover estimates are made for each species: total canopy cover and canopy cover within each of three layers. The majority of plants will have canopy cover in only one layer, in which case the total and layer canopy covers will be identical.

13.9.1 SUBPLOT NUMBER

Record the code corresponding to the number of the subplot.

When collected: All subplots with subplot status = 1
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1	Center subplot
2	North subplot
3	Southeast subplot
4	Southwest subplot

13.9.2 SUBPLOT SPECIES

See section 13.8 for guidelines concerning species codes and section 13.10 for guidelines concerning unknown plants. Only codes from the accepted PLANTS database or “unknown codes” are acceptable. Record species within accessible forested condition(s); include plants rooted in and/or overhanging accessible forested conditions (even if the overhanging species are rooted outside the subplot).

When collected: All subplots with subplot status = 1
Field width: 10 digits
Tolerance: No errors
MQO: 99% of the time
Values: see section 13.8.1

13.9.3 SUBPLOT SPECIES TOTAL PERCENT CANOPY COVER

A rapid canopy cover estimate is made for each species occurring within accessible forested condition(s). Estimate SUBPLOT SPECIES TOTAL PERCENT CANOPY COVER over the entire forested condition portion of the subplot, ignoring any boundaries between forested condition(s). Canopy cover is based on a vertically-projected polygon described by the outline of the foliage, ignoring any normal spaces occurring between the leaves of plants (Daubenmire 1959). Canopy cover estimates are only made for the

area within accessible forest condition(s) and should not include foliage on non-forested portions of the subplot. However, record the percent cover on the forested portion as if the subplot was 100% accessible forest. That is, if total cover for a given species is about equal to a circle with a radius of 5.3 ft, enter 5%, as you would for a fully forested subplot, on any partially forested subplot.

For species of moderate cover, it may be easiest to divide the subplots into quarters, estimate canopy cover of each quarter separately, and then add them together. Record a trace of canopy cover as 1%. The following area-cover sizes may be useful in developing estimates for an entirely forested subplot:

Subplot radius = 24.0 feet, Subplot area = 1809 ft^2

Cover	Area (ft^2)	Length of a side of a square(ft)	Radius of circular area(ft)
1%	18	4.3	2.4
3%	54	7.4	4.1
5%	90	9.5	5.3
10%	181	13.4	7.6
20%	362	19	10.7

For any species: total cover must be less than or equal to the sum of cover assigned for all layers, but greater than or equal to the greatest cover assigned for any one layer. (greatest single layer cover $\leq$ total cover $\leq$ sum of all layers).

When collected: Each subplot species recorded
Field width: 3 digits
Tolerance: +/- 1 class based on the following canopy cover classes: 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: at least 90% of the time
Values: 001 to 100

13.9.4 SUBPLOT SPECIES PERCENT CANOPY COVER LAYER 1 AND 2

A rapid canopy cover estimate is made for each species in a combined Layer1 and 2. Estimate SUBPLOT SPECIES PERCENT CANOPY COVER LAYER 1 AND 2 over the entire forested condition portion of the subplot, ignoring any forested condition class boundaries present, from ground level to 6 feet above the ground. For plants rooted in the subplot, but with no foliage in the combined layer, enter 0. Cover assigned to any one layer cannot be greater than the value assigned for total cover for that species. Canopy cover is based on a vertically-projected polygon described by the outline of the foliage, ignoring any normal spaces occurring between the leaves of plants (Daubenmire 1959). Canopy cover estimates are only made for the area within accessible forest condition(s) and should not include foliage on non-forested portions of the subplot. However, record the percent cover on the forested portion as if the subplot was 100% accessible forest. That is, if total cover for a given species is about equal to a circle with a radius of 5.3 ft, enter 5%, as you would for a fully forested subplot, on any partially forested subplot.

When collected: Each subplot species recorded
Field width: 3 digits

Tolerance: +/- 1 class based on the following canopy cover classes: 0, 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: at least 90% of the time
Values: 000 to 100

13.9.5 SUBPLOT SPECIES PERCENT CANOPY COVER LAYER 3

A rapid canopy cover estimate is made for each species in Layer 3. Estimate SUBPLOT SPECIES PERCENT CANOPY COVER LAYER 3 (from >6-16 feet above the ground) over the entire forested condition portion of the subplot, ignoring any forested condition class boundaries present. For plants rooted in the subplot, but with no foliage in layer 3, enter 0. Cover assigned to any one layer cannot be greater than the value assigned for total cover for that species. Canopy cover is based on a vertically-projected polygon described by the outline of the foliage, ignoring any normal spaces occurring between the leaves of plants (Daubenmire 1959). Canopy cover estimates are only made for the area within accessible forest condition(s) and should not include foliage on non-forested portions of the subplot. However, record the percent cover on the forested portion as if the subplot was 100% accessible forest. That is, if total cover for a given species is about equal to a circle with a radius of 5.3 ft, enter 5%, as you would for a fully forested subplot, on any partially forested subplot.

When collected: Each subplot species recorded
Field width: 3 digits
Tolerance: +/- 1 class based on the following canopy cover classes: 0, 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: at least 90% of the time
Values: 000 to 100

13.9.6 SUBPLOT SPECIES PERCENT CANOPY COVER LAYER 4

A rapid canopy cover estimate is made for each species in Layer 4. Estimate SUBPLOT SPECIES PERCENT CANOPY COVER LAYER 4 (>16 feet above the ground) over the entire forested condition portion of the subplot, ignoring any forested condition class boundaries present. For plants rooted in the subplot, but with no foliage in layer 4, enter 0. Cover assigned to any one layer cannot be greater than the value assigned for total cover for that species. Canopy cover is based on a vertically-projected polygon described by the outline of the foliage, ignoring any normal spaces occurring between the leaves of plants (Daubenmire 1959). Canopy cover estimates are only made for the area within accessible forest condition(s) and should not include foliage on non-forested portions of the subplot. However, record the percent cover on the forested portion as if the subplot was 100% accessible forest. That is, if total cover for a given species is about equal to a circle with a radius of 5.3 ft, enter 5%, as you would for a fully forested subplot, on any partially forested subplot.

When collected: Each subplot species recorded
Field width: 3 digits
Tolerance: +/- 1 class based on the following canopy cover classes: 0, 1-5%, 6-10%, 11-20%, 21-40%, 41-60%, 61-80%, and 81-100%
MQO: at least 90% of the time
Values: 000 to 100

13.10 UNKNOWN PLANTS AND VOUCHER SPECIMEN COLLECTION

When you encounter a plant you do not recognize and you cannot identify it quickly and confidently, using field guides, follow these basic steps:

1. Assign an Unknown code
2. Make a frequency record or canopy cover estimate for the sample unit where plant was encountered.
3. Document and describe on the unknown spreadsheet and label
4. Collect a sample off the subplot
5. Press and label if not identified by the end of the day

13.10.1 Assign an Unknown code

See section 13.8.1 for rules.

13.10.2 Plot data

Record the plant where encountered (Quadrat: section (13.8.1) or Subplot section (13.9)).

13.10.3 Documenting unknown specimens: labels and unknown spreadsheet

13.10.3.1 Specimen Label

Each vegetation specialist will be issued a set of pre-printed labels for unknown specimens (Figure 13-2). Information contained on the label include variables listed in Table 13.1 below: Pre-printed labels should be completed in the field to the extent required by the Region handling the unknown and should accompany the plant as it is collected, pressed, dried, and shipped. Properly used labels are essential for tracking specimens and updating species records.

Label Number:1 PLANTS CODE:
Hexagon: 9999999 Plot: 1 Subplot: 1
Quad: 2 Date: 8/06/03
Unknown Code: unminty2 Veg Spec. crew: John Doe
State: MN County: Hubbard
Community: Spruce-Fir
Description: opposite leaves, square stem, purple flowers, minty fragrance, possibly peppermint
Scientific Name:

Figure 13-2. Example of label for unknown specimen.

13.10.3.2 Unknown spreadsheet

Any time you encounter an unknown plant, the plant must be recorded on your **Unknown Spreadsheet**. Each Region should train the Vegetation specialists which set of variables are mandatory for tracking of unknowns. The Unknown Spreadsheet contains the fields for variables listed in Table 13.1:

Table 13.1 Summary of Variables for Unknown Specimen labels and spreadsheets

Variable	Label	Unknown Spreadsheet	Source
Label Number	X	X	Preprinted by Region for each VEG crew
Unknown code	X	X	13.8.1 (As assigned by VEG crew)
VEG spec. crew name	X	X	13.3.7
Hexagon Number	X	X	13.3.3
P2 Plot Number	X	X	13.3.4
P3 Plot Number	X	X	13.3.5
State	(descriptor*)	(descriptor)	13.3.1
County	(descriptor*)	(descriptor)	13.3.2
Subplot Number	X	X	13.9.1
Quadrat Number	X	X	13.7.2, if recorded on a quadrat
Date (Collected)	X	X	13.3.9
Community	X	X	Text entered by VEG crew
Description (of plant)	X	X	Text entered by VEG crew
PLANTS CODE	OPTIONAL**	X	NRCS code entered by identifier
Scientific Name	OPTIONAL**	X	Scientific Name of corresponding NRCS code

*Descriptor used, i.e., State and County NAMES, rather than FIPS code so that information has meaning to independent botanist or herbarium making the identification.

** PLANTS CODE and scientific name entry to label is highly recommended if specimen is kept for future reference.

13.10.4 Specimen Collection and Handling

A good rule of thumb for when to collect unknown specimens is "when in doubt, ***collect!***" Specimens of all plants present in the quadrats and subplots that cannot be quickly and confidently identified to species should be collected ***away from quadrats*** and off of the subplot, if possible. If fewer than 5 of the unknown plants are present DO NOT COLLECT (see section 13.8.1).

Use a digging tool to extract the entire plant, including any underground portions, flowers, fruits, and leaves. If the plant is abundant, collection of two samples will increase the likelihood of a good specimen. All specimens must be labeled, pressed, and dried for shipping and subsequent identification by the vegetation specialist, cooperating herbarium or specialist.

Collected unknown specimens should be transported in the field and from the field in the 1 and/or 2 gallon zip-lock bags provided. Only one species and label may be placed in a single bag. Acceptable methods of transporting collected specimens include:

Use a 3-hole-punch to punch holes in the bottom of your bags prior to traveling in the field. Place the punched bags into a 2-inch 3-ring binder with the zip-lock portion facing outward. Plants can then be placed with labels into the bag directly in the binder. This method prevents crumpling, tearing, and destroying the specimen during transportation.

Use a 1-hole-punch to punch a hole in the one upper corner of each bag. The hole should be placed in such a manner that it cannot easily be torn. Place the bags on an aluminum carabineer (available at drug stores) or on heavy twine and fasten to your field

vest or backpack. Be careful to seal the plants and labels securely inside the bags to prevent accidental loss.

Pressing specimens

1. Each specimen representing a unique species should be placed individually inside a single layer of folded newsprint. Each specimen is to be accompanied by its corresponding unknown specimen label. Small plant specimens are to be pressed individually. Large plant specimens may be folded in a "v", "z", or "w" arrangement to fit on a single newsprint page. Arrange the specimen so that at least one upper and one lower leaf surface is exposed. Plants may be trimmed to reduce bulk, so long as all diagnostic parts are included. Diagnostic portions include stem sections, petioles, leaves, roots, flowers, and fruits. Bulky fruits or nuts may be stored separately in a paper envelope that is taped to the newsprint and is accompanied by an identical copy of the specimen's unknown label. Unknown codes can be written on the outside of the folded newspaper to aid sorting as specimens are processed.

2. Stack the specimens in their individual newsprint sleeves between two pieces of cardboard. Bind the cardboard and plants together using a piece of twine or flat cloth ribbon wrapped around the length and width of the cardboard bundle. For mailing numerous specimens, several bundles may be used. Place all bundles inside a cardboard box for shipping.

Unknown specimens are to be packaged and shipped at the end of every work week. Exceptions will be made when extended field excursions prevent the vegetation specialist from reaching a post office.

All packaged specimens are to be accompanied by the following:

- Name and address to which final identifications are to be mailed
- One paper and one digital copy of the Unknown Spreadsheet

13.11 REFERENCES

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[5]USDA Forest Service North Central Research Station
[6]USDA Forest Service Northeast Research Station
[7]USDA Forest Service Interior West Research Station

DATA SHEETS: Plot and Subplot Information

State:	Sample Kind:	Plot Notes:		
County:	Year:			
Plot Number:	Month: Day:			
P3 Hexagon Number:				
P3 Plot:	VEG Crew Name:			
QA Status:				
Crew Type:				
	Subplot 1	**Subplot 2**	**Subplot 3**	**Subplot 4**
Subplot status				
Non-sample reason				
Percent Subplot Area in Accessible Forest Condition(s)				
Nonforest Land Use				
Layer Total Cover in Accessible Forest Condition(s)				
1 (0-2)				
2 (2-6)				
3 (6-16)				
4 (16+)				
Ground Variable Cover in Accessible Forest Condition(s)				
Cryptobiotic crust				
Lichen				
Litter/Duff				
Soil				
Moss				
Road/Trail				
Rock				
Water				
Stream				
Trash/Junk				
Wood				

Quadrat and Subplot Species (one per Subplot)

VEG Crew Name(s):		Qd1	Qd2	Qd3	Notes:
	Quadrat status				
Year: Month: Day:	Condition Class #				
Hex:	Trampling (1-3)				
Subplot:					

Plant Name	NRCS	UnCode/#	P/A Qd1	P/A Qd2	P/A Qd3	SP TCv	SP Cvr1&2	SP Cvr3	SP Cvr4