



Plant Community Composition and Structure Monitoring Protocol for the Northern Great Plains I&M Network - Standard Operating Procedures

Version 1.01

Natural Resource Report NPS/NGPN/NRR—2012/489.1



ON THE COVER

Photographs clockwise from top left:

1. Badlands at Theodore Roosevelt National Park, ND, July 2009
2. Deer enclosure at Devils Tower National Monument, June 2009
3. Post Rushmore 1 fire at Mount Rushmore National Memorial, SD, March 2006
4. American bison at Badlands National Park, June 2005
5. Riparian lowland at Fort Laramie National Historic Site, WY
6. Spiderwort at Badlands National Park, SD, June 2009
7. (Center) Agate Fossil Beds National Monument, June 2003

Photographs 1-3, 5-7 by Amy Symstad

Photograph 4 by C. Jason Tinant

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February 2012

U.S. Department of the Interior

National Park Service

Natural Resource Stewardship and Science

Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado publishes a range of reports that address natural resource topics of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

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This report received formal, high-level peer review based on the importance of its content. Peer review was conducted by highly qualified individuals with subject area technical expertise and was overseen by a peer review manager.

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Please cite this publication as:

Symstad, A. J., R. A. Gitzen, C. L. Wienk, M. R. Bynum, D. J. Swanson, A. D. Thorstenson, and K. J. Paintner-Green. 2012. Plant community composition and structure monitoring protocol for the Northern Great Plains I&M Network - Standard Operating Procedures: Version 1.01. Natural Resource Report NPS/NRPC/NRR—2012/489.1. National Park Service, Fort Collins, Colorado.

Revision History

Version numbers will be incremented by a whole number (e.g., 1.12 to 2.00) when a change is made that significantly affects requirements or procedures. Version numbers will be incremented by decimals (e.g., Version 1.06 to 1.07) when there are minor modifications that do not affect requirements or procedures included in the protocol. Add rows as needed for each change or set of changes tied to an updated version number.

Prev. Version	Revision Date	Revised by	Changes Made	Reasons for Change	New Version
1.00	Fall 2011	NGPN	Editorial, SOP revisions, new sample frame for FOUS. Added user documents for FFI. Updated field sheets. Separated SOPS from narrative.	Revisions based on the first field season and to better match sample frame of FOUS to vegetation management plan	1.01

Contents

	Page
Figures.....	xiii
Tables	xv
Introduction.....	1
SOP Field Preparation: <i>Preparations and Equipment Setup Prior to the Field Season</i>	3
Updating Training.....	3
Reviewing the Budget.....	3
Hiring the Field Crew	3
Scheduling the Field Season.....	4
Research Permits	5
Updating Target Species Lists	5
Updating Park Species Lists	5
Supplies and Equipment	5
Preparing Data Forms and Plot Folders.....	8
Preparing GIS Layers and Maps.....	9
Communication with Park Contacts	9
SOP Training Observers: <i>Training the field crew for plant community monitoring</i>	11
Administrative Processes and NPS-Required Training.....	12
Care and Use of Equipment.....	12
<i>Radios</i>	12
<i>Navigating in the Field and other GPS Use</i>	13
Training in Plot Establishment and Sampling	13
Training in Plant Identification.....	14
First Aid, Safety, and Emergency Procedures	14

Contents (continued)

	Page
Wilderness Rules and General Practices to Preserve Park Integrity	15
Attachment 1: List of Contents for Field Crew Handbook.....	16
Attachment 2: Example Plant Identification Training Schedule	17
Attachment 3: Plant Identification and Tree Damage Class Resources	19
SOP Using the GPS	21
Important Information	21
Setup prior to going to the field.....	21
ArcPad Initialization and Task Selection	22
Navigating to a Plant Community Monitoring Site.....	25
Collecting Plot Installation Data.....	26
Collecting General Waypoint Data.....	27
Editing Feature Attributes.....	28
Downloading files from GPS to workstation.....	29
SOP Site Evaluation.....	31
Equipment List.....	31
Procedures.....	31
1. <i>Order of site visits</i>	32
2. <i>Get to the site</i>	33
3. <i>Evaluate the site</i>	34
4. <i>Photograph the site</i>	39
5. <i>At the end of each day and the when site evaluation is complete for a park</i>	41
SOP Plot Establishment: <i>Establishing and Marking Active Plots</i>	43
Equipment List.....	43

Contents (continued)

	Page
Procedures.....	44
1. <i>Get to the plot</i>	44
2. <i>Mark transects for sampling</i>	44
3. <i>Describe the plot</i>	49
4. <i>Photograph the plot (Photographic Record Sheet PCM-3)</i>	50
5. <i>When Data Collection Is Completed – VERY IMPORTANT!!!</i>	54
6. <i>At the end of each day and park visit</i>	54
SOP Repeat Photography.....	55
Equipment List.....	55
Procedures.....	55
1. <i>General photography instructions</i>	55
2. <i>Photographing the site</i>	57
3. <i>Recording photo information on photographic record sheet.</i>	59
4. <i>At the end of each day, park visit, and field season</i>	60
SOP Plant Sampling: <i>Measuring Cover and Frequency of Herb-Layer Plant Species Using Point-Intercept Sampling and Nested Quadrats</i>	63
Equipment List.....	63
Before Going to the Field	63
Field Procedures	64
1. <i>Laying out Transects</i>	64
2. <i>Sampling Teams</i>	64
3. <i>Collecting Point-Intercept Cover Data</i>	64
4. <i>Collecting Nested Frequency Data</i>	67

Contents (continued)

	Page
When Data Collection Is Complete	70
At the End of Each Day and Park Visit	70
SOP Trees and Shrubs: <i>Measuring Tree and Tall Shrub Species</i>	73
Equipment List.....	73
Procedures.....	73
1. <i>Laying out Transects</i>	73
2. <i>Filling in Data Sheet Headers</i>	74
3. <i>Measuring trees, poles, and seedlings</i>	74
When Data Collection Is Complete	87
At the End of Each Day and Park Visit	87
SOP Surface Fuels: <i>Measuring Dead and Downed Woody Fuels in Pinus ponderosa Forest and Woodlands</i>	89
Equipment List.....	89
Procedures.....	89
1. <i>Laying out Tapes along Transects</i>	89
2. <i>Sampling Teams</i>	90
3. <i>Collecting Fuel Load Data</i>	90
When Data Collection Is Complete	93
At the End of Each Day and Park Visit	93
SOP Disturbance: <i>Disturbance and Target Species Assessment</i>	95
Equipment List.....	95
Procedures.....	95
1. <i>Begin data sheet</i>	95

Contents (continued)

	Page
2. <i>Describe disturbances in the site</i>	96
3. <i>Scan for target species in the plot</i>	97
When Data Collection Is Complete	98
SOP Unknown Plants: <i>Collecting and Documenting Unknown Plants and Vouchering Specimens</i>.....	99
Collecting and Documenting Unknown Plants.....	99
<i>Creating codes for unknown plants</i>	99
<i>Collecting and photographing unknown plants</i>	100
<i>Guidelines for filling out PCM-11, Unknown Plant Data Sheet</i>	101
<i>Guidelines for filling out PCM-15, Unknown Plant Log</i>	102
Voucher Specimens	102
SOP Wrapping up the Field Season.....	105
Inventory, Clean, and Store Field Equipment	105
Reviewing the Field Season and the Protocol	105
Checking out Seasonal Employees	107
SOP Data Management.....	109
Metadata	109
<i>Steps for Metadata Creation</i>	110
Paper Data Sheets	112
Scanning and Naming Scan Files for Paper Data Sheet Backup.....	112
Photograph Management	113
FFI Data Management and Entry	114
<i>User Roles</i>	114

Contents (continued)

	Page
<i>Structure of Data – Project Management in FFI</i>	114
<i>Assigning Species Lists to Databases – Species Management in FFI</i>	121
<i>Data Entry</i>	122
<i>Data Verification</i>	130
<i>Data Validation</i>	131
<i>Data Management</i>	132
<i>Data Storage</i>	132
<i>Data Archiving and Editing of Archived Data</i>	133
<i>Schedule</i>	134
<i>SOP Data Analysis: Data Analysis and Reporting</i>	181
1. Annual Reports	181
<i>Exporting Data for Summary Calculations</i>	183
<i>Summary Calculations</i>	197
2. Determination of Status and Trends	204
<i>Estimation and Detection of Trends in Data from Intensive Plots</i>	205
<i>Estimation of Status for Intensive-plot Data</i>	206
<i>Estimating Park- or Stratum-wide Status and Trends for Extensive Plot Data</i>	208
<i>Park-wide Estimates for Parks with Stratified Designs</i>	209
<i>Domain Analyses</i>	209
3. Comprehensive Syntheses	210
<i>Focusing on Specific Management Issues</i>	210
<i>Relationships between Plant Community Composition and Structure Attributes</i>	210

Contents (continued)

	Page
<i>Data from other Vital Signs</i>	210
<i>Using Different Analytical Techniques</i>	210
<i>Evaluating with respect to thresholds, etc.</i>	214
4. Variability Assessment and Sample Design Review	214
<i>Refining Estimates of Variance Components</i>	214
<i>Quantitative Sample Design Review</i>	215
5. Schedule	216
Attachment 1: Instructions for Category Unique Hits Calculations	218
SOP Protocol Revisions	219
Adapting to Decreased/Increased Funding or Land Acquisition	220
<i>Options for reducing sampling effort</i>	220
<i>Options for Increasing Sampling Effort</i>	222
<i>Options when a Park Acquires New Property</i>	222
Revision Procedures	222
Literature Cited	225
Appendix 1: Data Sheets	229

Figures

	Page
Figure 1. Construction of 1 m ² nested quadrat frame	8
Figure 2. An illustration of the process used to reject GRTS primary plots and replace them with overdraws.....	33
Figure 3. NGPN Plant community monitoring plot layout.....	34
Figure 4. Example tag for plot markers.	44
Figure 5. Flow chart for determining which transects and markers to install at a plot.....	45
Figure 6. Plot layout, including transect marker names and types and distances useful when establishing the plot.....	46
Figure 7. Layout of nested frequency quadrats along transects within a plot (top) and detail of the location of the smaller quadrats within the 10 m ² quadrat (bottom).	69
Figure 8. Example nested quadrats data sheet.	72
Figure 9. Example of list of previously recorded species provided for each plot.....	72
Figure 10. Illustration of rules for measuring diameter for forked trees for those species measured at breast height.....	79
Figure 11. Illustration of rules for measuring diameter at root collar in special circumstances	82
Figure 12. Illustration of intensive plot map and approximate order in which to visit quarters for mapping and recording trees (dotted line).....	84
Figure 13. Graphic of a fuel-sizing/go-no-go gauge.....	92
Figure 14. Illustration of tally rules for dead and down fuel	92
Figure 15. Example of reader/recorder/observer information into Team Tab of a Sample Event.	121
Figure 16. File structure used to store NGPN Plant Community protocol data and information.....	133
Figure 17. Different approaches for estimating status in a connected, rotating panel [2-3] design.	208
Figure 18. Idealized ordination diagram showing change in species composition through time (t1 to t9)	213

Tables

	Page
Table 1. Schedule for intensive plot sampling and recommended housing options for each park during intensive sampling period.	4
Table 2. Tree and tall shrub species in NGPN parks that qualify a plot for establishing tree transects ¹	46
Table 3. Substrate codes for point-intercept sampling of ground cover.	66
Table 4. Tree and tall shrub species in NGPN parks, with growth form and location where diameter should be measured.	76
Table 5. Common disturbance types in Northern Great Plains Network parks.	97
Table 6. Initial Project Units for NGPN data entry into FFI.....	115
Table 7. Example Table from PCM-2.....	117
Table 8. Deliverable products, responsible individual, and target completion date for data products from the NGPN Plant Community Composition and Structure Monitoring Protocol.....	134
Table 9. Attributes to be summarized and reported in annual reports.	182
Table 10. Vital Signs relevant to plant community comprehensive synthesis reports and some of the plant community attributes to which they may be related.	212

Acknowledgements

Funding for the development of this protocol was provided through the National Park Service Northern Great Plains Inventory and Monitoring Network (NGPN), the NPS Northern Great Plains Fire Ecology/Fire Effects Monitoring Program (NGP FireEP), and the U.S. Geological Survey Northern Prairie Wildlife Research Center. Several standard operating procedures and parts of this protocol were derived from those written by other I&M Networks, especially HTLN, NCPN, and KLMN. We thank those networks who have gone before us and made our path easier. We also thank D. Licht for his early input into the protocol, S. Wilson and J. Brumm for GIS, GPS and data management input, T. Philippi for teaching us GRTS and early review of the protocol, J. Freeman and V. Hofman for input on sampling methodology, and S. Sanders, D. Shorrock, and J. Yeo for reviewing the manuscript. We thank the 2011 NGPN and NGP FireEP seasonal crew for implementing the protocol in 2011 and providing feedback on the methods. We thank I. Ashton, M. Prowatzke, S. Wilson, and T. Shepherd for revising the protocol and producing this version.

Introduction

The Northern Great Plains Inventory and Monitoring Network (NGPN) includes thirteen park units located in five northern Great Plains states across six ecoregions. Plant community composition and structure monitoring comprises the core of the vegetation monitoring effort for the NGPN, covering the “Riparian Lowland Plant Communities” and “Upland Plant Communities” vital signs (Gitzen et al. 2010). The narrative portion of the plant community protocol can be found in Symstad et al. 2012. The narrative includes the rationale for vegetation monitoring, an overview of sample design, field methods, data management, and program requirements. This document contains the standard operating procedures needed to implement plant community monitoring.

SOP Field Preparation: *Preparations and Equipment Setup Prior to the Field Season*

Version 1.01

Prev. Version	Revision Date	Revised by	Changes Made	Reasons for Change	New Version
1.00	11/11	LEB	Changed to nrps style. Added unknown data sheet	Needed better unknown tracking	1.01

This standard operating procedure (SOP) explains the procedures that will be completed prior to the field season, including reviewing the budget, hiring the field crew, scheduling the field season, maintaining and repairing supplies and equipment, preparing data forms and maps, and communication with park contacts. Training of the field crew is described in SOP Training.

Updating Training

The Plant Ecologist and Plant Lead Biotech make sure their training is current. Training includes on-line training on credit card use, internet security, discrimination and whistleblowing, and records management, as well as defensive driving and wilderness first responder first aid courses. Both should receive formal training on FFI soon after being hired.

Reviewing the Budget

It is the Network Coordinator's responsibility to provide adequate funding to conduct this protocol. The Plant Ecologist will meet with the Network Coordinator prior to each field season to review the budget for this project's work plan and ensure that it meets salary, equipment, mileage, travel, and miscellaneous field expenses. If significant budget changes occur so that the scheduled amount of data collection will be impacted, the Network Coordinator, Plant Ecologist, and Technical Committee will determine how to make the sampling fit the budget. SOP Protocol Revisions provides information on the consequences and implications of various options in these circumstances.

Hiring the Field Crew

Recruitment of the field crew member(s) should begin so that position advertisements are posted by early January of the year of the field work and so that hiring can be completed by early March. Thus, the hiring process (submitting position announcements to Human Resources) needs to begin by late October each year. **Initiating the recruitment process early is critical for ensuring that well qualified candidates can be found.** Although the field crew members do not need to have the same level of experience nor all of the required skills as the Plant Ecologist, similar general qualities should be sought. All crew members should be:

- detail-oriented
- organized

- experienced in hiking and camping
- at least moderately physically fit (able to hike up to 5 miles in a day in hilly terrain)
- familiar with at least some field vegetation monitoring procedures
- able to work compatibly with other crew members for long periods of time.

At least two of the seasonal crew members should also be proficient at identifying vascular plants, especially in the northern Great Plains and Black Hills (completed or in-progress botany or range management degree preferred). This proficiency is demonstrated by classes completed and grades earned in plant taxonomy, histology, and dendrology, as well as experience in previous paid and volunteer positions. Application/Interview questions that can help distinguish qualified personnel include: how many plants can you identify to species on sight? what field guides and taxonomic keys have you used, and which do you prefer? how do you go about identifying a species when you do not recognize it in the field?

Soon after the field crew members are hired, the Plant Ecologist will send each of them a copy of the Plant Community Composition and Structure Monitoring Protocol.

Scheduling the Field Season

Because the number of intensive plots sampled is stable from year to year, and to ensure similar timing of sampling, the same field schedule is followed each year for intensive plots (Table 1). In late April-early May, the Plant Ecologist and Plant Lead Biotech develop the specific schedule for the entire season (subject to minor adjustments during the season) and begin making travel and housing arrangements for each tour. General housing recommendations for each park are listed in Table 1. A detailed list of housing and eating options for each park are maintained on the NGPN server.

Table 1. Schedule for intensive plot sampling and recommended housing options for each park during intensive sampling period.

Week	Tour	Parks	Housing
1 st week of June			
2 nd week of June	Southern	AGFO (non-riparian), SCBL, FOLA	AGFO – park housing; SCBL & FOLA – hotel
3 rd week of June			
4 th week of June	Badlands	BADL	Hotel, park campground, or combination thereof
1 st week of July			
2 nd week of July	Black Hills	DETO, JECA, MORU, WICA	DETO & WICA – park campground; JECA & MORU – daily travel from network office
3 rd week of July			
4 th week of July			
1 st week of August	Northern*	FOUS, KNRI, THRO	FOUS & KNRI – hotel; THRO – park or other campground
2 nd week of August			

*This tour is done in cooperation with the NGP FireEP, so coordination with that team is necessary.

The number of extensive plots and the parks in which they are sampled varies among years. In addition, some of this sampling is done by the NGP FireEP. In March of each year the Plant Ecologist and Plant Lead Biotech work with the Lead Monitor and Fire Ecologist of the NGP FireEP to determine the schedule and responsibility of each crew for extensive plot sampling. Two key points are important for this scheduling: (1) the sampling window for extensive plot

sampling is generally April-October; (2) intensive plot sampling is the priority for June-early August.

The beginning of the field season schedule will include ample time for crew training (see SOP Training); procurement of network access, email accounts, and travel credit cards; and implementation of the performance appraisal process. Included in the field scheduling process is listing all plots that will be visited/monitored during the field season. This includes reevaluating all dormant plots against the site rejection criteria in SOP Site Evaluation.

Research Permits

In the winter/early spring prior to the field work, the Plant Ecologist will use the NPS Research Permit and Reporting System (<https://science.nature.nps.gov/research/ac/ResearchIndex>) to ensure that research permits are up to date for all parks that will be visited that year. Research permits need to be updated/requested no later than March 30th.

Updating Target Species Lists

In the winter prior to the field work, the Plant Ecologist will work with staff from individual parks and the coordinator of the Northern Great Plains Exotic Plant Management Team to make additions, deletions, or corrections needed to the park's target species list. Information from the park's weed management district(s), county, and state should be consulted for changes in noxious weed lists and watch lists.

Updating Park Species Lists

Park species lists are updated annually prior to the field season in five steps. First, park lists are downloaded from IRMA NatureBib when there have been changes to the certified list. When there have been no changes, the NGPN list from the prior field season is used. Second, the park lists are imported into a database that contains lists from all parks. Third, when all lists are compiled, it is cross referenced with the Integrated Taxonomic Information System (ITIS, see <http://www.itis.gov/index.html>), which is a partnership of Federal agencies that provide scientifically credible and standardized taxonomic information about the nation's biota to make sure the most current taxonomy is used. Fourth, the list is cross-referenced with USDA Plants Database to determine the alpha-numeric code for each species that will be used in the field and FFI. Fifth, the final lists are exported by park and saved into the park folder on the server, and then printed and distributed to the field crews.

Supplies and Equipment

Equipment will be checked in March to provide sufficient time for needed repairs or replacement. If any new equipment is procured, the equipment inventory is updated with make, model, and serial number as appropriate. Once these are done, equipment and supplies are organized for use in the field. Settings on electronic equipment (GPS units, cameras, laptops, rangefinders) are also checked and corrected as necessary at this time. Below are lists of equipment needed for a field season for a single crew. Keep in mind that generally there are two field crews working at a time and extras are good to have in case of breakage. When NGP FireEP is contributing (Northern tour), equipment for a third field crew is needed.

Communication and coordination with NGP FireEP is necessary to ensure that they have the required equipment. Data sheet/plot map/GIS needs are addressed in following sections. *Note:* All items that will not stay in the field (i.e., not plot markers) should be made easily visible if

they are not already so. Finding a pencil (or even GPS unit) dropped in tall grass is easier if it has bright flagging tied to it. Bright paint and flagging are good ways to make things visible.

General Equipment and Supplies

- Magellan MobileMapper 6 GPS unit (or another unit of similar quality) with memory card, loaded with protocol-specific version of ArcMap
- Digital camera (Canon Powershot SX110 IS or another unit of similar quality) with memory card
- Extra memory card for camera or GPS
- Card reader
- Extra AA batteries for camera and GPS unit
- Laptop computer with ArcGIS and ArcMap interface
- Where appropriate, water-resistant topographic map of park (e.g., National Geographic Trails Illustrated maps for BADL, THRO, and WICA)
- Sighting compass for each person
- Radio(s) with proper frequencies
- Backpack for each person
- Field notebook
- Pencils, extra pencil lead, and erasers
- Sharpies
- Closable clipboards
- Magnetic locator/Metal detector (for finding plot markers)
- Hawgs (case for carrying plot folders, extra data sheets, and reference materials)
- Multitool (e.g., Leatherman)

Plot Establishment/Sampling Equipment

- Data sheets (see “Preparing Data Forms and Plot Folders” below)
- Rebar (18-24 inches long)
- Chaining pins (12)
- Transect-marking spikes (8-12 inch pole barn nails)
- Large washers through which large nails’ spikes, but not heads, fit
- Steel mallet
- Plot tags (brass; labeled with plot number, etc.)
- Tree tags (sequentially numbered, brass)
- Nails for attaching tags to trees in nail apron (aluminum if possible, 3” long)
- Steel wire for attaching tags to plot markers
- Pliers
- Clinometer (with % scale on *right* side)
- 50-m tapes (2)
- 30-m tapes (4)
- 30-m tape with 100-ft marked on one side

- Diameter tapes (2); if possible, one should be for small-diameter poles both should be metric
- Photo board (dry-erase board)
- Tripod rigged to hold photo board
- Dry-erase marker and cloth for wiping photo board
- Set of dyes for marking dates on plot tags
- Plunkers* (2)
- Nested quadrat frames* (2 each of 0.01 m^2 , 0.1 m^2 , 1 m^2)
- Non-stretchy, durable string $> 11\text{ m}$ long (loop at one end and knot at 10 m from loop) or surveyors tape 10 m in length
- Biodegradable flagging tape
- Colored sidewalk chalk
- Fuel sizing/Go-no-go gauge (see SOP Surface Fuels for illustration)
- Ruler or tape marked in 0.1-inch increments
- Range finder

Plant ID Supplies

- Reference books (Flora of the Great Plains, Vascular Plants of Wyoming, Weeds of the Great Plains, Weeds of the West, Plants of the Black Hills and Bear Lodge Mountains, Grassland Plants of South Dakota and the Northern Great Plains)
- Ziplock plastic bag for collection (gallon or 2-gallon size)
- Hand lens for each person
- Plant id/collection notebook for each person
- Plant press with newspaper and ventilators
- Park species list
- Plot species list
- Dissecting microscope, herbarium paper, herbarium glue, and specimen labels (for office)

Miscellaneous/Safety Items

- First aid kit
- Sun screen (individuals must provide their own)
- Insect repellent (individuals must provide their own)
- Insect head net for each person
- Leather gloves for each person
- Gaiters for each person
- Water bottles or other hydration systems (e.g., Camelback)

Camping Gear

- Large (~5-gallon) water containers for northern tour (water up there tastes horrible)
- Camp stove with extra fuel
- Pots, pans, food prep utensils
- Dishes and eating utensils
- Tent, ground tarp, sleeping bag, and sleeping pad for each person
- Cooler(s)

*Construction Information

Plunkers (aka point-intercept poles) are $\frac{1}{4}$ -inch-diameter, collapsible tent poles (with shock cord), marked in 1-cm increments. They should be approximately 2 m in length. If at all possible, engrave the poles to mark the increments; paint or electrical tape also works, but permanent marker wears off easily and must be reapplied frequently.

The nested quadrat frames are constructed by forming $\frac{1}{2}$ - to 1-inch diameter PVC pipe and PVC elbows into square frames. The internal dimensions for each of the nested quadrat frames are:

- 10 cm x 10 cm for 0.01 m^2 frame
- 31.6 cm x 31.6 cm for 0.1 m^2 frame
- 1 m x 1 m for 1 m^2 frame.

The 0.01 m^2 and 0.1 m^2 frames are glued so that they cannot be disassembled. For ease of carrying into the field, the 1 m^2 frames can be disassembled; each PVC elbow is glued to only one pipe (Figure 1).

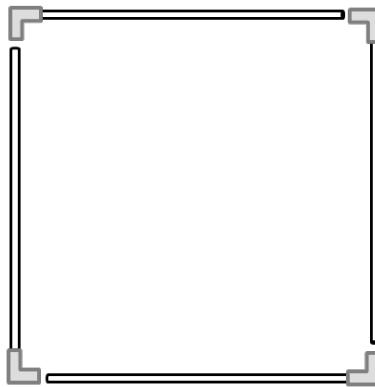


Figure 1. Construction of 1 m^2 nested quadrat frame. A PVC elbow (grey) is glued to one end of each of four pipes so that, when assembled, the internal dimensions of the frame are $1\text{ m} \times 1\text{ m}$.

Preparing Data Forms and Plot Folders

After the field season schedule is determined, the Plant Ecologist or designee works with the Data Manager to prepare a plot folder for each plot that will be visited during the field season.

For all plot types, each plot folder should contain a high quality copy of:

- all site evaluation checklists (PCM-1) filled out for the plot
- the plot location and description data sheet (PCM-2)
- a blank site evaluation checklist and plot location and description data sheet in case the plot's designation changes
- all photographic record sheets (PCM-3) for the plot, plus one blank for further records
- photo contact sheets of all photos taken in the plot (see SOP Repeat Photography)
- the most recent tree map (page 2 of PCM-6), where applicable
- any other data sheets from the most recent data collection visit to the plot
- a blank disturbance and target species data sheet (PCM-10)
- a blank unknown specimen data sheet (PCM-11)

- a blank unknown plant log (PCM-15).

For extensive plots and dual plots being visited only for extensive data collection, each folder should also contain:

- one blank trees data sheet (PCM-6)
- one blank poles data sheet (PCM-7)
- one blank seedlings data sheet (PCM-8)
- in Black Hills parks, one blank dead and downed fuels data sheet (PCM-9).

For intensive plots and dual plots being visited for intensive data collection, each folder should contain all of the above plus:

- the list of all species previously recorded in the plot, listed for each nested quadrat set (see SOP Plant Sampling for an example)
- two blank point-intercept data sheets (PCM-4)
- two blank nested quadrat data sheets (PCM-5).

Additional blank copies of all data sheets should be made as needed (check for leftovers from last year, but make sure no changes have been made in the meantime) and stored in folders in the folder hawg that is used to transport plot folders during tours. Enough copies for 25% of the plots to be sampled in a year should be on Rite-in-the-Rain paper and clearly marked as such.

Preparing GIS Layers and Maps

The GIS Specialist or Data Manager should maintain the most up-to-date baseline GIS layers (roads, trails, streams, ponds, park boundary, imagery, orthography, etc.) for each park. At least three weeks before the beginning of field work, the Plant Ecologist or designee will work with the GIS Specialist or Data Manager to create shape files of the sites that will be visited that year and load these onto the appropriate GPS units (see SOP Using the GPS). The plot location shapefile will include the following attributes:

- unique site name
- sampling frame stratum for the site (e.g., riparian vs. upland)
- plot type (intensive vs. extensive)
- sample panel.

The Plant Ecologist and/or GIS Specialist will produce hardcopy maps of all sites to be visited in the field season. Both these hardcopy maps and the GPS units will include all information necessary and helpful for navigation in the field (e.g., photographic imagery, roads, trails, streams).

Communication with Park Contacts

While preparing the field season schedule, the Plant Ecologist or designee will communicate with each Park Contact to ensure that the proposed schedule is appropriate for the park and to determine:

- whether housing or campground sites are available (make reservations as necessary)
- whether keys are needed to access plots
- whether there are any changes to access routes to plots (e.g., land ownership/neighbor relations changes, creek/river washouts)
- whether any park staff will be joining NGPN and/or NGP FireEP for part or all of the sampling at the park
- any last-minute additions/corrections to the park target species list.

This is also a good opportunity to ensure that all park contact information (phone numbers, email addresses, inclusion in email contact lists, etc.) is up to date. Program NGPN cell phones with phone numbers of park contacts and NGPN staff.

SOP Training Observers: *Training the field crew for plant community monitoring*

Version 1.01

Prev. Version	Revision Date	Revised by	Changes Made	Reasons for Change	New Version
1.00	11/11	LEB	Change to nrps style		1.01

This standard operating procedure (SOP) explains the preferred training procedures for all plant community composition and structure monitoring crew members. Training will cover administrative processes; care and use of equipment; field navigation; plot establishment and sampling; plant identification; safety, including emergency procedures; and wilderness rules. The first two weeks of the field season will be training.

Throughout training it is crucial to emphasize to crew members that they are the most important people for ensuring high quality data are used in the management of NPS resources. Stress that all the minutiae in the protocol and SOP's are there to help them collect high quality, consistent data, and that referring back to the documentation during the field season is encouraged and expected.

Upon arriving for duty, each crew member will be given a folder with at least the following items:

- NGPN seasonal crew handbook (List of contents for the crew handbook is in Attachment 1)
- Appointment Affidavits form
- Annual payroll schedule
- Leave Request form
- Time Sheet
- Direct Deposit Sign-up Form
- Employee Express letter
- Standards of Conduct letter and Receipt of Acknowledgement form
- Travel credit card application
- Request for Travel form
- SMIS Quick Reference for Accident Reporting
- Documentation of tick bite instructions
- Wilderness ethics handout
- NPS GSS User Account Request form (for computer use)
- Emergency Contact List (for employee to fill and turn in)
- Northern Great Plains I&M Network contact list

- NGPN vehicle cell phone number list
- State emergency telephone numbers list
- NPS Cell Phone and Driving Policy letter
- Gear check-out and inventory form
- Field season schedule
- NGPN Travel Chart (driving directions to network parks)
- Employee Performance Appraisal Plan
- NGPN key request form
- List of required online trainings and instructions on how to access them
- Magnetic Declination and Compass Use handout
- Using the Clinometer to Measure Slope handout
- Notebook for plant identification training

Administrative Processes and NPS-Required Training

Within the first week, the Project Lead, Network Coordinator, and/or Administrative Clerk will instruct all crew members on the material in the NGPN seasonal crew handbook, which describes timesheets, travel procedures and policies, equipment and gear check-in and check-out processes, vehicle use, computer use, Employee Performance Appraisal Plans, behavior and dress codes, and NPS-required online trainings. Crew members will complete the last of these as soon as possible.

Care and Use of Equipment

Crew members will be trained in proper handling, maintenance, and storage of equipment that is used regularly for this project:

- GPS unit and memory card
- digital camera and memory card
- memory card reader
- battery chargers
- sighting compass
- clinometer
- laser range finder
- magnetic locator
- radio (see radio section below)
- tent
- camp stove

SOP's relevant for this training are SOP Using the GPS and SOP Repeat Photography.

Radios

Training on radio use will include:

- care and maintenance (including battery charging)
- understanding the list of radio frequencies and channel labels provided with the radio

- preferred channels for communication within the crew vs. between the crew and other entities (park HQ, etc.)
- radio etiquette
 - last name vs. call numbers
 - when initiating a call, identify receiver first and then yourself
 - acknowledge that message is received and understood
 - keep conversations short
 - properly close out exchange.

Navigating in the Field and other GPS Use

Field crew members are expected to be able to independently navigate in the field using a map, compass, and/or GPS unit. They will be provided instruction on the following:

- basic features of the GPS unit(s)
- thorough understanding of the protocol-specific version of ArcMap (i.e., SOP Using the GPS)
- using GPS unit to capture points, tracks, and polygons
- ensuring correct identification of a site/plot
- navigation to and from plots
- understanding the correspondence between a map and GPS
- use of a compass in navigation.

Training in Plot Establishment and Sampling

Figure 9 of the main protocol shows which SOP's are done in each plot at each type of visit. Training will go through this figure in detail because it is a complicated issue.

SOP Plot Establishment describes in detail the procedures for establishing active plots. Training for this SOP will emphasize

- how to use the compass and clinometer, including setting the proper declination on a compass
- how to capture point locations with the GPS unit
- how to square up plot corners
- how to deal with difficult plot situations (rough terrain, lots of woody undergrowth, etc.).
-

SOP Repeat Photography, SOP Plant Sampling, SOP Trees and Shrubs, and SOP Surface Fuels describe in detail the procedures for sampling vegetation and fuels. Training for these SOPs will emphasize

- the order in which data are collected to minimize trampling effects
- the importance of placing transects, points, and quadrats in their marked/designated locations
- objective and plumb placement of the intercept pole
- recording only those species that touch the intercept pole when it is held still in the plumb position
- careful searching for plants in nested frequency quadrats

- attention to diameter tape placement on trees
- how to distinguish between duff and litter for fuels sampling
- distinguishing among damage classes to trees (see Attachment 3)
- writing clearly (all caps for species codes, for example) and heavily for maximum legibility and clear scans.

Training in Plant Identification

Field crew members are expected to be familiar with plant taxonomy and terminology in order to become quickly familiar with plants encountered in the NGPN parks. Botany training will be done in mid to late May with the NPG FireEP at WICA. The Plant Ecologist and Lead Plant Biotech, NPG FireEP permanent staff, and guest trainers as available will review with observers how to identify vascular plants using the materials developed and obtained by the Network (e.g., crib sheets for commonly confused species; crib sheets on identifying species with only vegetative characters), taxonomic keys, field guides, and herbarium specimens. Field crew members' training will include:

- reviewing lists of common northern Great Plains species and park species lists
- reviewing photographs, taxonomic keys, herbarium sheets, and photographic field guides
- practicing plant identification in the field
- collecting specimens into personal plant identification notebooks (to be used throughout the season)
- becoming especially familiar with species on watch lists (rare/imperiled or noxious/invasive).

Tests, both formal and informal, are a part of this training. These are not used for performance evaluation purposes, but to help the Project Lead and Assistant identify where (topics or individuals) more training is needed. Training will stress that it is more important to get it right than it is to make a quick identification. Asking questions throughout the field season will be strongly encouraged. Attachment 2 contains an example of a plant identification training schedule. Attachment 3 contains resources for plant identification training and reference.

First Aid, Safety, and Emergency Procedures

The field crew will be working in some remote areas, but even in not-so-remote areas, it is important that the crew be constantly aware of their safety and prepared for emergency situations. Training in safety will include:

- procedures for informing the proper people of your whereabouts
- proper hydration and heat stress
- ticks, mosquitoes, and the diseases they carry
- poison ivy
- bison, rattlesnakes, and other dangerous wildlife
- river crossings
- first aid procedures (Red Cross-certified First Aid/CPR courses are often available through individual parks at the beginning of the field season or online) and location of first aid kits
- emergency contacts/procedures/communications

- review of the NGPN safety plan
- Safety Management Information System (SMIS) – how to report an injury.

Wilderness Rules and General Practices to Preserve Park Integrity

A substantial portion of two NGPN parks (BADL, THRO) are officially designated wilderness areas. Each of these areas has a specific set of regulations (e.g., motorized equipment and mechanized transportation are prohibited) for these areas. The Plant Ecologist must consult with park wilderness coordinators regarding any wilderness rules that pertain to this protocol, follow these rules, and train the field crew as appropriate. The means for marking plots is an important issue for discussion.

Training of the field crew should emphasize that, no matter where in a park they are working, they should strive to minimize their impact on park resources to maintain the integrity of the plots and the data collected from them, to maintain the integrity of the park resources, and to set a good example for visitors. These practices include driving only on designated roads. Leave No Trace training is recommended (<http://www.lnt.org/>).

Attachment 1: List of Contents for Field Crew Handbook

MISSION STATEMENT

GOALS AND OBJECTIVES

ADMINISTRATION

POLICIES

 HOUSING

 UNIFORM

 ALCOHOL AND DRUGS

 PHYSICAL FITNESS

 CHARGE CARD USE

 COMPUTER USE

 TRAVEL EXPENSES AND PER DIEM

 VEHICLES AND DRIVING

 TIME, ATTENDANCE, AND LEAVE

 DISCRIMINATION AND HARASSMENT

GENERAL OPERATING PROCEDURES

 GUIDELINES OF PERSONAL CONDUCT

 FIELD PROCEDURES

 OFFICE PROCEDURES

 FIELD OPERATIONS

 Field Gear and Plot Work / Camping

 TRAVEL

 VEHICLES

CREW CONFIGURATION AND ORGANIZATION

 PLANT ECOLOGIST

 LEAD MONITOR

 MONITORING CREW MEMBER (MONITORS)

COLLATERAL DUTIES

 ADMINISTRATION MANAGER

 PLOT FOLDER HAWG MANAGER

 PHOTO MANAGER

 SUPPLY MANAGER

 BOOK HAWG AND CAMP KITCHEN MANAGER

 GPS MANAGER

 VEHICLE MANAGER

 PURCHASING AND BUDGET MANAGER

 PLANT COLLECTIONS MANAGER

CREW SAFETY PLAN

 TRAINING

 SAFETY MEETINGS

 PROTECTIVE EQUIPMENT AND SPECIAL CLOTHING

 VEHICLE TRAVEL

 JOB-RELATED INJURIES AND ILLNESSES

GEAR

 GEAR ISSUE AND RESPONSIBILITIES

 Field Equipment/ Group Camping Gear/ Recommended Personal Gear

Attachment 2: Example Plant Identification Training Schedule

Wednesday, May 19th

- 0700 Coffee/Tea- up
- 0730 Agenda and Outline, Goals
- 0745 Vegetation communities
- 0815 Reference materials: books, field sheets, internet & personnel, herbariums
Species lists & naming protocols (park species lists, need to collect lists, Rare spp. list)
- 0900 Break
- 0915 Issue and explain Field Botany Notebooks
- 0945 Plant & shrub terminology & office ID - scope, samples, field sheets (*Brassicaceae*, *Astragalus* & *Oxytropis*, Cacti), herbarium specimens
- 1100 Shrub/ tree ID near office
- 1200 Lunch at office
- 1230 Field ID (focus on Shrubs, Sages, Phloxes, *Liliaceae*, flowering *Asteraceae* and Cacti) - **Windy Point**
 - Prairie dog town, ponderosa slope, ridge top
- 1500 Return to office
- 1530 Dichotomous keys; ID and preserve specimens from day; organize botany notebooks

Thursday, May 20th

- 0700 Questions, review, misc.
- 0830 Grass and sedge terminology & office ID - scope, samples, field sheets, herbarium specimens
- 1000 Break
- 1015 Field ID (Grasses and more grasses) – **Look Out Point**
 - Prairie dog town, ponderosa slope, open ridge
- 1200 Lunch in field
- 1230 Field ID continued
- 1430 Return to office
- 1500 ID and preserve specimens from day; organize botany notebooks
- 1530 NGP Admin/ end of week AAR

Wednesday, May 26

- 0700 Questions, misc., review & Botany Bingo (Agenda & Outline for new folks)
- 0830 Legume, mustard & aster plant terminology & office ID
- 0930 Break
- 0945 Field ID (*Fabaceae*, *Brassicaceae*, *Asteraceae*) - **Wind Cave Canyon**
 - Ponderosa slope, canyon, open ridge, limestone outcrop, disturbed roadside
- 1200 Lunch in field
- 1230 Field ID continued
- 1530 Return to office (walk back?)
- 1600 Dichotomous keys, ID and preserve specimens from day; organized notebooks

Thursday, May 27

- 0700 Questions, misc., review

0745 Prep & leave for Cold Brook
0815 Field ID – **Cold Brook Trail**- Woody draws, ponderosa slope
1200 Lunch in field
1330 Return to office
1400 Botanizing
1600 NGP Admin/end of week AAR

Attachment 3: Plant Identification and Tree Damage Class Resources

BOOK MATERIALS (*field guides with pictures)

Plants of the Black Hills and Bear Lodge Mountains, Larson & Johnson*
Grassland Plants of South Dakota and the Northern Great Plains, Johnson & Larson*
Wildflowers, Grasses & Other Plants of the Northern Plains and Black Hills, Van Bruggen*
Weeds of the West, Western Society of Weed Science*
Weeds of the Great Plains, Stubbendieck, Coffin & Landolt*
Flora of the Great Plains, Great Plains Flora Association
Common Legumes of the Great Plains, Stubbendieck & Conard
Vascular Plants of Wyoming (3rd Edition), Dorn
Plant Identification Terminology, Harris & Harris

TECHNICAL REPORTS

(many of these are out of print and available only as photocopies in the NGPN library)
Prairie grasses identified and described by vegetative characters, Looman (Agriculture Canada, 1982)
The Vascular Plants of South Dakota, Van Bruggen
The Identification of Certain Native and Naturalized Grasses by their Vegetative Characters (Kansas State Agricultural Experiment Station, 1932)

COMPILED HANDOUTS USED IN TRAINING

These files are on the NGPN server, N:\Groups\Monitoring\Plant_Community\Protocol\Training_Documents\BotanyTraining

- Vegetative guide to 25 grasses and 3 sedges.pdf
- Grass and Sedge illustrated field guide.pdf
- Upland Carex sheet.xls
- Astragalus_Worksheet_Fire_EP.xls
- Helen's Grass Vegetative Characteristics sheet.doc
- Phlox, Paronychia, and Arenaria Keys.doc
- Down and Dirty Guide to the Cacti of the NGP.doc
- Recognizing Mountain Pine Beetle signs.doc
- Tree damage classes.doc

INTERNET/COMPUTER

USDA Plants Website <http://plants.usda.gov/>

IPM Images Website, plants

<http://www.ipmimages.org/browse/phylum.cfm?phylum=Magnoliophyta>

Southwest Environmental Information Network

<http://www.swbiodiversity.org/seinet/collections/index.php>

Wind Cave Seedling Identification Website <http://www.nps.gov/wica/naturescience/seed-study-species-table.htm>

- Herbariums -

Black Hills State University Herbarium <http://herbarium.bhsu.edu/aboutus.htm>

Kansas State University Herbarium <http://www.k-state.edu/herbarium/index.html>

UW- Steven's Point Freckman Herbarium <http://wisplants.uwsp.edu/VascularPlants.html>

Wisconsin State Herbarium <http://www.botany.wisc.edu/herbarium/>

Missouri Botanical Garden's Herbarium

<http://www.mobot.org/mobot/research/herbarium.shtml>

Arizona Herbarium <http://ag.arizona.edu/herbarium/> (good images of herbarium specimens)

PERSONNEL

For plant identification help

Beth Burkhart (WICA botanist)

Gary Larson (South Dakota State University Professor)

Mark Gabel (Black Hills State University Professor and Herbarium Curator)

SOP Using the GPS

Version 1.01

Prev. Version	Revision Date	Revised by	Changes Made	Reasons for Change	New Version
1.00	11/11	LEB	Edit/clarify		1.01

This standard operating procedure (SOP) describes how to use a GPS receiver with the plant community-customized ArcPad program for navigating to sites and capturing points. The GPS interface used in this SOP is ArcPad 7.1. More detailed information on uploading and managing datafiles can be found in the NGPN Data Management Plan.

Important Information

To ensure you're going to the right place or capturing points accurately, make sure your files are created correctly. Always use NAD 1983 as your projection when creating files. Below are the UTM zones for each park.

Park	Zone	Park	Zone
AGFO	13N	MNRR	14N
BADL	13N, except far E, which is 14N	MORU	13N
DETO	13N	NIQB	14N
FOLA	13N	SCBL	13N
FOUS	13N	THRO	13N
JECA	13N	WICA	13N
KNRI	14N		

When using the GPS unit touch screen, always use a stylus for interfacing with the screen. Pens, pencils, and sticks may leave marks or scratch the surface of the screen.

Setup prior to going to the field

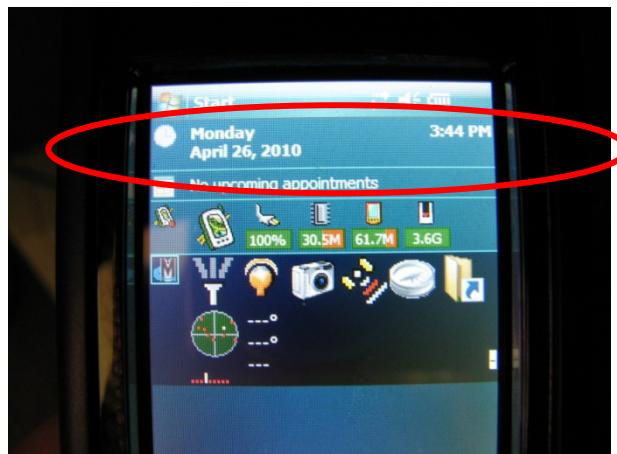
The NGPN Data Management group manages the geo-spatial data transfer from the NGPN server to the GPS units. The spatial data strategy is implemented through the use of ESRI ArcGIS geodatabases and the associated ArcPad extension, which allows users to manage transactions between ArcPad and ArcGIS. ArcGIS and the ArcPad extension are on a desktop or laptop computer. ArcPad is the user interface software on the GPS unit. NGPN uses the ArcPad extension to extract data for use with ArcPad (viewing and navigation on the GPS) and to add new features to a geodatabase by checking out the geodatabase for editing with the GPS unit. The integration of ArcPad and ArcGIS allows better data management and assists in the spatial data processing work flow.

The Network Data Manager has map templates and plant community monitoring geodatabases for use in ArcPad. These data are checked out and uploaded to the GPS unit using Microsoft ActiveSync software. A step-by-step guide to complete the spatial data transfer is available in the Network office. Field crews should also bring a backup GPS unit with a copy of the data, and for overnight trips the spatial data also should be stored on a laptop computer.

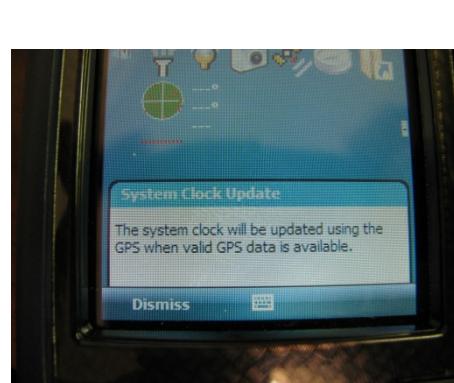
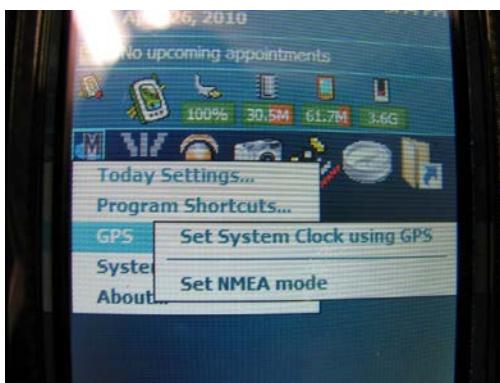
In addition to loading the data on the GPS unit, the NGPN data management group configures the GPS preferences to average 30 positions to create one point feature, and applies filters to ensure a standard level of quality (i.e., Maximum Position Dilution Of Precision (PDOP) value of 6 is acceptable; DGPS Mode Only; 3D Mode Only).

ArcPad Initialization and Task Selection

- A. Press and hold the power button until the screen lights up on the MobileMapper6 data logger.
- B. Verify that GPS date and time displayed near the top of the screen are correct.

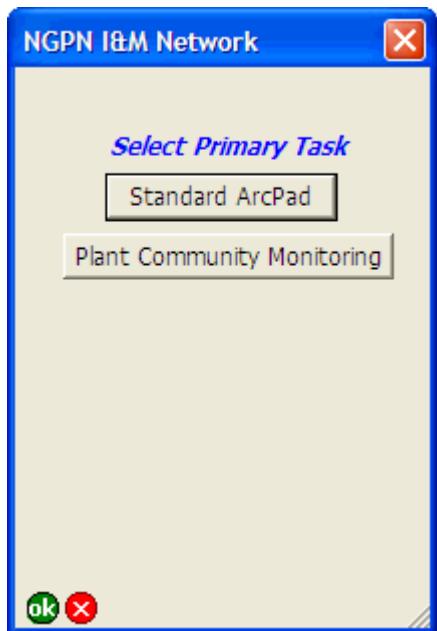


If the GPS date and time are incorrect, tap the MobileMapper Today  button and select **GPS, Set System Clock using GPS** (below left). A message stating the system clock will update with the GPS will appear (below right).





Start ArcPad by tapping the desktop shortcut **ArcPad**. The NGPN I&M Network custom startup interface form will appear. Select Plant Community Monitoring for your Primary Task.



Note: The custom task buttons are designed to make ArcPad more user friendly. Only select **Standard ArcPad** if you need access to all default ArcPad toolbars and associated tools, or are experiencing technical problems.

IMPORTANT NOTE: Do not Tap OK or Cancel (X in circle); this will cause the application to fail.

A. Select the park that you are working in by tapping the radio button to the left of the park's four-letter code and tap **OK**.

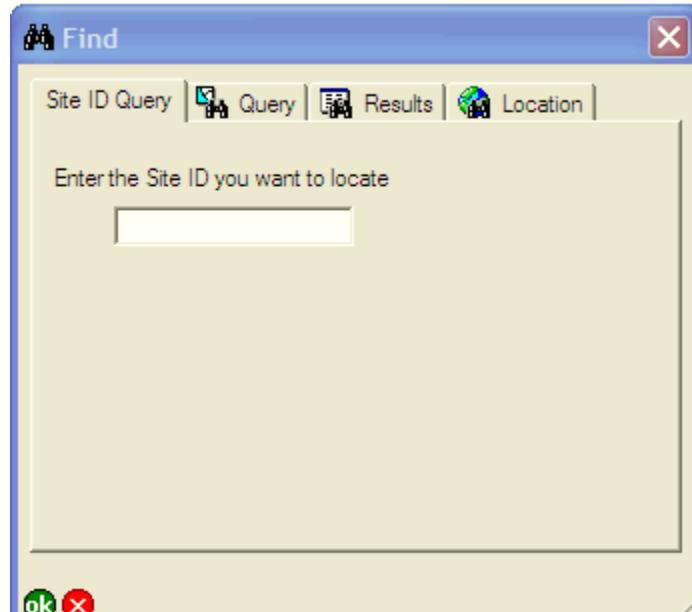


B. ArcPad loads the custom Plant Community Monitoring toolbars, opens the park's Plant Community Monitoring map, loads the predefined spatial layers, and enables the GPS.

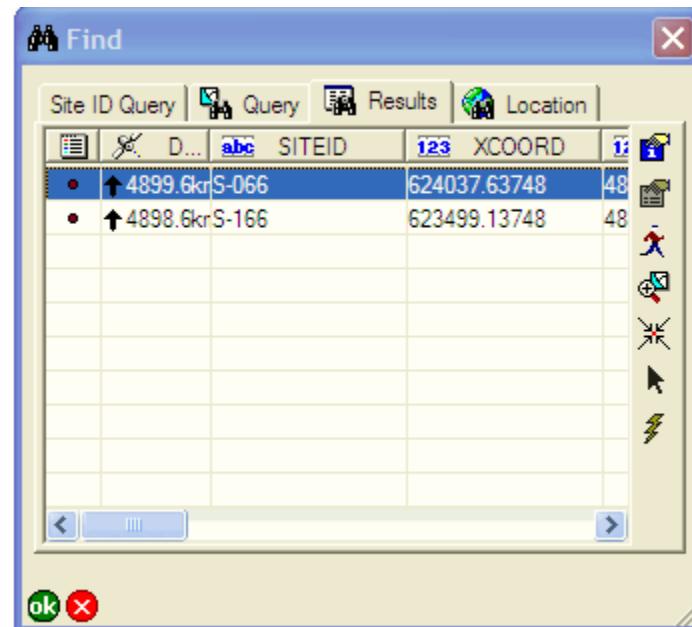


Navigating to a Plant Community Monitoring Site

A. Tap the **Find** button  to show the custom query form. Enter the site number using the keyboard and tap **OK**. Note: The query form is designed to search for any site containing the number you entered.



B. Select the record you want to navigate to by tapping the table row and then tap the **Go To** button  located on right side of the **Results** page. This action will highlight the plot of interest in the map.



C. Tap the **GPS Position Window** button  to display the GPS Position Window and then tap the Skyplot twice to toggle to the **Compass** display.



The compass in the GPS window displays the GPS direction, or course over ground (**TCOG**), with a black arrow and the direction or bearing (**BRG**) from the current GPS location to the selected destination with a red line. The distance(**DST**) from the current GPS location to the selected destination is also displayed.

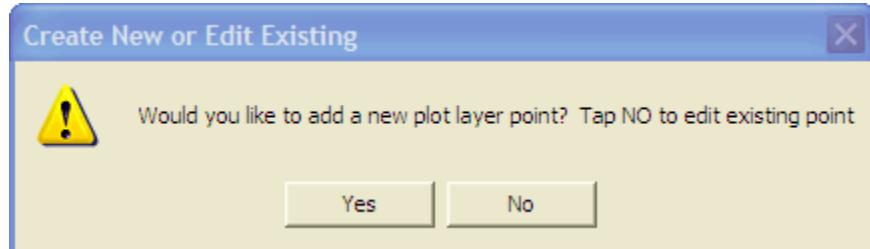
Note: As an alternative, you can navigate to the selected destination by staying on the map display. As you travel, follow the movement of the GPS cursor and zoom in on the map relative to your destination. The cross-hairs show your current location, and the red pointer around the cross-hairs show the direction in which you are moving.

Collecting Plot Installation Data

Stand at the location you wish to collect GPS data for.

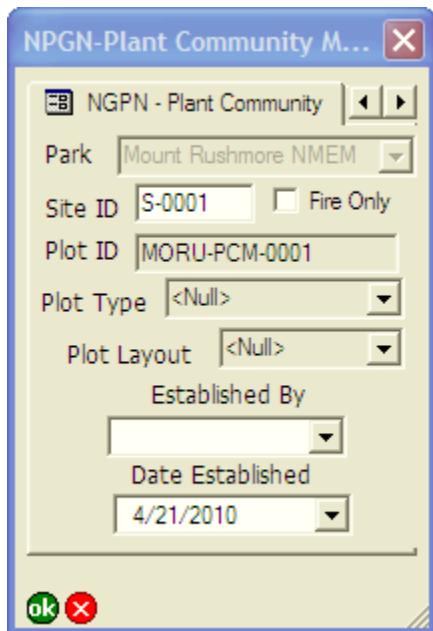
- Tap the Collect Plot Layout Point button . Do not do this before you are at the point you're collecting data for, since averaging starts when you tap this button. (GPS units are configured to average 30 positions per location.)
- Tap the Yes button to collect a new plot point and to display the data entry form. Note: There is a 10-20 second delay for the form to pop-up after tapping the YES button.

Alternatively, tap the **No** button to edit the attributes of an existing plot point. See the “Editing Feature Attributes” section at the end of this SOP for instructions on editing an existing point.



- Complete the NGPN – Plant Community page (Page 1 of data form) by inputting text using the soft input panel (soft input panel is activated by tapping the icon or by

using the arrow-up to select keyboard) and selecting values from the drop-down menus. This page must be completed for all plot layout point types.



Park – Auto-populates based on Select Park form

Site ID – Enter four characters after “S” (e.g., S-0001)

Fire Only – Tap if Fire Effects Only Plot; this modifies the Plot ID name

Plot ID – Auto-populates using Site ID and Fire Only inputs

Plot Type – Select Intensive, Extensive, or Dual

Plot Layout – Choose which point you are capturing: Plot Center, A0, A50, B0, B50, T2F, T2B, T1B, T1F

Established By – Select the field crew lead

Date Established – This should be correct, but make sure.

Note: Do not tap the “OK” button until all data for this point are filled in. Use the tabs at the bottom of the screen or arrows near the bottom right corner of the screen to navigate to the next page as necessary. (Tabs/arrows are shown at the top of the screen in this screen shot are on the bottom on the GPS unit.)

Collecting General Waypoint Data

General waypoints are used to GPS locations that are not part of the normal SOP. Examples include good parking locations for a given plot, good access points for scaling a steep hill or crossing a river, and notable objects/species found while traveling to/from a plot.

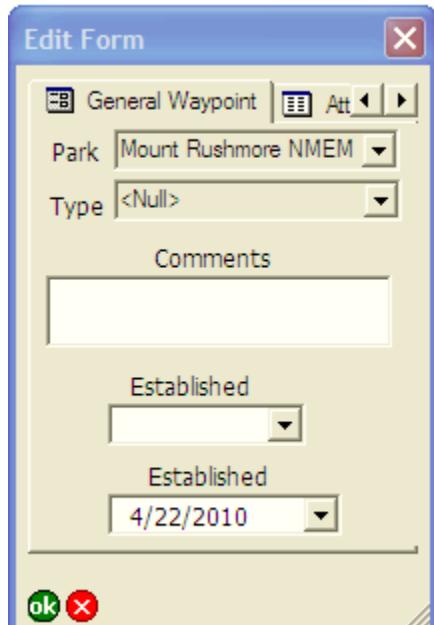
Stand at the location you wish to capture with the GPS.

- A. Tap the Collect General Waypoint button . Do not do this before you are at the point you’re collecting data for, since averaging starts when you tap this button. (GPS units are configured to average 30 positions per location.)
- B. Tap the YES button to collect a new waypoint, display the form, and capture an averaged GPS location (GPS units are configured to average 30 positions per location). **Note: There is a 10-20 second delay for the form to pop-up after tapping the YES button.**



Alternatively, tap the **No** button to edit the attributes of an existing plot point. See the “Editing Feature Attributes” section at the end of this SOP for instructions on editing an existing point.

C. Complete the **General Waypoint** page by inputting text and selecting values from the drop-down menus.



Park – Auto-populates based on **Select Park** form

Type – Choose the appropriate type

Comments – Type in descriptive comments

Established By – Choose the name of the Field Crew Lead

Date Established – This should be the current date. Make sure it is correct.

D. Tap the OK button to save the data.

Editing Feature Attributes

A. Depending on what type of feature attributes you need to edit, tap the **Collect General Waypoint** or **Collect Plot Layout Point** button. Tap the **NO** button to make the layer of interest editable.

- B. Select the feature of interest by tapping the **Find** button  to query the feature, or tap the **Advanced Select** button  and drag a box to select the feature you want to edit, or tap the **Select Feature** button  and tap the feature on the map.
- C. Regardless of what method used to select the feature of interest, you will need to tap the **Feature Properties** button  to display the edit form and edit the attributes. The **Feature Properties** button can be found inside the resulting **Find** or **Advanced Select** window. Alternatively, once the feature is selected then tap the drop-down arrow next to the **Find** button and tap the **Feature Properties** button.

You may occasionally goof up and want to get rid of a point you know was collected incorrectly. In order to prevent accidental deletion of data in the field, deleting points is not an option. However, you can collect and store more than one point (feature) with the same name and attributes. Make a note in the plot folder about which point is correct. After returning to the office and downloading the data, work with the Data Management team to look at the position, quality, number of satellites, and time stamp of a feature, as well as notes in the GPS data or on paper data sheets to select the appropriate feature to keep.

Downloading files from GPS to workstation

Ideally, GPS data will be downloaded to a computer (field laptop or desktop) at the end of each day in which GPS data are collected. At the very least, new data should be downloaded at the end of each tour. To do this, the GPS data are copied from the GPS unit to a computer using Microsoft ActiveSync software (instructions available on the Network server). Upon return to the office, these data are then transferred to the appropriate server folder for data verification, validation, and geodatabase updates. See SOP Data Management for details on verification and validation.

SOP Site Evaluation

Version 1.01

Prev. Version	Revision Date	Revised by	Changes Made	Reasons for Change	New Version
1.00	11/11	LEB	Edit/Clarify		1.01

This standard operating procedure (SOP) describes the process for evaluating sites generated by the GRTS draw for plot establishment. Two forms, PCM-1 “Site Evaluation Checklist” and PCM-3 “Photographic Record Sheet”, are filled out for this SOP. The default method is to fill PCM-1 out using the GPS form, if that is done, the paper copy is not needed.

Equipment List

- Site list
- Park map(s) with site locations and land ownership shown
- Photographic record sheet (1/site)
- Site evaluation checklist (1/site)
- GPS unit
- Clip board, pencils, extra lead
- Compass
- Clinometer
- 50-m tape
- Rebar (1/site) for marking plot center
- Hammer – for hammering rebar into ground
- Straight rebar for making initial hole, if the center rebar is bent
- Labeled tags and wire
- Pliers
- Photo board
- Dry-erase marker
- Tripod with 5 m cord attached to top
- Digital camera (having a backup is a good idea)

Procedures

Technically, all sites that were not previously permanently rejected (i.e., dormant and active sites) are reevaluated every year in which they are scheduled for data collection. Thus, a site designated as dormant but in a panel that will be sampled in a given year should be reevaluated in that year. It is prudent and recommended that all effort be made to use remote methods to evaluate a dormant site that would require substantial (>30 minutes) travel time for field checking. For example, one of the main reasons an intensive or dual site would be designated as dormant would be that it was in a river. The most recent aerial photographs or satellite imagery

could be used to determine whether the river's course has changed enough that the plot might now be terrestrial. In another example, a site may have been designated dormant because it was on private land or was disrupted by a construction project. A call to the park contact could determine whether these conditions have changed. When there is a reasonable chance that a dormant site does now pass all rejection criteria (and this is usually the case if an extensive site was dormant for lack of trees), the plot should be visited in the field and the procedures described below followed. For active sites, the plot should be re-evaluated against rejection criteria at every visit, but PCM-1 is filled out and photographs taken only if the status changes.

If, upon reevaluation, an active site is permanently rejected or becomes dormant, the next eligible site in the overdraw list must be evaluated until a suitable (i.e., active) replacement is found. The appropriate plot type is then established and sampled as if it were the original plot (uses the sampling schedule of the one it replaces).

1. Order of site visits

Before you go into the field, one or two lists of potential sites will be generated – parks with a stratified sample have two lists, others have just one. Within each list, site locations are designated with one set (northing, easting, and zone) of UTM coordinates. In addition, each site is appointed as intensive primary (assigned to a panel) or intensive overdraw and, where appropriate, extensive primary or extensive overdraw.

The potential sites are listed in the order generated by the GRTS draw. Sites appointed as primary are those that can be visited in any order because the primary list contains the minimum number of sites that must be visited to attain the sample size needed. Thus, primary sites should be visited in whatever order is most efficient. If some rejects are expected, it will save time to visit and establish a center point at (if the plot wouldn't be rejected or dormant) the first few overdraw sites (denoted as "overdraw" in the site list) in this first round of visits. The number of overdraw sites included in the first round of site visits depends on how many rejects are expected.

If one or more primary sites are rejected or designated dormant, visit overdraw sites (all of the remaining potential sites) until you have designated the desired number of sites in each stratum and of each type (if the park has both intensive and extensive plots) as active. If just one site is needed to achieve this, the first overdraw site on the Site List that is acceptable must be the replacement. If more than one site is needed, select the number of additional sites needed from the overdraw list following the order generated by the GRTS draw; you can visit these sites in whatever order is most efficient. The process is repeated until the desired number of active sites is achieved. At the end of the process, if X is the largest Site ID number of an accepted site, all numbers $< X$ must be either accepted or rejected sites; none can be skipped because sites were visited out of order. Once the required number of sites has been accepted, use the Site List to assign the replacement sites to panels in the order in which they appear on the list (see example at the end of this document).

An example of the process appears in Figure 2. Criteria for rejecting sites and designating them as active or dormant are described in detail below.

Riparian Stratum						Upland Stratum							
SiteID	Intensive			Extensive			SiteID	Intensive			Extensive		
	Type/ Panel	Decision	Final Panel	Type	Decision	Final Panel		Type/ Panel	Decision	Final Panel	Type	Decision	Final Panel
Rip-001	1/1	active	1	1	active	1	Up-001	1/1	active	1	1	active	1
Rip-002	1/2	active	2	1	active	1	Up-002	1/1	active	1	1	active	1
Rip-003	1/3	active	3	1	active	1	Up-003	1/1	active	1	1	active	1
Rip-004	1/4	reject		1	reject		Up-004	1/2	active	2	1	active	1
Rip-005	1/5	active	5	1	dormant		Up-005	1/2	active	2	1	active	1
Rip-006	0	active	4	1	active	1	Up-006	1/2	reject		1	active	3
Rip-007	0			1	active	1	Up-007	1/3	active	3	1	active	3
Rip-008	0			1	active	1	Up-008	1/3	active	3	1	active	3
Rip-009	0			1	reject		Up-009	1/3	active	3	1	active	3
Rip-010	0			1	active	1	Up-010	1/4	dormant	4	1	active	4
Rip-011	0			1	active	1	Up-011	1/4	active	4	1	active	4
Rip-012	0			1	dormant		Up-012	1/4	active	4	1	active	4
Rip-013	0			1	dormant		Up-013	1/5	reject		1	active	5
Rip-014	0			1	active	1	Up-014	1/5	active	5	1	active	5
Rip-015	0			1	active	1	Up-015	1/5	active	5	0	active	2
Rip-016	0			1	active	1	Up-016	0	active	2	0	active	4
Rip-017	0			1	active	1	Up-017	0	active	4	0	reject	
Rip-018	0			1	dormant		Up-018	0	reject		0	active	5
Rip-019	0			1	active	1	Up-019	0	active	5			
Rip-020	0			1	active	1	Up-020	0					
Rip-021	0			0	active	1	Up-021	0					
Rip-022	0			0	active	1	Up-022	0					
Rip-023	0			0	active	1	Up-023	0					
Rip-024	0			0	dormant		Up-024	0					
Rip-025	0			0	reject		Up-025	0					
Rip-026	0			0	active		Up-026	0					
Rip-027	0			0	active		Up-027	0					
Rip-028	0			0	active		Up-028	0					
Rip-029	0			0			Up-029	0					
Rip-030	0			0			Up-030	0					
Rip-031	0			0			Up-031	0					
Rip-032	0			0			Up-032	0					
Rip-033	0			0			Up-033	0					
Rip-034	0			0			Up-034	0					

Figure 2. An illustration of the process used to reject GRTS primary plots and replace them with overdraws.

2. Get to the site

Some sites may be designated as dormant before you even go to the field because they are known to be on private property or, for extensive woody plots, are not currently targeted for sampling (See Appendix B of Symstad et al. 2012 for further details). Do *not* visit these sites.

For all others, navigate to site's coordinates using the map and the GPS unit (see SOP Using the GPS). These coordinates mark the center of the cell represented by the site. Check the estimated accuracy of the GPS unit (PDOP) to ensure your confidence in the location. To do this, tap on the GPS position window button ; the position window showing satellites, your current location, and the PDOP will pop up. A PDOP of 5 or less is acceptable for capturing new points; it may not be achievable in areas with a lot of interference from rock walls, on certain slopes etc. If you cannot get $PDOP \leq 5$, get as low as you can, but write extra instructions (distance and bearing from prominent tree, rock, etc.) for finding the plot center marker if the site is accepted.

3. Evaluate the site

Upon arrival at the site (or as close as possible), fill in the park, site ID, date, PDOP, and observers blanks on the Site Evaluation Checklist (PCM-1), or on the GPS unit in the Site Evaluation Form. Determine the type of evaluation and circle either field or office. The default evaluation type is “field”. Office evaluations occur prior to field work using spatial data such as imagery, vegetation maps, and property boundary information.

With a compass, determine the dominant aspect of the area encompassed by the 53.85 m x 53.85 m cell. To do this, imagine a heavy downpour – where would most of the rain flow? Subtract 90 from the compass direction of this dominant aspect. This is the azimuth along which the 50 m transects of an intensive plot and, where appropriate, Tree Transect 1 will be established. If there is no dominant aspect, choose a random azimuth (e.g., spin a compass bezel until another person says “stop”). If necessary, the plot may be rotated to fit the terrain (e.g., to avoid steep slopes). This should be done only to ensure safety or to prevent excessive damage to resources and only if the location would otherwise be accepted. If the plot is accepted as active, this azimuth is recorded on the Plot Evaluation Checklist. Write “random” next to the azimuth if it was determined at random.

Based on this azimuth, roughly estimate where sampling would occur in this site by measuring with the tape or pacing (Figure 3). Evaluate the sampling area against permanent rejection criteria first, then against the temporary rejection criteria, checking the “Yes” or “No” box for each criterion according to the full descriptions of the criteria (see below).

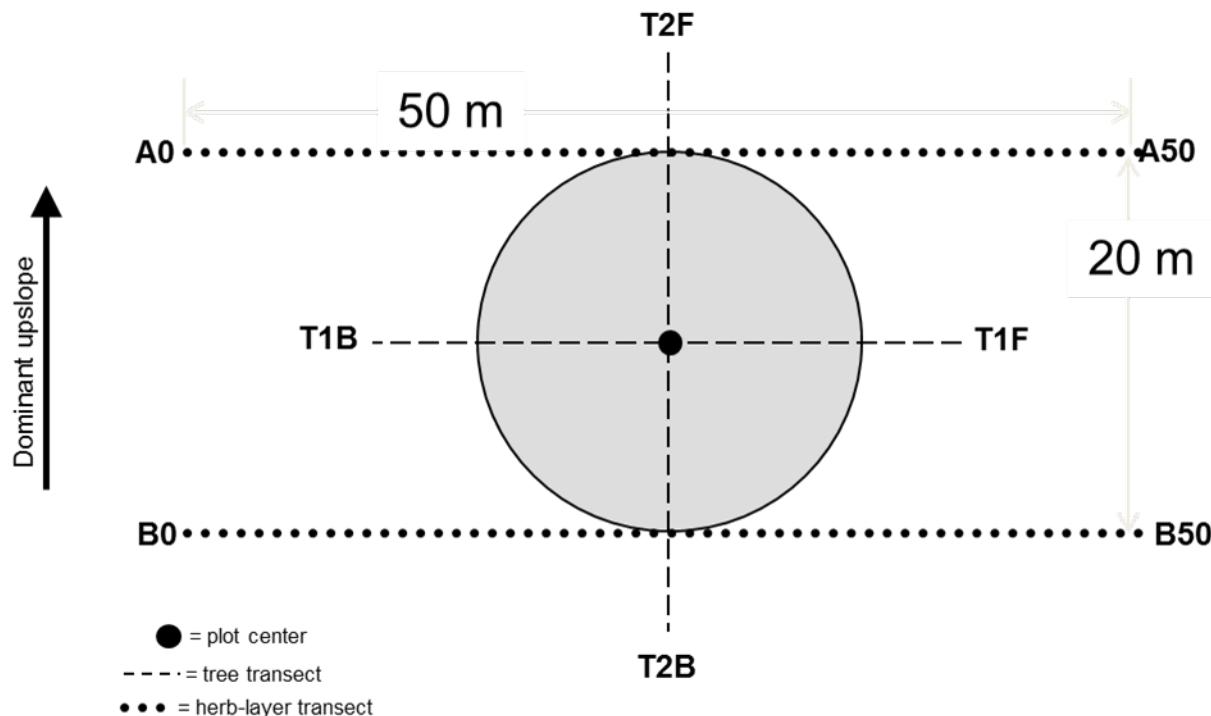


Figure 3. NGPN Plant community monitoring plot layout.

If **adjusting the center of the plot** will allow acceptance of a site that would otherwise be rejected or designated as dormant, this is allowable if both of the following conditions are met:

- the entire plot will still fall largely within the boundaries of the designated cell, and
- the adjustment does not move the plot into vegetation substantially different from the vegetation that would have been sampled in the original location.

To keep the plot entirely with the designated cell, the plot center shouldn't be shifted more than 17 m in any direction, assuming a grid size of 53 m and subplot of 10 m. If the center would have to be shifted more than 17 m to allow acceptance, the site should be rejected. If the location of the plot's center is adjusted, use the GPS unit to capture the location of the new center and record these coordinates on paper and on the GPS unit (see below).

Permanent Rejection Criteria (more than one may be checked “Yes”)

- **Out of park boundary:** The site coordinates are outside of the park administrative boundary (as designated by boundary markers on the ground), within the administrative boundary but in an area never to be acquired by the park (e.g., is within boundary only as a scenic easement), or so close to one of these boundary types that some part of the sampled area would fall within 10 m of the boundary when oriented according to the plot establishment rules.
- **Dangerous/prohibitively difficult to work on:** All sites with slope < 100% must be considered as potentially OK to work on, but good judgment must be used in deciding whether a site is too dangerous or difficult to work on and will be for the next 100 years. Examples of dangerous or difficult situations include loose substrate that would provide unsure footing, rock outcrops or tables (in badlands) in the working area (e.g., on transects) that are too tall for a single person to scale without equipment, or rattlesnake hibernacula.
- **Dangerous/prohibitively difficult to access:** This applies to the situation where a plot location may be workable, but the difficulty or danger in getting there prevents safe/timely access and this situation will remain for the next 100 years. Examples include sites that fall on a large table in a badlands area but have no good access route or require rock-climbing skills to access from all directions. Do NOT reject a site for this reason if it is only accessible by boat, as the river it's surrounded by may change course. In this case, use the corresponding temporary rejection criterion below.
- **More damage than good would come from working here:** Working in a plot would create long-term (>1 year) effects on/damage to the vegetation and/or substrate. One example is a steep hillside with little vegetation; walking on it causes the soil or substrate to slide or roll downhill to the extent that vegetation is disrupted. In borderline cases for this criterion, a site can be accepted under the condition that all sampling would be done down slope from a transect and that nested quadrats (in intensive plots) would be on the uphill side of a transect.

- **Road, improved trail, or utility corridor:** At least some portion of the plot would be on a designated driving track (paved or gravel road, or two-track), an improved (paved or gravel surface) trail, utility corridor, or in a regularly mowed right-of-way of any of these. Hiking trails that are not mowed are *not* rejected under this criterion, as the disturbance from these foot paths is usually less than or similar to that on “game” (and horse and bison) trails.
- **Will not support vegetation:** The site has no capacity to support vegetation with > 10% total cover now or in the next 100 years. This generally applies only in highly erodible badlands and at MORU, where large boulders and bedrock outcroppings provide little opportunity for vegetation growth.
- **Park says not to use this site:** Although every attempt was made to eliminate this type of area from the sampling frame before the GRTS draw, there will be instances where a park later decides that the plot should not be used for vegetation monitoring. Examples of this type of rejection include archaeological or paleontological sites.

Temporary Rejection Criteria (more than one may be checked “Yes”)

- **> 50% of either transect would be in water year-round:** > 50% of one herb-layer or tree transect, > 25% of the length of the two transects combined, or > 25% of the circular extensive woody plot would be in standing or flowing water year-round (i.e., there’s water there now and the water source is large/stable enough that it will only *not* be there in the most extreme drought conditions).
- **Currently on private land, but might not always be:** The site coordinates are outside of the boundary currently owned by the park (as designated by boundary markers on the ground), or so close to this boundary that some part of the plot or a transect would fall within 10 m of the boundary when oriented according to the plot establishment rules (Figure 3). The site could eventually become part of the park according to the land ownership map.
- **Currently dangerous/difficult to work on or access, but could change:** The site currently has dangerous or difficult working conditions or access as described above, but these conditions could change so that the site is acceptable in the next 100 years. For example, a site on an island in a river may become part of the mainland and not need boat access, or a severely burned site with multiple dangerous snags would eventually become safe after those snags have fallen.
- **Currently disrupted by temporary construction project; reveg expected:** Construction activities are currently occurring at the site, making it impossible to install a plot marker and be assured of its staying there. However, the construction is such that the site is expected to be revegetated, either actively (e.g., through planting) or passively (through natural succession).
- **Does not meet stratum definition:** The site is assigned to a stratum (upland or riparian lowland), but the site does not meet the definition of that stratum, >50% of one transect

(herb-layer or tree) would fall out of the stratum, or > 25% of an extensive woody plot would fall out of the stratum. The first of these conditions should occur only at THRO, where the stratum was defined by soil types in a GIS and errors in this definition (i.e., soil polygons do not accurately reflect ground conditions) are expected. At other parks, the riparian lowland stratum was defined on the ground. In these parks, the second two conditions may occur. Riparian sites should have little to no (< 10%) slope and be on an alluvial soil. Upland sites are everything outside of a riparian stratum defined specifically for plant community composition and structure monitoring on the park map.

- **No tree or tall shrub species and, in Black Hills Parks, no dead/downed woody fuels, within 38 m of site's center now and, if plot previously active, in last two visits (extensive plots only):** This site is to host only an extensive woody plot; no tree or tall shrub species* of any size occurs within 38 m[§] of the site's center coordinates; and, in Black Hills parks (DETO, JECA, MORU, WICA), no dead/downed ponderosa pine woody fuels occur within 38 m of the site's center coordinates. *If the plot was previously active* (i.e., there *were* tree or tall shrub species or woody fuels present), the plot is not designated as dormant until this rejection criterion is met for *three visits in a row*. On the third visit where there are no tree or tall shrub species or woody fuels present, the plot is designated as dormant.

*See SOP Trees and Shrubs for the list of tree and tall shrub species measured in extensive woody plots.

[§]The distance for evaluation is 38 m, which is larger than the grid cell, to ensure that plots with the potential for woody encroachment into the grid cell in the near future (because there is a tree or tall shrub nearby) are included in the active extensive woody sample.

If one or more permanent rejection criteria are checked “Yes”

- A. circle the “Reject” selection near the bottom of the Site Evaluation Checklist and write “reject” in the appropriate cell on the Site List;
- B. record notes on the Site Evaluation Checklist that will ensure similar sites will be evaluated the same way in the future;
- C. begin a Photographic Record Sheet (PCM-3) for the site (fill in the site ID at the top); and
- D. take photos using the digital camera following the instructions in Procedure 4 below.

If all permanent rejection criteria are checked “No”, but at least one temporary rejection criteria is checked “Yes”,

- A. circle the “Dormant” selection near the bottom of the Site Evaluation Checklist and write “dormant” in the appropriate cell on the Site List;
- B. record notes on the Site Evaluation Checklist that will ensure similar sites will be evaluated the same way in the future;

- C. record the site's assigned panel (according to the directions in the example in Figure 2) in the appropriate blank on the Checklist;
- D. begin a Photographic Record Sheet (PCM-3) for the plot (fill in the site ID at the top); and
- E. take photos using the digital camera following the instructions in Procedure 4 below.

If all permanent and temporary rejection criteria are checked “No”, circle the “Active” selection on the Site Evaluation Checklist and write “active” in the appropriate cell on the Site List;

- A. record the azimuth at which the 50 m transects of an intensive plot or Tree Transect 1 will be installed in the appropriate place at the top of the Site Evaluation Checklist;
- B. if appropriate, capture on the GPS and record GPS coordinates of the adjusted plot center in the “Notes” portion of the Site Evaluation Checklist and in the “Adjusted Center Coords” column on the Site List; also record your rationale for the adjustment in the “Notes” portion of the Site Evaluation Checklist;
- C. assign the site the appropriate plot ID (see below) and panel (according to the directions in Procedure 1; for overdraw sites, this cannot be done until after all sites before this one on the GRTS list have been evaluated) and record these in the appropriate blanks on the Site List and on the Site Evaluation Checklist form;
- D. record notes on the Site Evaluation Checklist regarding sampling requirements or any other special circumstances for this site (e.g., land-owner permission required to access site, sample only from down-slope side);
- E. pound a piece of rebar into the ground at the site's coordinates to mark the center of the plot and attach a tag with the appropriate plot ID to the rebar*;

* When in doubt, assume that rebar should be bent. It may be okay to use straight rebar at JECA, MORU and WICA. Use only bent rebar at BADL and THRO.

- F. begin a Photographic Record Sheet (PCM-3) for the plot (fill in the plot ID at the top); and
- G. take photos using the digital camera following the instructions in Procedure 4 below.

Assigning the proper Plot ID

As illustrated in the example in Figure 2, sites are given IDs by the GRTS draw according to their stratum and their order in the sample list. Record this in the “Site ID” blank at the top of the Site Evaluation Checklist. Plot IDs are assigned only to sites designated as active, as these are the only sites where plots are installed. Plot IDs are of the form PARK-PCM-xxx(x), where xxx(x) is the three- or four-digit number of the Site ID. For example, site S-010 at Devils Tower National Monument becomes DETO-PCM-010 when it is designated as active.

4. Photograph the site

There are three main goals of taking photos during site evaluation: (1) capture the essence of the site to aid in evaluating other sites consistently; (2) help future field crews locate the plot center marker; and (3) provide images of the park for future reference.

At most sites (those where the site's location point is accessible), this is accomplished by taking a set of photos that comprise a panoramic view from the site's location point.

- A. Set the camera on the tripod over the site's location point and adjust the height of the tripod so that the camera is at a comfortable level for taking photos (usually eye level).
- B. Label the photo board with the date (YEAR-MM-DD; e.g., 2009-05-24), the four letter park code, the site or plot ID, and the word "Panorama". If a site is designated as dormant or rejected, include this in the label on the photo board. Take a close-up photo of the photo board. (This helps bracket the photos on the camera.) Directions for using the camera are below.
- C. Change the "Panorama" portion of the photo board label to "Pan 1". Run a tape from the site's location point to 5 m away from this point in the direction of the azimuth determined for the transects. While one person stands at this point holding the photo board so that it is clearly visible, the other person takes a photo of them.
- D. Continue doing this, proceeding clockwise around the center about 52° for each photo, so that the entire panorama is captured, relabeling the photo board (from Pan 1 to Pan 7) as appropriate. Seven photographs are necessary and sufficient to capture the panorama.
- E. Record the appropriate information on the Photographic Record Sheet. (See "Recording information on the Photographic Record Sheet" below.)

If the site's location point is inaccessible, take one or more photos of the approximate target location from as close as possible. This photo should illustrate why the site was rejected. If appropriate, draw an arrow on the labeled photo board pointing to the approximate target location.

Using the Camera

These directions are for the Canon PowerShot SX110 IS cameras used by the NGPN, and they are limited to those actions needed to set the camera up for Plant Community Monitoring photography. The User Guide for the camera provided by the manufacturer gives detailed instructions for the use of the camera for other purposes.

Photos should generally be taken using the "AUTO" mode because in this mode the camera optimizes shutter speed for light levels and should result in clear photos. To use this mode, simply make sure the dial on the top of the camera is set so that the green "AUTO" indicator is lined up with the horizontal notch. When the camera is turned on, symbols indicating AUTO ISO and AUTO mode will appear for a few seconds in the upper left and right hand corners of the screen, respectively.

When you turn the camera on the first time each day, make sure that date and time are correct. To do this, press the “MENU” button in the bottom right corner of the back of the camera. Press the right side of the ring surrounding the “FUNC. SET” button so that the wrench and hammer symbol at the top of the screen is highlighted. The Date and Time are displayed at the bottom of the screen. The date should be in the “yyyy/mm/dd” (e.g., 2009.02.03) format. If any of these are incorrect, fix them:

Changing the Date/Time:

- Press the bottom of the ring surrounding the “FUNC SET” button (on the back of the camera) until the date/time is highlighted.
- Press FUNC SET.
- Press the left or right side of the ring around the FUNC SET button to navigate to the different items (month, day, year, hour, minute, format) and the top or bottom of the ring to change the value of the item highlighted.
- When all are correct, press FUNC SET to save the settings, then the MENU button to return to operating mode.

When first turning on the camera, also make sure the correct Recording Pixels icon (“M2” in the bottom left corner of the screen) and Compression Setting icon (■ immediately above the Recording Pixels icon) appear on the screen. If either of these are incorrect, change them as follows:

Changing the Recording Pixels:

- Press the “FUNC SET” button on the back of the camera.
- Press the top or bottom of the ring surrounding the FUNC SET button to select the icon in the bottom left corner of the screen.
- Press the right or left side of the ring surrounding the FUNC SET button to select the M2 Recording Pixels setting. This setting is appropriate for printing clear images to about letter-size paper (8.5 x 11 inches).
- Press the FUNC SET button to save this setting.

Changing the Compression:

- Press the “FUNC SET” button on the back of the camera.
- Press the top or bottom of the ring surrounding the FUNC SET button to select the icon second from the bottom, on the left edge of the screen.
- Press the right or left side of the ring surrounding the FUNC SET button to select the ■ (fine) compression setting.
- Press the FUNC SET button to save this setting.

Finally, make sure that the optical zoom feature is set for wide angle, rather than telephoto or any points in between. To do this, rotate the optical zoom lever (on top of the camera surrounding the round silver shutter button) all the way left towards the forest icon.

After all settings are correct, stand at the photo starting point and aim the camera so that the image in the camera's screen is centered on the center of the photo board. Press the round, silver shutter button on the top of the camera half-way down and ensure that the photo board is in focus in the center of the screen. A green rectangle in the center of the screen is the focus point. If a green light appears next to the screen, you are good to go; press the shutter button all the way down to take the photo. If a red light flashes next to the screen and flashing red icons appear on the screen, you do not have enough light and you need to raise the flash. Do this (lift the flash on the top of the camera), refocus, and take the photo. Press the  button on the back of the camera to review the photo, making sure it is centered and focused correctly. If it isn't, try again. When a satisfactory photo of that point is obtained, delete any defective photos, then record the information about the photo on the Photographic Record Sheet for the site/plot.

Recording information on the Photographic Record Sheet

All photos taken at a site or in a plot are recorded on that site's/plot's Photographic Record Sheet (PCM-3). This includes photos taken when establishing the plot, collecting data upon revisit, and documenting an unidentifiable specimen (SOP Unknown Plants).

Information to be recorded on the photographic record sheet is as follows:

Date: Record the date that the photograph was taken.

Photo Purpose: Briefly state the purpose of the photo (e.g., Site Eval Panorama, transect photo, interesting species, unidentifiable specimen).

Photo Name: Record the name of the photograph as shown on the photo board (e.g., Pan 1).

Photo #: Record the number assigned to the photo by the camera. This can be seen in the "review" mode on the camera. Press the  button, then the "DISP." button on the bottom of the back of the camera. The photo number is near the upper right-hand corner and is of the form "100-0001". Record this whole number.

File Name: This field is filled in when the photographs are downloaded from the camera to a computer. At this point, the photo numbers assigned by the camera (e.g., 100-0001) are turned into a file name (e.g., 100-0001.jpg). Record this file name.

Notes: If necessary and useful, record GPS coordinates of the photo location. In addition, record anything unusual about the photo, such as if a flash was used, a branch was held out of the way to get a clear view, etc.

You're done with this site. Go back to Procedure 1 and go to the next site.

5. At the end of each day and the when site evaluation is complete for a park

At the end of each day:

- If at all possible, download the photos taken that day to a computer as backup. Leaving the photos on the memory card rather than deleting them will ensure that there are no duplicate photo numbers.
- Check that the same information is filled in on both the Site List and the Site Evaluation Checklist for each site visited that day. Ensure that Photographic Record Sheets are completely filled out as appropriate. **It is important to validate the data at the plot. All changes made to datasheets after leaving the plot will need to be done in red ink, initialed, and dated.**
- If a photocopier or scanner is available, photocopy or scan completed data sheets.

When site evaluation is complete for a park (or incrementally as work is completed):

- Download all photos onto the NGPN server into the appropriate directory (N:\Groups\Monitoring\Plant_Community\PARK\IMAGES\Originals\, where “PARK” is the park’s four-letter code).
- Update the following fields in the attribute table of the GIS file containing all points drawn in the GRTS draw for this park. (NOTE: *This may be a slightly different file than the points file loaded on the GPS unit used in the field. Sometimes the number of points is reduced for the field file. Check with the data manager to ensure information is entered into the correct file.*)
 - EVALSTATUS is filled with “Active”, “Dormant” or “Reject”.
 - EVALREASON is filled with the number code(s) of the rejection criteria checked on the Site Evaluation Checklist. Separate numbers with a comma and a space.
 - PLOTID is filled with the Plot ID (e.g., SCBL-PCM-006) assigned when a plot is designated as active.
 - ADJCTRCRD is used to temporarily record the UTM coordinates of a new location when the center point is adjusted in the field.
 - FIELDFLAG is used when the site has special circumstances, such as when all sampling must be done down slope from a transect and nested frames must be on the uphill side of a transect.
 - AZIMUTH is the azimuth for herb-layer transects or Tree Transect 1.

For sites with adjusted center coordinates, use GIS to edit the location of the appropriate point. This should be done by/under supervision of an experienced GIS-user. Simply changing the values in the “XCOORD” and “YCOORD” fields does *not* adjust the location of the site in the GIS files. After the location is adjusted, enter the new coordinates in the XCOORD and YCOORD fields and put the original coordinates in the ADJCTRCRD field as “Original Coords: XXXXXX, YYYYYYYY” (using numbers instead of X and Y).

Scan all datasheets, file the original data sheets, and store the scan files in the appropriate locations on the server.

SOP Plot Establishment: *Establishing and Marking Active Plots*

Version 1.01

Prev. Version #	Revision Date	Revised by	Changes Made	Reasons for Change	New Version #
1.00	11/11	LEB	Edit/clarify		1.01

This standard operating procedure (SOP) gives step-by-step instructions for establishing and marking plant community composition and structure monitoring plots that pass all rejection criteria and are therefore actively monitored. The SOP describes the procedures for filling in Form PCM-2 “Plot Location and Description Data Sheet” and Form PCM-3 “Photographic Record Sheet”.

Equipment List

- Map of plot location in park
- GPS unit
- Clip board
- Pencils, extra lead
- Plot location and description data sheet
- Compass (2)
- Clinometer
- Rebar: (4 for each intensive or dual site)
- Large nails and washers (12 each for each intensive or dual plot with fuel lines; 8 each for each intensive or dual plot without fuel lines; 4 each for each extensive plot)
- Hammer (preferably 2) – for hammering markers into ground and stamping dates
- Labeled tags and wire
- Pliers
- 50-m tapes (2)
- 30-m tapes (3)
- Photographic record sheet
- Photo board
- Photo board stand
- Dry-erase markers
- Digital camera
- Steel dies for marking dates on tags
- Laser range finder

Procedures

Text in italics describes how to fill in blanks on the Plot Location and Description Data Sheet (PCM-2) for procedures 1-3 and on the Photographic Record Sheet (PCM-3).

1. Get to the plot

Before going in the field, fill in the following sections of PCM-2 with information collected during the Site Evaluation process (SOP Site Evaluation): Park Code, Plot ID, Plot Type (circle appropriate selection), all fields in the Plot Location section, and Azimuth of herb-layer transects and/or Tree Transect 1. When no information for the description of where to start and how to get there exists, it means that no special instructions are needed. (However, if you do not agree with this assessment after your trip to the plot, go ahead and fill in these sections at that time.) Use the starting point and route descriptions on the data sheet or whatever else is reasonable to navigate to the coordinates on the data sheet with the GPS unit (see SOP Using the GPS). These coordinates mark the center of the plot, which is marked with a piece of rebar tagged with the plot name and the letter “C” for center (Figure 4).

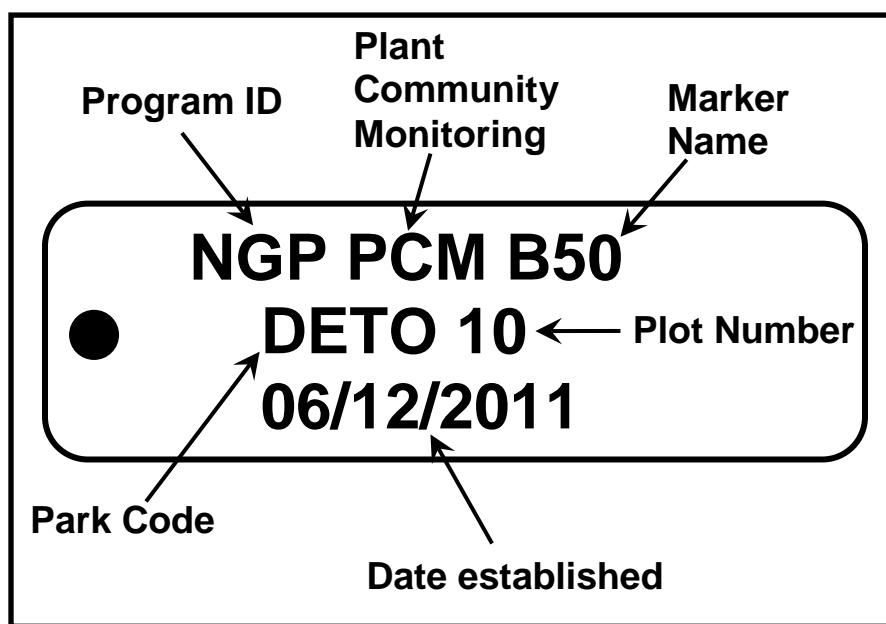


Figure 4. Example tag for plot markers.

When you arrive at the center point, use the GPS to capture the UTM coordinates of the center point according to SOP Using the GPS, *then record these coordinates, the elevation (in meters, to the nearest meter) and the PDOP of the captured data from the attribute table on the GPS unit on the data sheet. Record today's date and the initials of people establishing the plot at the top of the data sheet in the plot location section.*

2. Mark transects for sampling

All plots are marked with the center marker, but you will not establish both types of transects in all plots. The flow chart in Figure 5 summarizes which transects/lines are appropriate for different situations. Detailed instructions for deciding what to install and how to install it follow.

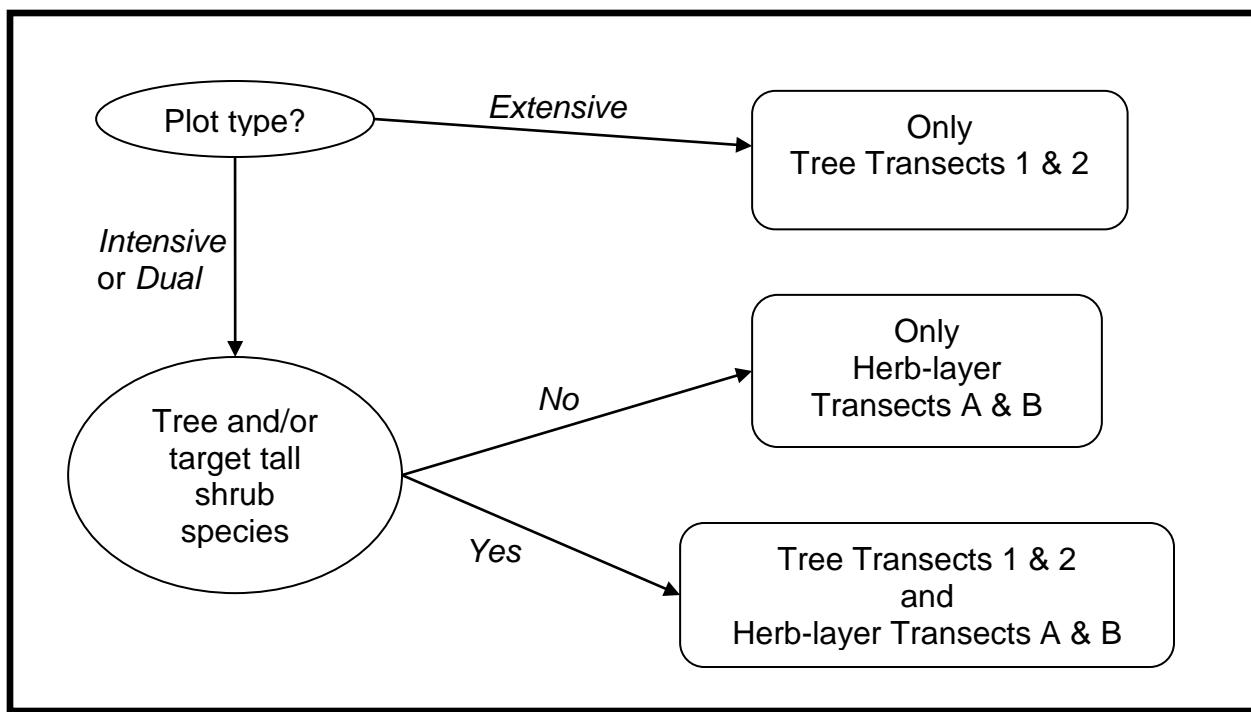


Figure 5. Flow chart for determining which transects and markers to install at a plot.

A. Where applicable, establish tree transects.

If this is an extensive plot, two perpendicular transects are established for measuring tree density and, where applicable, fuel loads. If this is an intensive plot and any tree or tall shrub species (see list in Table 2), no matter what size, occurs within 38 m of the plot's center point, these transects are established; in this case, if the plot is in an extensive woody sampling frame, the plot type is "Dual".

The azimuth of Tree Transect 1 was determined during the site evaluation process and is recorded on the PCM-2 data sheet for this plot. The beginning of the tree transect is determined by the dominant slope of the plot: when facing **up** this dominant slope, the beginning of Tree Transect 1 (T1B) is on the left (Figure 6). If there is no dominant slope, use the azimuth which was randomly determined and previously recorded as such on the site evaluation sheet. Use a 50 m tape to measure a 30.48 m (100 ft) straight line along the azimuth, centered at the plot's center. (The center post should be at 15.24 m.) If the transect azimuth goes directly through a rock or stump, in most cases you can run the tape up and over it. If the obstruction is a tree, go around it and pick up the correct azimuth on the other side. *Be sure to note the obstacles on the drawing of the plot on the data sheet.* At each end of this transect, insert a large nail through the center of the washer with the appropriate label (T1B or T1F) and pound the nail into the ground so that the top of the nail protrudes < 2.5 cm (1 inch) above the ground's surface. The "T1B" (for Tree 1 Beginning) washer goes with the nail at the start end. **Distances for transects are not corrected for slope and should be measured by following the surface of the ground; for example, do not pull a tape tight across a ravine.** *Capture the UTM coordinates of the transect ends and plot center on the GPS unit according to SOP Using the GPS, then record the captured coordinates and PDOP in the appropriate cells in Table 1 on the data sheet.*

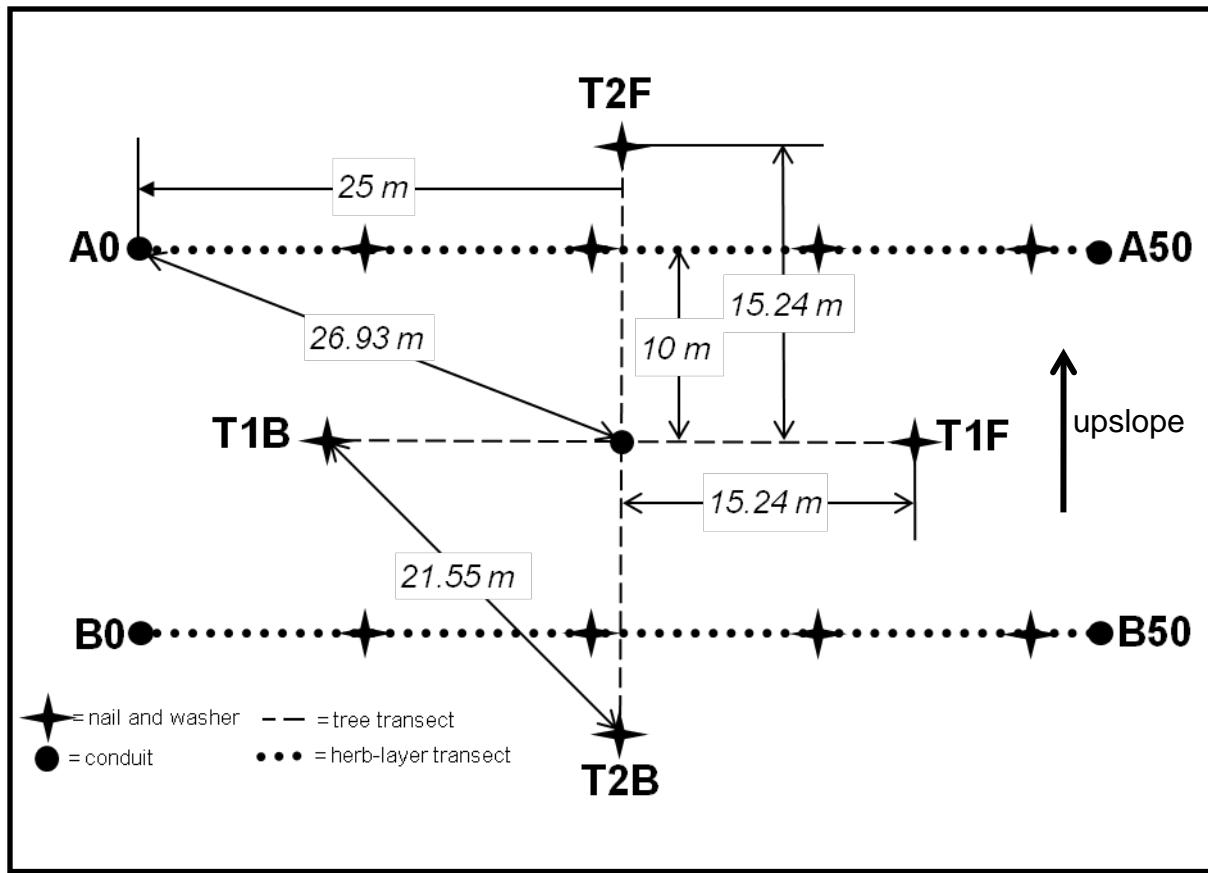


Figure 6. Plot layout, including transect marker names and types and distances useful when establishing the plot.

Table 2. Tree and tall shrub species in NGPN parks that qualify a plot for establishing tree transects¹.

<i>Acer negundo</i>	<i>Malus pumila</i>	<i>Salix bebbiana</i>
<i>Amelanchier alnifolia</i>	<i>Ostrya virginiana</i>	<i>Salix eriocephala</i>
<i>Amelanchier humilis</i>	<i>Picea glauca</i>	<i>Salix exigua</i>
<i>Betula occidentalis</i>	<i>Picea pungens</i>	<i>Salix fragilis</i>
<i>Betula papyrifera</i>	<i>Pinus ponderosa</i>	<i>Salix lucida</i>
<i>Celtis occidentalis</i>	<i>Populus alba</i>	<i>Salix lutea</i>
<i>Crataegus chrysocarpa</i>	<i>Populus angustifolia</i>	<i>Sambucus nigra ssp. canadensis</i>
<i>Crataegus douglasii</i>	<i>Populus balsamifera</i>	<i>Shepherdia argentea</i>
<i>Crataegus succulenta</i>	<i>Populus deltoides</i>	<i>Sorbus scopulina</i>
<i>Elaeagnus angustifolia</i>	<i>Populus tremuloides</i>	<i>Syringa vulgaris</i>
<i>Elaeagnus commutata</i>	<i>Prunus mexicana</i>	<i>Tamarix chinensis</i>
<i>Fraxinus pennsylvanica</i>	<i>Prunus pensylvanica</i>	<i>Tamarix ramosissima</i>
<i>Gleditsia triacanthos</i>	<i>Prunus virginiana</i>	<i>Ulmus americana</i>
<i>Juglans nigra</i>	<i>Quercus macrocarpa</i>	<i>Ulmus pumila</i>
<i>Juniperus scopulorum</i>	<i>Rhamnus cathartica</i>	<i>Ulmus rubra</i>
<i>Juniperus virginiana</i>	<i>Salix alba</i>	<i>Viburnum lentago</i>
<i>Malus ioensis var. ioensis</i>	<i>Salix amygdaloides</i>	

¹If you aren't sure if a woody species you found is actually on this list, it is better to install transects and not use them in the future than to have to install them when data are collected.

Measure and record the slope aspect of the plot. Aspect is the compass direction (0-359°) that the general slope of the plot faces. (For example, a slope with an eastern [90°] aspect faces the morning sun.) If grade < 5%, aspect = “NA”. In most cases, –plot aspect is 90° different from the azimuth of T1. If a transect crosses a canyon bottom or narrow ridge top, record the aspect of the canyon bottom or top of the ridgeline if the transect is centered on the canyon bottom or ridge top. Otherwise, record the aspect of the majority of the plot.

Measure the slope grade of Tree Transect 1 following the instructions below in section 2C.

Tree Transect 2 is established perpendicular to Tree Transect 1 (parallel to the dominant slope of the plot; Figure 6). To get the correct orientation, extend the 50 m tape 15.24 m from the center point in approximately the right direction (down the dominant slope). Use the 30 m tape to make the distance between the far end of this tape and T1B = 21.55 m, adjusting the location of the new (50 m) tape as necessary to achieve this. Do the same on the other side of the center to establish the other end of Tree Transect 2. Your line going through the center should be straight. Mark each end of Tree Transect 2 with a nail and the appropriately labeled washer (T2B or T2F) as you did for Tree Transect 1. The beginning of Tree Transect 2 is on the downslope side or, if there is no dominant slope, to the right when facing from beginning to finish of Tree Transect 1 (see diagram on data sheet); use the “Tree 2 Beginning” (T2B) washer at this end, and the T2F washer at the other end. Measure and record the slope grade of Tree Transect 2 using the method described in section 2C. *Capture the UTM coordinates of beginning and end of the transect on the GPS unit according to SOP Using the GPS, then record the **captured** coordinates and PDOP of the locations on the data sheet.*

Draw any obstacles (trees, rocks, etc.) to laying a straight transect and where the transect lies with respect to them in the appropriate location on the diagram on the data sheet. Also note on this diagram if a transect marker was placed in a non-standard location because of an obstacle. This ensures that future sampling is done in the same location as the original sampling.

B. If this is an intensive or dual plot, mark the ends of the cover/nested frames transects.

The paired herb-layer sampling transects are 50 m long, 20 m apart, and run parallel to each other and to the elevation contours. This azimuth was determined as part of the site evaluation process and is recorded on PCM-2 for the plot. If tree transects have been established in this plot, the herbaceous sampling transects are parallel to Tree Transect 1 (Figure 6). If there is no dominant slope and no tree transects have been established, randomly assign names (A vs. B) to the two transects.

Transect A, the upslope transect, is laid out and surveyed first. Use a 30 m tape to measure a distance of 10 m from the plot’s center up the dominant slope of the site (if tree transects have been established, this is towards T2F). Use a second 30 m tape to measure 26.93 m from the plot center in approximately the direction of A0 (see Figure 6). Finally, use a 50 m tape to make the distance between the far ends of the first two tapes equal 25 m. Pound a piece of rebar into the ground at the A0 point as for the center point, and attach the plot-appropriate, “A0” tag to this rebar. Note that when using bent rebar for a plot marker, it is easier to pound a straight piece of rebar into the appropriate location to get the appropriate hole, then remove the straight rebar and replace it with the curved. Repeat this process for the other three corners of the plot, checking that the distance between A0 and B0, and between A50 and B50, is 20 m before pounding in

corner markers. **Distances for transects are not corrected for slope and should be measured by following the surface of the ground; for example, do not pull a tape tight across a ravine.** In rough terrain, it is difficult to get a perfectly rectangular plot; just do the best that you can.

Capture the UTM coordinates of each nail/washer location on the GPS unit according to SOP Using the GPS, then record the captured coordinates and PDOP in the appropriate cell in Table 1 on the data sheet. Then, following the directions for measuring slope grade described in section 2C below, measure and record the slope grade for four vectors:

- $B0 \rightarrow A0$
- $B0 \rightarrow B50$
- $B50 \rightarrow A50$
- $A0 \rightarrow A50$.

Install a nail and washer at the following locations (indicated by four-pointed star on Figure 2) on each transect:

- 10.92 m
- 23.42 m
- 35.92 m
- 46.84 m.

If you cannot place a marker (rebar or nail/washer) in its standard location because of an obstacle (tree, rock, etc.), place it on the transect as close to the standard location as possible and *document its location on the plot diagram on PCM-2. Draw any obstacles (trees, rocks, etc.) to laying a straight transect and where the transect lies with respect to them in the appropriate location on the diagram on the data sheet.* This ensures that future sampling is done in the same location as the original sampling. Nests should still be read at 10.92 m, 23.42 m, etc., even if the nail, or corner stake, was moved to avoid an obstacle.

Before removing the tapes that delineate the herb-layer transects, photograph the plot following Procedure 4 (below).

C. Measuring the slope grade of a transect

1. Determine the change point in slope grade of the transect. This change point is where the change in slope grade is more than 5% (absolute value; e.g., slope grade goes from 35 to 40%). The person with the clinometer stands at this location. *Record this location [distance from the transect's beginning point ("0" or "B")], in meters, in column c of the appropriate row in Table 2 on the data sheet.*
2. The person with the clinometer faces the beginning point of the transect being read (e.g., T1B, A0).
3. Hold the clinometer so that the round side-window faces to the left.
4. Hold the clinometer up to one eye but keep both eyes open.
5. Aim the clinometer along the transect.
6. Fix the hair line of the clinometer on an object in your line of sight **at the same height as your eye level.** A person standing at the end of the transect indicating your eye height on themselves is an accurate way to do this.
7. Look into the viewing case, and read where the hair line intersects the **percent scale.** **(The percent scale ranges from -150 to 150; this is often on the right side of the scale,**

but make sure!) Record the absolute value (i.e., no negative sign) of this number in column **a** of the appropriate row in Table 2.

8. Repeat steps 2-7, but facing the finish end of the transect and recording the grade (%) in column **b** of the appropriate row in Table 2.
9. For reference, 100% slope is a 45° angle.

If there is no change point, (i.e., the grade is consistent along the transect), measure the slope as in steps 3-7 from the beginning point to the end point and *place a “0” in column **c** for the appropriate row, and enter the single grade value in both columns **a** and **b** for this row.*

If the slope grade and aspect vary enough within the length of the transect that these measurements do not make sense, *simply write “variable” in the cells for the appropriate row in Table 2.*

3. Describe the plot.

Circle the appropriate descriptors of the plot’s location under “Plot Description” on the PCM-2 data sheet using the following guidelines:

Topographic position/features: (*Circle the one position prevalent in the plot.*)

- level = no slope
- lower-slope = gently inclined surface at the base of a slope
- mid-slope = intermediate slope position
- upper-slope = the uppermost inclined surface at the top of a slope, typically convex in profile
- crest = top of a ridge, hill or mountain; the elevated area between two drainage-ways that sheds water
- drainage = bottom of draw (small valley) at intersection of two slopes, but also inclined in direction perpendicular to aspects of intersecting slopes (i.e., not necessarily gently inclined); typically vegetated
- streambed = bed of single or braided watercourse, typically barren and formed of modern alluvium
- rock outcrop = exposed bedrock larger than 1 m², often protruding above level of surrounding ground

Surface water: (*Use a laser range finder to determine distance.*)

in plot = standing or running water present within the plot

- < 50 m = less than 50 meters from any edge of the plot to standing or running water
- > 50 m = greater than 50 meters from any edge of the plot to standing or running water

Hydrologic regime: (*Circle the regime that is most prevalent.*)

- permanently flooded = water covers the surface at all times of the year in all years
- semi-permanently flooded = surface water persists throughout the growing season in most years; land surface is generally saturated when the water level drops below the surface

- temporarily flooded = surface water is present for a portion of each year or in periods of increased precipitation, but at other times the land surface is dry; this includes intermittent streams
- seep = intermittent, seasonal, or permanent flow of water from a subterranean source that is generally confined to a relatively discrete area
- upland = the plot cannot be characterized as a wetland as it either sheds or absorbs water quickly; the water table is almost always well below the soil surface

Vegetation type: (Circle the one type that best describes the majority of the plot and its immediate surroundings.)

- upland grassland = hydrologic regime is upland, grasses are dominant, < 10% tree canopy cover and < 20% shrub aerial (i.e., not basal) cover
- badlands sparse = vegetation is sparse (< 25% cover); comprised of eroding cliffs, mounds, haystacks, fans, drainages, and flats formed from mudstone, claystone, siltstone, scoria and some sandstone; occurs at AGFO, BADL, SCBL, and THRO
- shrubland = shrub aerial cover > 20%
- herbaceous riparian = vegetation influenced by flowing water; vegetation cover > 25%, primarily herbaceous, with < 10% tree or shrub aerial cover
- riparian woodland = tree canopy cover > 10%, trees mostly deciduous, located within floodplain/riparian area
- ponderosa pine woodland/forest = ponderosa pine canopy cover > 10%
- woody draw = moderately to steeply sloped valleys (draws) with > 10% (usually > 25%) tree canopy cover

Record any notes about the plot that help clarify anything about the plot's setting or setup that is not captured elsewhere on this datasheet or in the Site Disturbance Assessment (PCM-11).

4. Photograph the plot (Photographic Record Sheet PCM-3)

After all appropriate transects are established, but while the tapes that delineate transects are still in place, photograph the plot in the following manner.

A. Standard photo locations

Depending on the type of plot, four or eight standard photos are taken. In extensive plots, standard photos are taken along the two tree transects. In intensive and dual plots, standard photos are taken along the two herb-layer transects and along the two tree transects if the latter are installed. All standard photos are taken while standing at one transect marker and are centered on the opposite end of that transect. The photo board is placed on a tripod on the transect 5 m from the photographer.

B. Label and place the photo board.

The photo board is a white, 11" x 14" dry-erase board. The label on this board is critical for accurate record-keeping of which photo is which, so make sure it is labeled clearly, with large letters, as follows:

Generic	Intensive Example	Extensive Example
Today's Date	2010-06-13	2013-09-05
Plot Name	DETO-PCM-010	DETO-PCM-044
Photo Name	A0 → A50	T1B → T1F

Names of standard transect photos are in the form: point at which the photographer is standing
→ opposite end of transect (direction of photo).

For extensive plots, the standard photos taken are:

- T1B → T1F
- T1F → T1B
- T2B → T2F
- T2F → T2B

For all intensive plots, the following photos are taken:

- A0 → A50
- A50 → A0
- B0 → B50
- B50 → B0

For intensive plots in which tree transects are installed (including dual plots), both above sets of photos are taken, for a total of 8 standard photos.

C. Take the standard photographs.

Standard photo locations ensure consistency in photos among plots and within plots across sample dates, but just as important are standard camera settings, and where possible, standard cameras. These directions are for the Canon PowerShot SX110 IS cameras used by the NGPN, and they are limited to those actions needed to set the camera up for PCM photography. The User Guide for the camera provided by the manufacturer gives detailed instructions for the use of the camera for other purposes.

Photos should generally be taken using the “AUTO” mode, as in this mode the camera optimizes shutter speed for light levels and should result in clear photos. To use this mode, simply make sure the dial on the top of the camera is turned so that the green “AUTO” indicator is lined up with the horizontal notch. When the camera is turned on, symbols indicating AUTO ISO and AUTO mode will appear for a few seconds in the upper left and right hand corners of the screen, respectively.

When you turn the camera on the first time each day, make sure that date and time are correct. To do this, press the “MENU” button in the bottom right corner of the back of the camera. Press the right side of the ring surrounding the “FUNC. SET” button so that the wrench and hammer symbol at the top of the screen is highlighted. The Date and Time are displayed at the bottom of the screen. The date should be in the “yy/mm/dd” (e.g., 2009.02.03) format. If any of these are incorrect, fix them:

Changing the Date/Time:

- Press the bottom of the ring surrounding the “FUNC SET” button (on the back of the camera) until the date/time is highlighted.

- Press FUNC SET.
- Press the left or right side of the ring around the FUNC SET button to navigate to the different items (month, day, year, hour, minute, format) and the top or bottom of the ring to change the value of the item highlighted.
- When all are correct, press FUNC SET to save the settings, then the MENU button to return to operating mode.
- When first turning on the camera, also make sure the correct Recording Pixels icon (“M2” in the bottom left corner of the screen) and  Compression Setting icon (immediately above the Recording Pixels icon) appear on the screen. If either of these are incorrect, change them as follows:

Changing the Recording Pixels:

- Press the “FUNC SET” button on the back of the camera.
- Press the top or bottom of the ring surrounding the FUNC SET button to select the icon in the bottom left corner of the screen.
- Press the right or left side of the ring surrounding the FUNC SET button to select the M2 Recording Pixels setting. This setting is appropriate for printing clear images to about letter-size paper (8.5 x 11 inches).
- Press the FUNC SET button to save this setting.

Changing the Compression:

- Press the “FUNC SET” button on the back of the camera.
- Press the top or bottom of the ring surrounding the FUNC SET button to select the icon second from the bottom, on the left edge of the screen.
- Press the right or left side of the ring surrounding the FUNC SET button to select the  (fine) compression setting.
- Press the FUNC SET button to save this setting.

Finally, make sure that the optical zoom feature is set for wide angle, rather than telephoto or any points in between. To do this, rotate the optical zoom lever (on top of the camera surrounding the round silver shutter button) all the way left towards the forest icon.

After all settings are correct, stand at the photo starting point and aim the camera so that the image in the camera’s screen is centered on the center of the photo board. Press the round, silver shutter button on the top of the camera half-way down and ensure that the photo board is in focus in the center of the screen. A green rectangle in the center of the screen is the focus point. If a green light appears next to the screen, you are good to go; press the shutter button all the way down to take the photo. If a red light flashes next to the screen and flashing red icons appear on the screen, you do not have enough light and you need to raise the flash. Do this (lift the flash on the top of the camera), refocus, and take the photo. Press the  button on the back of the camera to review the photo, making sure it is centered and focused correctly. Use the “zoom in” function of the camera to make sure the photo board is legible. If it isn’t, try again, angling the photo board as necessary to reduce or eliminate glare. In some instances, the photo board must be placed in a non-standard location because of obstacles. If this is the case, note its location on



the photographic record sheet (PCM-3). When a satisfactory photo of that point is obtained, delete any defective photos, then go on to the next photo point.

D Record photo information on photographic record sheet.

A new photographic record sheet is used for each year in which the site/plot is visited. Information to be recorded on the photographic record sheet is as follows:

Date: *Record the date that the photograph was taken.*

Photo Purpose: *Record the photo purpose as “transect photo”.*

Photo Name: *Record the name of the photograph following the convention described above. See the next section for naming non-standard photographs.*

Photo #: *Record the number assigned to the photo by the camera. This can be seen in the “review” mode on the camera. Press the  button, then the “DISP.” button on the bottom of the back of the camera. The photo number is near the upper right-hand corner and is of the form “100-0001”. Record this whole number.*

File Name: This field is filled in when the photographs are downloaded from the camera to a computer. At this point, the photo numbers assigned by the camera (e.g., 100-0001) are turned into a file name (e.g., 100-0001.jpg). *Record this file name.*

Notes: Record anything unusual about the photo, such as if a flash was used, a branch was held out of the way to get a clear view, etc.

E. Take non-standard photographs (optional)

In some instances, additional photographs are necessary to fully capture the setting of the plot, to document unusual circumstances (e.g., a bison trail through the plot), or to aid future crews in relocating transect markers. If these photographs are taken, *record all the information as described for the standard photos above on the Photographic Record Sheet, but record a meaningful purpose of the photo (e.g., “plot overview”, “notable plot feature”, “marker location”), give the photo a meaningful name (e.g., “plot overview”, “bison trail on A transect”, or “A0 marker location”), and fully document how the photo was taken in the notes column (using additional rows on the data sheet as necessary).* This documentation must include:

- the point from which the photo was taken. If this is close to a marker, the distance and compass direction from the marker are sufficient; if it is more than 10 m from a marker, a GPS point plus a description of the location (distance and direction from some marker in the plot) helps with better relocation of the photo point.
- the direction in which the photo was taken. This can be a compass direction or a focus point (such as a transect end marker). Be sure that that focus point is permanent or can be relocated via directions from permanent plot markers – trees can disappear in five years.

5. When Data Collection Is Completed – VERY IMPORTANT!!!

When data collection is complete but before leaving the site, the crew lead is responsible for checking the GPS data on the GPS unit to make sure points are in the correct locations, the data sheet to ensure that all blanks are filled as appropriate, that entries are legible and make sense, that the completed data sheet is in the appropriate plot folder, and that the plot folder is in a backpack for transport. **It is important to validate the data at the plot. All changes made to datasheets after leaving the plot will need to be done in red ink, initialed, and dated.**

Another person is responsible for ensuring that all equipment is collected and ready for transport.

6. At the end of each day and park visit

At the end of each day:

- If at all possible, download the photos taken that day to a computer as backup. Leaving the photos on the memory card rather than deleting them will ensure that there are no duplicate photo numbers.
- Check that all information is filled in and legible on any data sheets used that day.
- If a scanner is available, scan completed data sheets.

At the end of a park visit:

- Download all photos onto the NGPN server into the appropriate directory (N:\Groups\Monitoring\Plant_Community\PARK\IMAGES\Originals\, where “PARK” is the park’s four-letter code).
- If not already done, scan all completed data sheets. File the original data sheets and store the scan files in the appropriate locations on the server.
- Communicate any notable finds (new species, invasive species, disturbances where not expected, etc.) to your park contact.

SOP Repeat Photography

Version 1.01

Prev. Version	Revision Date	Revised by	Changes Made	Reasons for Change	New Version
1.00	11/11	LEB	Edit/clarify		1.01

This standard operating procedure (SOP) gives step-by-step instructions for repeat photography at dormant and active plant community composition and structure monitoring plots. The SOP describes the procedures for filling in Form PCM-3 “Photographic Record Sheet”. This SOP assumes you are at the plot already.

Equipment List

- Clip board
- Pencils, extra lead
- Compass
- Photographic record sheet specific to plot
- Photo contact sheet specific to plot
- Photo board
- Photo board stand (tripod)
- Dry-erase markers (make sure to have at least two markers in case one is lost or dries out. Once a marker has dried out, don't leave it in the photo bag—throw it away!)
- Digital camera
- GPS receiver
- Extra batteries
- Back-up SD card
- 5-m long cord

Procedures

1. General photography instructions

A. Using the camera

These directions are for the Canon PowerShot SX110 IS cameras used by the NGPN, and they are limited to those actions needed to set the camera up for PCM photography. The User Guide for the camera provided by the manufacturer gives detailed instructions for the use of the camera for other purposes.

Photos should generally be taken using the “AUTO” mode, as in this mode the camera optimizes shutter speed for light levels and should result in clear photos. To use this mode, simply make

sure the dial on the top of the camera is set so that the green “AUTO” indicator is lined up with the horizontal notch. When the camera is turned on, symbols indicating AUTO ISO and AUTO mode will appear for a few seconds in the upper left and right hand corners of the screen, respectively.

When you turn the camera on the first time each day, make sure that date and time are correct. To do this, press the “MENU” button in the bottom right corner of the back of the camera. Press the right side of the ring surrounding the “FUNC SET” button so that the wrench and hammer symbol at the top of the screen is highlighted. The Date and Time are displayed at the bottom of the screen. The date should be in the “yy/mm/dd” (e.g., 2009.02.03) format. If any of these are incorrect, fix them:

Changing the Date/Time:

- Press the bottom of the ring surrounding the “FUNC SET” button (on the back of the camera) until the date/time is highlighted.
- Press FUNC SET.
- Press the left or right side of the ring around the FUNC SET button to navigate to the different items (month, day, year, hour, minute, format) and the top or bottom of the ring to change the value of the item highlighted.
- When all are correct, press FUNC SET to save the settings, then the MENU button to return to operating mode.
- When first turning on the camera, also make sure the correct Recording Pixels icon (“M2” in the bottom left corner of the screen) and  Compression Setting icon (immediately above the Recording Pixels icon) appear on the screen. If either of these are incorrect, change them as follows:

Changing the Recording Pixels:

- Press the “FUNC SET” button on the back of the camera.
- Press the top or bottom of the ring surrounding the FUNC SET button to select the icon in the bottom left corner of the screen.
- Press the right or left side of the ring surrounding the FUNC SET button to select the M2 Recording Pixels setting. This setting is appropriate for printing clear images to about letter-size paper (8.5 x 11 inches).
- Press the FUNC SET button to save this setting.

Changing the Compression:

- Press the “FUNC SET” button on the back of the camera.
- Press the top or bottom of the ring surrounding the FUNC SET button to select the icon second from the bottom, on the left edge of the screen.
- Press the right or left side of the ring surrounding the FUNC SET button to select the  (fine) compression setting.
- Press the FUNC SET button to save this setting.

Finally, make sure that the optical zoom feature is set for wide angle, rather than telephoto or any points in between. To do this, rotate the optical zoom lever (on top of the camera surrounding the round silver shutter button) all the way left towards the forest icon.

After all settings are correct, stand at the photo starting point and aim the camera so that the image in the camera's screen is centered on the desired location. Press the round, silver shutter button on the top of the camera half-way down and ensure that the photo board is in focus in the center of the screen. A green rectangle in the center of the screen is the focus point. If a green light appears next to the screen, you are good to go; press the shutter button all the way down to take the photo. If a red light flashes next to the screen and flashing red icons appear on the screen, you do not have enough light and you need to raise the flash. Do this (lift the flash on the top of the camera), refocus, and take the photo. Press the  button on the back of the camera to review the photo, making sure it is centered and focused correctly. Use the "zoom in" function of the camera to make sure the photo board is legible. If it isn't, try again, angling the photo board as necessary to reduce or eliminate glare. In some instances, the photo board must be placed in a non-standard location because of obstacles. If this is the case, note its location on the photographic record sheet (PCM-3). When a satisfactory photo of that point is obtained, delete any defective photos, then go on to the next photo point.

All standard plot photos should be taken with the camera in the standard orientation (i.e., the shutter button is up).

B. Labeling the photo board.

The photo board is a white, 11" x 14" dry-erase board that should appear in every standard photo (i.e., those on transects and from the plot center). The label on this board is critical for accurate record-keeping of photos, so make sure it is labeled clearly, with large letters, as follows:

Generic	Evaluation Example	Intensive Example	Extensive Example
Today's Date	2014-07-02	2010-06-13	2013-09-05
Plot Name	DETO S-031	DETO-PCM-010	DETO-PCM-044
Photo Name	Pan 1	A0 → A50	T1B → T1F

Names of transect photos are in the form:

point at which the photographer is standing → opposite end of transect (direction of photo).

2. *Photographing the site*

The goal of repeat photography is to document visually how a location or item changes (or stays the same) over time. Thus, care should be taken to replicate the original photo location, direction, and field of view as closely as possible. Consequently, if you find that previous photographers didn't take a standard photo in exactly the right place, it is more important to replicate that error rather than correct it and lose continuity of the photo record. In this situation, use the photo contact sheet (which shows all previous standard photos from the plot) to help make the determination of which direction/location/etc. will provide the greatest continuity.

A. Dormant plots

If a plot that was previously established as dormant still meets the dormant criteria (SOP Site Evaluation), consult the plot's photographic record sheet and photo contact sheet to determine the exact location of photos previously taken at this site and repeat them.

Standard dormant plot photos are a panorama:

- a. Set the camera on the tripod over the site's center point and adjust the height of the tripod so that the camera is at a comfortable level for taking photos (usually eye level).
- b. Label the photo board as described above, with "Pan 1" as your first label.
- c. Use the 5-m cord to go 5 m away from the center point in the direction of the first photo described on the photographic record sheet. While one person stands at this point holding the photo board so that it is clearly visible, the other person takes the photo centered on the cord.
- d. Continue doing this, proceeding clockwise around the center about 52° for each photo, so that the entire panorama is captured, relabeling the photo board (from Pan 1 to Pan 7) as appropriate. Seven photographs are necessary and sufficient to capture the panorama.
- e. *Record the appropriate information on the Photographic Record Sheet.* (See "Recording information on the Photographic Record Sheet" below.)

When standard photos were not taken (e.g., only those in cardinal directions, or not from the site's center point), take the repeat photos as described on the photographic record sheet and shown on the photo contact sheet.

If, upon revisit, a plot that was previously established as active must become dormant (e.g., because it is now in a river), exact replication of the previous photos may not be possible. Replicate as many photos as possible, then add new locations and orientations as necessary to document the reason for the plot's becoming dormant and to accurately capture the essence of the plot. Record the appropriate location on the photographic record sheet.

B. Active plots

Replicate previous standard photos as they are described on the photographic record sheet, recording the information for the new photos on the photographic record sheet. The standard locations and directions are as follows:

Depending on the type of plot, four or eight photos are taken. In extensive plots, photos are taken along the two tree transects. In intensive and dual plots, photos are taken along the two herb-layer transects and along the two tree transects if the latter are installed. All photos are taken while standing at one transect marker and are centered on the opposite end of that transect. The photo board is placed on a tripod on the transect 5 m from the photographer. When setting up the photo board, make sure that it is oriented so that glare does not make the writing on it invisible.

For extensive plots, or for dual plot visits in which only extensive data are being collected, the standard photos taken are:

- T1B → T1F
- T1F → T1B
- T2B → T2F
- T2F → T2B

For all intensive plots, the following photos are taken:

- A0 → A50
- A50 → A0
- B0 → B50
- B50 → B0

For intensive plots in which tree transects are installed (including dual plots), both above sets of photos are taken, for a total of 8 standard photos.

At some plots, non-standard photos may have been taken in the past. These were taken to fully capture the setting of the plot, to document unusual circumstances (e.g., a bison trail through the plot) or to aid future crews in relocating transect markers. When it makes sense, these photos should be replicated. Those that are most likely to be useful for documentation are plot overviews and those documenting unusual circumstances. New non-standard photos may also be taken, for the same reasons as stated above. If non-standard photos are taken, *record all the information as described for the standard photos below on the photographic record sheet, but record a meaningful purpose of the photo (e.g., “plot overview”, “notable plot feature”, “marker location”), give the photo a meaningful name (e.g., “plot overview”, “bison trail on A transect”, or “A0 marker location”), and fully document how the photo was taken in the notes column (using additional rows on the data sheet as necessary)*. This documentation must include:

- the point from which the photo was taken. If this is close to a marker, the distance and compass direction from the marker are sufficient; if it is more than 10 m from a marker, a GPS point plus a description of the location (distance and direction from some marker in the plot) helps with better relocation of the photo point.
- the direction in which the photo was taken. This can be a compass direction or a focus point (such as a transect end marker). Be sure that that focus point is permanent or can be relocated via directions from permanent plot markers – trees can disappear in five years.

3. Recording photo information on photographic record sheet.

All photos taken in or near a plot are recorded on that plot's photographic record sheet (PCM-3). This includes photos taken when establishing the plot, collecting data upon revisit, and documenting an unidentifiable specimen (SOP Unknown Plants). A new photographic record sheet is used for each year the site/plot is visited.

Information to be recorded on the photographic record sheet is as follows:

Date: *Record the date that the photograph was taken.*

Photo Purpose: *Record the photo purpose.* Examples: plot establishment transect, plot monitoring transect, dormant panorama, notable plot feature

Photo Name: *Record the name of the photograph following the conventions for standard and non-standard photos described in the previous section.*

Photo #: *Record the number assigned to the photo by the camera.* This can be seen in the “review” mode on the  camera. Press the  button, then the “DISP.” button on the bottom of the back of the camera. The photo number is near the upper right-hand corner and is of the form “100-0001”. *Record this whole number.*

File Name: This field is filled in when the photographs are downloaded from the camera to a computer. At this point, the photo numbers assigned by the camera (e.g., 100-0001) are turned into a file name (e.g., 100-0001.jpg). *Record this file name.*

Notes: *Record anything unusual about the photo, such as if a flash was used, a branch was held out of the way to get a clear view, etc.*

4. At the end of each day, park visit, and field season

At the end of each day:

If at all possible, download the photos taken that day to a computer as backup. Leaving the photos on the memory card rather than deleting them will ensure that there are no duplicate photo numbers.

Check that all information is filled in and legible on any photographic record sheets used that day. **It is important to validate the data at the plot. All changes made to datasheets after leaving the plot will need to be done in red ink, initialed, and dated.**

If a scanner or photocopier is available, scan or photocopy the record sheets.

At the end of a park visit:

- Download all photos onto the NGPN server into the appropriate directory (N:\Groups\Monitoring\Plant_Community\PARK\IMAGES\Originals\, where “PARK” is the park’s four-letter code).
- If not already done, scan all completed photo record sheets (see SOP Data Management). File the original data sheets and store the scans in the appropriate locations on the server according to the NGPN data management plan.

At the end of the field season:

- Use PowerPoint or some other friendly program to create and print labeled “contact sheets” of all the photos taken that year and place them in the appropriate plot folder. Print quality must be good enough that the photos can be used for relocating plot markers. An example of a contact sheet follows (grey text and arrows are for instruction purposes only).

Plot name

BADL-PILOT-04; 19 JUNE 2008

Date of photos

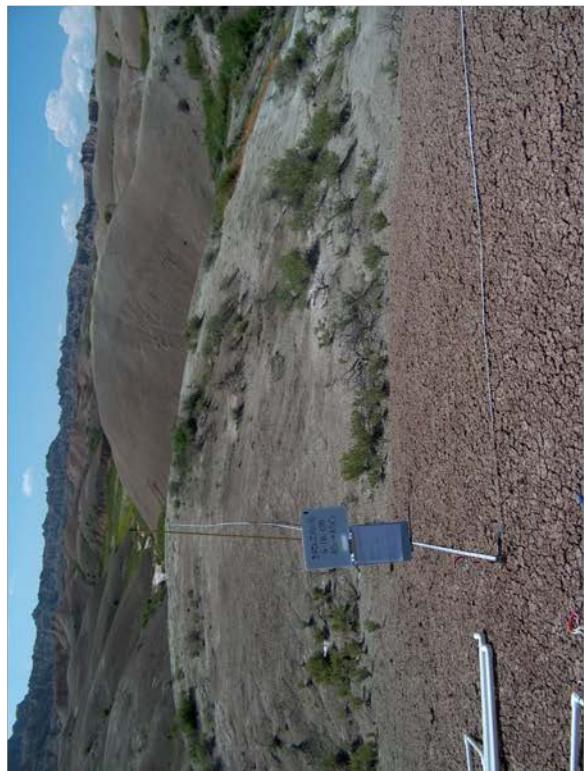


\rightarrow **B50 \rightarrow B0**

Photo name



\rightarrow **A0 \rightarrow B0**



\rightarrow **A0 \rightarrow A50**



\rightarrow **B0 \rightarrow B50**

SOP Plant Sampling: Measuring Cover and Frequency of Herb-Layer Plant Species Using Point-Intercept Sampling and Nested Quadrats

Version 1.01

Prev. Version	Revision Date	Revised by	Changes Made	Reasons for Change	New Version
1.00	10/17/11	DMJ			1.01
1.00	11/11	LEB	Change to nrps style		1.01

This standard operating procedure (SOP) gives step-by-step instructions for obtaining cover and frequency estimates of herbaceous and shrub species using the point-intercept method and nested square quadrats along transects. The SOP describes the procedures for filling in Forms PCM-4 “Point-Intercept Data Sheet” and PCM-5 “Nested Quadrats Data Sheet”.

Equipment List

- Magnetic locator/Metal detector
- Clip boards (2)
- Copy of Plot Location and Description Data Sheet (PCM-2) specific to plot
- Point-intercept data sheets (2)
- Nested quadrats data sheets (2)
- Species list by 10 m² quadrat specific to plot
- Pencils, extra pencil lead
- Sampling poles = ¼ inch diameter collapsible tent poles, marked in 1-cm increments (2)
- Quadrats (0.01 m², 0.1 m², 1 m², 2 sets)
- 50 meter tapes (2)
- 30 meter tapes (2)
- Chaining pins (12)
- Plant press or plastic bag with moist paper towel
- Unknown specimen forms
- Field guides and identification keys/books as needed
- Species list (with codes) for appropriate park

Before Going to the Field

Before going to the field, prepare data sheets for the plot. To do this, fill in the Park and Plot ID fields at the top of two Point-Intercept and two Nested Quadrat Data Sheets. In addition, consult the Site Evaluation files for special instructions for the plot, such as nested quadrats being placed on the upslope side of a transect. Write these instructions prominently on the appropriate data sheets.

Field Procedures

The procedures are done in this particular order:

1. Transects are laid out.
2. Sampling teams are assigned.
3. Point-intercept data are collected.
4. Nested frequency data are collected.

1. Laying out Transects

Each 20 m x 50 m monitoring plot includes two 50 m transects (A and B), which form the long edges of the plot. (See SOP Plot Establishment for information on establishing monitoring plots.) Each end of a transect is marked with a piece of rebar labeled with a metal tag containing pertinent plot and transect information. Each transect is also marked with large nails and washers sunk flush with the ground at 10.92 m, 23.42 m, 35.92 m, and 46.84 m from the 0 end of the transect.

Once all four corners of the sampling plot have been located, team members lay a 50 m tape along each transect. Attach the origin (0 m end) of the 50 m tape to the “0” end of the transect, and secure the tape in the correct position by inserting chaining pins into the ground at each nail/washer. Take care to make sure the distance on the tape matches the location of the nail/washer (e.g., the tape indicates 10.92 m at the nail closest to the 0 end of the transect). If there are obstacles (tree trunks, large rocks, etc.) along the transect line, check the Plot Location and Description Data Sheet for the plot to make sure the tape goes around/over these obstacles in the same path it has for previous sampling events.

All members of the sampling team assist in locating corner stakes and setting up transect lines. **Be careful to avoid trampling vegetation in the plot, especially on the transects and 3.5 m into the plot from the transects.** Walk around, not on, these areas as much as possible.

All transects have a “beginning” (0 m) end and a “finish” (50 m) end, which are indicated by the tags on the corner stakes. It is absolutely crucial that the sampling begin at the 0 end and that the team records the correct transect name (A or B) on the data sheet.

2. Sampling Teams

One sampling team, each consisting of a reader and a recorder, is assigned to a transect line and procures the necessary equipment and data sheets. The sampling team is responsible for the following: (1) collecting all of the required data; (2) collecting and describing any unknown plants encountered and relaying the information to the team leader before leaving the site; and (3) ensuring that their equipment, data sheets, and any unknown specimens are properly stowed before moving to the next site.

3. Collecting Point-Intercept Cover Data

Fill in the information on the top of the first page of the point-intercept data sheet (PCM-4) according to the following directions.

Park and Plot ID will already be filled in.

Transect: Circle A or B as appropriate. Check against the tag on the stake!

Reader/Recorder: The unique initials of the first, middle, and last name of each person in the team collecting data. If initials of two or more persons are the same, include some other distinguishing initial. Reader is the person collecting the data; recorder is the person recording the data.

Date: Include month / day / year (mm/dd/yyyy)

Points are located every 0.5 m, beginning at 0.3 m, from the 0 end of the transect. (If doing only 50 points per transect, points are located every 1.0 m, beginning at 0.3 m, from the 0 end of the transect.) At each appropriate point (as indicated on the data sheet), gently insert the pole to the ground, making sure that the pole is exactly on this point and on the side of the tape that is *inside* the plot. The pole should be *plumb* to the ground (going straight down as a dropped object would), which on a slope will *not* be perpendicular to the ground. Plumb placement exactly on the designated point is your goal to avoid bias in the cover measurements! Record the height (**to the nearest cm**) of the upper-most piece of *live* vegetation touching the pole. Then record the code for each species that touches the pole, starting with the upper-most hit and working down, on the data sheet in the appropriate row (point number) and column (hit number). Species codes are the plant symbols used by the USDA's national plants database (<http://plants.usda.gov/>) and consist of the first two letters of the genus and species, sometimes followed by additional numbers and/or letters (e.g., *Andropogon gerardii*'s code is ANGE; *Artemisia campestris* is ARCA12 and *Artemisia cana* is ARCA13); **if in doubt, refer to the list of codes for species in the park you're in.**

- Count each species only once at each point, even if the pole touches it more than once.
- Record only live vegetation. (See special situations below regarding senesced individuals.)
- If a species cannot be identified, record its presence with a unique “unknown” code (see SOP Unknown Plants) instead of a species code.
- If the pole fails to intercept any vegetation above ground level, put a dash “—“ in the “Height” and “Top Hit” columns for that point and move to the final column labeled “Ground”.

For the column labeled “Ground” at each of the marked points, record the substrate code (Table 1) of what the pole touches where it intersects the ground. A species code should be recorded only if the pole intersects a point at which the plant is rooted in the ground, as the goal of this measurement is to record basal cover (plant material holding soil in place) of plants vs. substrate cover. If the ground cover is the bole of a tree or shrub, the species code, followed by -BOL, is recorded. Exposed roots of trees are recorded as ROOT (see Table 3) instead of as their species code because these indicate erosion problems. ROCK, BEDROCK, WOOD, ROOT, and BARE are used *only* if they are *not* covered by any of the other ground cover categories, with BARE having higher priority than ROCK, BEDROCK, WOOD, or ROOT (i.e., if there's soil on top of any of these, record it as soil). If the bottom hit is a plant, use the code VEG; there is no need to identify species.

Table 3. Substrate codes for point-intercept sampling of ground cover.

Code	Description
-BOL	tree bole; indicate species of tree with species code (e.g., PIPO-BOL)
ROCK	rock >5 mm diameter (diameter of pole) with soil underneath
BEDROCK	rock with no soil underneath
LIT	litter: dead, non-woody material, including fallen leaves and needles of trees and shrubs
WOOD	dead wood (e.g., twigs, logs, stumps)
ROOT	live root with soil underneath
MOSS	moss
CRUST	biotic soil crust (mixture of lichens, mosses, algae, cyanobacteria)
VEG	live vegetation of any species
SCAT	animal droppings
BARE	bare soil unprotected by any of the above

Rules for special situations:

A leaf is considered alive (and therefore recorded as a hit) if there is live (green) tissue anywhere on that leaf or if it is all brown but obviously this year's growth. Similarly, interception with a mature fruit is recorded if the fruit was produced in the current growing season. The latter two cases are particularly relevant for mustards and annual brome grasses that mature early in the growing season. Gray herbaceous vegetation is almost always previous years' growth and should therefore not be recorded.

A branch is considered alive if there are any live leaves beyond the point at which it intersects with the pole, or if the cambium is alive (scratch a small portion of a twig; if it's green under the bark, it's alive).

Do not record foliage or branches of a woody species if the pole/vegetation interception height is > 2 m.

Do record herbaceous vegetation no matter what its height. In the very rare occasion that it is > 2 m tall, use a second pole above the first to determine interception and height.

Do record the species code of a woody species if the pole intercepts its foliage or branches at or below the 2 m mark.

If the bole (trunk) of a live tree or shrub that is over 2 m tall encompasses all hits at a point, place a dash in the "Height" column and record the species code followed by "-BOL" (e.g., PIPO-BOL) in the "Top Hit" and "Ground" columns. In FFI, BOLE is entered as the Ground hit then add species to comment section.

If the bole of a dead tree or shrub of any size encompasses all hits at a point, place a dash in the "Height" and "Top Hit" columns and record the ground cover as "WOOD".

If a tree or rock hangs over the transect (above 2 m) and there is vegetation underneath this overhanging object, record the vegetation and ground hit as usual, but do NOT include the overhanging object as one of the hits. When the overhanging object is too low to sample the underlying vegetation with the sampling pole without breaking or bending it, do your best to visualize a plumb line going through the overhanging object and record the vegetation and ground that would be hit by this line.

4. Collecting Nested Frequency Data

Fill in the information on the top of the first page of the nested quadrats data sheet (PCM-5) according to the following directions.

Park and Plot ID are already filled in.

Transect: Circle A or B as appropriate. Check against the tag on the stake!

Date: Include month / day / year (mm/dd/yyyy)

Observers: The unique initials of the first, middle, and last name of each person in the team collecting and recording data. If initials of two or more persons are the same, include some other distinguishing initial. Team members are not distinguished as reader and recorder for this procedure because both people generally contribute to species observations.

Nested Quadrat Locations and Setup

Sets of nested quadrats are named for their distance from the 0 end of the transect. The 1st set of nested quadrats (Set 1) is at the 0 end of the transect, the 5th set of nested quadrats (Set 5) is at the 50 m end, and the 2nd – 4th sets (Sets 2-4) are intermediate. All quadrats within a set are located so that they share the same “origin” corner (Figure 7, bottom), which is marked with a corner stake (Set 1) or nail/washer (Sets 2-5) (Figure 7, top). In the case that a stake or nail has been moved (e.g., due to rock), the “origin” corner should still be placed at the location along the transect at which the nail/stake should have been placed (e.g., 10.92 m, 23.42 m, etc.). These circumstances should have been noted on the plot establishment sheet. Quadrats of all sizes are oriented so that they lie inside the 20 m x 50 m plot, with one corner at the origin location and the adjacent edge on the transect tape running towards the 50 m end of the transect (see Figure 7).

PVC frames are used to delineate the 0.01 m², 0.1 m², and 1 m² quadrats. (See SOP Field Preparation for construction instructions.) The 10 m² quadrat is delineated with a 30 m tape and chaining pins with the following procedure:

1. Anchor the 0 end of the 30 m tape at the quadrat origin.
2. Run the 30 m tape out 3.16 m perpendicular to the transect. The 1 m² frame is useful in determining perpendicularity. Insert a chaining pin at the **3.16** m mark.
3. Now run the tape around this pin another 3.16 m (to the **6.32** m mark) perpendicular to the first segment and insert a second chaining pin. To check this corner for square, run the tape back to the origin, keeping it taut against the first two chaining pins. The tape

should read **10.79** m ($6.32\text{ m} + 3.16\text{ m} * 1.414$) at the origin. If it doesn't, adjust the location of the second chaining pin until both distances are correct (6.32 m and 10.79 m).

4. Finally, run the 30 m tape from the second chaining pin back to the transect so that it intersects the transect tape at 3.16 m more than the value at the origin. If all was done correctly, the 30 m tape should read 9.48 m. If it doesn't, check the perpendicularity of all corners and lengths of all sides. Use a third chaining pin to secure the tape in place when all distances are correct. At the end of a hot day in the field, it's sometimes hard to do arithmetic, so the important numbers are included at the top of the Nested Frequency Data Sheet.

Data Collection

Begin at the 0 end of the transect. Record the number of the quadrat set in the "SET" column of the data sheet. Possible values for this column are at the top of the data sheet.

At each quadrat set, begin with the 0.01 m^2 quadrat. Place the smallest quadrat frame so that two edges are on top of the tapes used to delineate the 10 m^2 quadrat, and the origin marker (center of nail or corner stake) is at the **inside** corner of the frame's origin corner. Identify all species rooted in this quadrat and record their codes in the species column; fill in blanks in the SET and AREA columns adjacent to these species codes appropriately (see example in Figure 8). If no species occur in this quadrat, fill in a row on the data sheet with the SET and AREA, but place a dash in the SPECIES column. This shows that the quadrat was searched and not mistakenly omitted. Unknown or unidentifiable species are given a unique code and catalogued following SOP Unknown Plants.

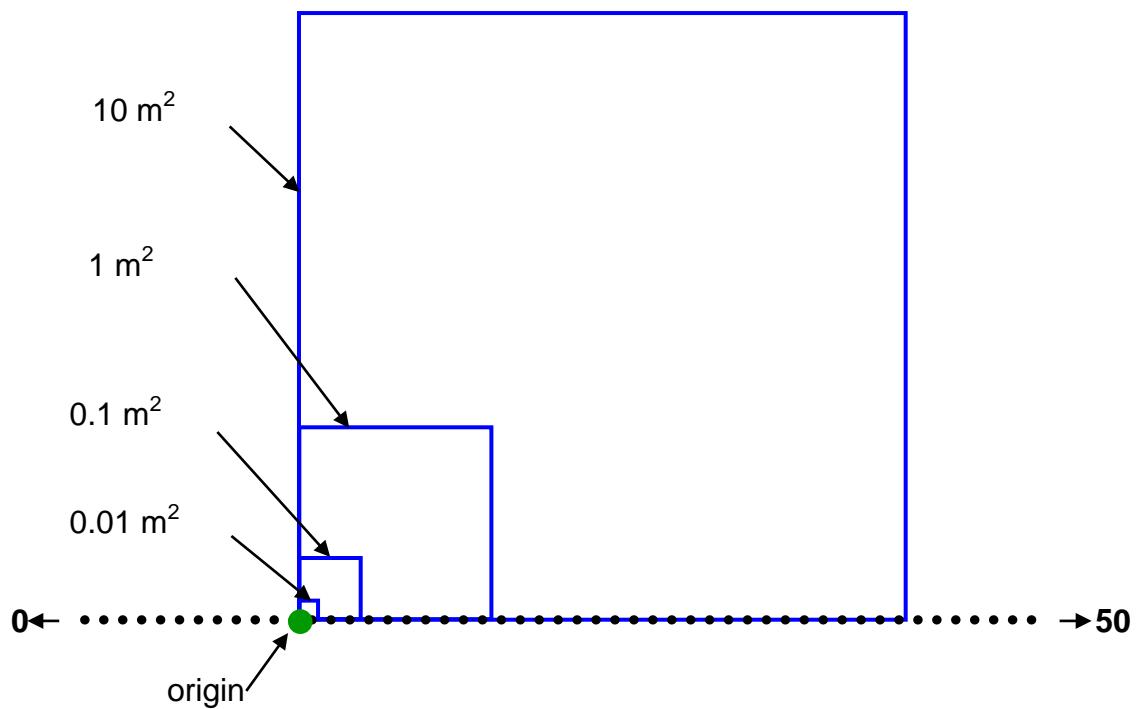
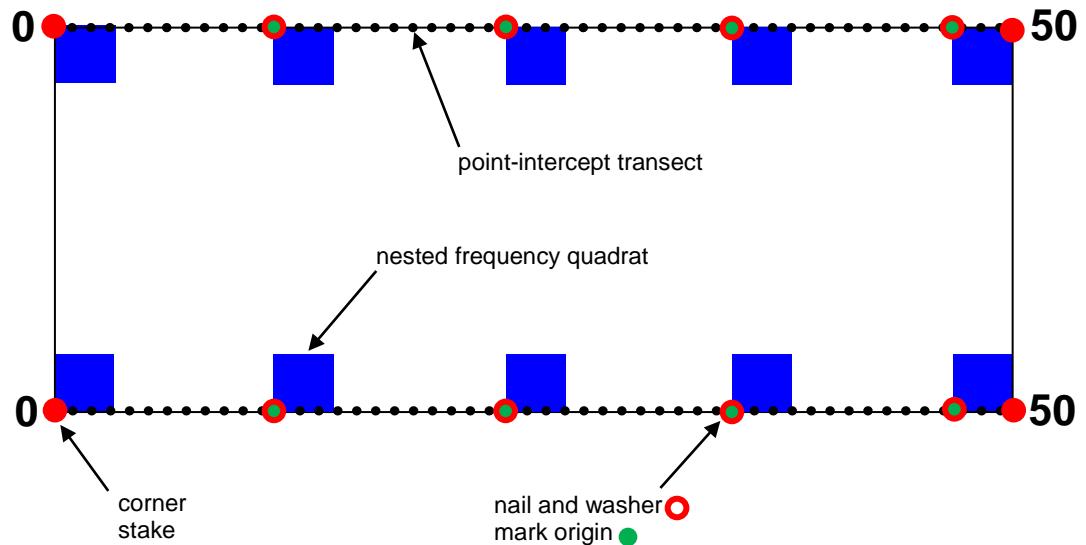


Figure 7. Layout of nested frequency quadrats along transects within a plot (top) and detail of the location of the smaller quadrats within the 10 m^2 quadrat (bottom).

Once all species in this quadrat are recorded, move onto the 0.1 m² quadrat, placing it on top of the 0.01 m² quadrat so that two of its edges are on the tapes. Identify and record all species in this quadrat but that were not already recorded for the 0.01 m² quadrat, and fill in the SET and AREA columns appropriately. If no new species occur in this larger quadrat, fill in a row for the quadrat size and place a dash in the SPECIES column. Again, this shows that the quadrat was not accidentally omitted.

Repeat this process for the 1.0 m² and 10 m² quadrats. Only species rooted in each quadrat and not previously recorded for a smaller quadrat in that same set are included in the species list for that quadrat. Thus, for any given set of quadrats a species code can appear only once.

A reference list for each 10 m² quadrat is provided for each plot (see example in Figure 9). This list shows the names of species previously collected in that quadrat for comparison to those being recorded. Consult this list only **after** you have thoroughly searched the 10 m² quadrat for your current location. If any species from previous years were missed, search the quadrat again for the species. Comparison with the previous year's species list maintains consistency in species identification and creates a check for missing species, but do not rely on this list too heavily – new species could appear each year and previously existing species may not be present!

When Data Collection Is Complete

When data collection is complete, the crew lead is responsible for checking all data sheets to ensure that all blanks are filled as appropriate, entries are legible and make sense, species codes are accurate, codes for unknowns are clearly described, the completed data sheets (there should be four) are in the appropriate plot folder, voucher specimens are labeled and safely stowed, all non-standard photographs are recorded on the photolog, and the plot folder is in a backpack for transport. **It is important to validate the data at the plot. All changes made to datasheets after leaving the plot will need to be done in red ink, initialed, and dated.** Another person is responsible for ensuring that all equipment is collected and ready for transport.

At the End of Each Day and Park Visit

At the end of each day:

- Check that all information is filled in and legible on any data sheets used that day.
- If a scanner is available, scan completed data sheets.

At the end of a park visit:

- If not already done, scan all completed data sheets. File the original data sheets and store the scanned files in the appropriate locations.
- Communicate any notable finds (new species, invasive species, disturbances where not expected, etc.) to your park contact.

NESTED QUADRATS DATA SHEET

Park: DETO

Plot ID: PCM-013

Transect: A B

Date 08/16/2011

Observers DMJ, RM²

SET values: 1, 2, 3, 4, 5

AREA values: 0.01, 0.1, 1, 10

10 m² quadrat locations along transect: 0.00-3.16; 10.92-14.08; 23.42-26.58; 35.92-39.08; 46.84-50.00Diagonal of 10 m² square = 4.47 m.

SET	AREA	SPECIES	SET	AREA	SPECIES	SET	AREA	SPECIES
1	0.01	PASM	2	10	PIPO	5	.10	CEAR2
		HEOC8	1		TRDU		✓	BOCU
		COCAS			KOMA		1.0	HESP11
		LATAP	1	10	DIOLS			COCAS
	.10	MARE11	3	.01	POPR			LOUN
		CALO			HESP11			CAINH2
		DIOLS			AMPS		✓	POALY
		EUESF			EUESF		10	POPR
	✓	POPR		.10	—			SAMI2
	1.0	ARUL2		1.0	CAINH2			VUOC
	10	PEARL			DIWIS			PEARL
		CAINH2			LATAP			DASP2
		CEAR4		✓	10	—		HEOC8
		KOMA		4	.01	EUESF		ACMI62
		ANGE				HESP11		SCSCS
	✓	ARHOC				POPR		TRDU
2	.01	HEOC8				1.0	—	PIPO
		✓	EUESF					ELTRS
	.10	POPR				10.0	CALO	
		CAINH2					✓	LOUN
	✓	ANGE						ELTRS
	1.0	PEARL		5.	.01	ANGE		
		LATAP				DIWIS		
		COCAS				EUESF		
	✓	DIWIS				BRJA		
	10	LYJU				LOAIS		
	✓	✓	HESP11	✓	.10	AMPS		

Figure 8. Example nested quadrats data sheet.

Previously recorded species for SCBL-PCM12				
Transect A				
SET = 1	SET = 2	SET = 3	SET = 4	SET = 5
ASGR	BOGR2	BRAR5	ASGR	BRAR5
BOGR2	BRAR5	CAFI	BRAR5	BRTE
BRAR5	BRTE	CHPR	CAFI	CAFI
BRTE	CAFI	DEPI	DEPI	GACO5
CAFI	HEAN	GACO5	HECOC8	HECOC8
DEPI	LAOC	LYJU	LYJU	PASM
GACO5	LYJU	PASM	OPMA	SIAL2
HECOC8	HECOC8	SIAL2	PASM	SPCO
KOMA	SPCO	SPCO	SIAL2	VIAM
LIPU	VUOC	TAOF	VIAM	
LIIN		TRDU		
OPPO		VUOC		
PHAN				
SPCO				
TRDU				
VINU				
VUOC				
ZIVE				
Transect B				
SET = 1	SET = 2	SET = 3	SET = 4	SET = 5
BOGR2	ARFR4	ASGR	BRAR5	ASGR
BRAR5	BRAR5	BRAR5	CAFI	BOCU
CAFI	BRTE	CAFI	DEPI	BRAR5
DEPI	CAFI	DEPI	HECOC8	BRTE
GACO5	CHPR	HEAN	LAOC	CAFI
HECOC8	GACO5	HECO	LYJU	CHPR
OPPO	HECOC8	LASE	MILI	DEPI
PASM	LASE	LYJU	OPMA	GACO5
SPCO	LAOC	PASM	PASM	HECOC8
VUOC	OPMA	SIAL2	SOMI	KOMA
	SPCO	SPCO	SPCO	LASE
	TRDU		TRDU	LAOC
	VINU			LAPO
	VUOC			LEDE
				LIIN
				OPMA
				PASM
				PEAR6
				SIAL2
				SPCO
				VIAM

Figure 9. Example of list of previously recorded species provided for each plot.

SOP Trees and Shrubs: *Measuring Tree and Tall Shrub Species*

Version 1.01

Prev. Version	Revision Date	Revised by	Changes Made	Reasons for Change	New Version
1.00	11/11	LEB, IWA	Edit/clarify	Clarify instructions for junipers and other exceptions	1.01

This standard operating procedure (SOP) gives step-by-step instructions for measuring density of tree and tall shrub species and for filling in three forms: PCM-6 “Trees Data Sheet”; PCM-7, “Poles Data Sheet”, and PCM-8 “Seedlings Data Sheet”. It is adapted from the NPS Fire Monitoring Handbook (USDI National Park Service 2003) and the USDA Forest Service Forest Inventory and Analysis Phase 2 Core Field Guide (USDA Forest Service 2007).

Equipment List

- Clip boards
- Copy of Plot Location and Description Data Sheet (PCM-2) specific to plot
- Magnetic locator/Metal detector
- Tree, Pole, and Seedling Data sheets
- Pencils, extra pencil lead
- Sidewalk chalk
- Diameter tape(s): at least one small, spring-loaded, and one larger, reel-type
- Fuel sizing gauge (a.k.a. go-no-go gauge)
- 50-meter tapes (2; intensive plots only)
- 30-meter tapes (2 in extensive plots, 4 in intensive plots)
- Chaining pins (12)
- Nails
- Sequentially numbered brass tags
- Hammer
- Non-stretchy, durable string > 11 m long. **See below regarding length!**
- Biodegradable flagging tape
- Laser range finder

Procedures

1. Laying out Transects

In intensive plots, the two 50-m transects will be laid out for herbaceous sampling before tree sampling is done. Leave them in place, and use two 30 m tapes to mark the ends of the

rectangular plot (i.e., A0-B0 and A50-B50). This rectangle demarcates the tree sampling area for the intensive plot.

All plots with trees have two perpendicular, 100-foot (30.-48 m) transects (Tree Transect 1 and Tree Transect 2) that cross in the center of the plot. (See SOP Plot Establishment for information on establishing monitoring plots.) Each end of a tree transect is marked with a large nail and washer sunk flush with the ground. The center of these transects is marked with rebar, which is also usually sunk flush with the ground. Washers are labeled to indicate the transect name and end, whereas the rebar is labeled with a metal tag containing pertinent plot and transect information.

Before sampling any trees, set up these two transects. Secure the origin (0 ft end) of the tape to the “B” (for beginning) end of the transect with a chaining pin, then secure the rest of the tape in the correct position by inserting chaining pins at the center and “F” (for finish) end of the transect. If there are obstacles (tree trunks, large rocks, etc.) along the transect line, check the Plot Location and Description Data Sheet for the plot to make sure the tape goes around/over these obstacles in the same path it has for previous sampling events.

All members of the sampling team assist in locating center and end stakes and setting up transect lines. **Be careful to avoid trampling vegetation in the plot, especially on herbaceous vegetation transects (in intensive plots) and, if you are in ponderosa pine forest, near the beginning of the tree transects, where fine fuels are subject to trampling.**

Before beginning any sampling, check the length of the string used for the circular plot. The loop of the string goes at the center of the plot, and the knot indicating the outside edge of the circular plot should be exactly 10 m. Moisture and use seem to affect the length of the string, so this check should be done at every plot.

2. Filling in Data Sheet Headers

Fill in the information on the top of the page of all three data sheets (PCM-6, 7, and 8) according to the following directions.

Park, Plot ID, and Visit Type should already be filled in.

Date: Include month / day / year (mm/dd/yyyy)

Observers: The unique initials of the first, middle, and last name of each person in the team collecting data. If initials of two or more persons are the same, include some other distinguishing initial.

3. Measuring trees, poles, and seedlings

The following instructions may seem daunting because of the many special circumstances. Split trunks, root sprouts, and other plasticities of woody plants make it difficult to measure them consistently. Consequently, this SOP tries to account for all the special circumstances that will occur in the field. Knowing that this is impossible, however, it is the responsibility of the data collector to keep in mind the overarching goals of this data collection:

- **Describe the structure of the tall woody vegetation in the plot.**
- **Describe the potential for that structure to change.**

Use these goals to direct decisions that are made when collecting data. Also, use plot maps and comment fields profusely to document special circumstances and the decisions made in those circumstances.

Before beginning any of these measurements, each crew member should ensure that s/he knows exactly where on her/his body the official “breast height” (137 cm, or 4.5 ft, from ground level) is. Depending on the height of the crew member, this could be anywhere from the bottom of the rib cage to eye level.

Tall woody species (potential height ≥ 3 m) are recorded in three different size classes on three different data sheets:

Tree size class

- tree species only (see Table 4)
- diameter at breast height (DBH) > 15 cm; for Rocky Mountain juniper, diameter at root collar (DRC) > 15 cm. **Note that *Juniperus scopulorum* is the only tree (as opposed to all tall shrubs) to be measured at DRC. It should be treated the same as other tree species except that it should be measured and tagged at the root collar, not at breast height.**
- record data on PCM-6

Pole size class

- tree species: $2.54 \text{ cm} \leq \text{DBH} \leq 15 \text{ cm}$; for Rocky Mountain juniper, use DRC instead of DBH
- tall shrub species (see Table 4): diameter 30 cm above root collar (see DRC procedures below) ≥ 2.54 cm
- record data on PCM-7

Seedling size class

- tree species: $\text{DBH} < 2.54$ cm and exhibiting signs of growth in previous year (see below; by definition, anything less than 137 cm tall is a seedling); for Rocky Mountain juniper, DRC < 2.54 cm
- tall shrub species: diameter 30 cm above root collar (see DRC procedures below) < 2.54 cm or stem length < 30 cm and exhibiting signs of growth in previous year (see below)
- record data on PCM-8

When there is doubt about the species identity of an individual, and therefore whether it should be measured as a tree or tall shrub, or not measured in this protocol, acknowledge this uncertainty on the data sheets but make clear via notes and descriptions how such individuals were treated so that they can be treated similarly in the future.

Table 4. Tree and tall shrub species in NGPN parks, with growth form and location where diameter should be measured.

Scientific Name	Code	Growth Form	Breast Height or Root Collar?
<i>Acer negundo</i>	ACNE2	Tree	Breast Height
<i>Amelanchier alnifolia</i>	AMAL2	Tall Shrub	Root Collar
<i>Amelanchier humilis</i>	AMHU2	Tall Shrub	Root Collar
<i>Betula occidentalis</i>	BEOC2	Tree	Breast Height
<i>Betula papyrifera</i>	BEPA	Tree	Breast Height
<i>Celtis occidentalis</i>	CEOC	Tree	Breast Height
<i>Crataegus chrysocarpa</i>	CRCH	Tall Shrub	Root Collar
<i>Crataegus douglasii</i>	CRDO2	Tree	Breast Height
<i>Crataegus succulenta</i>	CRSU5	Tree	Breast Height
<i>Elaeagnus angustifolia</i>	ELAN	Tree	Breast Height
<i>Elaeagnus commutata</i>	ELCO	Tall Shrub	Root Collar
<i>Fraxinus pennsylvanica</i>	FRPE	Tree	Breast Height
<i>Gleditsia triacanthos</i>	GLTR	Tree	Breast Height
<i>Juglans nigra</i>	JUNI	Tree	Breast Height
<i>Juniperus scopulorum</i>	JUSC2	Tree	Root Collar
<i>Juniperus virginiana</i>	JUVI	Tree	Breast Height
<i>Malus ioensis var. ioensis</i>	MAIOI	Tree	Breast Height
<i>Malus pumila</i>	MAPU	Tree	Breast Height
<i>Ostrya virginiana</i>	OSVI	Tree	Breast Height
<i>Picea glauca</i>	PIGL	Tree	Breast Height
<i>Picea pungens</i>	PIPU	Tree	Breast Height
<i>Pinus ponderosa</i>	PIPO	Tree	Breast Height
<i>Populus alba</i>	POAL7	Tree	Breast Height
<i>Populus angustifolia</i>	POAN3	Tree	Breast Height
<i>Populus balsamifera</i>	POBA2	Tree	Breast Height
<i>Populus deltoides</i>	PODE3	Tree	Breast Height
<i>Populus tremuloides</i>	POTR5	Tree	Breast Height
<i>Prunus mexicana</i>	PRME	Tree	Breast Height
<i>Prunus pensylvanica</i>	PRPE2	Tree	Breast Height
<i>Prunus virginiana</i>	PRVI	Tall Shrub	Root Collar
<i>Quercus macrocarpa</i>	QUMA2	Tree	Breast Height
<i>Rhamnus cathartica</i>	RHCA3	Tall Shrub	Root Collar
<i>Salix alba</i>	SAAL2	Tree	Breast Height
<i>Salix amygdaloides</i>	SAAM2	Tree	Breast Height
<i>Salix bebbiana</i>	SABE2	Tall Shrub	Root Collar
<i>Salix eriocephala</i>	SAER	Tall Shrub	Root Collar
<i>Salix exigua</i>	SAEX	Tall Shrub	Root Collar
<i>Salix fragilis</i>	SAFR	Tree	Breast Height
<i>Salix lucida</i>	SALU	Tall Shrub	Root Collar
<i>Salix lutea</i>	SALU2	Tall Shrub	Root Collar
<i>Sambucus nigra ssp. canadensis</i>	SANIC4	Tall Shrub	Root Collar
<i>Shepherdia argentea</i>	SHAR	Tall Shrub	Root Collar
<i>Sorbus scopulina</i>	SOSC2	Tall Shrub	Root Collar
<i>Syringa vulgaris</i>	SYVU	Tall Shrub	Root Collar
<i>Tamarix chinensis</i>	TACH2	Tree	Breast Height

Scientific Name	Code	Growth Form	Breast Height or Root Collar?
<i>Tamarix ramosissima</i>	TARA	Tall Shrub	Root Collar
<i>Ulmus americana</i>	ULAM	Tree	Breast Height
<i>Ulmus pumila</i>	ULPU	Tree	Breast Height
<i>Ulmus rubra</i>	ULRU	Tree	Breast Height
<i>Viburnum lentago</i>	VILE	Tall Shrub	Root Collar

Instructions for determining where, on which stems, and how to measure diameter.

Where and on which stems to measure diameter depends on the species and on the shape of the individual specimen. Table 4 lists all tree and tall shrub species known to occur in at least one NGPN park and whether their diameter should be measured at breast height (BH) or root collar (RC). The rule is: trees except for *Juniperus scopulorum* (Rocky Mountain juniper) are measured at BH, whereas tall shrubs and *Juniperus scopulorum* are measured at root collar. If you encounter a tree or tall shrub not on this list, follow this rule.

Diameter at Breast Height Measurements (for tree species other than Juniperus scopulorum)

Unless one of the following special situations is encountered, measure DBH at 137 cm above the ground line at the center of the bole on the **uphill** side of the tree. To measure the diameter, wrap the diameter tape around the tree in the plane perpendicular to the stem at the appropriate height. Take care to read at the measurement line, not at the end of the tape. Round each measurement down to the last 0.1 cm. For example, a reading of 5.68 cm is recorded as 5.6 cm.

Special DBH situations:

A. **Forked tree:** In order to qualify as a fork, the stem in question must be at least 1/3 the diameter of the main stem (“bole”) and must branch out from the main stem at an angle of 45 degrees or less. **Forks originate at the point on the bole where the piths intersect.** Forked trees are handled differently depending on whether the fork originates below 30 cm, between 30 and 137 cm, or above 137 cm.

- Trees forked below 30 cm:** Trees forked below 30 cm are treated as distinctly separate trees for recording and tagging purposes. DBH is measured for each stem at 137 cm above the ground (Figure 10Aa). When stems originate from pith intersections below 30 cm, it is possible for some stems to be within the plot or subplot, or in different quarters of the plot or subplot. If stems originating from forks that occur below 30 cm fork again between 30 and 137 cm (Figure 10Ab), the rules in the next paragraph apply. Multiple forks are possible if they all originate from approximately the same point on the main stem. In such cases, measure DBH on all stems at 137 cm above the ground.
- Trees forked between 30 and 137 cm:** Trees forked between 30 and 137 cm are also counted as separate trees for recording and tagging purposes. Multiple stems should be recorded as they occur in clockwise order (starting at due north). The DBH of each fork is measured at a point 107 cm above the pith intersection (Figure 10Ab). When forks originate from pith intersections between 30 and 137 cm, they are either all on, or all off the plot, and all are recorded in the same quarter. Multiple forks are

possible if they all originate from approximately the same point on the main stem. In such cases, measure DBH on all stems at 107 cm above the common pith intersection (Figure 10Ab). Once a stem is tallied as a fork that originated from a pith intersection between 30 and 137 cm, do not recognize any additional forks that may occur on that stem. Measure the diameter of such stems just below the base of stem separation (i.e., do not move the point of diameter the entire 107 cm above the first fork).

- c. Tree forks at or above 137 cm: Trees forked at or above 137 cm count as one single tree (Figure 10Ac). If a fork occurs at or immediately above 137 cm, measure diameter below the fork just beneath any swelling that would inflate DBH.

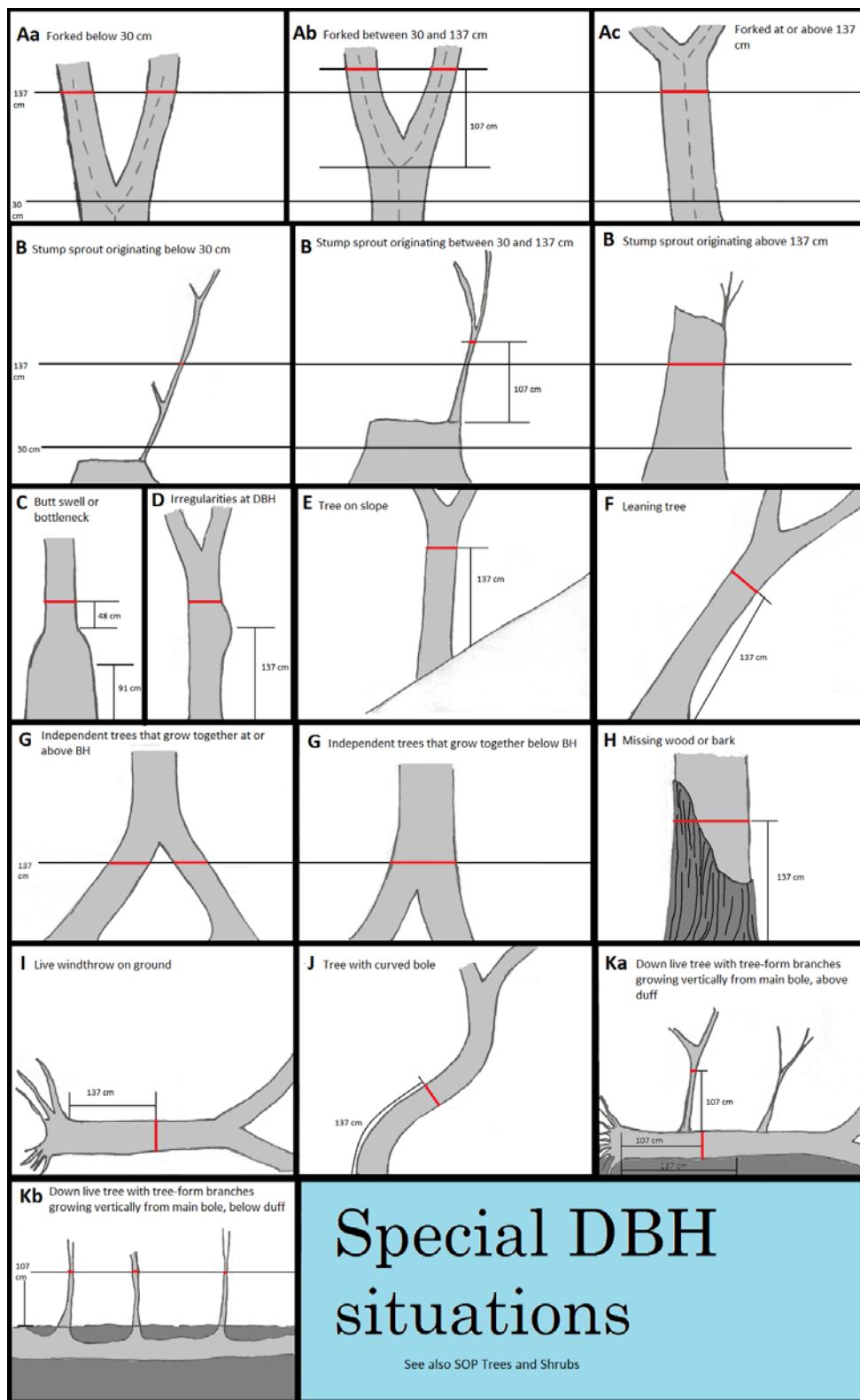


Figure 10. Illustration of rules for measuring diameter for forked trees for those species measured at breast height. Red, horizontal lines on stems indicate location at which diameter should be measured for the given situation.

B. Stump sprouts: Stump sprouts originate between ground level and 137 cm on the boles of trees that have died or been cut. Stump sprouts are handled the same as forked trees, with the exception that stump sprouts are not required to be 1/3 the diameter of the dead bole. Stump sprouts originating below 30 cm are measured at 137 cm from ground line. Stump sprouts originating between 30 and 137 cm are measured at 107 cm above their point of occurrence. As with forks, rules for determining the location of the stem depend on whether the sprout originates above or below 30 cm (Figure 10B).

C. Trees with butt-swell or bottleneck: Measure these trees 48 cm above the end of the swell or bottleneck if the swell or bottleneck extends 91 cm or more above the ground (Figure 10C).

D. Trees with irregularities at BH: On trees with swellings, bumps, depressions, and branches at BH, measure diameter immediately above (preferably) or below the irregularity at the place it ceases to affect normal stem form (Figure 10D).

E. Tree on slope: Measure the diameter at 137 cm from the ground along the bole on the uphill side of the tree (Figure 10E).

F. Leaning tree: Measure the diameter at 137 cm from the ground along the bole. The 137 cm distance is measured along the underside face of the bole (Figure 10F).

G. Independent trees that grow together: If two or more independent stems have grown together at or above BH, treat them as separate trees. Estimate the diameter of each and explain the situation in the notes (Figure 10G).

H. Missing wood or bark: Do not reconstruct the DBH of a tree that is missing a small amount of wood or bark at the point of measurement. Record the diameter of the wood and bark that is still attached to the tree. If a **large** part of the bole is missing (e.g. on a broken-off snag) it may be necessary to reconstruct DBH (Figure 10H).

I. Live windthrown tree on the ground: Measure diameter at the point 137 cm along the stem from the top of the root collar (Figure 10I).

J. Tree with curved bole: Measure along the bole on the side slope side (upper surface) of the tree (Figure 10J).

K. Down live tree with tree-form branches/sprouts growing vertical from main bole: When a down live tree, touching the ground, has vertical ($< 45^\circ$ from vertical) tree-like branches coming off the main bole, first determine whether or not the pith of the main bole is above or below the duff layer (Figure 10K).

- If the pith of the main bole is above the duff layer, use the same forking rules specified for a forked tree, and take all measurements accordingly (Figure 10Ka).
 - If the pith intersection of the main down bole and vertical tree-like branch occurs less than 137 cm from the root collar along the main bole, treat that

branch as a separate tree, and measure diameter 107 cm above the pith intersection for both the main bole and the tree-like branch.

- ii. If the pith intersection between the main down bole and the tree-like branch occurs beyond 137 cm from the root collar along the main bole, treat that branch as part of the main down bole (i.e., its diameter is not measured).
- b. If the pith of the main tree bole is below the duff layer, ignore the main bole, and treat each tree-like branch as a separate tree; take diameter and length measurements from the ground, not necessarily from the top of the down bole. However, if the top of the main tree bole curves out of the ground towards a vertical angle, treat that portion of that top as an individual tree originating where the pith leaves the duff layer (Figure 10Kb).

A flow diagram was developed to complement Figure 10 (see Attachment 1 of this SOP). The field crew can use the diagram to help determine where DBH should be measured in special cases.

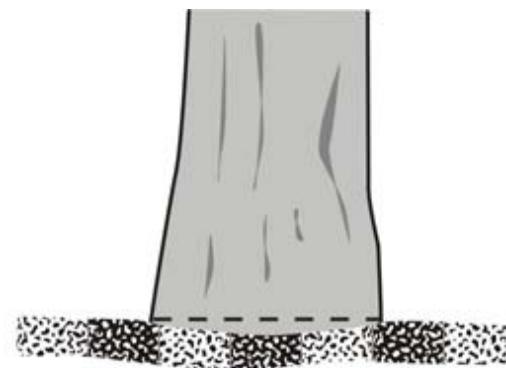
Diameter at Root Collar Measurements (for tall shrub species and Juniperus scopulorum)

In order for DRC to be measured, regardless of special situations, at least one stem must be at least 30 cm in length and at least 2.54 cm in diameter 30 cm up from the diameter measurement point. When DRC is impossible or extremely difficult to measure with a diameter tape (e.g., due to thorns, or extreme number of limbs, stem diameters may be estimated to the nearest 1-cm class. Note this special circumstance in the comments field on the data sheet.

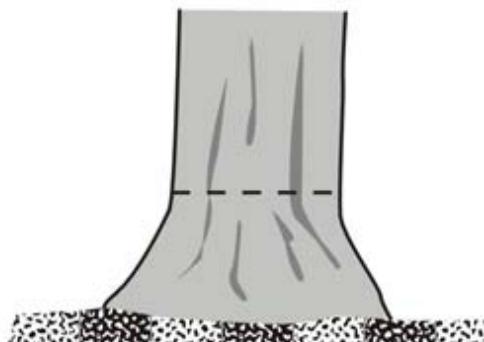
Unless one of the following special situations is encountered, measure diameter at the ground line (Figure 11) or at the stem root collar, whichever is higher. Treat clumps of stems having a unified crown and common root stock as a single tree (Figure 11.3). To measure the diameter, wrap the diameter tape around the tree in the plane perpendicular to the stem at the appropriate height. Take care to read at the measurement line, not at the end of the tape. Round each measurement down to the last 0.1 cm. For example, a reading of 5.68 cm is recorded as 5.6 cm.

Special DRC situations:

- A. Diameter at root collar inflated by stem convergence (Figure 11.4) or stems originate at or below ground (Figure 11.6): Measure diameter immediately above the stem convergence (former) or as close to ground level as possible (latter), recording each stem individually on the data sheet. Tag and number only the largest stem, but record the diameter of each stem on a separate line. As long as one stem is > 15cm, count it as a tree even if other stems are < 15 cm. Indicate on the data sheet that these are all from one individual by putting a circle around the multiple stems and making a note in the comment field. When entering data into the database, DRC for this individual will be calculated as the square root of the sum of the squared stem diameters, rounded to the nearest 0.1 cm.
- B. Cut or missing stem(s) (Figure 11.5): Ignore the cut/missing stems, measuring DRC as if they were not there. If necessary, measure multiple stems for computed DRC as described above.



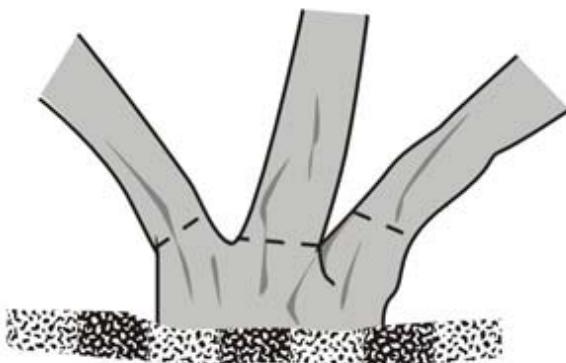
1. Measure at ground line when reasonable.



2. Measure above root collar.



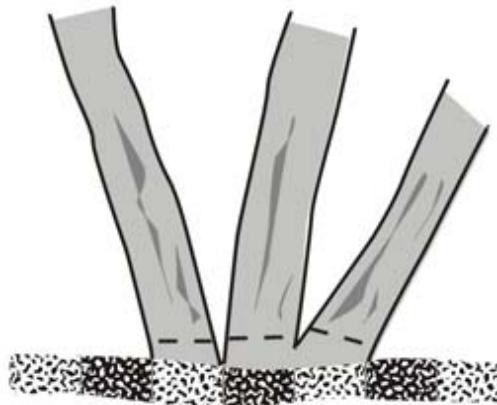
3. Multistemmed above diameter.



4. Excessive diameter below stems. Measure stems. Compute DRC.



5. Ignore cut/missing stem(s). Compute DRC.



6. Multistemmed at or below ground. Compute DRC.

Figure 11. Illustration of rules for measuring diameter at root collar in special circumstances. Dotted lines on stems indicate location at which diameter should be measured on each stem. The difference between cases 3 and 4 may be a judgment call; the idea is to measure at ground level if that measurement will accurately reflect the combined diameters of the stems, but measure each stem separately if measuring at ground level would inflate the diameter.

Recording Data for Trees

Trees (DBH > 15 cm): Record data on PCM-6

- A. On the first visit in a purely intensive plot or when doing intensive measurements in a dual plot, measure, tag and map all trees, either alive or standing dead, with diameter at breast height (DBH) > 15 cm. On revisits, measure trees at the height marked by the tag, check the previously made map for omissions, and be especially careful to tag and add trees that previously had DBH \leq 15 cm to the map. When doing extensive-only measurements in a dual plot, or in a purely extensive plot, simply measure trees; no tagging or mapping is done. If there are a lot of trees, chalk can be used to mark trees once they've been measured to avoid confusion. In all plot types, move through the plot systematically so that no trees are missed. Record all data described below for all trees encountered. Include a tree on the plot boundary line if > 50% of its base is within the plot.
 - a. When doing INTENSIVE measurements, trees are recorded in the entire 20 x 50 m plot area. Starting at the center of the plot, work your way through the plot in the order shown in Figure 12. Going in this order makes it easier for crews on future visits to relocate individual trees quickly. Map trees on Page 2 of PCM-6.
 - b. When doing EXTENSIVE measurements, trees are recorded in the 10-m radius plot area. Starting at the center of the plot in Quarter 1, work your way through the plot in the order of the quarter numbers (Q1, Q2, Q3, Q4) shown in Figure 4. Going in this order makes it easier for crews on future visits to relocate individual trees quickly.
- B. Record which quarter of the plot the tree is in (see Figure 12) and whether it is in or out of the central 10 m radius circle.
- C. On the first visit, or when a tree has not previously been tagged, tag the tree with a numbered brass tag by nailing the tag into the tree at BH and record the tag number in the "Tag" column. Map the location of the tree (to the nearest meter) on page 2 of PCM-6 by placing a dot on the map and the tag number next to it.
 - a. Tags should be placed in the tree at the height where diameter was measured. Follow the rules for special situations described above. Consequently, some trees will have more than one tag.
 - b. Getting the tag at the correct height is important, because this designates the height at which all future diameter measurements will be taken.
 - c. Orient the tag so that it faces the plot center, except in areas (e.g., near trails) where they need to be less visually obtrusive. In those areas, orient the tag so that it is out of view.
 - d. Pound the nail into the tree at a slightly upward angle so that the tag hangs down and away from the tree and 2-3 centimeters of nail remains exposed, leaving ample space for tree growth.
- D. Record the tree's species code. Species codes are the plant symbols used by the USDA's national plants database (<http://plants.usda.gov/>) and consist of the first two letters of the genus and species, sometimes followed by a number. See codes in Table 1. For unidentifiable dead trees, put a dash in the species code column.
- E. Record whether the tree is live ("L") or dead ("D") in the L/D column. Trees are considered live if they have any living parts (leaves, buds, cambium) at or above the point of diameter measurement.

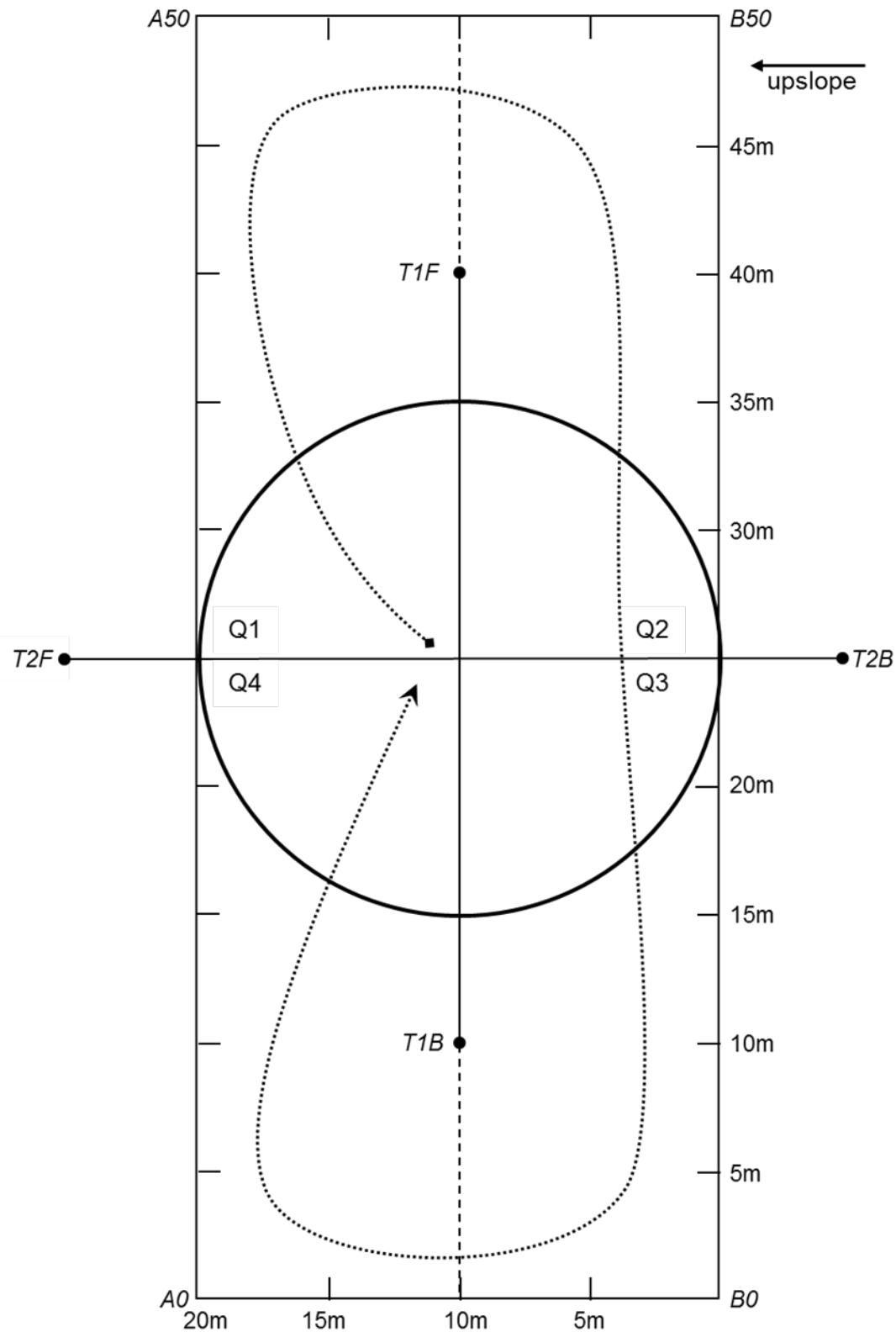


Figure 12. Illustration of intensive plot map and approximate order in which to visit quarters for mapping and recording trees (dotted line).

F. Record the tree's condition code. Live trees can have more than one condition code if "SND" is not one of them (write the primary codes in the same box and the second in the notes). Condition codes are listed at the bottom of the first page of PCM-6 and described in detail here:

- a. RS = recent snag: recently dead tree with bark intact; branches and needles may also be intact.
- b. LS = loose bark snag: tree dead several years on which the bark is partially deteriorated and fallen off; the top is often broken.
- c. CS = clean snag: tree that has been dead several years with no bark left; usually most of the branches will be gone, and the top is often broken.
- d. SND = sound: live tree in which none of the other condition codes apply.
- e. DBK = dieback: recent mortality of branches with fine twigs that begins at the terminal portion of a branch and proceeds toward the trunk. Considered dieback only when it occurs in the upper and outer portions of the tree, not in lower portion where self-thinning is expected. Designate only if dieback comprises > 10% of crown.
- f. DIS = foliage discoloration: at least 30% of the foliage is more than 50% affected, where affected means foliage is more of some color other than green.
- g. DEC = decay: signs of advanced decay present, including conks and fruiting bodies on the main bole and at the point of branch attachment, bird cavities, and "punk" (soft, moist, degraded) wood.
- h. INS = insect signs: visible insect use of tree, including piles of frass, pitch tubes, or bark beetle galleries.

G. Measure and record the DBH of the tree to the nearest lower tenth of a centimeter with a diameter tape, just above the nail.

- a. If a large part of the bole is missing at BH, and it would be impractical to simply measure above or below this void, it may be necessary to estimate what the DBH would be if the bole were intact. If this is done, make a note of this in the comments section of the data sheet.

H. On EXTENSIVE plots only: If fewer than 5 trees and poles (all species combined) are recorded for the 10-m radius plot, extend the plot's radius to 20 m and record trees as you would for the smaller plot.

- a. A laser range finder is useful for determining whether a tree is in the 20-m radius circle, but a tape is the most accurate method.
- b. Make sure to record this extension in the comments field on the data sheet

If a tree that was tagged on a previous visit has fallen and died, or been cut down, don't measure or record the tree this year, but make a note in the comments section about what happened to the tree.

Recording Data for Poles and Seedlings

Poles and seedlings are recorded on separate data sheets, but they are counted at the same time. This ensures that an individual stem is counted in only one category. Starting in the first quarter (Q1, Figure 12) of the 10-m radius, central plot, and moving through the remaining quarters in numerical order, measure poles and seedlings according to the instructions below. Use the fuel sizing gauge to distinguish between poles and seedlings, since one opening on this is exactly 2.54 cm. Where stems are dense, use extra tapes, string, or flagging tape to divide a quarter into

smaller sections to ensure all stems are counted, and only counted once. Marking seedlings/poles with sidewalk chalk as they are counted is a wonderful way to keep track of what's been counted.

Poles ($2.54 \text{ cm} \leq \text{DBH} \leq 15 \text{ cm}$): Record data on PCM-7

Methods for measuring and recording pole data are identical to those for trees, with the following exceptions:

- A. Tall shrub species (see Table 4) are included in pole measurements.
- B. Poles are recorded *only* in the central, 10-m radius, circular plot regardless of plot type. Use the non-stretchy string, attached to the plot's center, to determine whether a pole is inside this circle. Include a pole on the plot boundary line if $> 50\%$ of its base is within the plot.
- C. Poles are NOT tagged; the quarter in which they occur is recorded on the data sheet.
- D. A condition code is NOT assigned. Instead, the pole is simply recorded as live or dead by circling the appropriate letter in the Live/Dead column on the data sheet.
- E. To ensure proper data entry, draw a star next to the diameter value for individuals for which diameter was measured at root collar, and explain this in the Comments section. This will remind the data entry person that the diameter value must be entered as DRC, not DBH.

Seedlings ($\text{DBH} < 2.54 \text{ cm}$): Record data on PCM-8

Methods for measuring seedlings are somewhat different from those for trees and poles.

- A. Individuals of tree species (except *Juniperus scopulorum*) that are shorter than BH, and individuals of tall shrub species (or *Juniperus scopulorum*) with no stems at least 30 cm in length and at least 2.54 cm in diameter 30 cm up from the diameter measurement point are treated as seedlings, regardless of age and diameter. Seedlings less than one year old, i.e., those with cotyledons present and/or stem not yet woody) are NOT counted because of their ephemeral nature. Only LIVE seedlings are counted.
- B. Data are not recorded for individual seedlings; instead, seedlings are tallied by location (quarter), species, height class, and whether or not it is a stump sprout (see situation B on page 7 for description of stump sprout). A given combination of these (e.g., Q2, PRUVIR, height $> 137 \text{ cm}$, not a stump sprout) is recorded in a single line on the data sheet. Fill in the Quarter and Species Code cells in a row appropriately, circle "Y" or "N" as appropriate in the height and stump sprout columns, then keep a running tally of the number of individuals meeting that description in the "Tally" column. When data collection in a quarter is finished, count the tally marks in the row and write the total number in the "Total" column.
- C. At the *maximum*, seedlings are counted in the entire central, 10-m radius, circular plot. Where the seedlings of an individual species are particularly dense, the count *for that species* can be done on fewer than four quarters. However, these rules must be followed for this situation:

- a. Once the count for a species has reached 100, that species does not have to be counted in the following quarters. *Important:* The count for that species must be completed for the entire quarter in which the 100-count point was reached. This ensures that the area counted is known. For example: 80 stems of *Prunus virginiana* are counted in Q1, and an additional 30 stems of the same species are counted in the first half of Q2. Do not stop counting that species yet! The count for *Prunus virginiana* seedlings must be completed for all of Q2, even if there are 120 more of them in that quarter. *Prunus virginiana* is then not counted in Q3 and Q4.
- b. The 100-count cut-off is for the species, not the combination of species, height, and stump sprout (i.e., row on a data sheet).

D. For all species, record the number of quarters in which that species was counted (i.e., the number of quarters in which you **looked for and counted** seedlings of that species, NOT necessarily the number of quarters in which they are growing).

When Data Collection Is Complete

When data collection is complete, the crew lead is responsible for checking all data sheets to ensure that all blanks are filled as appropriate, entries are legible and make sense, species codes are accurate, codes for unknowns are clearly described, voucher specimens are labeled and safely stowed, all on-standard photographs are recorded on the photo log, completed data sheets (there should be three) are in the appropriate plot folder, and the plot folder is in a backpack for transport. **It is important to validate the data at the plot. All changes made to datasheets after leaving the plot will need to be done in red ink, initialed, and dated.** Another person is responsible for ensuring that all equipment is collected and ready for transport. Also make sure all temporary flagging tape is removed. (By the way, this tape can be re-used many times.)

At the End of Each Day and Park Visit

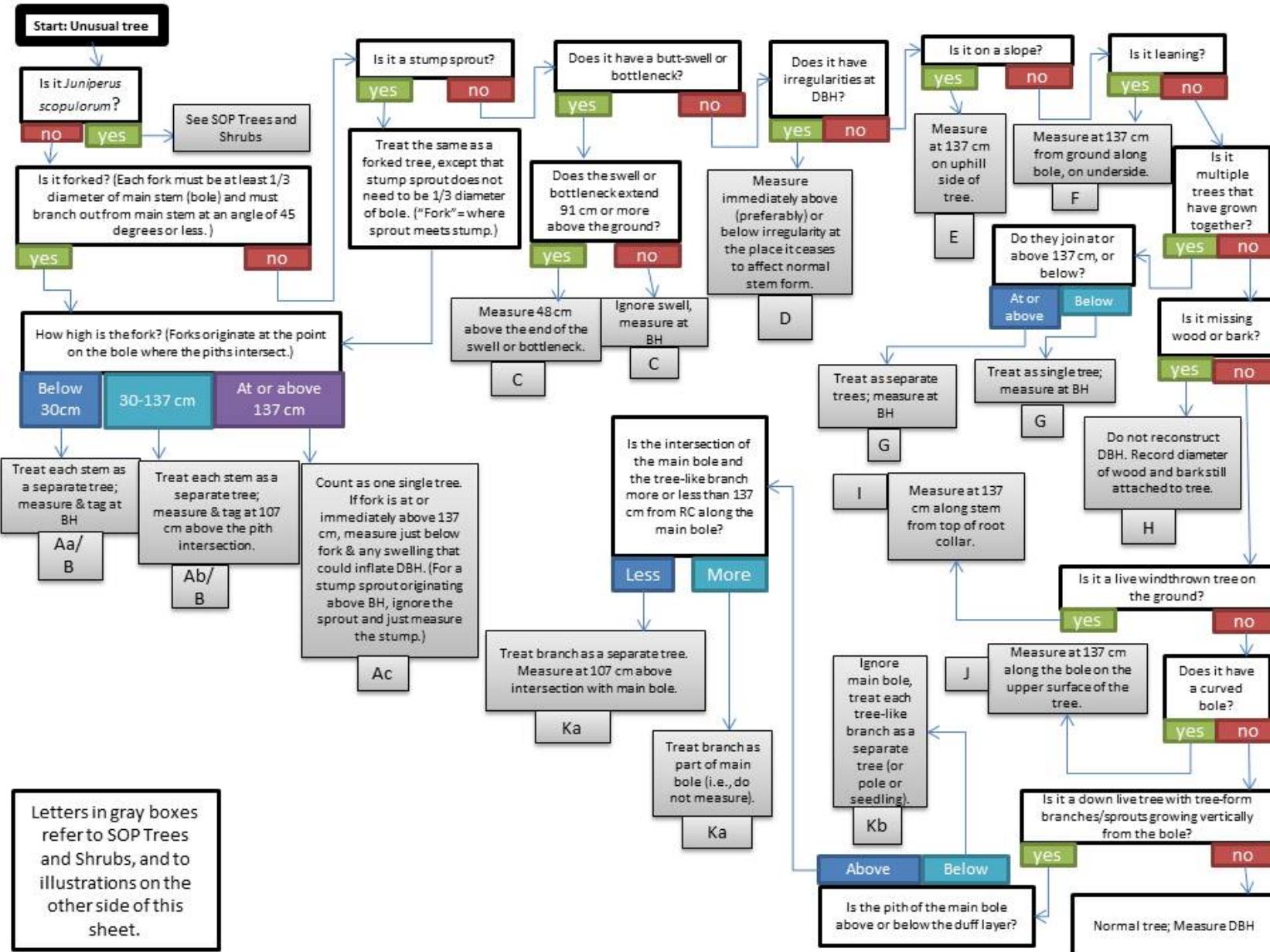
At the end of each day:

- Check that all information is filled in and legible on any data sheets used that day.
- If a scanner is available, scan completed data sheets.

At the end of a park visit:

- If not already done, scan all completed data sheets. File the original data sheets and store the scanned files in the appropriate locations.
- Communicate any notable finds (new species, invasive species, disturbances where not expected, etc.) to your park contact.

Attachment 1



SOP Surface Fuels: Measuring Dead and Downed Woody Fuels in *Pinus ponderosa* Forest and Woodlands

Version 1.01

Prev. Version	Revision Date	Revised by	Changes Made	Reasons for Change	New Version
1.00	11/11	LEB	Change to nrps style		1.01

This standard operating procedure (SOP) gives step-by-step instructions for measuring dead and downed fuel load in *Pinus ponderosa* forest and for filling in Form PCM-9 “Dead and Downed Fuels Data Sheet”. It is adapted from the NPS Fire Monitoring Handbook (USDI National Park Service 2003), which follows Brown’s (Brown 1974, Brown et al. 1982) methodology for measuring forest fuel loads.

Equipment List

- Clip board (1)
- Copy of Plot Location and Description Data Sheet specific to plot
- Magnetic locator/Metal detector
- Dead and downed fuels data sheet (1)
- Pencils, extra pencil lead
- Fuel sizing gauge (a.k.a. go-no-go gauge) (1)
- Ruler or tape marked in 0.1-inch increments (1)
- 30-meter tape marked in feet on one side, or 100-foot tape (2)
- Chaining pins (5)

Procedures

1. Laying out Tapes along Transects

Each monitoring plot with *Pinus ponderosa* present has two perpendicular, 100-foot transects (Tree Transect 1 and Tree Transect 2), which cross in the center of the plot. (See SOP Plot Establishment for information on establishing monitoring plots.) Each end of a transect is marked with a large nail and washer sunk flush with the ground. The center of the transects is marked with a more substantial marker (rebar, rolled steel). All are tagged and labeled with a metal tag containing pertinent plot and transect information.

Once the three markers on a tree transect are located, team members lay a tape along the transect. Secure the origin (0 ft end) of the tape to the “B” (for beginning) end of the transect with a chaining pin, then secure the rest of the tape in the correct position by inserting chaining pins into the ground at the center and “F” (for finish) end of the transect. If there are obstacles (tree trunks, large rocks, etc.) along the transect line, check the Plot Location and Description Data Sheet for the plot to make sure the tape goes around/over these obstacles in the same path it has for previous sampling events.

All members of the sampling team assist in locating center and end stakes and setting up transect lines. **Be careful to avoid trampling vegetation in the plot, especially on herbaceous vegetation transects (in intensive plots) and near the beginning of the tree transects, where fine fuels are subject to trampling.**

All transects have a “beginning” (B) end and a “finish” (F) end, which are indicated by the tags on the end stakes. It is absolutely crucial that the sampling begin at the B end and that the team records the data in the correct table (Tree Transect 1 or 2) on the data sheet.

2. Sampling Teams

One sampling team, each consisting of a reader and a recorder, is responsible for collecting all of the required data and ensuring that their equipment and data sheets are properly stowed before moving to the next site.

3. Collecting Fuel Load Data

Fill in the information on the top of the page of the dead and downed fuels data sheet (PCM-9) according to the following directions.

Park: Park’s unique 4-letter identifier.

Plot ID: A unique sample unit identification consisting of the park’s four-letter identifier, a dash, and the plot’s name. Example: DETO-PCM-010, is the 10th Plant Community Monitoring (PCM) plot at Devils Tower National Monument (DETO). Note that this format is slightly different than what is printed on the plot tag (see SOP Plot Establishment), but it is necessary to include “PCM” for data summary purposes.

Date: Include month / day / year (mm/dd/yyyy)

Observers: The unique initials of the first, middle, and last name of each person in the team collecting data. If initials of two or more persons are the same, include some other distinguishing initial.

When piles or chips from thinning activities are located on the plot:

If there are any piles or chips from thinning activities within 27 m of the plot’s center, do **not** collect fuel load data in the plot. The plot is temporarily out of the target population for fuels measurement because models for fuel biomass in piles or by chip depth in Black Hills ponderosa pine forest has not yet been calibrated, making it difficult to accurately measure fuels in this situation. Instead, on the data sheet directly below the header information, record that piles and/or chips were present; if applicable, note the number of piles present in the 10-m (32.8 ft) radius circle centered at the plot’s center.

For each transect:

Record the azimuth (compass direction from B end to F end) and slope of the transect by copying these values from the Plot Establishment and Description data sheet.

For all data collection, use the right side of the tape (when you are facing the F end) to determine whether a fuel particle intersects the tape (see Figure 2). Record dead fuels up to 6 feet above the ground that would intersect the tape, but do *not* count or record stems or branches attached to *standing* shrubs or trees.

The two smallest size classes (< 0.25" and 0.25"-1" diameter) of downed woody material are measured between the 3 foot and the 9 foot mark. The next largest size class (1"-3" diameter) is tallied between the 3 foot mark and the 15 foot mark, and the largest size class (> 3" diameter) is recorded for the entire length of the transect (100 ft). In the distance appropriate to the size class, tally by size class each particle intersected by the right side of the tape. The go-no-go gauge has a 0.25" opening, a 1" opening, and a 3" opening (Figure 13). Use these to determine which size class a particle falls in. For all particles the following rules apply:

Measurement of all particles is taken perpendicular to the point where the tape crosses the central axis (Figure 14).

- Count dead and down woody material, but *not* cones, bark, needles, or leaves.
- Do *not* count dead woody stems and branches still attached to standing shrubs and trees.
- Do *not* count twigs and branches when the intersection between the central axis of the particle and the sampling plane lies in the duff.
- If the sampling plane intersects the end of a piece, tally only if the central axis is crossed (Figure 14).
- Do *not* tally any particle having a central axis that coincides perfectly with the sampling plane.
- If the sampling plane intersects a curved piece more than once, tally each intersection.
- Tally uprooted stumps and roots not encased in dirt. Do not tally undisturbed stumps.

When a rooted stump or tree occurs at the point of measurement, offset the measurement 1 foot perpendicular to the right side (as viewed when looking from the "B" end to the "F" end) of the tape. If this offset does not get past the obstruction, offset 1 foot perpendicular to the left side. Other options include 1 foot offsets on the transect (e.g., at 14 feet instead of 13 feet). **Record on the data sheet what the offset is.** If this is not the first time that fuel load has been measured in the plot, check the data sheet from the most recent prior visit to ensure that you offset in the same location(s) as in that year.

For particles with diameter > 3", measure the diameter of each log (Figure 14) and record it in the appropriate column.

Rotten wood is that which is obviously deteriorating or punky, whereas **sound** wood is not deteriorating and is hard.

- Measure the log diameter to the nearest 0.1" with a diameter tape or ruler.
- Ignore particles buried more than halfway into the duff at the point of intersection with the sampling plane.

- Visually reconstruct rotten logs as a cylinder and estimate the diameter. This reconstructed diameter should reflect the existing wood mass, not the original sound diameter.
- Measure through rotten logs whose central axis is in the duff layer.

If the measurement is done in an offset, circle the diameter recorded to indicate as such.



Figure 13. Graphic of a fuel-sizing/go-no-go gauge. [Figure is from Forestry Suppliers, Inc.]

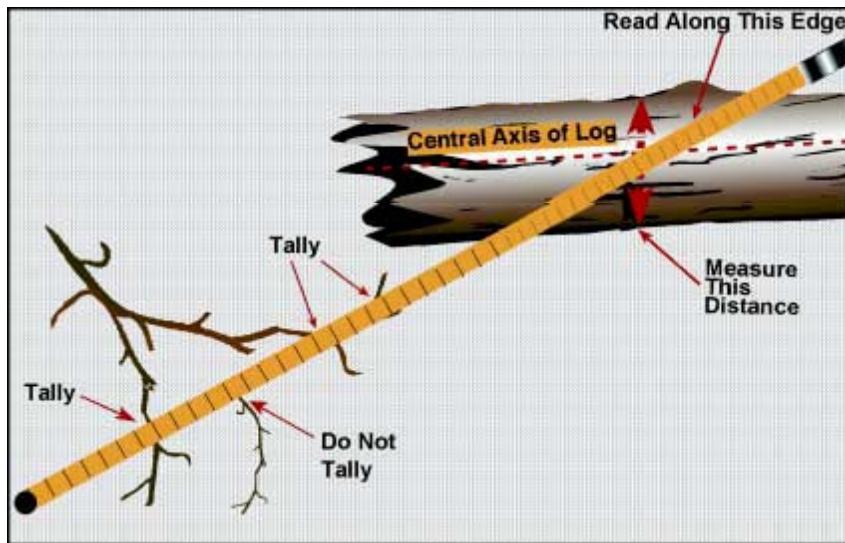


Figure 14. Illustration of tally rules for dead and down fuel. Count all intersections, even curved pieces, on a single edge of the tape. In order to be tallied, the intersection of the tape and the particle must include the particle's central axis. [Figure is from NPS Fire Monitoring Handbook (USDI National Park Service 2003).]

At each of the points indicated on the data sheet, measure the litter and duff depths. At each sampling point, gently insert a trowel, knife, or sturdy ruler into the litter/duff until you hit mineral soil, then carefully pull it away to expose the litter/duff profile. Locate the boundary between the litter and duff layers. Vertically measure the litter and duff to the nearest tenth of an inch and record depth of each on the data sheet. Refill holes created by this monitoring technique.

Litter includes freshly fallen leaves, needles, bark, flakes, fruits (e.g., acorns, cones), cone scales, dead matted grass, and a variety of miscellaneous vegetative parts. Does not include twigs and larger stems.

Duff is defined as the fermentation and humus layers. It does not include the freshly cast material in the litter layer or ash. The top of the duff is where needles, leaves, fruits and other cast-off vegetation material have noticeably begun to decompose. Individual particles usually are bound by fungal mycelia. The bottom of the duff is mineral soil.

Do *not* include twigs and larger stems in litter depth measurements.

If moss is present at the litter/duff depth data collection point, measure the duff from the base of the green portion of the moss. If a stump or large rock is on the point and litter and duff have accumulated on top of it and this litter/duff is no more than 6 feet above the surrounding ground, record the litter and duff depth as usual. When the litter/duff are >6 feet above the surrounding ground, record the depth for both as 0.

If a *tree* occurs at the litter or duff measuring point, there is no litter or duff to measure – both are zero. **Note that this differs from the practice for woody materials!**

If a *log* occurs at the litter or duff measuring point, move the data collection point one foot over to the right (as viewed when looking from the “B” end to the “F” end), perpendicular to the tape. If this offset does not get past the log, offset 1 foot perpendicular to the left side. Other options include 1 foot offsets on the transect itself (e.g., at the 14 foot mark instead of at the 13 foot mark). **Record on the data sheet what the offset is.**

When Data Collection Is Complete

When data collection is complete, the crew leader is responsible for checking the data sheet to ensure that all blanks are filled as appropriate, that entries are legible and make sense, that the completed data sheet is in the appropriate plot folder, and that the plot folder is in a backpack for transport. **It is important to validate the data at the plot. All changes made to datasheets after leaving the plot will need to be done in red ink, initialed, and dated.** Another person is responsible for ensuring that all equipment is collected and ready for transport.

At the End of Each Day and Park Visit

At the end of each day:

- Check that all information is filled in and legible on any data sheets used that day.
- If a scanner is available, scan completed data sheets.

At the end of a park visit:

- If not already done, scan all completed data sheets. File the original data sheets and store the scanned files in the appropriate locations.
- Communicate any notable finds (new species, invasive species, disturbances where not expected, etc.) to your park contact.

SOP Disturbance: *Disturbance and Target Species Assessment*

Version 1.01

Prev. Version	Revision Date	Revised by	Changes Made	Reasons for Change	New Version
1.00	11/11	LEB	Edit/clarify		1.01

This SOP provides instructions for qualitatively describing disturbances and target species occurrences in or near Plant Community Composition and Structure Monitoring plots. This assessment is done every time an active plot is visited.

This SOP is written assuming that the plot in the site being assessed is already delineated by tapes and plot markers. For this SOP, the “plot” is the area in which composition and structure data are collected and the “site” is a 27 m-radius circle centered at the center of the plot^a.

Equipment List

- Laser range finder
- Clip board
- Pencil
- Site Disturbance and Target Species Assessment Data Sheet (PCM-10)
- Target species list for park

Procedures

For efficiency and to minimize trampling, as much as possible of this SOP should be accomplished while recording other plot measurements. If this SOP cannot be accomplished during other plot measurements, it should be completed after all other measurements have been completed. The target species assessment should be done at the same time as the disturbance assessments to minimize trampling. This SOP is meant to be a relatively fast assessment. Spend no more than 30 minutes on it.

1. Begin data sheet

Designate one person on the sampling team to be responsible for recording everything on the PCM-10 data sheet. This person fills in the top of the data sheet with the following:

Park – Standard 4-letter code.

^a This distance encompasses the grid cell used for the GRTS sampling regime.

Plot ID – Pre-assigned, unique number.

Date – mm/dd/yyyy.

Observers – Record the initials of the person(s) making observations for and recording these data.

2. Describe disturbances in the site

A list of common disturbances is in Table 5 (below) and on PCM-10. At any time during plot set-up or data collection, watch for signs of disturbance in the 27m-radius circle centered at the plot's center. Inform the assessment recorder immediately so that s/he can record the disturbance. The list of disturbances in Table 5 and on PCM-10 is not comprehensive. If a significant ($> 1 \text{ m}^2$) disturbance not on the list is present, it should be recorded. Be careful not to walk on areas where data collection takes place.

Check the site for all the disturbance types listed on the data sheet. If you see no evidence of any of these, write "None" to indicate this.

For each disturbance encountered, *record whether it is at least partially in ("IN") or wholly outside of ("OUT") the plot where vegetation data were collected, the approximate size, and informational notes in the appropriate columns.* For notes, good things to include are:

When the disturbance occurred: dates of disturbance, estimated as best you can, and a description of your confidence in that estimate. For example, if you know a prescribed fire occurred on a given date, record that date. If the site was grazed sometime in the growing season of your visit, record the current year and, if very fresh grazing, the current month, noting the signs of fresh grazing (no regrowth). If the disturbance is ongoing, (e.g., an active prairie dog town), record "ongoing".

Severity: characteristics of the disturbance expected to impact present or future vegetation (such as scorch height on trees for a recent fire, chip depth in a chipping project)

Keep in mind that some categories in FFI are more specific than the categories on this data sheet. To make it easier to choose a disturbance category when entering this data in FFI, it's helpful to note the following details if possible: For "Road": Is it paved or not? For "Fire": Prescribed or wildfire? Ground or crown? Was there pile burning? For "Tree removal": Is there chipping, clearcut, logging, pruning, salvage logging, selection cut, stumpwooding, thinning, turpentining? For "Wind/Snow/Ice/Hail": Which one was it?

Sketch: If at all possible, sketch the approximate size and location of the disturbance on the third page of the data sheet.

Table 5. Common disturbance types in Northern Great Plains Network parks.

Disturbance Type	Description
Road	Dirt or paved road
Off-road, human travel	Noticeable vehicle tracks, official or unofficial foot trails, bike activity
Large animal trail	Trampled or missing vegetation, rutted or compacted ground
Grazing	Recently grazed vegetation
Wallow or mineral lick	Patch of bare ground, often indented into ground where animals spend a lot of time resting or licking soil to get minerals
Fire	Burn scars on trees or snags, charcoal, singed plants, blackened litter or herbaceous vegetation
Water	Recent flooding or inundation denoted by debris piles, scour marks, flattened vegetation, etc.
Storm Damage	Wind/Snow//Ice/Hail. Denoted by uprooted or broken trees and limbs, bent over poles and seedlings, shredded vegetation
Prairie dog colony	Vegetation clipped close to ground, mounds of dirt surrounding holes
Other animal excavation	Mounds of dirt other than by prairie dogs (e.g., gophers, badger)
Logging	Evidence of historical logging where large diameter trees were removed; numerous large diameter stumps remain
Thinning	Usually a park-instigated management action; evidence includes cut stumps or small diameter trees and piles of branches and/or logs
Chipping	Usually a park-instigated management action; evidence includes piles of sawdust and chips on the soil surface
Herbicide	Blue dye on plants (indicates application since last rain); yellowing or deformed (growing points twisted) plants. Be careful with this one as other factors can cause the latter conditions.
Other erosion	Substantial soil loss/movement caused by factors not described above
Insects	Tree mortality clearly due to insect damage (e.g., mountain pine beetles in ponderosa pine); defoliation of herbaceous vegetation by grasshoppers

3. Scan for target species in the plot

Each park has a short list of species that are targeted for special notice. Usually these are invasive and/or exotic species that are not currently widespread in the park but pose a significant threat. The information gathered from this SOP is critical for early detection and rapid response to these threats. This SOP provides a semi-quantitative measure of the abundance of target species in a park.

While collecting data for other SOPs and other portions of this SOP, constantly watch for the species on the park's target list. If you find any, alert the PCM-10 recorder so that s/he can record the species' name and location. During this process, the entire plot sampling area (20 x 50 m rectangle when doing intensive measurements; or 10 m-radius [when fuels are not measured] or 15.24 m-radius [when fuels are measured] circles when doing extensive measurements) should be scanned. Use a tape or laser rangefinder to determine the area included in this circle. After scanning of the plot is complete, work together as a group to fill in the rest of the Target Species Assessment table on the data sheet:

Species: species' scientific name or USDA Plants Symbol

Abundance class: abundance class code as described at the bottom of the data sheet (1 = one individual; 2 = few individuals, cover < 1 m²; 3 = cover 1-10 m²; 4 = cover 11-25 m²; 5 = cover 25m² of site).

Location: Describe the location of the species, being as specific as possible but not taking too much time. Sketch this location on 2nd page of data sheet if helpful. If you only find the species outside the site (e.g., you find it when looking for surrounding-area disturbances), explicitly state that it is outside the 27 m radius. Record UTM coordinates of an individual or center of a patch if this will aid in relocation. Examples of location descriptions:

- “3 m into plot from point # 20 on A transect” (for a single individual)
- “1 m-radius clump 5-10 m NE of A0 corner; inside site” (for a single clump)
- “5 m outside site boundary at bearing of 230° from plot center”
- “scattered in NE quarter of site” (for more diffuse, but not widespread, occurrence)
- “throughout site”

Comments: Add any comments that could help someone find the species again or anything else that could be helpful.

When Data Collection Is Complete

When data collection is complete, the crew lead is responsible for checking all data sheets to ensure that all blanks are filled as appropriate, entries are legible and make sense, species codes are accurate, codes for unknowns are clearly described, the completed data sheets (there should be one, four-page form) are in the appropriate plot folder, voucher specimens are labeled and safely stowed, all non-standard photographs are recorded on the photolog, and the plot folder is in a backpack for transport. **It is important to validate the data at the plot. All changes made to datasheets after leaving the plot will need to be done in red ink, initialed, and dated.** Another person is responsible for ensuring that all equipment is collected and ready for transport.

SOP Unknown Plants: Collecting and Documenting Unknown Plants and Vouchering Specimens

Version 1.01

Prev. Version	Revision Date	Revised by	Changes Made	Reasons for Change	New Version
1.00	11/11	LEB/IWA	Change to nrps style. Changed coding instructions	The old method caused loss of data and misidentification in FFI	1.01

This standard operating procedure (SOP) explains the procedures for collecting and documenting specimens that cannot be identified in the field and for preparing voucher specimens. The “Unknown Specimen” datasheet (PCM-11) is used for the unknowns. Both the SOP and the datasheet are modeled after those used by the Heartland I&M Network.

Collecting and Documenting Unknown Plants

Sometimes species determinations of individual plants encountered in sampling are difficult or uncertain. When this occurs, search the area surrounding the unknown plant for a specimen of the unknown that is in flower or fruit. These may assist in correctly identifying the species in the field. Keep in mind that an inordinate amount of time should not be spent trying to identify an unknown plant. If the plant can be keyed out quickly using a plant guide, identification should be attempted. “Inordinate” may vary from day to day or plot to plot – the crew leader will need to use his/her best judgment to determine this.

Creating codes for unknown plants

When a plant cannot be identified in the field, it should be **recorded on the data sheet and the Unknown Plant Log (PCM-15) with a set unknown code**. There should be a new Unknown Plant Log datasheet for every plot where an unknown occurred. The unknown code will vary depending on the level of confidence and the possibility of identification. The code does not include the park code because that is tracked on the top of the Unknown Plant Log. Below is a list of the range of possibilities of unknowns that might be found in the field and how to label them:

(1) *The most common case:* A plant is unknown but there is sufficient material present to collect a sample and/or take photographs and identify it at a later time. In this case, use a unique code for each unknown species at that plot that follows the following convention. The first three letters are “UNK”, follow with “-Plot Number” and then follow with “-Unique number”. So, the first and fifth unknown plant at PCM-016 would be “UNK-016-1” and “UNK-016-5”, respectively.

(2) A very small seedling or plant is present, but identification is nearly impossible or will take an inordinate amount of time and be of low confidence. This assumes a sample is not taken

because it would not be useful. In this case, determine the lifeform of the plant. Choose and record one of the following

- UNKFORB
- UNKGRAM
- UNKSHRUB
- UNKTREE
- UNKVINE

(3) A very small seedling or plant is present, but identification is nearly impossible or will take and inordinate amount of time and be of low confidence. However, you have some evidence not only of growth form but also whether it is annual or perennial. This assumes a sample is not taken because it would not be useful. In this case, determine the lifeform and lifecycle of the plant. Choose and record one of the following

- UNKFORBANN
- UNKFORBPER
- UNKGRAMANN
- UNKGRAMPER

(4) The genus is known, but the species cannot (and will not) be distinguished. A sample does not need to be taken if you are confident that the species will not be distinguished. In this case, write the 5 letter code of the genus. Most often, this is the first five letters of the genus. There are some notable and common exceptions where numbers are included, so if you don't know the code- write the entire name of the genus. Some of the exceptions are:

- Chamaesyce = "CHAMA15"
- Erigeron = "ERIGE2"
- Arabis = "ARABI2"

(5) The family is known, but the genus and species cannot (and will not) be distinguished. A sample does not need to be taken if you are confident that the species will not be distinguished. However, the family cannot be entered into FFI. So in this case, the species should be treated as case (2) or (3) and coded with the appropriate lifeform.

(6) The family and/or genus are known and the species *can* be distinguished at a later date. This should be treated as case (1). Take a sample and assign an unknown code in the same series (e.g. "UNK-016-6"). Add the additional information about genus or family to the Unknown Specimen datasheet (PCM-11) for that species and the Unknown Plant Log (PCM-15).

Collecting and photographing unknown plants

Whenever possible, collect a specimen of the unknown, collecting as much of the complete plant as possible (including roots, flowers, and seed-heads). Place the sample in a plastic bag and label the specimen with the same name as recorded on the datasheet, plot number, and date. If it's really dry, a damp paper towel in the plastic bag may help maintain the plant's freshness until the end of the day. If you know that the plant will not be identified within 24 hours, place the

specimen in a book or plant press. Pressing the plant in a book between the pages of a filled out “Unknown Specimen” datasheet (PCM-11) works well.

Complete specimens should not always be collected. Never collect a plant from a local population of < 10 individuals. If the population is < 10 individuals, collect several photographic vouchers rather than a specimen. When using photographic vouchers, make sure to take photos of all the characteristics that commonly are used for keying out plants – leaf arrangement, hairs, floral arrangement, floral part numbers, fruit (if present), and growth form (i.e., whole plant), etc. If no plants of the unknown occur outside the plot, collect only a portion of the plant; **at no time should the roots be dug up or the entire plant be collected from inside the plot**. Collecting the roots and/or the entire above-ground portion of the plant may affect future sampling events. Even when a specimen is collected, it can be helpful to have photographic vouchers, particularly for showing the way the plant appears in the field rather than pressed flat. **Record information about photos taken for identification purposes on the plot’s Photographic Record Sheet (PCM-3) and on the Unknown Plant Log (PCM-15)**.

Fill out an Unknown Plant Data Sheet (PCM-11) for all unknown plants, whether a specimen or a photographic voucher is collected. The more detailed information that is recorded here, the greater the possibility of a future identification. At a minimum this should include the lifeform of the plant. Guidelines for filling out this form are at the end of this section. Place the data sheet in the appropriate plot folder or, if the plant was collected away from a plot, in the team leader’s field notebook.

Try to identify the unknown (using either specimen or photos) the same day that the plot was visited. Car trips back to base camp or the office are one good time to do this. Use plant guides and the expertise of other field crew members and park staff. If there is insufficient time to identify a plant soon (<24 hours) after it is collected, the specimen should be placed in a plant press and the enclosing newspaper labeled with the Unknown Code, park code, and date. If you wish to keep the specimen unpressed overnight, keep it cool (refrigerator, cooler). At the end of each day, the press and datasheets should be reviewed to make sure that all unknown specimens are accounted for and have been transferred to the plant press.

As soon as possible after the specimen is identified, update the relevant datasheets. On the datasheet(s), find the record(s) for that species (the Unknown Plant Data Sheet should help with finding the first instance, but check the whole data sheet for other instances), and **place a single red line through the unknown code and write the actual name of the species (or species code) on the datasheet using a red pencil or pen. Initial and date the change with the red pencil. The only changes that can be made without using a red pen are those made before leaving the plot.** If the specimen is identified after the data have been entered into the database, consult with the Data Manager for the appropriate way to handle this.

Guidelines for filling out PCM-11, Unknown Plant Data Sheet

Unknown Code: A unique code as described above

Park: Park’s four-letter alpha code

Date: Include month (mm) / day (dd) / year (yyyy)

Observer(s): Initials of those involved in documenting the unknown

Plot, transect and quadrat/point: If the plant was found while collecting data on a transect, record the unique plot ID, transect (A or B), and quadrat set number or point number (i.e., circle *quadrat* or *point* on the data sheet to distinguish between the two). This helps match unknown codes with plant specimens collected for identification purposes. Note that point number is *not* the same as the distance of the point from the transect anchor. Examples:

AGFO-PCM-05 B38 (point) = plot number 5 at AGFO, transect B, point #38

AGFO-PCM-05 A1 (quad) = plot number 5 AGFO, transect A, quadrat set 1

If the plant is collected in or near a plot, but not while collecting data, simply record the plot ID.

GPS zone, coordinates/Elevation: If the plant was found away from a plot, record the GPS zone (13N or 14N), easting, and northing, and, if possible, elevation (in m).

Specimen collected/Photographs taken: Circle yes or no as appropriate.

Plant Type: Circle the appropriate plant type (or describe in “other” if not sure).

Most Salient Feature: Describe the feature that identifies this plant from all others; a unique characteristic.

Leaf Characteristics: Describe the leaf type, leaf margin, leaf surface, petiole, stipule etc.

Stem Characteristics: Describe the shape, pubescence, markings, and color of the stem, branching pattern and location, etc., as well as the bud characteristics.

Flower Characteristics: Describe the floral formula (number of stamens, styles, etc.),, whether ovary is superior or inferior, location of flowers (axillary or terminal), habit (indeterminate or determinate), pubescence, and color.

Habitat/Microhabitat Characteristics: List other species located in the general vicinity and describe the habitat or microhabitat in which it was found.

Best Guess: Preliminary, field guess about species identity.

Confirmed: After consultation of reference books, herbarium, or expert, the species determined. Also record who made this confirmation in the **Confirmed by** space.

Guidelines for filling out PCM-15, Unknown Plant Log

Voucher Specimens

If you find a species not on the park’s verified plant species list, collect a voucher specimen. For this purpose, the collection should be as complete as possible and should be pressed in a manner so that the specimen will fit on herbarium paper and salient characteristics will be identifiable on the mounted specimen. Fill out an Unknown Plant Data Sheet for the specimen, since this

information may help with confirmation of identification and some of it is necessary for herbarium specimen labels. In some cases (e.g., taxa with many similar species), it is wise to send the specimen to an expert (university taxonomist or natural heritage biologist, usually) for an official determination before it is added to the park's species list. Voucher specimens can be left in the plant press until ready to be mounted or sent to an expert.

When the plant is ready to be mounted (sufficiently pressed and dried), do so. Mount the label (see below) in the lower right corner of the mounting sheet. The mounting sheet should be acid-free (use 11 ½" x 16 ½" herbarium stock), and so should the label. Lay the dried specimen on the mounting paper to determine how it will fit on the paper. Attach the specimen to the paper with archival grade glue or mounting tape. When using glue, a nice trick, especially when mounting multiple specimens, is to thin the glue (herbarium glue) with some water, then spread a thin coat onto a cookie sheet. Place the specimen on the glue (careful which side you want up when mounted), press it down so all points are in contact with the glue, then transfer it to the paper

Weights (clean rocks and drinking glasses work well) are often needed to hold the specimen flush with the mounting paper. Allow the mounted specimens to dry overnight before stacking them.

It is the responsibility of the Plant Ecologist to ensure that the specimens are archived in the correct facility (park herbarium, etc.) and the park species list updated as appropriate.

Example of a properly filled out label:

Date: July 18, 2009	Collector: Jane B. Goode	Collection #: 3
Binomial: <i>Centaurea solstitialis</i>		
Authority: L.		
Family: Asteraceae	Common Name: yellow star thistle	
Habitat: Roadside in grassland		
Location Description: S entrance of Wind Cave National Park, Gobbler Ridge		
Numeric Location/UTMs: NAD83 Zone 13N, 622762E, 4819831N		
Elevation: 1224 m		
Determined by: Jane B. Goode		

SOP Wrapping up the Field Season

Version 1.01

Prev. Version	Revision Date	Revised by	Changes Made	Reasons for Change	New Version
1.00	11/11	LEB	Change to nrps style		1.01

Acknowledgement: This is a modified version of the KLMN's SOP #15 "Post Field Season".

This SOP explains procedures that will be completed at the end of the field season, including handling equipment, reviewing the field season and protocol, and checking out seasonal staff. Seasonal crew members will assist the Plant Ecologist and Plant Lead Biotech in completing post season field tasks.

Inventory, Clean, and Store Field Equipment

The Plant Lead Biotech is responsible for the completion of these tasks, but seasonal crew members will carry out much of the work.

1. All equipment should be checked-in following the NGPN property guidelines. Fill out each crew member's gear check-out and inventory form as the equipment is checked in. Electronic equipment (GPS units, rangefinders, laptop computers, etc.) should be checked in with the Data Manager.
2. Record broken or missing equipment on the Network's equipment inventory sheet. Label the equipment with sufficient information so that someone else will understand the specific problem.
3. Report missing or faulty equipment and/or equipment needing repairs to the Plant Ecologist, so that equipment can be repaired or replaced before the following field season. It is the Plant Ecologist's responsibility to account for all equipment and have it repaired or replaced at the end of the field season.
4. All equipment should be cleaned, in working order, and stored in the proper storage location. Equipment should be prepared for winter storage, which will include removing batteries, emptying fluids, and winterizing when applicable.

Reviewing the Field Season and the Protocol

While all field crew members are still employed with the Network, the Plant Ecologist and/or Network Coordinator will meet with the Plant Lead Biotech and seasonal employees to discuss the field season.

Record results from the following tasks on the Field Season Review Form (PCM-12). Numbers here correspond to items on PCM-12.

1. Complete a final, thorough check of all data sheets and clarify any ambiguities.

- Record decisions made regarding these ambiguities and the reasons behind those decisions.

2. Review what was accomplished and what did not get completed.
 - Record all instances of missing data (plot ID, SOP not accomplished) and explain why they are missing.
3. Discuss any and all information that would impact the quality of data collected. This may include species identification problems, misunderstandings of data collection procedures, inclement weather, etc.
 - Record detailed descriptions of these issues, including the specific data to which they apply.
4. Determine whether the field crew has any concerns that should be addressed prior to the next field season. Include a discussion of how issues in item 3 above could be remedied.
 - Record the concerns and suggestions.
5. Determine how the field season went overall.

Record the results from the following tasks on the Protocol Review Form (PCM-13). Numbers here correspond to items on PCM-13.

1. Discuss options to improve upon any aspect of the written protocol. Think about whether specific areas need clarification, how the SOPs are organized, whether fewer or more SOPs are needed, etc.
2. Discuss field and office equipment. Topics may include whether software needs updating, suggestions for additional or different equipment for specific tasks, etc.
3. Review the training process and see if there are any areas for improvement or if there is additional training the field crew needs.

In addition to the field crews, the Plant Ecologist should contact each Park Contact to accomplish the following:

Ensure that all park keys have been returned.

If park housing was used, make certain it was left in proper order.

Discuss the field season and determine if the park staff had any concerns or areas for improvement. (*Record this information in item 5 on Field Season Review Form*)

Checking out Seasonal Employees

It is the Network Coordinator's responsibility to follow the Network's employee check-out procedures when ending the employment of seasonal employees. At the end of the field season, at least two weeks prior to the end of the seasonal employee's employment, the Plant Ecologist should inform the Network Coordinator about an end date for each employee. The Network Contact should then work with administrative staff to complete the final paperwork, including Employee Performance Appraisals.

SOP Data Management

Version 1.01

Prev. Version	Revision Date	Revised by	Changes Made	Reasons for Change	New Version
1.00	11/11	LEB, IWA	Change to nrps style; added content related to automated data checks	Added automated data checks	1.01

Acknowledgement: The metadata, data storage, and scheduling portions of this SOP are based on data management SOPs of the Klamath Network (KLMN), with substantial revisions by Stephen Wilson of the NGPN.

This standard operating procedure (SOP) explains the procedures for managing data from the plant community composition and structure monitoring project of the Northern Great Plains I&M Network (NGPN). FEAT/FIREMON Integrated (FFI) is the primary software environment for plant community data. Instructions in this SOP are for version 1.04.00. ESRI ArcGIS is used for managing spatial data associated with plant community monitoring locations. Procedures and guidelines in this document follow recommendations of the NGPN Data Management Plan (Appendix E of Gitzen et al. 2010), S. Fancy at <http://science.nature.nps.gov/im/monitor> and citations therein, and the NPS Natural Resource GIS Program.

Metadata

Metadata is defined as structured information about the content, quality, condition, and other characteristics of a product. In addition to spatial information, metadata include information about data format and collection methods, time of collection, originator, access/use constraints, and distribution.

Data products from this protocol will be of two major types: spatial data in ArcGIS format and FFI databases. Metadata for ArcGIS products will be created using the NPS Metadata Tools and Editor (http://science.nature.nps.gov/NGRIS/applications/gisapps/gis_tools/mte.aspx) or the metadata tool in ArcCatalog, which automatically harvests spatial organization and reference information. Metadata for FFI products will be extracted using FFI or created by the Data Manager using the NPS Metadata Tools and Editor. For both product types, the following standards and responsibilities apply:

1. Data collected through I&M-funded projects will meet FGDC, NBII (National Biological Information Infrastructure; www.nbii.gov), and NPS standards, including being described with the NPS Metadata Profile.

2. The Plant Ecologist is expected to submit a data dictionary (for tabular and spatial data) and Metadata Interview (PCM-14) form prior to the start of the first field season of data collection under this protocol.
3. The Plant Ecologist is expected to review and revise all data dictionaries and Metadata Interview forms at the end of each field season and report changes to the Data Manager before the beginning of the next field season.
4. It is the responsibility of the Data Manager to develop the official metadata based on the data dictionary and Metadata Interview form provided by the Plant Ecologist.
5. It is the Data Manager's responsibility to parse and transfer metadata to the NPS Natural Resource Information Portal, if applicable.
6. The Data Manager will work with the Plant Ecologist and park staff to determine the sensitivity level of any data.

Steps for Metadata Creation

1. Metadata Interview Form and Information Gathering
 - a. The Plant Ecologist should complete the NGPN Metadata Interview Form (PCM-14) as completely as possible at the project onset to facilitate compiling the information required to create compliant metadata. It is recognized that changes to the answers to this form will occur throughout the project.
 - b. The Plant Ecologist or designee will create a data dictionary to help the Data Manager create or update the official metadata. The data dictionary should include:
 - i. the name and purpose of each table, shapefile, coverage, or feature class;
 - ii. a list of attribute names, types, sizes, and descriptions by table (see example at the end of this SOP).
 - c. The Project Lead should provide a copy of any additional information that might be valuable for the development of metadata to the Data Manager.
2. Sensitivity Review
 - a. The Network Data Manager will be responsible for marking data as sensitive when uploading to the NPS Natural Resource Information Portal. Sensitivity will be determined through the "Sensitivity" question in the Metadata Interview Form and through consultation with park staff.
3. Biological Data Profile

- a. If a dataset includes biological information (most Plant Community Protocol datasets do), the Biological Data Profile provides a set of extended metadata elements to document the species observed, taxonomic information, methods, and analytical tools.

4. Metadata Review

- a. The Data Manager will review metadata for quality control (QC) prior to posting them to the NPS Natural Resource Information Portal (<http://nrinfo.nps.gov/Home.mvc>).

5. Metadata Parsing and Exporting to XML Format

- a. Metadata records shall be parsed into the NPS Metadata Profile and then exported to XML format.
- b. These steps can both be done directly with the NPS Metadata Tools and Editor (see help menu in NPS Metadata Tools and Editor). If using other applications, export the metadata first to ASCII text format and then parse with Metadata Parser (MP). MP can simultaneously output an XML format metadata file as well. MP must be customized to handle NPS, Biological Data, or ESRI Profile metadata elements.

6. Posting Metadata to the Natural Resource Information Portal

- a. Anyone with an Active Directory/NPS Account and logged on to a NPS computer can create or post metadata (referred to as a Reference) records.
- b. Currently the only profile that is accepted is the NPS Metadata Profile. More information about uploading metadata is available at:
<https://nrinfo.nps.gov/ReferenceDomain.mvc/Welcome>

7. Editing/Updating Metadata Already Posted to NPS Natural Resource Information Portal

- a. The NPS Natural Resource Information Portal allows online editing of metadata record (referred to as a Reference) details. Only Reference Owners have permission to edit the record. Any updates made to metadata that are posted to the portal will not be reflected in the source xml file that was uploaded.
- b. If a metadata record posted to the NPS Natural Resource Information Portal contains errors or requires significant edits, it will need to be deleted from the NPS Natural Resource Information Portal, edited locally, and then uploaded again. Refer to Natural Resource Information Portal Help (<http://nrinfo.nps.gov/Help.mvc/showWelcomePage>).

Paper Data Sheets

With the exception of GPS data, all data from this protocol are initially recorded on paper data sheets. Therefore, it is imperative that these records are safeguarded against loss or damage while in the field and office.

All data sheets and their copies will be printed on acid-free paper for long-term storage.

Original data sheets will be stored in fire-proof cabinets in the Network Office upon return from the field tour in which the data were collected. They will be removed only when in use for data entry, verification, and validation, and returned to the cabinet at the end of each day.

Scans of completed data sheets are to be made as soon as possible, preferably at the end of the day on which they were completed, but no later than the day of return to the office at the end of the tour in which the data were collected.

Scans will be thoroughly checked to make sure that all information on the originals is legible. The original data sheets will be stored as described above. Scan files are stored on the server. Refer to the scanner user manual for assistance in setting the scanner to optimize scan quality without unnecessarily increasing file size. The Network has a simplified user guide for the current scanner.

Any data sheets that were annotated (e.g., corrections made) during the data entry, verification, and validation processes are scanned again when validation is complete. Scan files made before the annotations were done are destroyed and replaced with the new versions.

Scanning and Naming Scan Files for Paper Data Sheet Backup

All data sheets are scanned and saved in Adobe PDF format using the following standard naming convention and stored in their respective subfolder (refer to Data Storage section later in this SOP).

Data from the site evaluation data sheet (PCM-1) are scanned into a site evaluation scan file.

Data from the plot establishment data sheet (PCM-2) are scanned into a site establishment scan file.

Data from the photo-log datasheet (PCM-3) are scanned into a photolog scan file.

All other data collected at a plot (PCM-4, 5, 6, 7, 8, 9, 10, 11) are scanned into the plot data scan file.

Field season (PCM-12) and protocol (PCM-13) review forms are scanned into a field season or protocol review scan file.

The standard naming convention is: PARK_PCM_XXX(X)_contents_YYYYMMDD.pdf, where PARK is the four-letter park code (five-letter code to distinguish between the north

and south unit of THRO), PCM is always used to indicate plant community monitoring, XXX(X) is the plot number (some parks will have 3 digits, others 4), “Contents” indicates the contents of the file, and the date (YYYYMMDD) is in the format: year (four digits) month (2 digits) day (2 digits). All file name components are separated by an underscore.

Options for the file contents portion of the name are “SiteEval” for the site evaluation scan file; “SiteEstab” for the site establishment scan file, “Photolog” for the photolog scan file, “PlotData” for the plot data scan file, “FieldSeasonReview” for the field season review scan file, and “ProtocolReview” for the protocol review scan file.

Scanned files shall be checked to ensure that the file names correctly reflect the file content.

Photograph Management

Plant community monitoring photographs (recorded on PCM-3) are managed similarly to scanned datasheets. Each photograph is named using standard file naming conventions and stored in their park subfolders. The original digital photographs are copied from the camera’s memory card to the NGPN server

(N:\Groups\Monitoring\Plant_Community\PARK\IMAGES\Originals\, where “PARK” is the park’s code). Then, a copy is made, stored in a new folder

(N:\Groups\Monitoring\Plant_Community\PARK\IMAGES\Edited\), and given a more descriptive file name that includes the original photo number (see below). This temporary duplication is needed to retain the ability to cross-check photos with original datasheets and/or photo-logs until the photo files are ready for archiving. Only the edited files are archived.

Photo-log data sheets (PCM-3) are scanned into the photolog scan file as described in the previous section and stored in the appropriate Originals folder until verification and validation are complete. When these steps are complete, the scan file is transferred to the appropriate Edited folder.

The standard naming convention for photographs (i.e., the names given to copies) is PARK_PCM_XXX(X)_Contents_OriginalPhotographName_YYYYMMDD.jpg, where PARK is the four-letter park code [five-letter code to distinguish between the north (THRON) and south (THROS) unit of THRO]; PCM is always used to indicate plant community monitoring; XXX(X) is the plot number (some Parks will have three digits, others four); “Contents” indicates the contents of the file; OriginalPhotographName is the file name (number) given to the photo file by the camera and recorded in the “File Name” column of PCM-3; and the date (YYYYMMDD) is the date the photo was taken in the format: year (four digits), month (two digits), and day (two digits). All file name components are separated by an underscore.

The Contents portion of the name is from the Photo Name column of PCM-3. Examples include “SEP_PAN1” (panorama photo 1 from site evaluation); “Trans_T1BT1F” (tree transect 1 from beginning to finish end); “Trans_A0A50” (herb-layer transect A from 0 end to 50 end); and “UnkGrass1_Collar” (photo of the collar of a grass that could not be identified).

When a photograph is not associated with a specific plot (e.g., the crew comes across a plant that might be a target species while walking to a plot), the plot number portion of the name is eliminated.

NGPN does not record the direction (bearing) in which the photograph was taken for standard photographs, but rather relies on the plot establishment protocol that records transect bearings. Bearing can be recorded in non-standard circumstances and included in the file contents portion of the file name.

Edited images shall be checked to ensure that image name correctly reflects the image content.

FFI does have the capability to link photographs to plots through the Plot Description protocol. NGPN will likely use this feature in the future.

FFI Data Management and Entry

FFI is installed as a networked system, with the databases residing on the NGPN server in the default SQL directory. Users access the databases through client computers that are connected to the local area network. General instructions for using FFI are thoroughly documented in the FFI User Guide, which is included with the FFI software and can be accessed online at <http://frames.nbii.gov/ffi/help/ffi>.^b Therefore, only data entry instructions specific to NGPN are included in this SOP. Attachment 1 includes detailed user documents for entering data into FFI for this protocol.

User Roles

FFI has four levels of users: Administrator, Manager, Data Entry, and Reader (see “User roles and permissions” in the FFI User Guide for details on the permission allowed for each of these roles). For NPGN, the Database Manager and Plant Ecologist will have the Administrator user level; the Plant Lead Biotech will have the Manager user level, and field crew members will have the Data Entry user level. Others wishing to use the data may be assigned a Reader user role.

Although the Data Entry user role in FFI allows Data Entry users to create Macro Plots and Sample Events (see “Structure of Data” below), field crew members will **not** perform these tasks while entering data. Only the Data Manager, Plant Ecologist, or Plant Lead Biotech will do these tasks in order to reduce the chance for errors.

Structure of Data – Project Management in FFI

This section describes the setup of FFI databases. The processes described in this section are done only by permanent Network staff (Data Manager, Plant Ecologist, and Plant Lead Biotech).

^b If questions about using the program are not answered in its user guide, they can be posted to the FFI Discussion Group and are usually quickly answered. Contact information for direct technical support is also on the FFI Web Site

(http://frames.nbii.gov/portal/server.pt?open=512&objID=483&&PageID=2216&mode=2&in_hi_userid=2&cached=true).

Data are entered into an FFI Database, which only Administrator-level users can create. Each NGPN park is a distinct FFI Database named with the park's four-letter code. This structure allows for improved performance within the database and provides for ease of querying and analyzing data. It is possible to have more than one "Administrative Unit" per database, but NGPN's standard procedure is to have only one, and it has the same name as the database (i.e., the park's code). Only Administrator- and Manager-level users can create administrative units.

Within an Administrative Unit are Project Units and Macro Plots. Project Units are defined so that they represent an area on the ground, and they provide a means to functionally group Macro Plots for management and analysis. Project Units based on the NGPN sampling design are the same as sampling strata, but there are additional Project Units, such as those for Prairie Cluster Prototype legacy plots. Table 1 shows initial Project Units. Other Project Units may be defined for analysis purposes (e.g., domain analyses concentrating on a certain portion of a park). Project Units may overlap spatially.

Table 6. Initial Project Units for NGPN data entry into FFI. These project units correspond to strata designated when sampling frames were defined for each park. Other Project Units may be created.

Park	Project Unit	Description
AGFO	Park	whole park
	Prairie Cluster	area encompassing legacy plots from Prairie Cluster LTEM program
	Legacy	
	Riparian	area in which riparian-specific protocol is used
BADL	North Unit	entire North Unit
DETO	Upland	upland stratum
	Riparian	riparian lowland stratum
FOLA	Upland	upland stratum
	Riparian	lowland stratum
FOUS	Bodmer	Bodmer Overlook stratum
	Fort	Fort stratum
JECA	Park	whole park
MORU	Park	whole park
SCBL	Park	whole park
	Prairie Cluster	area encompassing legacy plots from Prairie Cluster LTEM program
	Legacy	
	Riparian lowland	area to which extensive woody sampling is limited
THRO	North Upland	North Unit's upland stratum
	North Riparian	North Unit's riparian lowland stratum
	South Upland	South Unit's upland stratum
	South Riparian	South Unit's riparian lowland stratum
WICA	Park	entire park
	Forest	area in which extensive woody sampling occurs

When a Project Unit is created, at a minimum, the following information must be entered:

1. Name (see Table 1)
2. Date (automatically populated with current date)
3. Agency = National Park Service
4. GRID file location = location of GIS file delineating spatial extent of Project Unit
5. Description Tab = description of how the Project Unit is delineated and why it was created
6. Macro Plots Tab = Macro Plots associated with this Project Unit (See “Creating a Project Unit” in the FFI User Guide.)
7. Monitoring Status Tab = Add “Monitoring Status” classes for the plots that will be sampled that year using the “Monitoring Status Builder” that pops up when you click on “Add”:
 - a. If the plot is being visited on its normal schedule (i.e., according to the set revisit design), use “Sched” (for scheduled) for the Prefix. If the plot visit is supplementary (not on the normal revisit schedule), use “Suppl” for the Prefix.
 - b. Base is the Panel to which the plot is assigned, designated by Panel1, Panel2, Panel3, Panel4, etc. for Intensive plots. For Extensive Plots, use PanelE.
 - c. Suffix is the visit number; the first data collection visit is Visit1, the second is Visit2, etc. Scheduled and Supplementary visits have separate sequences.
8. Metadata
 - a. Physical Description = description of how Project Unit is delineated; see Appendix B of the Plant Community Protocol document for the Project Units in Table 1.
 - b. Comment = reason for delineation of Project Unit (e.g., reason stated in Appendix B of the Plant Community Protocol document).

A Macro Plot is a geographic sample point around which data are collected. Thus, a Macro Plot in FFI corresponds to a NGPN plot. Multiple Macro Plots occur in each Project Unit, and an individual Macro Plot may be assigned to multiple Project Units.

Data from the Plot Establishment Data Sheet (PCM-2) are entered into the Macro Plot form. Before doing this, calculations using the values in Table 2 on page 3 of PCM-2 must be

completed using the Excel spreadsheet made for this (N:\Groups\Monitoring\Plant_Community\Miscellaneous\grade_calcs.xlsx). An explanation of the values calculated by this sheet follows.

1. The average grade for each transect is calculated using the general formula

$$d = \frac{(a \times c) + b \times (distance - c)}{distance}$$

where “distance” is the distance between the beginning and end of the vector, and a, b, and c refer to the columns in Table 2. The correct formula for each cell in column **d** is shown in the example below.

2. The average grade for each transect for which there are data entered in columns **a-c** is calculated using this formula. For example, in Row 1, a=18, b=14, and c=9; the result of the formula is 15.846. Round the result to the nearest whole number (16). (The result should be between the values in columns **a** and **b**.)
3. *Average 1* is the average of the values in column **d**, rows 1-3.
4. *Average 2* is the average of the values in column **d**, rows 4-6.

Table 7. Example Table from PCM-2.

Vector	(a) Start to Change Point Slope Grade (%)	(b) Change Point to End Slope Grade (%)	(c) Location of Change Point (m)	(d) Average Grade
(1) B0 → A0	18	14	9.23	$\frac{(a \times c) + b \times (20.00 - c)}{20.00} = 16$
(2) T2B → T2F	10	16	15.29	$\frac{(a \times c) + b \times (30.48 - c)}{30.48} = 13$
(3) B50 → A50	16	25	8.47	$\frac{(a \times c) + b \times (20.00 - c)}{20.00} = 21$
				Average 1: 17
(4) B0 → B50	1	8	40.21	$\frac{(a \times c) + b \times (50.00 - c)}{50.00} = 2$
(5) T1B → T1F	5	5	0	$\frac{(a \times c) + b \times (30.48 - c)}{30.48} = 5$
(6) A0 → A50	2	4	14.19	$\frac{(a \times c) + b \times (50.00 - c)}{50.00} = 3$
				Average 2: 3

Proceed to enter data from the Plot Establishment Data Sheet (PCM-2) and grade_calcs.xlsx into the Macro Plot form, where the Macro Plot field name is followed by the PCM-2 field name. *Be sure to type carefully and avoid adding extra spaces or dashes instead of underscores:*

1. Name: Plot ID (e.g., BADL_PCM_0025, THRON_PCM_0043, KNRI_PCM_014)
2. Type: Leave blank
3. Purpose: enter “IM_Dual”, “IM_Intensive” or “IM_Extensive” according to the type circled for Plot Type

4. Project Units: use “Assign to project units” to assign to appropriate project units, which are not on PCM-2.
5. Elevation: Elevation
6. Elevation Units: Select “meters” from the drop-down list.
7. Azimuth: Azimuth of herb-layer transects (0 to 50) and/or Tree Transect 1 (B to F)
8. Aspect: Overall aspect of plot (°)
9. Hill slope: Cell E5 in grade_calcs.xlsx (Average 1). If variable, add “9999”.
10. Transect slope: Cell E8 in grade_calcs.xls (Average 2). If variable, add “9999”.
11. UTM Easting: Plot Center UTM E
12. UTM Northing: Plot Center UTM N
13. UTM zone: Plot Center UTM Zone (Enter only the digits – 13 or 14 – no “N”!)
14. Datum: enter “NAD83”
15. Error: GPS precision (used only when GPS unit gives precision in meters, which is generally not the case if the standard GPS unit is used)
16. PDOP: Plot Center PDOP
17. Longitude: leave blank
18. Latitude: leave blank
19. Install date: Date Established
20. Future visit date: leave blank
21. Retire date: leave box unchecked
22. Located by: Established By (3-letter initials, separated by commas)
23. Directions Tab, Start Point: Description of point at which to start walking...
24. Directions Tab, Directions: Description of route to plot from starting point
25. Metadata Tab: leave blank
26. Comments Tab: Notes

27. User Variables: For UV1, UV2, UV3, and UV4, enter the two-letter code of the item circled on the data sheet

- a. UV 1: Topographic position
- b. UV 2: Surface water
- c. UV 3: Hydrologic regime
- d. UV 4: Vegetation type
- e. UV 5: leave blank
- f. UV 6: leave blank
- g. UV 7: leave blank
- h. UV 8: leave blank

Each Macro Plot has at least one Sample Event, which is a specific point in time at which sampling was conducted. For NGPN, a Sample Event corresponds to a sampling date, which is recorded at the top of every data sheet. A Sample Event belongs to only one Macro Plot, but many kinds of data can be entered for each Sample Event. Each type of data is referred to as a Protocol. For NGPN, the following FFI Protocols, and their corresponding NGPN SOPs and data sheets, are used:

FFI Protocol “Cover – Points (metric)” is used for PCM-4 (Point-Intercept Data Sheet) in SOP Plant Sampling.

FFI Protocol “Density – Belts (metric)” is used for PCM-5 (Nested Quadrats Data Sheet) in SOP Plant Sampling.

FFI Protocol “Trees – Individuals (metric)” is used for PCM-6 (Trees Data Sheet) and PCM-7 (Poles Data Sheet) in SOP Trees and Shrubs.

FFI Protocol “Density – Quadrats (metric)” is used for PCM-8 (Seedlings Data Sheet) in SOP Trees and Shrubs.

FFI Protocol “Surface Fuels” is used for PCM-9 (Ponderosa Pine Forest Dead & Downed Fuels Data Sheet) in SOP Surface Fuels.

FFI Protocol “Disturbance History” is used for the Site Disturbance Assessment portion of PCM-10 (Site Disturbance and Target Species Assessment) in SOP Disturbance.

FFI Protocol “Cover – Species Composition (metric)” is used for the Target Species portion of PCM-10 (Site Disturbance and Target Species Assessment) in SOP Disturbance.

For each Sample Event data are entered as follows (Macro Plot field name followed by instructions):

1. Date: Date at top of data sheet (e.g., PCM-5). In the unusual event that data are collected from the same plot on different dates in the same year, but in close temporal proximity (e.g., ran out of time on the first day, so had to complete the next day), the date assigned to the Sample Event should be the earliest date.
2. Macro Plot: field is automatically filled in
3. Default Monitoring Status: *leave blank*
4. UV1: Version of protocol under which data were collected (e.g., PCCSM 1.00)
5. UV2, UV3: leave blank
6. Protocols Tab: use “Add/Remove Protocols” button to select the Protocols used in this Sample Event
7. Team Tab: Enter the names of readers/recorders or observers on each data sheet, specifying the data/protocol to which they belong. See example in Figure 1.
8. Comments Tab: Enter the information in the “Comments” field from individual data sheets, specifying the data/protocol to which they belong as in the Team Tab.

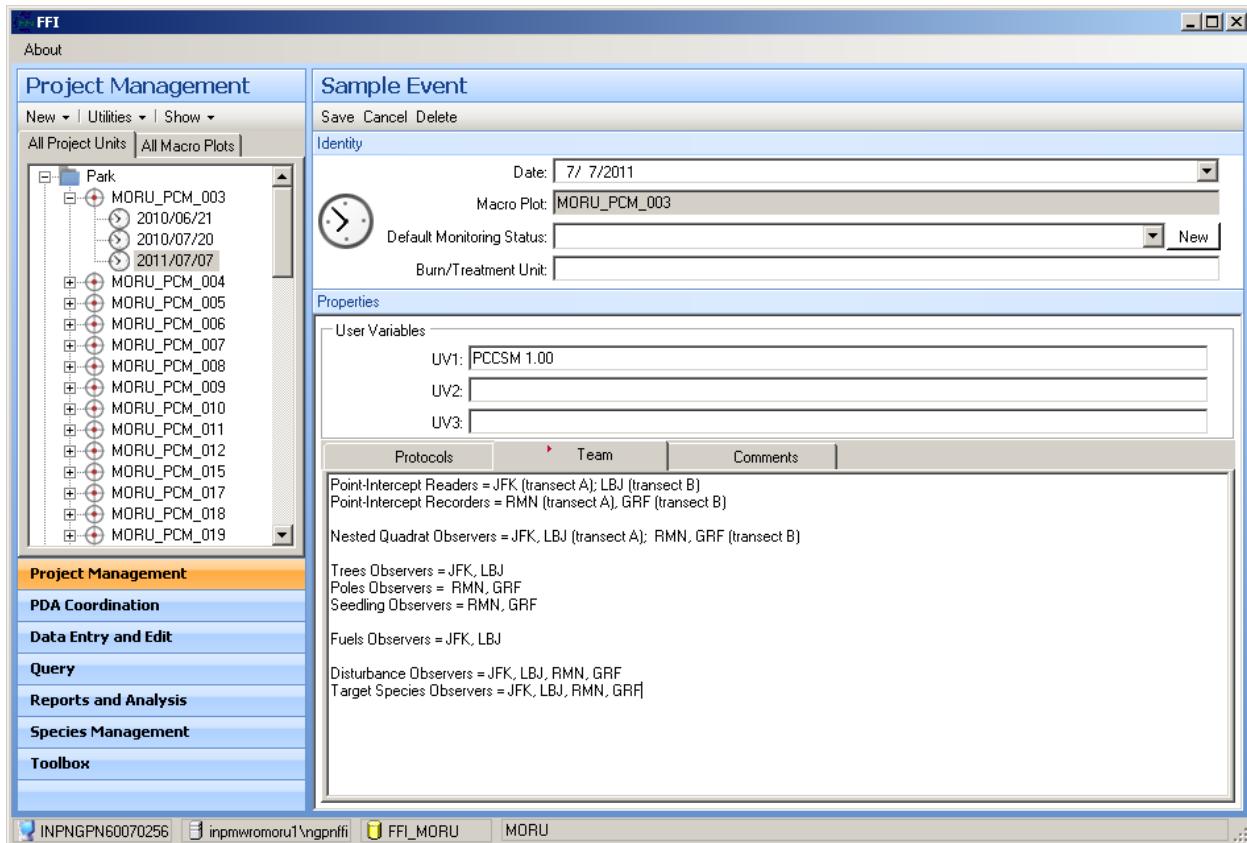


Figure 15. Example of reader/recorder/observer information into Team Tab of a Sample Event.

Assigning Species Lists to Databases – Species Management in FFI

This section describes NGPN-specifics about species lists that are used during data entry. More details about common processes used with species lists (e.g., creating new picklists, adding user species, adding species from the Master List, and working with unknowns) are given in the FFI User's Guide. Species lists are created by permanent Network staff (Data Manager, Plant Ecologist, Plant Lead Biotech), but field crew members may, during the course of data entry, edit a generic unknown species already in a list to accommodate an unknown species on a data sheet. This will be done under the supervision of a permanent staff member.

When entering species codes into an established FFI field, a picklist limits the codes that can be entered to those that are appropriate for that field. In most cases, this picklist is the entire species list specific to the park. Custom picklists can be created for certain protocols to reduce the number of choices, thereby speeding up data entry and reducing errors. For example, a picklist for the Trees – Individuals Protocol could be created to include only tree and tall shrub species. NGPN picklists were created for each park that include all species seen in the PCM plots in 2010 and 2011.

Before data entry involving species can begin, a species list must be attached to the Database. The Data Manager, Plant Ecologist, and Plant Lead Biotech work together to create these lists, one for each park. The most expedient method to create these lists is to import and slightly revise those already created for Network parks by the NGP FireEP. These lists were created

from the NGPN-certified lists completed during the Inventory stage of the program, and they have been updated to include information on life cycle, life form, and origin of each species. In addition, they include entries for commonly occurring “unknowns”, such as *Astragalus* species. The NGP FireEP does not have species lists for three NGPN parks (FOLA, MNRR, and NIOB). For these, species lists can be built within FFI by adding species from the FFI Master List (which includes all species in the USDA PLANTS database) or by creating a list outside of FFI, then importing it. Consultation with FFI technical staff is recommended for the latter. When species codes change or there are taxonomic revisions, these changes are noted on the Species Name Change Log (PCM-16). Changes are then made in FFI by batch replacing old species codes with the newer name. A scan of PCM-16 is kept with the species lists.

Data Entry

This section describes NGPN-specifics of entering data into FFI Protocols. Data entry is best performed by a person who is familiar with the data and data collection processes. Therefore, the field crew members enter data as soon as possible after the data are collected. The processes described in this section can be done by any FFI user at the Data Entry or higher user level.

Specific instructions for entering each kind of data follow the same format. The field name in the FFI protocol is first, followed by a colon. After the colon, the field name on the data sheet (plain text) or instructions (*italics*) is given. Where applicable, the unit of measure used for the field in FFI is given in underlined text after the FFI field name. See Attachment 1 for a detailed user guide with screen captures.

Cover – Points (metric) Protocol, data from PCM-4

1. Visited: click on bar to change to “Yes”
2. Num. Transects: enter “2”
3. Tran. Length (meters): enter “50”
4. Num. Pts./Tran.: enter “50” or “100”, as appropriate
5. Offset: enter “-0.2”
6. Transect: enter “1” for A transect, “2” for B transect
7. Point: Point
8. Tape: field is filled in automatically
9. Order: hit number, where Top Hit = 1, Hit 2 = 2, etc.; for the Ground hit, enter “0” (zero)
10. Height (meters): Height This is filled in only when Order = 1; otherwise leave blank.
Range 0.01- 3.00.
11. Species: species code entered in cell corresponding to Point and Order

- a. Type the value in or use the pick list to select the appropriate code. Only values on the appropriate park species list are allowed to be entered.
- b. If the species code on the data sheet is not in the pick list and it is a valid code (i.e., an unknown or confirmed to be new to the park), use the Species Management function of FFI to add the species to the picklist. (See FFI User Guide for instructions.)

12. Status: select “L” (live) for living material (live plants) and “D” (dead) for non-living material.

13. Comment: enter any comments associated with this cell (e.g., brief summary of, or salient feature recorded on, PCM-11 Unknown Plant Data Sheet); leave blank if there are none

14. UV1, UV2, UV3: leave blank

Density – Belts (metric) Protocol, data from PCM-5

- 1. Visited: click on bar to change to “Yes”
- 2. Num. Transects: enter “2”
- 3. Num. Subbelts: enter “5”
- 4. Tran. Length (meters): enter “1”
- 5. Tran. Width (meters): enter “1”
- 6. Tran. Area (square meters): enter “10”
- 7. Transect: enter “1” for A transect, “2” for B transect
- 8. Subbelt: Set
- 9. Item Code: Species Code
 - a. Type the value in or use the pick list to select the appropriate code. Only values on the appropriate park species list are allowed to be entered.
 - b. If the species code on the data sheet is not in the pick list and it is a valid code (i.e., an unknown or confirmed to be new to the park), use the Species Management function of FFI to add the species to the picklist. (See FFI User Guide for instructions.)
- 10. Status: select “L”
- 11. Size Class, Age Class: leave blank

12. Count: enter “1”
13. Height: leave blank
14. Subplot Frac.: enter the Area divided by 10, i.e., where Area is 0.01, enter “0.001”; where Area is 0.1, enter “0.01”; where Area is 1, enter “0.1”; and where Area is 10, enter “1”.
15. Comment: enter any comments associated with this cell (e.g., brief summary of, or salient feature recorded on, PCM-11 Unknown Plant Data Sheet); leave blank if there are none
16. UV1, UV2, UV3: leave blank

Trees – Individuals (metric) Protocol, data from PCM-6 and PCM-7

1. Visited: click on bar to change to “Yes”

2. Plot Size (hectares):

- a. for intensive visits (Visit Type at top of PCM-6), enter “0.1”
- b. for extensive visits, enter “0.031”

3. Snag Plot Size (hectares):

- a. for intensive visits, enter “0.1”
- b. for extensive visits, enter “0.031”

4. Break Pnt. Dia. (centimeters): enter “15”

Before entering data, Click on “View” (upper left corner of table) and check/uncheck boxes as necessary so that only the following columns show: Is Verified, Quarter, Subplot Frac, Tag Num., Species, Status, DBH, DRC, Comment, UV1, UV2. Select “Save View Settings” at the top of the check list so this will be the view whenever this protocol is used.

5. Is Verified: leave this alone for now

6. Quarter: Quarter

7. Subplot Frac.:

- a. for trees (PCM-6) in either visit type, enter “1”
- b. for poles (PCM-7) in intensive visits, enter “0.314”
- c. for poles (PCM-7) in extensive visits, enter “1”

8. Tag Num.:

- a. for trees from an intensive read (PCM-6), Tag
- b. for trees (PCM-6) from an extensive plot and for poles (PCM-7) in any type of read, enter a three-digit number, where the 1st digit is the quarter (1-4) and the 2nd and 3rd digits are a dummy tree number, beginning with 01, and increasing with order of entry (FFI requires a tag number even if tree is not tagged in field)

9. Species: Species Code

10. Status:

- a. for trees (PCM-6), select “L” when Condition Code = SND, DBK, DIS, DEC or INS, select “D” when Condition Code = RS, LS, or CS

- b. for poles, select L or D as circled in Live/Dead

11. DBH/DRC (centimeters): DBH or Diameter

- a. For trees (PCM-6), enter the value in the DBH field on the data sheet into the DBH field in FFI unless Species Code is JUSC2; for JUSC2, enter the Diameter value on the data sheet into the DRC field of FFI.
- b. For poles (PCM-7), consult the species list in SOP Trees and Shrubs to determine whether the value in the Diameter field on the data sheet should be entered into the DBH or DRC field in FFI.
- c. If multiple stems are to be treated as a single individual (which is indicated by a circle encompassing two or more lines on the data sheet; see SOP Trees and Shrubs, Special DRC situations), enter only one line of data for these multiple stems; you must calculate the value to enter into DRC as the square root of the sum of the squared stem diameters of those grouped on the data sheet.
- d. A value should be entered either in DBH or DRC, not in both. Leave the other one blank.

12. Comment: enter any comments associated with this cell (e.g., brief summary of, or salient feature recorded on, PCM-11 Unknown Plant Data Sheet); leave blank if there are none

13. UV1:

- a. for trees (PCM-6), enter In or Out as recorded in In/Out
- b. for poles (PCM-7), leave blank

14. UV2:

- a. for trees (PCM-6), Condition Code (separate multiple codes with a space)
- b. for poles (PCM-7), leave blank

When done entering all data from PCM-6 and PCM-7, check carefully through the data then click on the “Verify All” button just under “Save”.

Density – Quadrats (metric) Protocol, data from PCM-8

1. Visited: click on bar to change to “Yes”
2. Num. Transects: enter “1”
3. Num. Quad./Tran.: enter “4”
4. Quad. Length (meters): enter “10”; note that this is simply a reminder of the radius of the plot; FFI does not use it for any calculations

5. Quad. Width (meters): enter “10”; note that this is simply a reminder of the radius of the plot; FFI does not use it for any calculations
6. Quad. Area (square meters): enter “314.2”
7. Transect: enter “1”
8. Quadrat: Quarter
9. Item Code: Species Code
10. Status: select “L”
11. Size Class:
 - a. if Height > 137 cm? is “Y”, select “SA”
 - b. if Height > 137 cm? is “N”, select “SE”
12. Age Class:
 - a. if Stump sprout? is “Y”, select “R”
 - b. if Stump sprout? is “N”, select “I”
13. Count: Total
14. Height: leave blank
15. Subplot Frac.: Refer to the number of quarters counted for the species at the bottom of the data sheet; enter “1” if 4 quarters were counted, “0.75” if 3 quarters were counted, “0.50” if 2 quarters were counted, and “0.25” if 1 quarter was counted.
16. Comment: enter any comments associated with this cell; leave blank if there are none
17. UV1, UV2, UV3: leave blank

Note: If no seedlings occurred in this plot, enter values as directed for steps 1-6. Then create one row of data, for which Transect is 1, Quadrat is 1, Item Code is “NOSP”, Status is X, Size Class remains blank, Age Class is X, Count is 0, and Subplot Frac. is 1.

Surface Fuels Protocol, data from PCM-9

1. Visited: click on bar to change to “Yes”
2. Fine Woody Debris section
 - a. Num. Transects: enter “2”
 - b. 1-hr Tran. Len. (feet): enter “6”

- c. 10-hr Tran. Len. (feet): enter “6”
- d. 100-hr Tran. Len. (feet): enter “12”
- e. Transect: enter “1” or “2” as appropriate for the Tree Transect number
- f. Azimuth (degrees): Azimuth
- g. Slope (percent): Slope (%)
- h. 1 Hr Count: total of tally in 0-0.25” (1 hr) column
- i. 10 Hr Count: total of tally 0.25-1” (10 hr) column
- j. 100 Hr Count: total of tally in 1-3” (100 hr) column
- k. FWDFuConSt: select “Ponderosa pine”
- l. Comment: enter any comments associated with the fine woody debris data for this transect
- m. UV1, UV2, UV3: leave blank

3. Coarse Woody Debris section

- a. Num. Transects: enter “2”
- b. Tran. Length (feet): enter “100”
- c. Transect: enter “1” or “2” as appropriate for the Tree Transect number
- d. Slope (percent): Slope (%)
- e. Log No.: leave blank
- f. Diameter (inches): Diameter in 1000-hr section
- g. Decay Class:
 - i. if Diameter is recorded in >3” sound (1000 hr) column, enter “3”
 - ii. if Diameter is recorded in >3” rotten (1000 hr) column, enter “4”
- h. CWDFuConSt: select “Ponderosa pine”
- i. Comment: enter any comments associated with the log
- j. UV1, UV2, UV3: leave blank

4. Duff and Litter section

- a. Num. Transects: enter “2”
- b. Transect: enter “1” or “2” as appropriate for the Tree Transect number
- c. Samp. Loc.: Point (feet)
- d. Offset: if a note on the data sheet indicates that the point is offset, select “Yes”, otherwise select “No”
- e. Litter Depth (inches): value in Litter column for appropriate row (Point)
- f. Duff Depth (inches): value in Depth column for appropriate row (Point)
- g. Fuelbed Depth: leave blank
- h. DLFuConSt: select “Ponderosa pine”
- i. Comment: enter any comments associated with this point, including an where the point was offset to and an explanation as to why a point was offset
- j. UV1, UV2, UV3: leave blank

Disturbance History Protocol, data from Site Disturbance section of PCM-10

- 1. Visited: click on bar to change to “Yes”

Because of the qualitative nature of the information collected for this SOP, information is entered as text. Before beginning data entry, click on the “View” box (upper left corner of table) and check/uncheck boxes as necessary so that only the following columns are showing: Change Agent, Change Description, Comment, UV1, UV2, UV3.

- 2. Change Agent: select description that most closely matches Disturbance Type, using “Other” when necessary
- 3. Change Description: Type in the Disturbance Type (verbatim) from the first column of the table on PCM-10.
- 4. Comment: Notes
- 5. UV1: In/Out of Plot
- 6. UV2: Approx. Size (*include units*)
- 7. UV3: Use the sketch to briefly describe the location of the disturbance (e.g., transect A, 0-20 m).

Cover – Species Composition (metric) Protocol, data from Target Species Assessment section of PCM-10

- 1. Visited: click on bar to change to “Yes”

2. Min. Cov. Level: leave blank
3. Item Code: Species
4. Status: unless otherwise noted in Comments, select “L” for live
5. Size Class, Age Class: leave blank
6. Cover: Abundance Class (note that you do not have to select one of the terms in the drop-down list)
7. Height: leave blank
8. Comment: Comments
9. UV1: Location
10. UV2, UV3: leave blank

Note: If none of the target species were found, enter the code “NOSP” for Item Code, select “L” for Status, and leave the rest of the fields beyond that blank.

Data Verification

Data verification occurs immediately after data entry. For spatial data collected in the field (i.e., by a GPS), data are verified by ensuring the proper coordinate system is attached with the spatial information. For photographs, photo file names are checked against the images and information on photo record sheets. For plot data collected on paper data forms, a printout of the data entered into FFI is compared to the original field forms by someone other than the person that entered the data into FFI. Errors are corrected immediately.

Some common errors to watch for during data verification are:

- In the Density Belts protocol, make sure each species is entered only once for each subbelt.
- In the Cover-Points protocol, make sure
 - each species is entered only once for the same transect-point combination;
 - there is a ground hit entry (i.e., order is 0) for every transect-point combination;
 - a height value is entered for a given transect-point combination with order 1;
 - each transect-point-order combination occurs only once in a plot.
- In the Trees-Individuals protocol, make sure
 - each tag number is used only once;

- DBH **or** DRC (not both) is entered for each line;
- UV1 and UV2 are filled in for all data from PCM-6 (trees).

To minimize transcription errors, 100% of records are verified to their original source. A further 10% of records are reviewed a second time by the Plant Ecologist and/or Plant Lead Biotech and the results of that comparison are reported as part of the metadata. If errors are found in this second review, the entire data set is verified again.

In addition to 100% and 10% manual checks, all data can be run through automated checks. In 2011, NGPN built an access database that queries FFI for logical errors, duplications, and out of bound entries. The database is accessible upon request or the NGPN server at N:/Monitoring/Plant Community. A set of technical instructions can be found with the database. After running the data through checks, errors are corrected in FFI and on all datasheets.

Data Validation

Data validation ensures that entered data are accurate and logical. For example, a DBH of 327 cm for a green ash tree could be accurately transcribed from the paper form, but it is illogical and almost certainly incorrect (32.7 cm is more likely). GPS points collected during plot establishment should form the correct shape.

Validation of spatial data is done by visually inspecting the data in ArcPad on the mobile GPS unit while still on-site, then again in ArcGIS with other relevant spatial data (e.g., topographical maps, aerial photographs, and park boundaries). This second validation is done by two people that visited the location from which the data were collected. It should be done at the latest at the end of the tour in which the data were collected, but preferably at the end of the day in which they were collected.

Validation of photographs is done twice – in the field immediately after the photo is taken (i.e., make sure photo board is labeled correctly), and during photo file naming. Validation is done by comparing photo content (i.e., vegetation, photo board information) with the file's name/date and by comparing photo content among all photos with the same plot/date labels (e.g., vegetation should generally not change drastically among photos within a single plot).

Validation of plot data takes place at three times –after data collection is complete but before leaving the plot, during data entry, and after data verification is complete.

Validation during data entry occurs when the person entering data encounters a value that does not make sense to him/her. The huge green ash tree DBH is an example. Rather than leave this enigma until later when it may not be caught, the person doing the data entry consults with the people who collected the suspicious data. If they believe the data are invalid and should be changed to a different value (a decimal point added, for example), the Plant Ecologist must give approval for this change. If approved, the original value is left on the data sheet, but a note is made on the data sheet near that value, in red ink, indicating the change made when data were entered into the Database. The original value and the change made is then recorded in the appropriate “Comment” field in the Protocol in which the data are being entered.

Post-verification validation is done by the Plant Ecologist for all data. Validation procedures for FFI at this stage include, but are not limited to:

- ensuring all Sample Events set up for the year have data entered into all the appropriate Protocols
- checking that all intensive plots have data entered for 2 transects, each with 5 subbelts/sets of quadrats (unless data sheet indicates no plants at all in one or more sets of quadrats)
- checking that all heights in the Cover – Points protocol are < 2 m
- comparing data to previous years' data to identify gross species identification differences and large changes in woody species density.

Data Management

During the entry, verification, and validation phases, the Plant Ecologist is responsible for the data. Once validation of the data (FFI databases, scanned datasheets, images, etc.) is complete, the Plant Ecologist notifies the Data Manager that the paper data forms, electronic database files, images, GIS data, and completed Metadata Interview form are ready for archiving and storage. The Data Manager creates a new metadata record and proceeds to archive the data.

Data Storage

Electronic files from the Plant Community monitoring protocol are stored following the structure depicted in Figure 3. These files are considered the working files; after data validation the files are moved to the Archived Data directory on the Network server. This directory is read-only to all users except the Data Manager. Descriptions of the types of files stored within each park's folder within the Plant_Community folder follow:

ANALYSIS: FFI summary report files, other derived data, and files for and from statistical analysis for this park.

DATA: species lists and scanned datasheets;

DOCUMENTS: correspondence, development documents, contracts, agreements, reports, and presentations associated with the Plant Community Vital Sign that are specific to the park;

GIS: shapefiles, coverages, layer files, geodatabases, GPS files, GIS/GPS-associated metadata, and spatial imagery specific to the park and the Plant Community Vital Sign;

IMAGES: photographs from the park related to the project and photolog scan files.

Other folders within the Plant_Community folder contain the following types of files:

Miscellaneous: files/documents that do not logically go into other folders available;

Multi_Park_Analyses: derived data, files for and from statistical analysis for more than one park;

Multi_Park_Reports: reports and presentations covering more than one park;

Protocol: correspondence, development documents, reports and presentations related to the protocol; protocol narrative; SOPs; blank datasheets; field season and protocol review forms (PCM-12, PCM-13); training documents, including crew handbook; instructions for data entry/analysis/etc. not in SOPs.

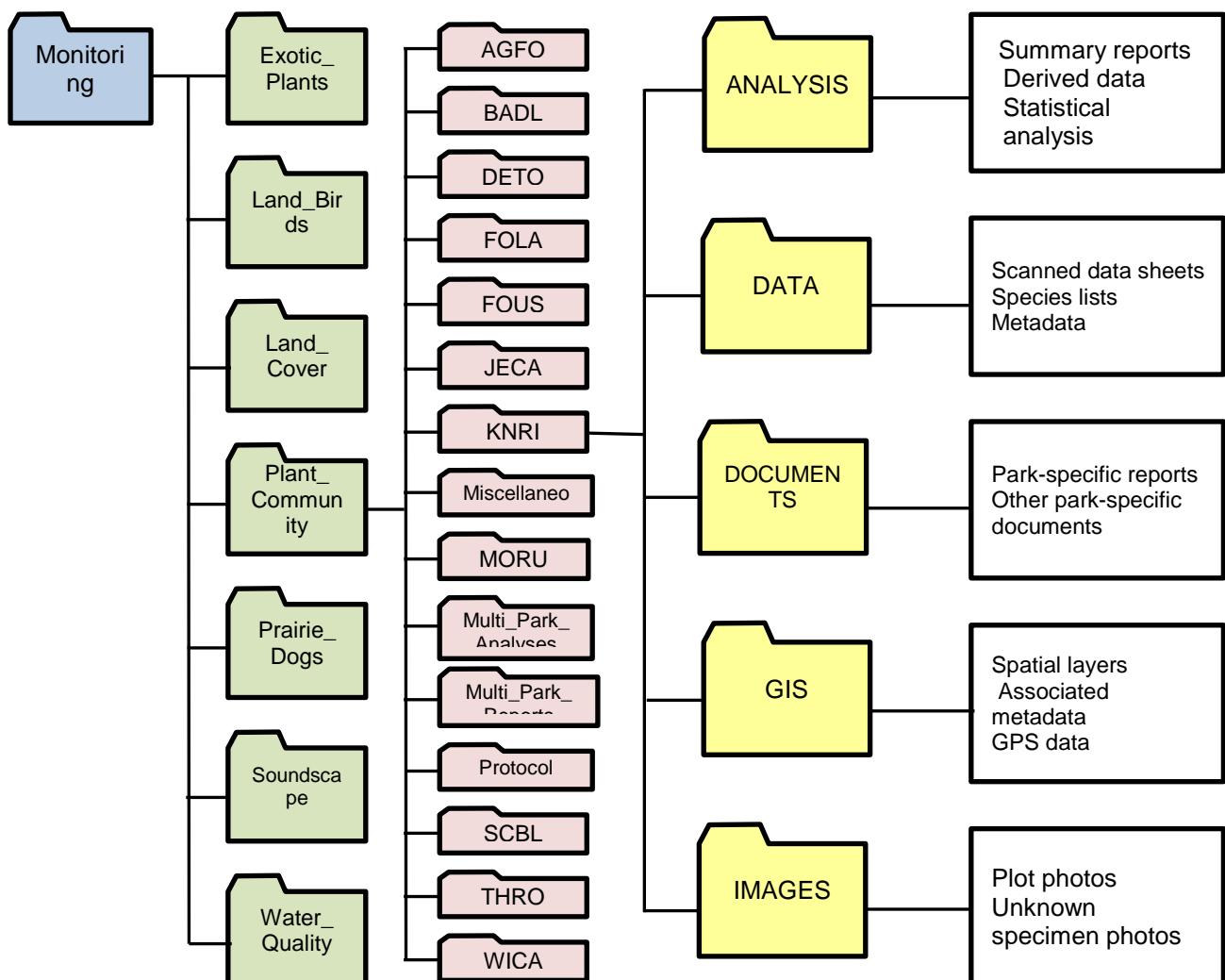


Figure 16. File structure used to store NGPN Plant Community protocol data and information.

Data Archiving and Editing of Archived Data

Archiving consists of storing read-only, electronic versions of the FFI database, datasheets, and images (edited photo files) on the NGPN server. The archive copy of an FFI database is created using FFI's Database Manager "backup database" command. The database name includes the date on which it was archived (e.g., NGPN_FFI_AGFO_valid_20101016.bak for the validated AGFO FFI database file archived on October 16, 2010). Backup copies of the data are maintained at the NGPN office and an additional digital copy is forwarded to the NPS Inventory

and Monitoring Program Archive. Tape backups of all NGPN server files occur daily. Weekly and monthly server backups are transferred for offsite storage at Mount Rushmore National Memorial. Both sites store the tapes in a secure, access-restricted lockbox. An additional backup option for the FFI databases is to perform daily backups through the FFI Database Manager.

The Database Manager maintains a data management log for each project. This log includes a data edit log, which records changes made to data sets after they have been archived. Such changes are inevitable and necessary, but they are done only under the following conditions: 1) data integrity must be maintained; 2) once archived, all changes to the data set must be documented; and 3) mistakes made during editing must be recoverable. Any editing of archived data is accomplished jointly by the Plant Ecologist and Data Manager. Every change must be documented in the data edit log and accompanied by an explanation that includes pre- and post-edit data descriptions. Once the data are archived, original field forms are not altered. Field forms can be reconciled to the FFI database through the use of the data edit log.

Prior to any changes in an archived data set, a copy is stored with the appropriate date in the file name, which allows for the tracking of changes over time. Versioning of archived data sets is handled by changing the date included in the file name. With proper controls and communication, versioning ensures that only the most current version is used in any analysis. Frequent users of the data are notified of the updates and provided with a copy of the most recent archived version.

Schedule

A set schedule for various stages of data management ensures that all steps are completed in a timely manner, ensuring that the information is useful. Table 2 describes the deliverable products, responsible individual, and target completion date for data products from the Plant Community protocol. Details of some of these products are in other SOPs. A schedule for reports derived from these data is presented in SOP Data Analysis.

Table 8. Deliverable products, responsible individual, and target completion date for data products from the NGPN Plant Community Composition and Structure Monitoring Protocol.

Deliverable Product	Primary Responsibility	Target Date
Products at protocol start-up		
Initial Metadata Interview Form	Plant Ecologist	3 weeks prior to start of first field season
Initial Data Dictionary	Plant Ecologist	3 weeks prior to the first field season
Annual products		
Completed data sheets stored, scanned, and photocopied, with photocopies in plot folders	Plant Lead Biotech	Day of return from field tour in which data were collected
FFI database with verified intensive plot data	Plant Lead Biotech	August 30
Validated GPS data	Plant Lead Biotech	September 30
Digital Photographs and Validated Photo Log	Plant Lead Biotech	October 30
FFI database with validated intensive plot data	Plant Ecologist	November 30
FFI database with verified extensive plot data	Plant Lead Biotech	November 30

FFI database with validated data from all (intensive and extensive) plots	Plant Ecologist	January 30 (year following field season)
Updated Metadata Interview Form and Data Dictionary (if necessary) for FFI database	Plant Ecologist	January 30 (year following field season)

Attachment 1: FFI user documents for entering NGPN Plant Community Data

Accessing and using the FFI 1.04 Database

You should have the FFI software installed on your machine. If you do not have a shortcut on your desk top (or don't want the shortcut), you can start the program from the Start menu.

Start > All Programs > FFI 1.04.01 > FFI 1.04.01 (Within the FFI program folder, are access to the FFI Database Administration 1.04.01 and Protocol Manager 1.04.01.)

If interested, there is a full User Guide for FFI in Groups -

N:\Monitoring\Plant_Community\Protocol\Version_1.00\Training_Documents_FFI User Docs\FFI_User_Guide_201103.pdf

When you start FFI, you should get the screen below.



Your computer may or may not find servers. In either case, you need to fill in the different boxes (notice that the text on the last box is grayed out, this will change after correctly entering your user name and password).

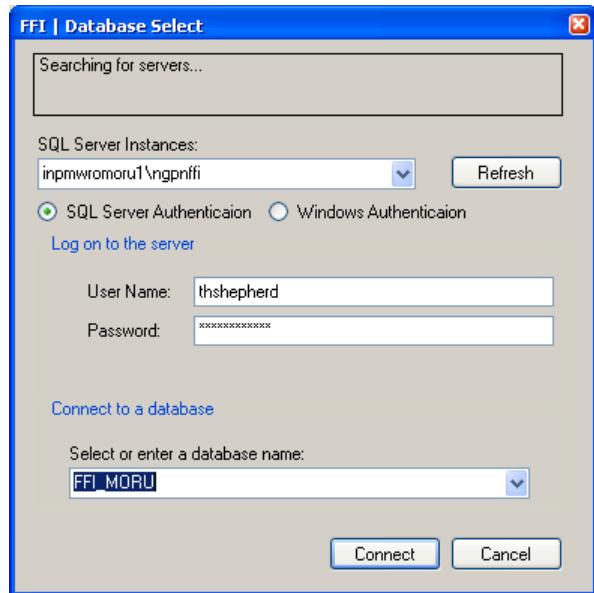
For SQL Server Instances, type in: **inpmwromoru1\ngpnffi**

User Name: (you're provided user name)

Password: (the provided password)

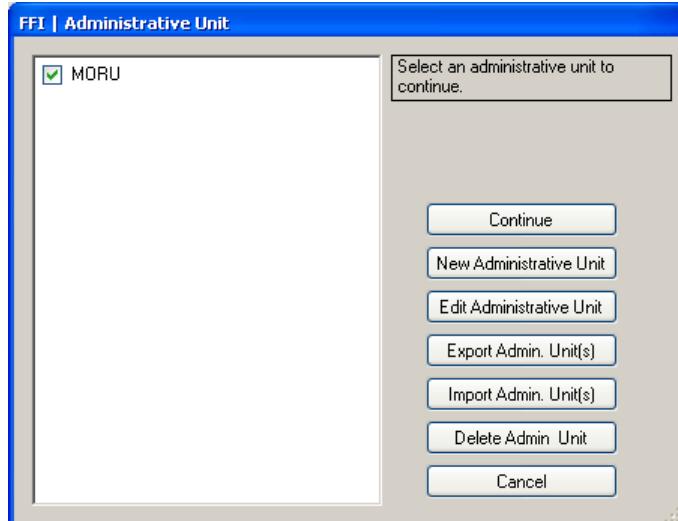
After typing in and leaving the Password box, the program will check what you typed for User Name and Password. If the name and password are correct, the last box will show normal text and you can select the park

that you wish to enter data. See below for selecting Mount Rushmore for data entry (each park has its own database named FFI_[four letter park code].

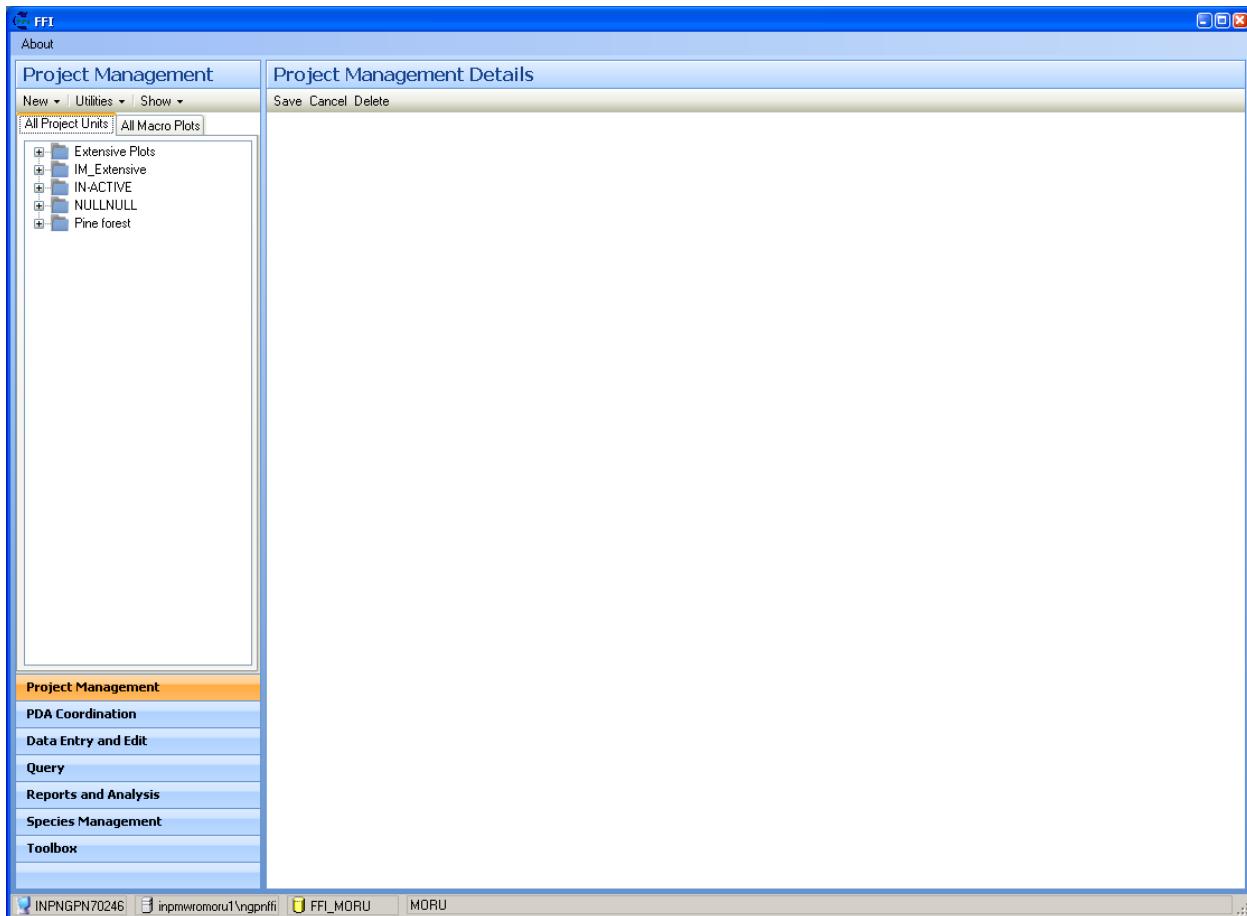


Click **Connect** to open the database.

A window will open asking for you to select the Administrative Unit for the database you are opening. Each park **ONLY** has one Administrative Unit and it is the four letter code for the park. Check the box next to the Administrative Unit and click **Continue**.



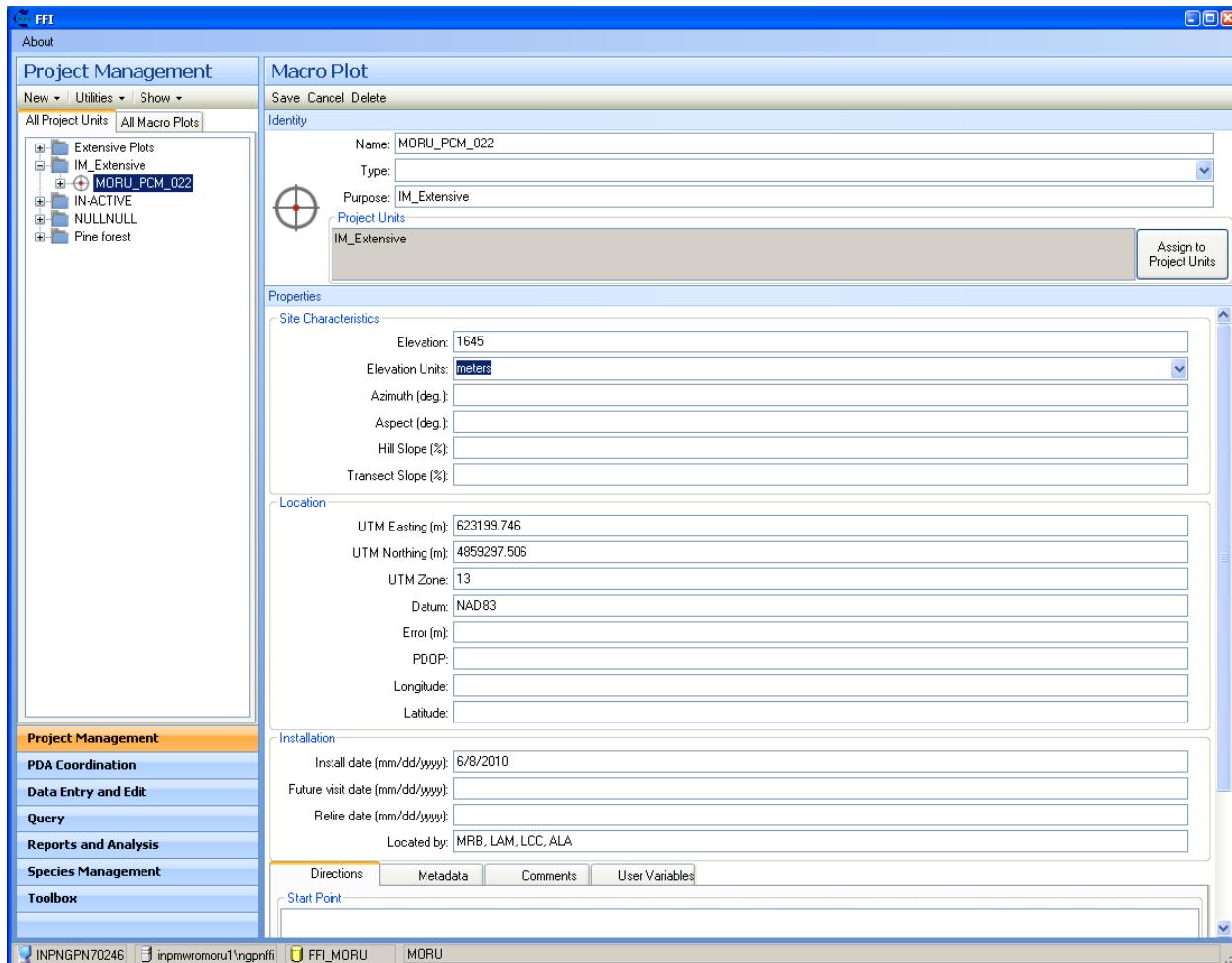
The FFI database window should open. The left side of the window controls where in the database you are and what information you can add.



The database will open with you in Project Management. In Project Management, you control and enter information on the sampling plots (in FFI, the sampling plots are called Macro Plots). This is also where you manage sampling events at the plot and enter basic information about the event.

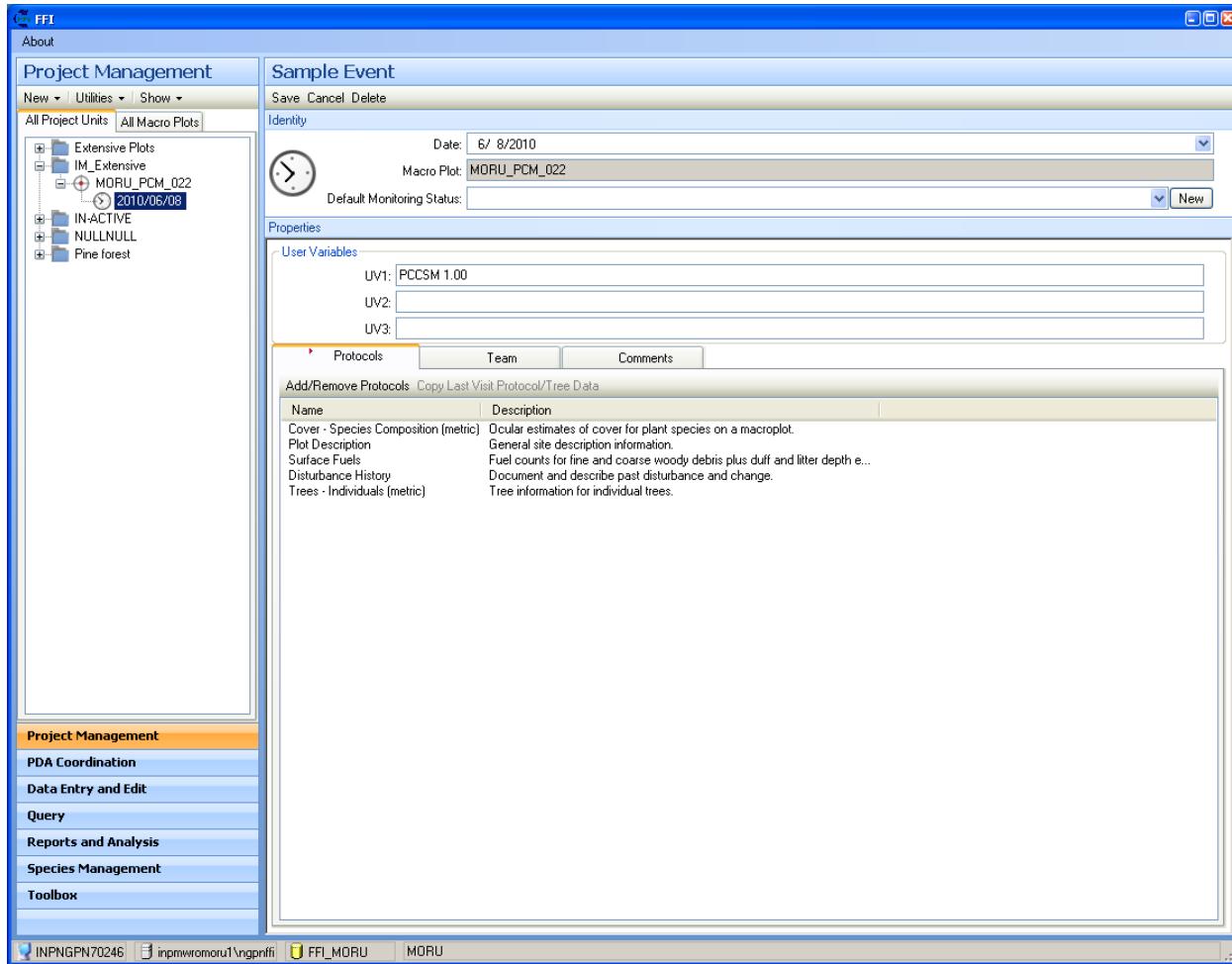
When entering information about plots, sampling events, or entering data from a sampling event, refer to the Plant Community protocol SOP 13 for Data Management or the FFI user guides (located on the N drive (N:\Monitoring\Plant_Community\Protocol\FFI User Docs)). These should provide you the an explanation of what information goes in which field than this document (hopefully this document gets you into FFI and shows how to move around the database).

In the Project Management window, click the + or - next to the project units to expand or collapse them (allows you to see or hide the macro plots associated with a Project Unit). Currently, the Rushmore plot with data is PCM 022. Expand IM_Extensive (this Project Unit may change after the creation of this document (Friday, November 19, 2010) As of December 2010, the project Unit for I&M sampling is “Park”.



The image above shows the information already entered for the plot MORU_PCM_022 (NOT all of the data for the plot has been entered).

With the plots, you can click on the + to expand to see what sampling events are associated with the plot.



It's here that you enter basic information about the event. On the right side of the database window, with the Protocols tab, you control what data forms are available for data entry (the ones listed in the image above are not necessarily associate with this sampling event).

To enter data for a sampling event, you click on Data Entry and Edit on the left side of the FFI window. After clicking on the Data bar, you will need to use the tree (list of projects, macro plots and sampling events) to find the sampling event you wish to enter/edit. The protocols that are associated with the sampling event appear as tabs across the Data Entry window.

The example above shows the Surface Fuels data entry form with some of the data entered for the June 08th sampling event at MORU PCM 022 plot. By clicking on the tabs above, you can change to the data entry form that you need to enter data into.

NOTE: This document was done to get you into FFI and start moving around within the database. More complete documents were created that will highlight were commands and functions are that you will need to use for data entry and plot management. The database is pretty good about asking if you want to perform an action, so don't be too afraid to move around the database.

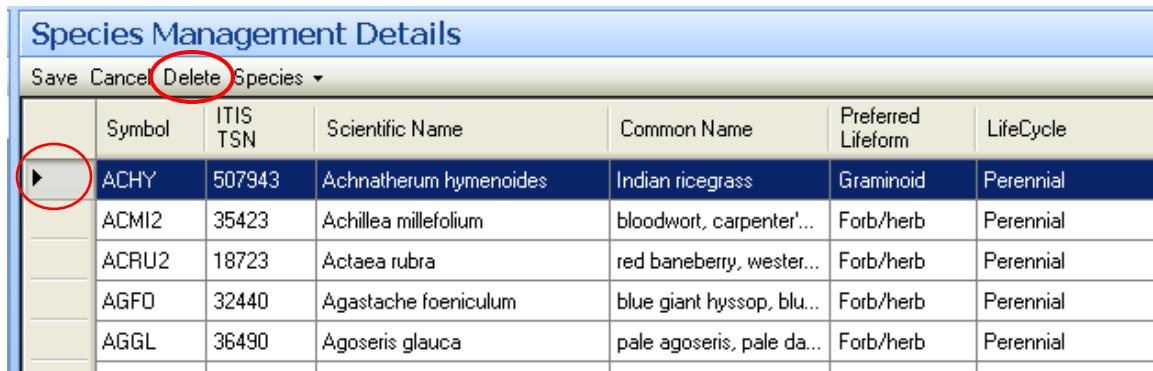
Species Management

This document describes how to manage the local species list in FFI. It also describes how to create a custom species list (based on the local list) and associate the list to a species drop-down field for data entry. To access the master species list, you click on Species Management button on the left side of the database window.

The database should look similar to the image above after clicking on Species Management. The list of species you see is the local list of species associate with the park for the database you are in (the list above is the one for Mount Rushmore). In the database window, you see the list of species, and to the right, you see the details of the species selected (in this case, *Achnatherum hymenoides*). The boxes that are grey are uneditable fields; this data is pulled directly from the USDA PLANTS database when you add a known species. Within Species Management, you can delete species from the list, add species to the list (either pulled from PLANTS or a user defined species, including non-species such a BARE for bare ground), and edit and create custom species picklists.

Delete Species

To delete a species from the list, you select the species by clicking on the gray box next to the species of interest to select it. You then click on the Delete button at the top of the Species Management window.

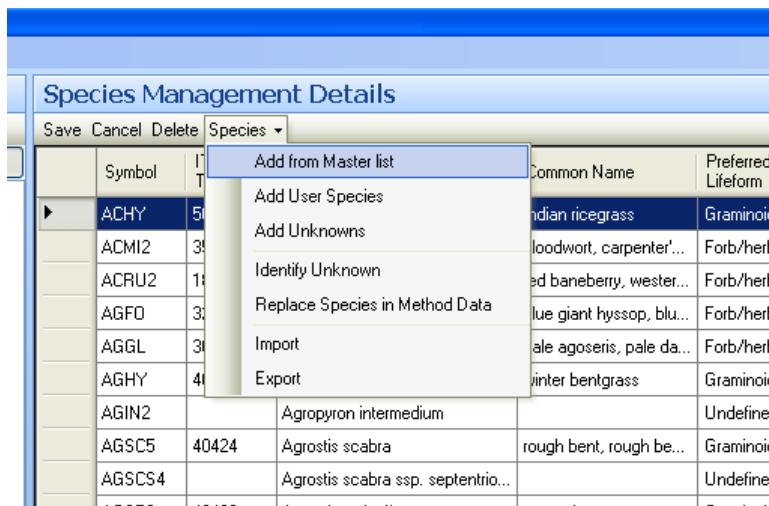


Species Management Details						
Save Cancel Delete Species ▾						
	Symbol	ITIS TSN	Scientific Name	Common Name	Preferred Lifeform	LifeCycle
▶	ACHY	507943	Achnatherum hymenoides	Indian ricegrass	Graminoid	Perennial
	ACMI2	35423	Achillea millefolium	bloodwort, carpenter'...	Forb/herb	Perennial
	ACRU2	18723	Actaea rubra	red baneberry, wester...	Forb/herb	Perennial
	AGFO	32440	Agastache foeniculum	blue giant hyssop, blu...	Forb/herb	Perennial
	AGGL	36490	Agoseris glauca	pale agoseris, pale da...	Forb/herb	Perennial

If a species name is in use (i.e. it has been selected during data entry), you will not be able to delete it from the list. Also, do not forget to use the Save button while making changes to the list. The database will ask if you want to save changes if you forget.

Add a Species

To add a species, you need to click the Species button and select the action you would like to perform from the drop down menu.



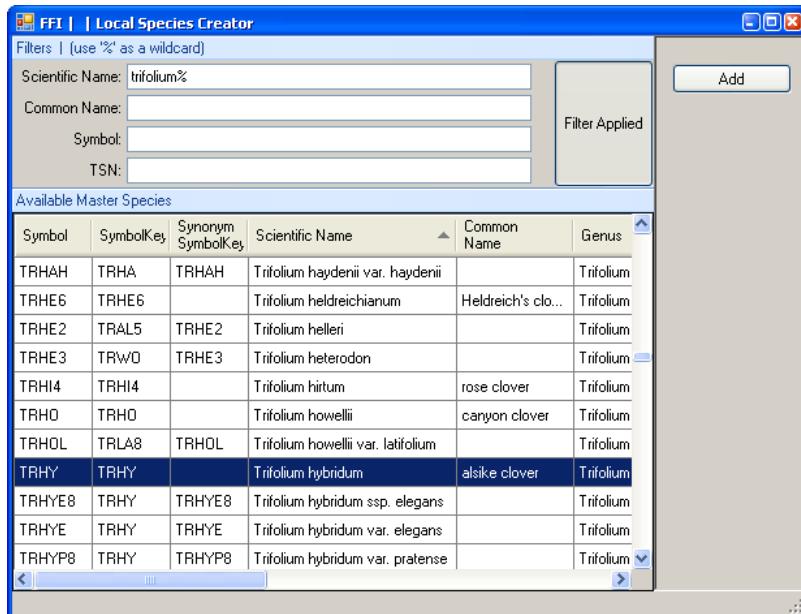
You select “Add from Master list” to add a species from the PLANTS database.

You select “Add User species” to add a species name not in PLANTS or create a non-species selection like BARE (bare ground).

“Add Unknown” allows you to create a unique unknown species that can be references multiple times. If a particular unknown species get identified, you can replace all of the referenced unknown species (that particular unknown) using the menu selection “Identify Unknown”.

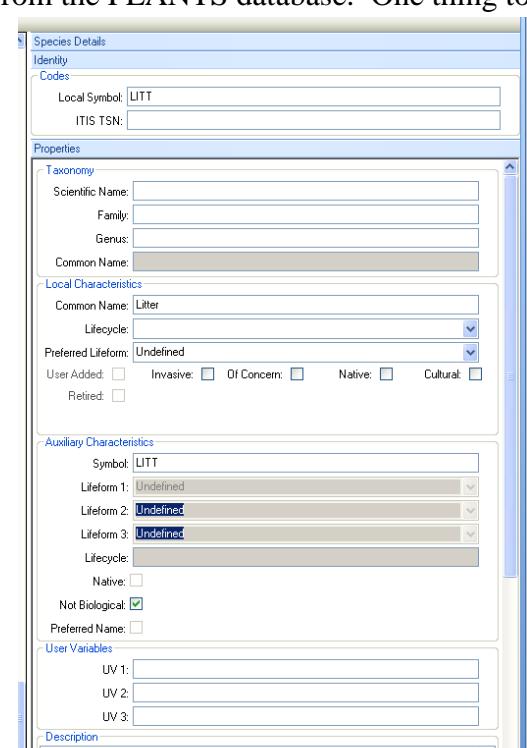
If a species list is in a XML format, you can import a local list edited outside FFI with “Import”. “Export” will allow you to export the species to an XML format (which can be opened in Excel).

To add a species from the Master List, you select that choice from the menu and a window will appear.



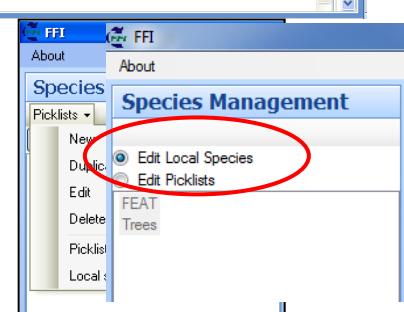
This window allows you to search for and add species to the local list from the PLANTS database. One thing to note is that if a species is current on the local list, you will not see it listed in this window; this keeps you from adding a species name to the list twice by accident. You can sort the list by clicking on a column heading. You can also limit what you see in the list by filtering it using the boxes in the top part of the window. In the image above, only scientific names starting with “trifolium” will be seen. Notice that you can use a wildcard character, you use the “%” symbol (the typical wildcard is “*”). If you are filtering by symbol, I recommend always using the wildcard. From the image above, if I searched using “trhy”, only *Trifolium hybridum* would show, and none of the subspecies.

If the species is not in PLANTS or you need a user defined code (say for rocks), you create those through the “Add User Species” command. When you select this menu option, a new row will be added to the species table with the default code of XXXX. You are able to change the code and add other information to describe what the selection is defining. To the right, you see what information has been entered for a Litter selection (code LITT). Before assigning a code, it is best to insure that the code is not currently in use by the PLANTS database. To do that, search the PLANTS database directly from the USDA website (<http://plants.usda.gov>).



Custom Picklists (Dropdowns)

Besides controlling what species are associated with a park, you can create a custom list for a particular protocol. To access or create a new picklist, you click



on the “Edit Picklists” radio button on the left side of the database window (FEAT and Trees are existing picklists). This will give you access to the Picklist menu.

New: create a new pick list. New will pop-up a window where you fill in basic information on the picklist including its name.



If there is a list you want to modify slightly, you can “Duplicate” the list then make changes.

“Edit” allows you to change the name or other information in the picklist properties.

To add or change species in a picklist, you click on the list name with the Edit Picklist active (when editing picklists, the button name changes to read “Edit Local Species”; you must have the species you want in your picklist already present in the local list). When you select a list to edit, the right side of the database window should look similar to below.

Available Species					Assigned Species				
	Symbol	ITIS TSN	Scientific Name	Common Name		Symbol	ITIS TSN	Scientific Name	Common Name
▶	ACHY	507943	Achnatherum hymenoides	Indian ricegrass	>	BE0C2	19488	Betula occidentalis	water birch
	ACMI2	35423	Achillea millefolium	bloodwort, carpenter's weed, common yarrow, hierba de la sangre		BEPA	19489	Betula papyrifera	paper birch
	ACRU2	18723	Actaea rubra	red baneberry, western baneberry		PIGL	183295	Picea glauca	black hills spruce, canadian spruce, cat spruce, porsild spruce, skunk spruce
	AGFO	32440	Agastache foeniculum	blue giant hyssop, blue giant-hyssop		PIPO	183365	Pinus ponderosa	ponderosa pine, western yellow pine
	AGGL	36490	Agoseris glauca	pale agoseris, pale dandelion, pale dandylion, prairie dandelion		POAC5	22450	Populus xacuminata	lanceleaf cottonwood
	AGHY	40394	Agrostis hyemalis	winter bentgrass		PODE3	22445	Populus deltoides	common cottonwood, cottonwood, eastern cottonwood, plains cottonwood
	AGIN2		Agropyron intermedium			POTR5	195773	Populus tremuloides	quaking aspen
	AGSC5	40424	Agrostis scabra	rough bent, rough bentgrass, ticklegrass		QUMA2	19287	Quercus macrocarpa	bur oak
	AGSCS4		Agrostis scabra ssp. septentrionalis						
	AGST2	40400	Agrostis stolonifera	carpet bentgrass, creeping bent, creeping bentgrass, redtop					
	AGTR		Agropyron trachycaulum						
	ALCE2	42721	Allium cernuum	nodding onion					
	AMAL2	25109	Amelanchier alnifolia	juneberry, pacific serviceberry, saskatoon serviceberry, shadberry					
	AMHU2	182045	Amelanchier humilis	low service-berry, low serviceberry					
	ANGE	40462	Andropogon gerardii	big bluestem, bluejoint, turkeyfoot					
	ANMA	36529	Anaphalis margaritacea	western pearly everlasting					
	ANNE	36745	Antennaria neglecta	field pussytoes					
	ANPA4	36749	Antennaria parviflora	little-leaf pussytoes, Rocky Mountain pussytoes, small leafed pussytoes					
	ANPL	36717	Antennaria plantaginifolia	plantainleaf pussytoes, woman's tobacco					
	ANSP80		Antennaria speciosa						
	APAN2	30156	Apocynum androsaemifolium	bitterroot, flytrap dogbane, spreading dogbane					
	ARLU	35474	Artemisia ludoviciana	cudweed sagewort, gray sagewort, Louisiana sagewort					
	ARMI2	36546	Arctium minus	bardane, beggar's button, burdock, common burdock, leathery burdock					
	ARNU2	29376	Aralia nudicaulis	wild sarsaparilla					
	ARUV	23530	Arctostaphylos uva-ursi	bearberry, bearberry manzanita, kinnikinnick, mealberry					
	ARUVA		Arctostaphylos uva-ursi var. ade...						
	ASLA27	565016	Astragalus laxmannii	Laxmann's milkvetch					

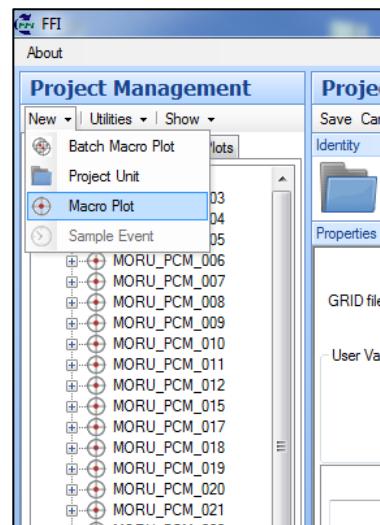
The list on the left is the local list; the list on the right is the species you've selected from the local list to show in your picklist. The chevron buttons between the two lists are used to move species onto or off of the picklist (“>” will add species to list; “<” will remove species from list). That should get you going with species management. Good Luck.

Create a Macro Plot

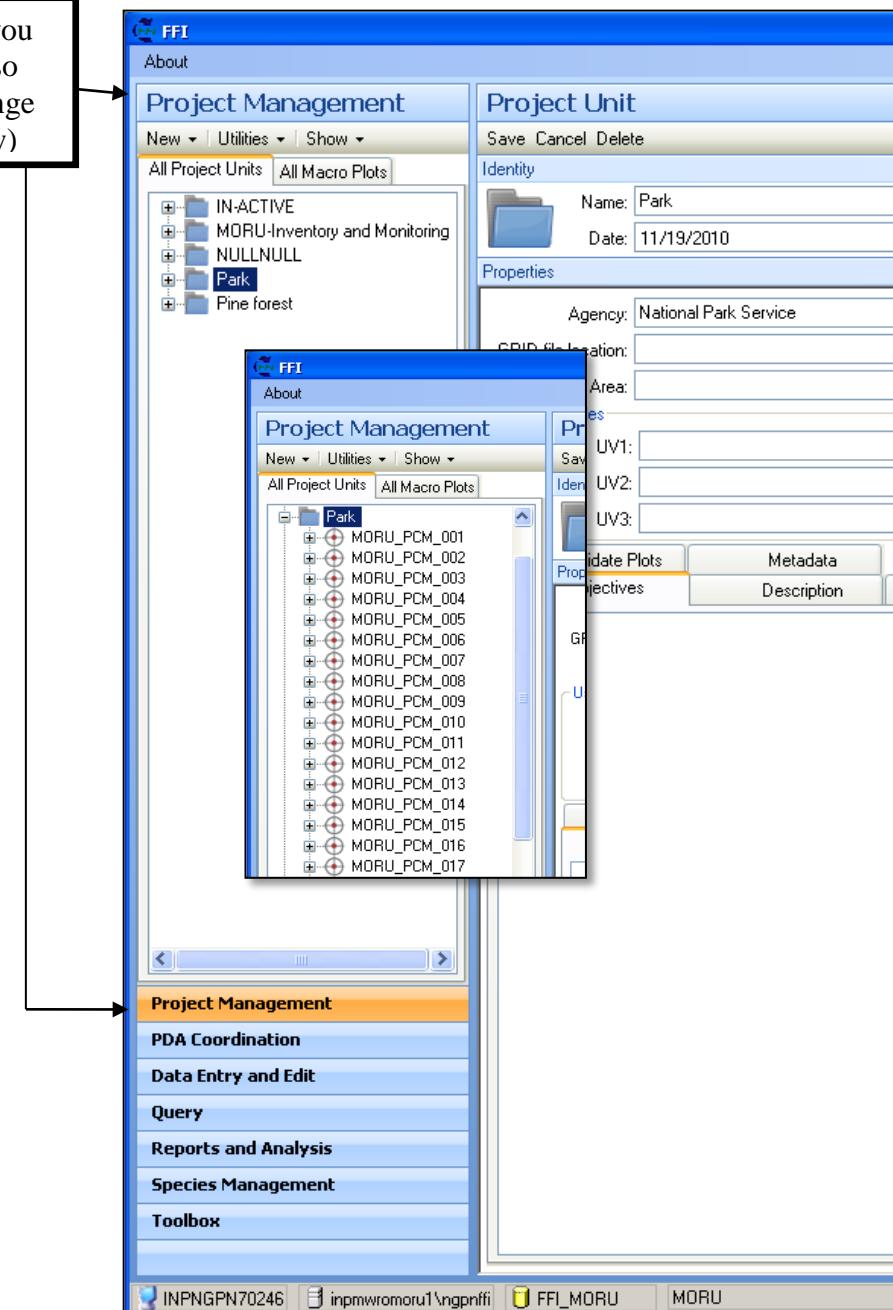
Start and log into FFI with selecting the Park database and Administrative Unit.

When FFI open, you will be in the Project Management area. The Network's plots (or Macro Plots in FFI) will be in the Project Unit "Park". Click the "+" next to Park to see the Network's macro plots.

To create a macro plot, you want to click "Park" to highlight it. Next click on "New" below the Project Management heading; then click Macro Plot.



Database section you are working in (also highlighted in orange below tree window)



With the new macro plot, fill in the information about the plot while in the Project Management area. You will need information from the Plot Establishment datasheets (PCM 2).

147

Macro Plot

Save Cancel Delete

Identity

Name:

Type: ←

Purpose: ←

Project Units
Park

Properties

Site Characteristics

Elevation:

Elevation Units:

Azimuth (deg.):

Aspect (deg.):

Hill Slope (%):

Transect Slope (%):

Location

UTM Easting (m):

UTM Northing (m):

UTM Zone:

Datum:

Error (m):

PDOP:

Longitude:

Latitude:

Installation

Install date (mm/dd/yyyy): 6/1/2011 1:21:52 PM ←

Future visit date (mm/dd/yyyy):

Retire date (mm/dd/yyyy): Leave Blank

Located by:

Directions Metadata ← Comments User Variables

Start Point

Plot ID follows the formula:
[Park Code]_PCM_[Plot
Number] (e.g.
MORU_PCM_008)

Plot Type: the option circled on
the datasheet preceded by
"IM_"

PCM-2
Plot Establishment Data Sheet – Draft Version – September 30, 2009
Page 1 of 2

PLOT LOCATION AND DESCRIPTION DATA SHEET

Park Code: MORU Plot ID: PCM-008 Plot Type: Intensive / Extensive / Dual (I&E)

Date Established: 6-29-2010 Established By: MB, LC, AA

Plot Location

Plot Center UTM Zone: 15 UTM N: 624786.430 UTM E: 4659732.216 Elevation: 1489.517

Description of point at which to start walking to plot, including good place to park vehicle:
park & hike from Concessionary housing

Change "Install Date" to the Date Established
from the datasheet (e.g. 6/29/2010).

Enter the initials of those who established the
plot (e.g. MB, LC, AA)

The above is the bare minimum that you should enter. However, since you are already here, it would be good if you entered the other information about the plot into the database. The data sheet in the example is from an older form; the new one has UTM N and UTM E in different positions.

Properties

Elevation: 1490 ← Elevation on the data sheet should be in meters

Elevation Units: meters ←

Azimuth (deg.): 205

Aspect (deg.):

Hill Slope (%):

Transect Slope (%):

Location

UTM Easting (m): 4859732.296 ←

UTM Northing (m): 624786.43 ← Elevation on the data sheet should be in meters

UTM Zone: 13 ←

Datum: NAD 83

Error (m):

PDOP: ← The new data sheet has a place to record PDOP (error associated with the GPS coordinate reading). Enter value here.

Longitude: Leave Blank

Latitude: Leave Blank

Installation

Install date (mm/dd/yyyy): 6/29/2010 12:00:00 AM

Future visit date (mm/dd/yyyy):

Retire date (mm/dd/yyyy):

Located by: MB, LC, AA

Directions Metadata Comments User Variables

Start Point

Park and hike from concessioner's housing.

Directions

PCM-2 Plot Establishment Data Sheet – Draft Version – September 30, 2009 Page 1 of 2

PLOT LOCATION AND DESCRIPTION DATA SHEET

Park Code: MORU Plot ID: PCM-008 Plot Type: Intensive / Extensive / Dual (I&E)

Date Established: 6-29-2010 Established By: MB, LC, AA

Plot Location

Plot Center UTM Zone: 13 UTM N: 624786.430 UTM E: 4859732.296 Elevation: 1489.517

Description of point at which to start walking to plot, including good place to park vehicle:
park & hike from Concessioner's housing

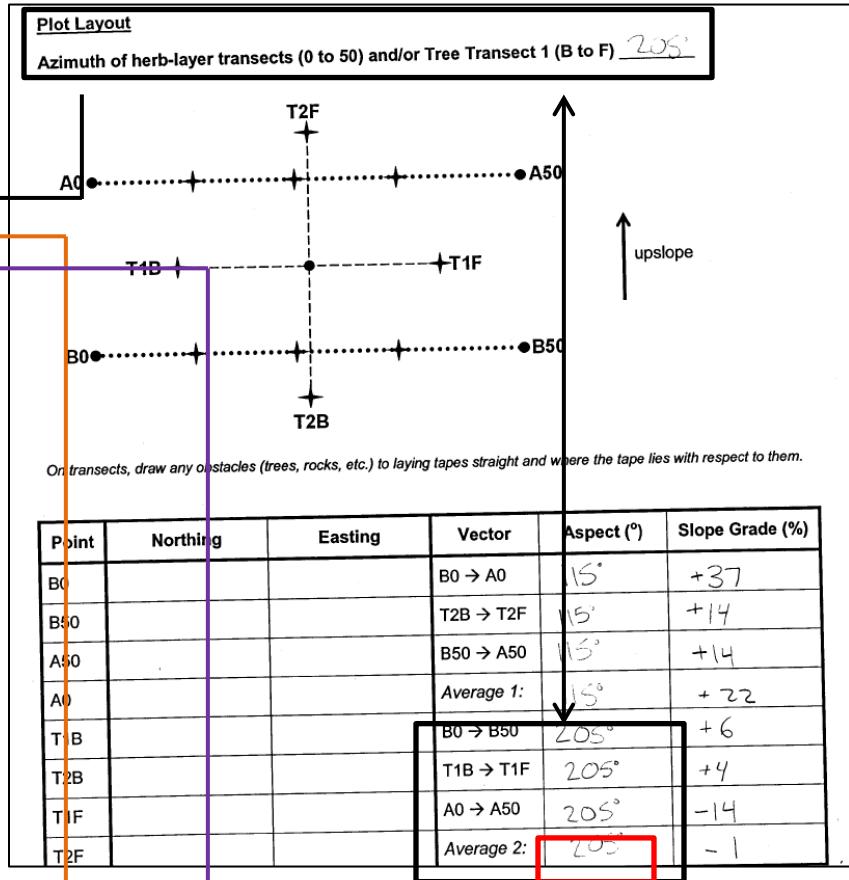
This is an older data sheet; the newer ones have a slightly different design

Plot Azimuth

Properties

Elevation:	1490
Elevation Units:	meters
Azimuth (deg.):	205
Aspect (deg.):	115
Hill Slope (%):	22
Transect Slope (%):	
Location	
UTM Easting (m):	4859732.296

With older plots this was not always recorded or recorded correctly. In the data sheet to the right, I would be suspect of the Azimuth with all three transects (B0-B50, A0-A50, and T1B-T1F) exactly the same. This is what you want when establishing the plot, but in reality this would be difficult to accomplish (I have seen some data sheets where the Azimuth recorded does not match the ones recorded for each transect; if you see this leave azimuth in the FFI database blank). You will also want to enter the Aspect and Hill Slope. One last variable to enter from this table is the Average 2 for slope. This value gets entered into the User Variables in UV 5.



Directions

UV 1: MS
UV 2: >50m
UV 3: UP
UV 4: PP
UV 5: -1
UV 6:
UV 7:
UV 8:

FFI MORU MORU

String

String	Vector	Aspect (°)	Slope Grade (%)
B0 → A0		115°	+37
T2B → T2F		115°	+14
B50 → A50		115°	+14
Average 1:	115°	+22	
B0 → B50		205°	+6
T1B → T1F		205°	+4
A0 → A50		205°	-14
Average 2:	205°	-1	

The other tabs in Macro Plot management

Install date (mm/dd/yyyy):	6/29/2010 12:00:00 AM
Future visit date (mm/dd/yyyy):	
Retire date (mm/dd/yyyy):	
Located by:	MB, LC, AA
Directions	
Metadata	
Comments	
User Variables	
UV 1:	MS
UV 2:	>50m
UV 3:	UP
UV 4:	PP
UV 5:	
UV 6:	
UV 7:	
UV 8:	

Description of route to plot from starting point:

Information entered here would go under the Directions tab

Plot Description

Topographic position: level lower-slope mid-slope upper-slope crest
drainage streambed rock outcrop

Surface water: in plot <50m >50m

Hydrologic regime: permanently flooded semi-permanently flooded seasonally/temporarily flooded
intermittently flooded seep upland

Vegetation type: upland grassland badlands sparse shrubland herbaceous riparian
riparian woodland ponderosa pine woodland/forest woody draw other

Notes:

Information entered here would go under the Comments tab

With entering the Plot Description data in the UV fields, please use the two letter codes (these codes are present on the new data sheets).

The Metadata tab does not receive any information, so move along.

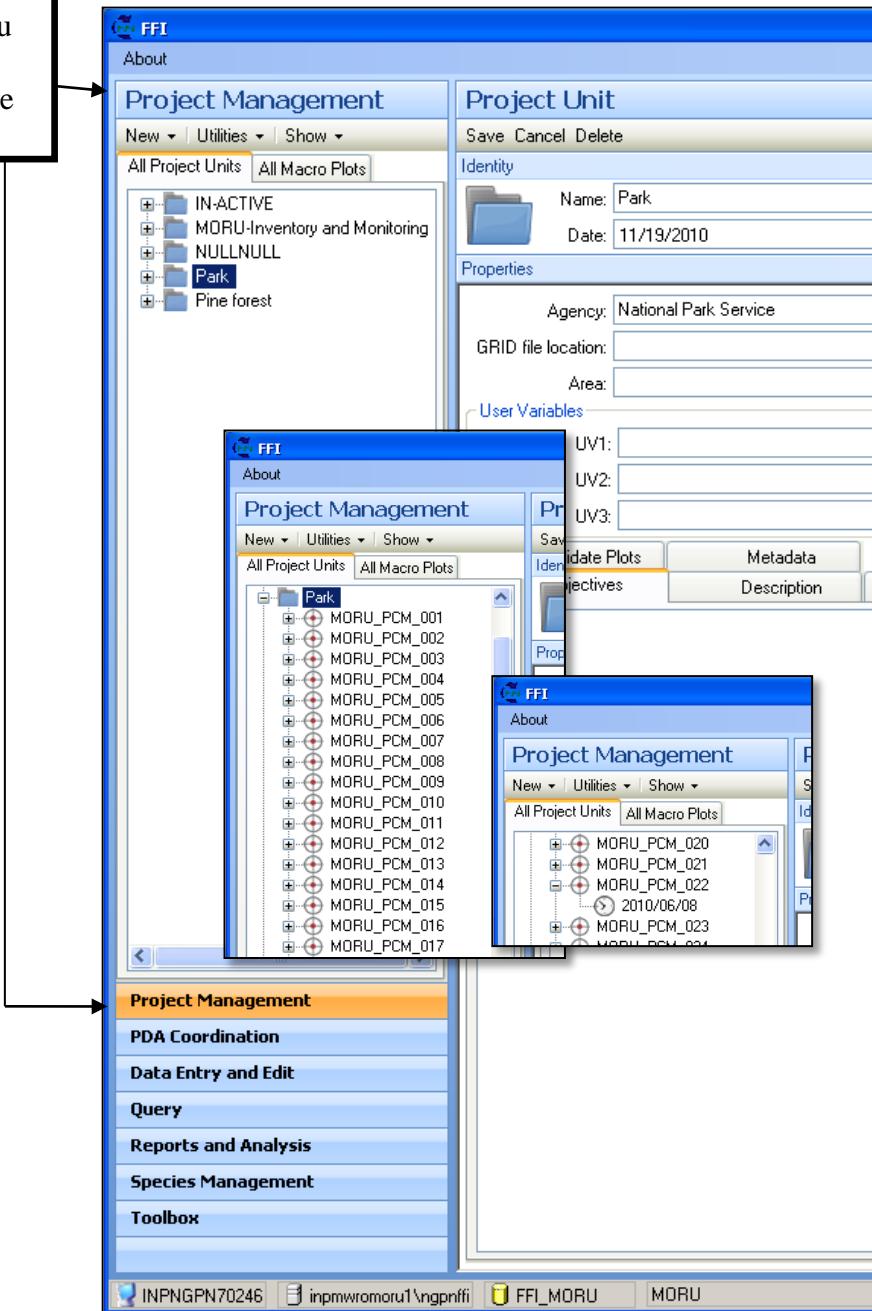
Don't forget to Save your data entries!

Create a Sample Event for a Macro Plot

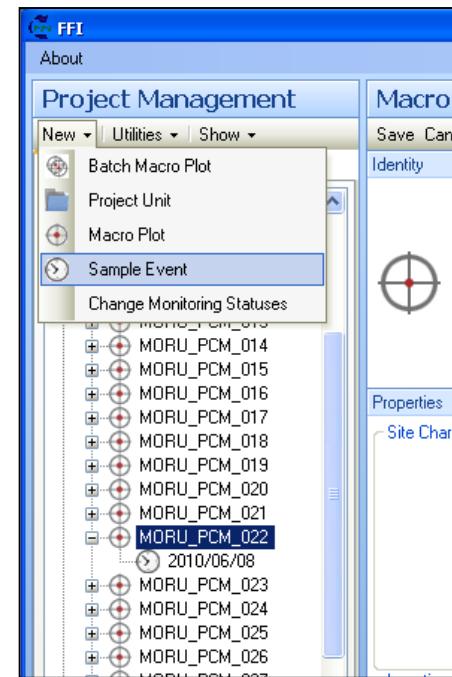
Start and log into FFI with selecting the Park database and Administrative Unit (MORU with be the example)

When FFI open, you will be in the Project Management area. The Network's plots (or Macro Plots in FFI) will be in the Project Unit "Park". Click the "+" next to Park to see the Network's macro plots. Click the "+" next to a macro plot, and you will see the Sample Events, listed as dates, associated with that plot.

Database section you are working in (also highlighted in orange below tree window)



To create a sample event for a macro plot, you want to click on the macro plot of interest to highlight it. Next click on “New” below the Project Management heading; then click Sample Event.



With the new sample event, fill in the information about the sample event while in the Project Management area.

Project Management

Sample Event

Save Cancel Delete

Identity

Date: 6/8/2010 Date of sampling

Macro Plot: MORU_PCM_022 Auto filled

Default Monitoring Status: Leave Blank

Properties

User Variables

UV1: PCCSM 1.00 Version of protocol that was used to collect the data

UV2: Leave Blank

UV3: Leave Blank

Protocols

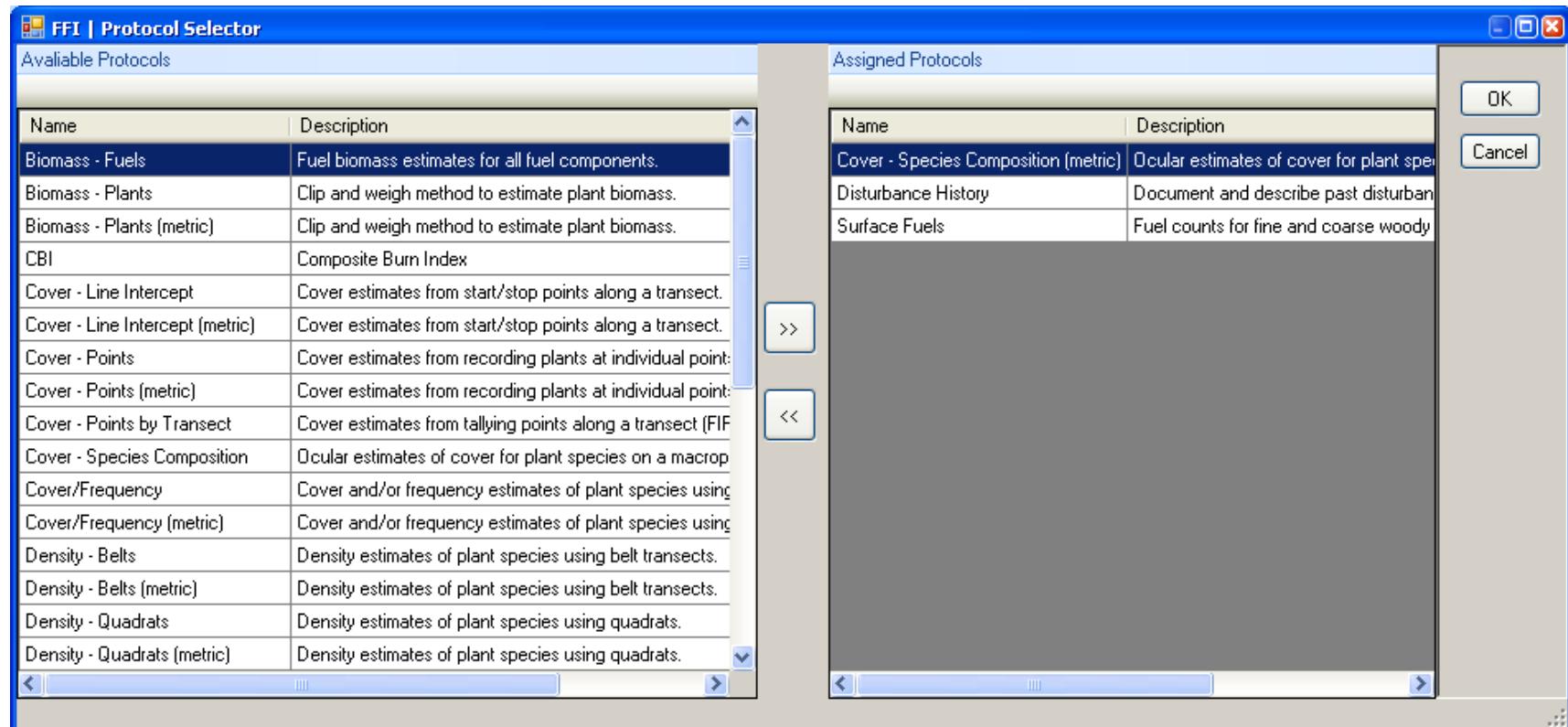
Add/Remove Protocols Copy Last Visit Protocol/Tree Data

Name	Description
Cover - Species Composition (metric)	Ocular estimates of cover for plant species on a macroplot.
Surface Fuels	Fuel counts for fine and coarse woody debris plus duff and litter depth e...
Disturbance History	Document and describe past disturbance and change.

The list of method protocols that were used to collect data during sample event. The "Add/Remove Protocols" button allows you to change what data methods were used with the Sample Event.

* In the unusual event that data are collected from the same plot on different dates in the same year, but in close temporal proximity (e.g., ran out of time on the first day, so had to complete the next day), the date assigned to the Sample Event should be the earliest date.

Add/Remove Protocols: Within FFI, protocols define what data you can enter for a Sample Event. What data you collect at a plot depends on what the plot type is. When you click on the Add\Remove button, you will get the window below.

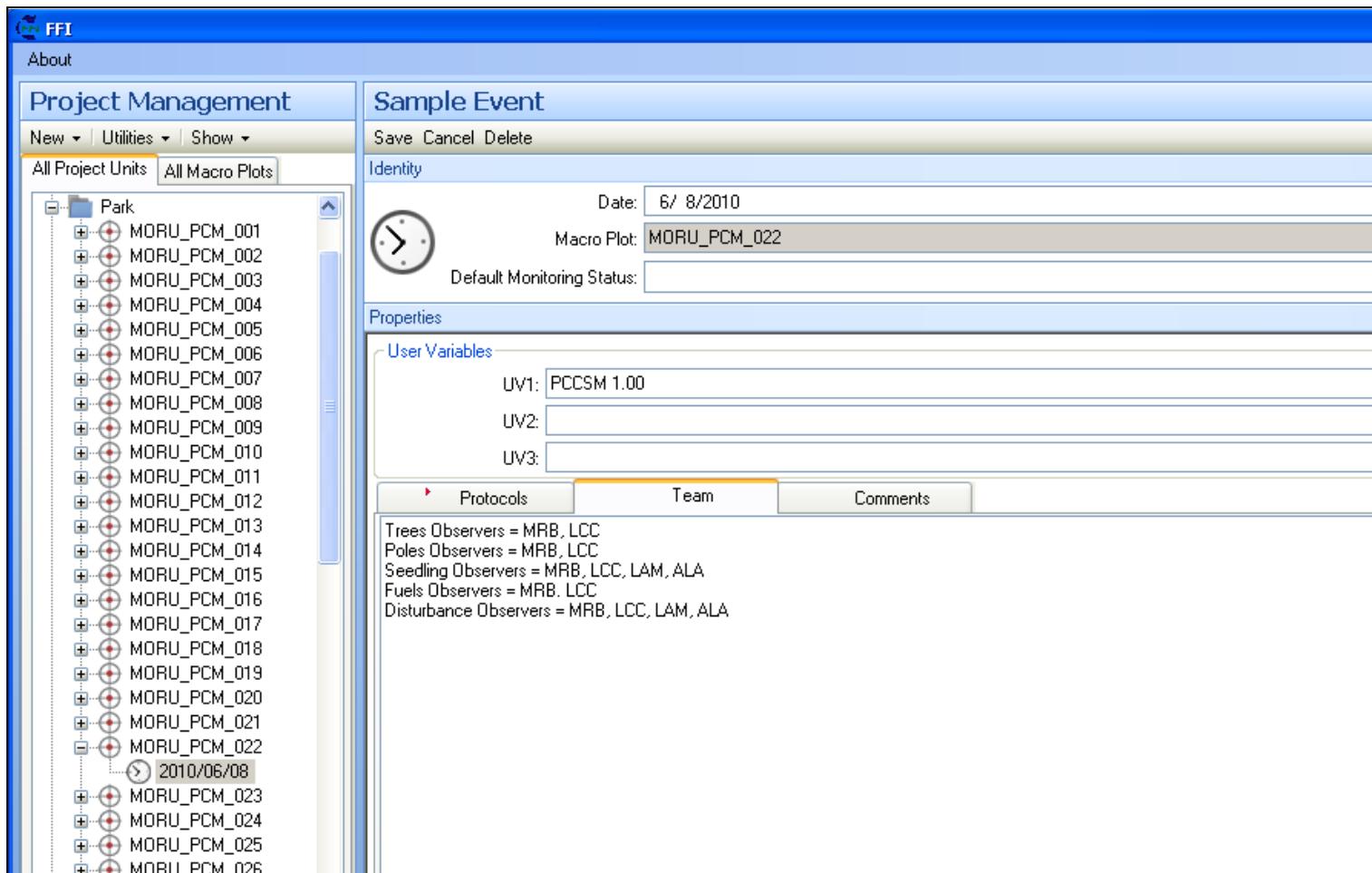


154

Available Protocols are ones you can add to the Sample Event; Assigned Protocols are ones already associated with the Event. To add a Protocol, you click on it to highlight it (Biomass – Fuels is highlighted above) and then click on the >> button. If you click on the << button, you will remove the highlighted Assigned Protocol (in the above image, it would be Cover – Species Composition (metric)).

Network's Data Sheet	FFI Protocol Name
PCM-4: Point-Intercept Data Sheet	Cover – Points (metric)
PCM-5: Nested Quadrates Data Sheet	Density – Belts (metric)
PCM-6: Trees Data Sheet (same as PCM-7)	Trees – Individuals (metric)
PCM-7: Poles Data Sheet (same as PCM-6)	Trees – Individuals (metric)
PCM-8: Seedling Data Sheet	Density – Quadrates (metric)
PCM-9: Ponderosa Pine Forest Dead & Downed Fuels Data Sheet	Surface Fuels
PCM-10: Site Disturbance Assessment	Disturbance History
PCM-10: Target Species – Site Disturbance and Target Species Assessment	Cover – Species Composition (metric)

After adding the protocols, you add the observers involved with the sample event under the Team tab. You want to identify who was involved with each set of data collection. See image below. On the data sheets that capture who was collected and recording the data, be sure that information is shown here.



The Comments tab is used to record the comments from the data sheets, be sure to note which data sheet the comments came from (the example plot used for screen capture does not have any sampling comments).

Data Entry: PCM 4 (Point-Intercept Data Sheet)

To enter data in FFI, you need to have created a sample event (and added protocols) for the plot in Project Management. With an event ready, you click on the “Data Entry and Edit” navigation button on the right side of the FFI screen (see image to the right). You will then expand the Project Unit (“Park” is what the network is using). Find the macro plot you are entering data for and click on the “+” next to it. Now, select the date for which you wish to enter or edit data.

When you click on the sample event date, you will see a number of tabs across the top of the database window. These tabs correspond to the FFI Protocols you selected when creating the Sample Event. The image below shows the “Cover – Point (metric)” selected.

156

Data Entry and Edit Details

Picklist: Local Species

Surface Fuels | Cover - Points (metric) | Cover - Species Composition (metric) | Density - Belts (metric) | Density - Quadrats (metric) | Disturbance History | Trees - Individuals (metric)

Save | Cancel | Delete | Delete Visit

Visited: Click to change to "Yes"

Num. Transects:

Tran. Length:

Num. Pts./Tran.:

Offset:

View	Transect	Point	Tape	Order	Height	Species	Status	Comment	UV1	UV2	UV3
*											

For Transect A enter 1
For Transect B enter 2

Enter the point number from the data sheet for that entry

Tape will automatically fill after you leave that record line

Hit number: Top Hit = 1, Hit 2 = 2, etc.
For Ground enter 0

Enter "L" (live) for living material; "D" (dead) for non-

Only enter Height (in meters) for the Top Hit species (Order =

Leave

Enter comments about data row, including information on PCM-

INPNPGPN70246 | inpmwromoru1\ngprfli | FFL_MORU | MORU

Data Entry and Edit

IN-ACTIVE | MORU-Inventory and Monitoring | NULLNULL | Park

MORU_PCM_001 | MORU_PCM_002 | MORU_PCM_003 | MORU_PCM_004 | MORU_PCM_005 | MORU_PCM_006 | MORU_PCM_007 | MORU_PCM_008 | MORU_PCM_009 | MORU_PCM_010 | MORU_PCM_011 | MORU_PCM_012 | MORU_PCM_013 | MORU_PCM_014 | MORU_PCM_015 | MORU_PCM_016 | MORU_PCM_017 | MORU_PCM_018 | MORU_PCM_019 | MORU_PCM_020 | MORU_PCM_021 | MORU_PCM_022 | MORU_PCM_023 | MORU_PCM_024 | MORU_PCM_025 | MORU_PCM_026 | MORU_PCM_027 | MORU_PCM_028 | MORU_PCM_029 | MORU_PCM_030 | MORU_PCM_031 | MORU_PCM_032 | MORU_PCM_033 | MORU_PCM_034

Project Management | PDA Coordination | **Data Entry and Edit** | Query | Reports and Analysis | Species Management | Toolbox

INPNPGPN70246 | inpmwromoru1\ngprfli

Notice how Point 1 takes up three rows in FFI (Top Hit, Hit 2, and Ground).

157

FFI (Top Hit, Hit 2, and Ground) for Point 1

View	Transect	Point	Tape	Order	Height	Species	Status	Comment	UV1	UV2	UV3
	1	1	0.3	1	0.27	ARNU2	L		Leave Blank	Leave Blank	Leave Blank
	1	1	0.3	2		MAST4	L				
	1	1	0.3	0		LITT	D				
	1	2	0.8	0		LITT	D				
	1	3	1.3	0		LITT	D				
	1	4	1.8	1	0.16	SPBE2	L				
	1	4	1.8	2		CARI	L				
	1	4	1.8	0		LITT	D				
	1	5	2.3	1	0.33	ARNU2	L				
	1	5	2.3	2		SPBE2	L				
	1	5	2.3	0		LITT	D				
	1	6	2.8	0		MOSS	L				
	1	7	3.3	0		ROCK	D				
	1	8	3.8	0		WOOD	D				

POINT-INTERCEPT DATA SHEET

Park: MORU Plot ID: PCM-012 Transect: A B Date: 8-4-2010

Reader: MB Recorder: AA Start Time: 1050 Finish Time: 1350

Point	Tape	Height	Top Hit	Hit 2	Hit 3	Hit 4	Hit 5	Hit 6	Hit 7	Ground
1	0.3	27cm	ARNU	MAST						lit
2	0.8	—								lit
3	1.3	—								lit
4	1.8	16cm	SPBE	CARI						lit
5	2.3	33 cm	ARNU	SPBE						lit
6	2.8	—								moss
7	3.3	—								bedrock
8	3.8	—								wood
9	4.3	25 cm	SPBE							lit
10	4.8	—								bedrock
11	5.3	—								bedrock
12	5.8	—								bedrock
13	6.3	—								bedrock
14	6.8	36 cm	JUCO							bedrock
15	7.3	—								lit
16	7.8	10 cm	JUCO	CARI						lit
17	8.3	20cm	DASP							lit
18	—	—								

158

If you are entering data and a species is not present in the drop-down, you will need to add the species through the Species Management area of FFI (See the Species Management User Guide).

Once finished entering data, click on the “Save” button on the upper right of the data entry window. After you have entered all of the data, proof your data entry. Go through each line of data and insure that you typed it in correctly and fix any errors you come across.

When finished proofing the data you entered, enter your initials and date you finished in the “Entered (name & date)” line at the bottom of the data sheets. Someone else will be checking the data, so do not enter your info in the “Checked” line.

While you are entering data, you may want to periodically click on the “Save” button, especially if you are needing to be away from your computer. If you forget to save or accidentally click on another tab, you will either be told that you must save the data before leaving the tab you are in or asked if you want to save the data depending on where you clicked.

Data Entry and Edit Details

Picklist Local Species

Quads Fuels Cover - Species Composition (metric) Density - Quadrats (metric) Disturbance History Trees - Individuals (metric)

Save Cancel Delete Delete Visit

Enter All Visited: Yes

Plot Size: 0.031

Snag Plot Size: 0.031

Break Pnt. Dia.: 15

Data Entry: PCM 5 (Nested Quadrats Data Sheet)

To enter data in FFI, you need to have created a sample event (and added protocols) for the plot in Project Management. With an event ready, you click on the “Data Entry and Edit” navigation button on the right side of the FFI screen (see image to the right). You will then expand the Project Unit (“Park” is what the network is using). Find the macro plot you are entering data for and click on the “+” next to it. Now, select the date for which you wish to enter or edit data.

When you click on the sample event date, you will see a number of tabs across the top of the database window. These tabs correspond to the FFI Protocols you selected when creating the Sample Event. The image below shows the “Density – Belts (metric)” selected.

Data Entry and Edit Details

Picklist Local Species

Surface Fuels | Cover - Points (metric) | Cover - Species Composition (metric) | **Density - Belts (metric)** | Density - Quadrats (metric) | Disturbance History | Trees - Individuals (metric)

Save Cancel Delete Delete Visit

Visited:

Num. Transects:

Num. Subbelts:

Tran. Length:

Tran. Width:

Tran. Area:

Leave Blank

159

View	Transect	Subbelt	Item Code	Status	Size Class	Age Class	Count	Height	Subplot Frac.	Comment	UV1	UV2	UV3
*			<input type="text" value=""/>										

For Transect A enter 1
For Transect B enter 2

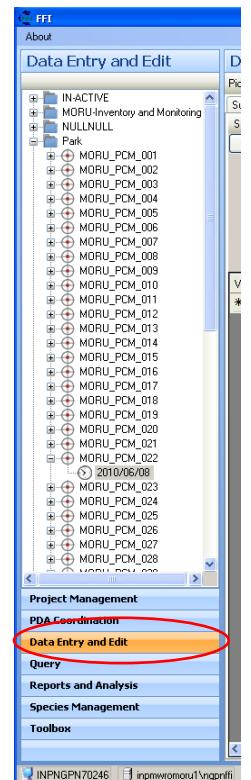
Enter “L” for Species Code

Set

Enter “1”

Enter the Area divided by 10 (i.e. Area is 0.01 enter “0.001”, Area is 0.1 enter

Enter any comments about the row of data or information about the unknown species from PCM-11 (Unknown Plant Data Sheet)



Data Entry and Edit Details

Visited: Yes

Num. Transects: 2

Num. Subbelts: 5

Tran. Length: 1

Tran. Width: 1

Tran. Area: 10

View	Transect	Subbelt	Item Code	Status	Size Class	Age Class	Count	Height	Subplot Frac.	Comment	UV1	UV2	UV3
►	1	1	SYAL	L			1		0.001				
	1	1	SPBE2	L			1		0.01				
	1	1	MOFI	L			1		0.01				
	1	1	LAOC2	L			1		0.01				
	1	1	VIOLA	L			1		0.01				
	1	1	ARUV	L			1		0.01				
	1	1	SOSP2	L			1		0.01				
	1	1	MAST4	L			1		0.1				
	1	1	APAN2	L			1		0.1				
	1	1	ORAS	L			1		0.1				
	1	1	HICA3	L			1		0.1				
	1	1	CARI	L			1		0.1				
	1	1	PIPO	L			1		1				
	1	1	PRVI	L			1		1				
	1	1	PHMO4	L			1		1				
	1	1	ALCE2	L			1		1				
	1	1	SCSC	L			1		1				
	1	1	ANNE	L			1		1				
	1	2	CARI	L			1		0.01				
	1	2	PIPO	L			1		0.1				
	1	2	MAST4	L			1		0.1				
	1	2	APAN2	L			1		1				
	1	2	ARNU2	L			1		1				

Leave Blank

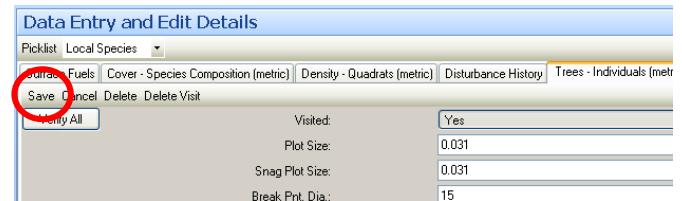
Compare the Subplot Frac. value to the Area number on the data sheet (Subplot = Area/10).

SET	AREA	SPECIES	5
1	.01	SYAL	
1	.1	SPBE	
1	.1	MOFI	
1	.1	LAOC 2	
1	.1	VIXX	
1	.1	ARUV	
1	.1	SOSP	
1	.1	MAST	
1	1	APAN	
1	1	ORAS	
1	1	HICA	
1	1	CARI	
10	10	PIPO	
10	10	PRVI	
10	10	PHMO	
10	10	ALCE2	
10	10	SCSC	
10	10	ANNE	
2	.01	—	
1	.1	CARI	

If you are entering data and a species is not present in the drop-down, you will need to add the species through the Species Management area of FFI (See the Species Management user guide).

Once finished entering data, click on the “Save” button on the upper right of the data entry window. After you have entered all of the data, proof you data entry. Go through each line of data and insure that you typed it in correctly and fix any errors you come across.

When finished proofing the data you entered, enter your initials and date you finished in the “Entered (name & date)” line at the bottom of the data sheets. Someone else will be checking the data, so do not enter your info in the “Checked” line.



The screenshot shows a software interface titled "Data Entry and Edit Details". At the top, there is a toolbar with several buttons: "Juras, Fuels", "Cover - Species Composition (metric)", "Density - Quadrats (metric)", "Disturbance History", and "Trees - Individuals (metric)". Below the toolbar, there are four buttons: "Save", "Cancel", "Delete", and "Delete Visit". The "Save" button is circled in red. To the right of the toolbar, there are four data fields: "Visited" (set to "Yes"), "Plot Size" (set to "0.031"), "Snag Plot Size" (set to "0.031"), and "Break Pnt. Dia." (set to "15").

While you are entering data, you may want to periodically click on the “Save” button, especially if you are needing to be away from your computer. If you forget to save or accidentally click on another tab, you will either be told that you must save the data before leaving the tab you are in or asked if you want to save the data depending on where you clicked.

Data Entry: PCM 6 & 7 (Trees and Poles Data Sheets)

To enter data in FFI, you need to have created a sample event (and added protocols) for the plot in Project Management. With an event ready, you click on the “Data Entry and Edit” navigation button on the right side of the FFI screen (see image to the right). You will then expand the Project Unit (“Park” is what the network is using). Find the macro plot you are entering data for and click on the “+” next to it. Now, select the date for which you wish to enter or edit data.

When you click on the sample event date, you will see a number of tabs across the top of the database window. These tabs correspond to the FFI Protocols you selected when creating the Sample Event. The image below shows the “Trees – Individuals (metric)” selected.

162

Data Entry and Edit Details

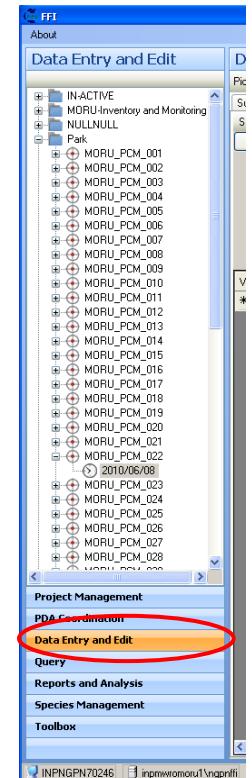
Visited: No *Click to change to "Yes"*

Plot Size: Intensive/Dual = 0.1; Extensive = 0.031

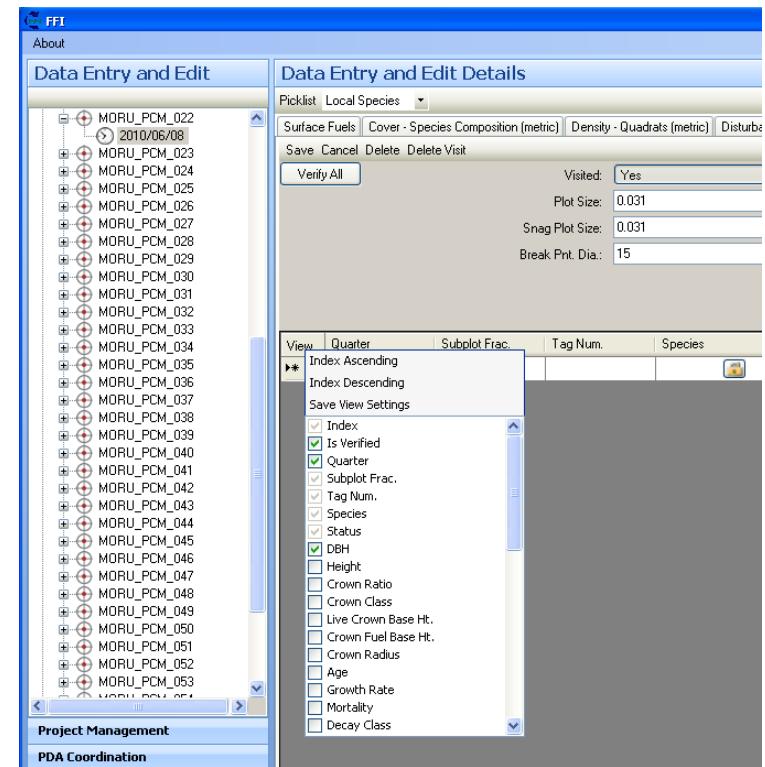
Snag Plot Size: Intensive/Dual = 0.1; Extensive = 0.031

Break Pnt. Dia.: 15

View	Quarter	Subplot Frac.	Tag Num.	Species	Status	DBH	Damage 1	Height	Crown R.
*				🔒	🔒				



Before entering data, you can click on “View”. A window will pop-up, this allows you to control which data columns are visible for entering data. The boxes with checks will be visible; the unchecked boxes will be hidden from view. You will want to be sure you can see the fields (columns): Is Verified, Quarter, Subplot Frac., Tag Num., Species, Status, DBH, DRC, Comments, UV1, and UV2. The “Is Verified” shows at the end of the data fields even though it is at the beginning of the check boxes.



Because the Trees data and Poles data are treated slightly different, there is no easy method for data entry. I would enter all of the Trees data first then the Poles data. After entering the Trees data, you will want to click on the “Subplot Frac.” column heading to sort by this column (if you leave FFI and return later, you may need to sort by another column). This will keep the data in the order that you enter them, otherwise the data is sorted by Quarter and as you switch to the Poles data, the Quarter 1 Poles data will move under the Quarter 1 Trees data. The example below is from MORU PCM 022 (an extensive plot).

164

Data Entry and Edit Details

Picklist Local Species ▾

Surface Fuels Cover - Species Composition (metric) Density - Quadrats (metric) Disturbance History **Trees - Individuals (metric)**

Save Cancel Delete Delete Visit

Verify All

Visited: Yes

Plot Size: 0.031

Snag Plot Size: 0.031

Break Pnt. Dia.: 15

Notice the “Triangle”: indicates a sort on the data by this column

View	Quarter	Subplot Frac.	Tag Num.	Species	Status	DBH	DRC	Comment	UV1	UV2	Is Verified
	1	1	101	PIPO	L	34.2			In	SND	No
	1	1	102	PIPO	L	16.2			In	SND	No
	2	1	201	PIPO	L	19.2			In	SND	No
	2	1	202	PIPO	L	43.4			In	SND	No
	2	1	203	PIPO	L	21.4			In	SND	No
	2	1	204	PIPO	L	36.1			In	SND	No
	3	1	301	PIPO	L	48.5			In	SND	No
	3	1	302	PIPO	L	49.1			In	SND	No
	4	1	401	PIPO	L	21.2			In	SND	No
	4	1	402	PIPO	L	21.1			In	SND	No
	4	1	403	PIPO	L	32.6			In	SND	No
	1	1	103	PIPO	L	6.9					No
	1	1	104	PIPO	L	4.4					No
	1	1	105	PIPO	L	14					No
	1	1	106	PIPO	L	4.2					No
	1	1	107	PIPO	L	3.1					No
	1	1	108	PIPO	L	9					No
	1	1	109	PIPO	L	10.1					No
	1	1	110	PIPO	L	3.4					No
	1	1	111	PIPO	L	12.8					No
	1	1	112	PIPO	L	4.9					No
	1	1	113	PIPO	L	5					No
	1	1	114	PIPO	L	4.1					No

FFI MORU MORU

Trees Data Sheet (PCM-6)

Poles Data Sheet (PCM-7)

FFI requires a Tag Number. For Poles data (all plot types) and Extensive Trees data, the number is made up using the quarter number and sequential starting with 01 (i.e. the first tree list for quarter 1 is 101).

Guide to entering the Trees Data PCM-6

For Trees Data (PCM-6), the Subplot Frac. field gets a “1” regardless of plot type.

165

If trees were not tagged, this is a made up number; otherwise, enter the tag number. FFI requires a tag

Enter L or D based on “Condition Code” from data sheet: L (live) for codes – SND, DBK, DIS, DEC, INS

Field indicates whether you have proofed your data entry. After you finish entering all the data (PCM-6 & 7), you double check your entered data. With the data proofed and errors corrected, click the “Verify All” button under “Save”.

Is Verified

View	Quarter	Subplot Frac.	Tag Num.	Species	Status	DBH	DRC	Comment	UV1	UV2	Is Verified
	1	1	101	PIPO	L	34.2			In	SND	No
	1	1	102	PIPO	L	16.2			In	SND	No
	2	1	201	PIPO	L	19.2			In	SND	No
	2	1	202	PIPO	L	43.4			In	SND	No
	2	1	203	PIPO	L	21.4			In	SND	No
	2	1	204	PIPO	L	36.1			In	SND	No
	3	1	301	PIPO	L	48.5			In	SND	No
	3	1	302	PIPO	L	49.1			In	SND	No
	4	1	401	PIPO	L	21.2			In	SND	No
	4	1	402	PIPO	L	21.1			In	SND	No
	4	1	403	PIPO	L	32.6			In	SND	No
	1	1	103	PIPO	I	6.9			In	SND	No

Comments: enter any notes about the tree for that record.

Condition Code

DCR (diameter at root collar): If species code is JUSC2 (*Juniperus scopulorum* – Rocky Mountain juniper), enter into this column; otherwise enter into DBH

In/Out column on the data sheet.

DBH (diameter at breast height): Enter all tree diameter reading here except for the species JUSC2 (*Juniperus scopulorum* – Rocky Mountain juniper), which gets entered into the field DRC (diameter at root collar).

Guide to entering the Poles Data PCM-7

For Poles Data (PCM-7), the Subplot Frac. field gets a “1” for EXTENSIVE plots. The field gets a “0.314” for INTENSIVE/DUAL plots.

Poles are not tagged, this is a made up number. FFI requires a tag

Enter L or D based on “Live/Dead” from data

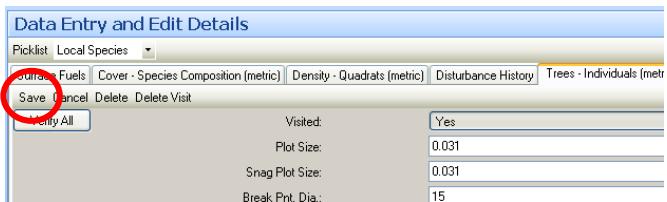
Field indicates whether you have proofed your data entry. After you finish entering all the data (PCM-6 & 7), you double check your entered data. With the data proofed and errors corrected, click the “Verify All” button under “Save”.

View	Quarter	Subplot Frac.	Tag Num.	Species	Status	DBH	DRC	Comment	UV1	UV2	Is Verified
	1	1	104	PIPO	L	4.4					No
	1	1	105	PIPO	L	14					No
	1	1	106	PIPO	L	4.2					No
	1	1	107	PIPO	L	3.1					No
	1	1	108	PIPO	L	9					No
	1	1	109	PIPO	L	10.1					No
	1	1	110	PIPO	L	3.4					No
	1	1	111	PIPO	L	12.8					No
	1	1	112	PIPO	L	4.9					No
	1	1	113	PIPO	L	5					No
	1	1	114	PIPO	L	4.1					No
	1	1	115	PIPO	L	2.7					No
	1	1	116	PIPO	D	4.1					No
	1	1	117	PIPO	L	4.9					No
	1	1	118	PIPO	L	2.7					No
	1	1	119	PIPO	L	6					No
	1	1	120	PIPO	I	12					No

Leave Blank
Leave Blank

The “Diameter” column on the data sheet is entered either into DBH (diameter at breast height) field or DRC field (diameter at root crown), which column it goes into depends on the species. SOP 8 has a table listing species and which measurement is taken.

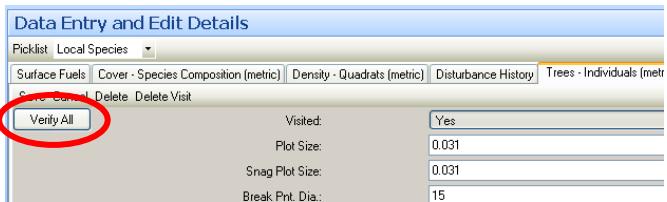
Once finished entering data, click on the “Save” button on the upper right of the data entry window. After you have entered all of the data from the PCM-6 (Trees) and PCM-7 (Poles) data sheets, proof your data. Go through each line of data and insure that you typed it in correctly and fix any errors you come across.



The screenshot shows a software interface titled "Data Entry and Edit Details". At the top, there is a "Picklist" dropdown set to "Local Species". Below the dropdown are several tabs: "Surface Fuels", "Cover - Species Composition (metric)", "Density - Quadrats (metric)", "Disturbance History", and "Trees - Individuals (metric)". The "Trees - Individuals (metric)" tab is active. A red circle highlights the "Save" button in the toolbar. The main area contains data entry fields for "Visited" (Yes), "Plot Size" (0.031), "Snag Plot Size" (0.031), and "Break Pnt. Dia." (15).

Once you have verified that your data was correctly entered, you can click on the “Verify All” button located under the “Save” button. The “Is Verified” field should now say “Yes”.

When finished proofing the data you entered, enter your initials and date you finished in the “Entered (name & date)” line at the bottom of the data sheets. Someone else will be checking the data, so do not enter your info in the “Checked” line.



This screenshot is identical to the one above, showing the "Data Entry and Edit Details" window. The "Trees - Individuals (metric)" tab is active. A red circle highlights the "Verify All" button in the toolbar. The data entry fields are the same as in the first screenshot.

While you are entering data, you may want to periodically click on the “Save” button, especially if you are needing to be away from your computer for a time. If you forget to save or accidentally click on another tab, you will either be told that you must save the data before leaving the tab you are in or asked if you want to save the data depending on where you clicked.

Data Entry: PCM 8 (Seedlings Data Sheet)

To enter data in FFI, you need to have created a sample event (and added protocols) for the plot in Project Management. With an event ready, you click on the “Data Entry and Edit” navigation button on the right side of the FFI screen (see image to the right). You will then expand the Project Unit (“Park” is what the network is using). Find the macro plot you are entering data for and click on the “+” next to it. Now, select the date for which you wish to enter or edit data.

When you click on the sample event date, you will see a number of tabs across the top of the database window. These tabs correspond to the FFI Protocols you selected when creating the Sample Event. The image below shows the “Density – Quadrats (metric)” selected.

168

Data Entry and Edit Details

Surface Fuels

Cover - Species Composition (metric)

Density - Quadrats (metric) **(selected)**

Disturbance History

Trees - Individuals (metric)

Save

Cancel

Delete

Delete Visit

Visited: Click to change to “Yes”

Num. Transects:

Num. Quad./Tran:

Quad. Length:

Quad. Width:

Quad. Area:

Leave Blank

Total

Stump sprout? Y = “R”; N =

Comments about the row of data

Status will always be

Species Code

Quarter

Transect will always be “1”

Height > 137 cm? Y = “SA”; N =

The fraction of Quarters that the species was searched for (bottom part of data sheet): if “# Quarters Counted” = 4 enter “1”; = 3 enter “0.75”; = 2 enter “0.5”; = 1 enter “0.25”

Project Management

PDA Coordination

Data Entry and Edit **(selected)**

Query

Reports and Analysis

Species Management

Toolbox

INPNPGPN70246

INPNPGPN70246

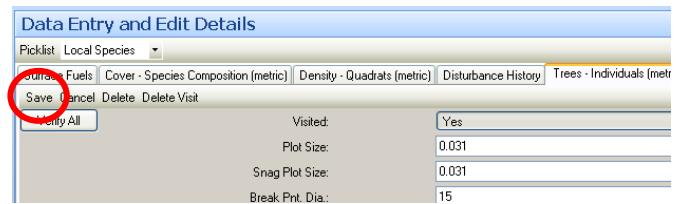
Data for MORU 022 entered along with the data sheet.

If no seedlings are in the plot enter one record of data similar to the one in red. The species code should be “NOSP” (No Species).

Once finished entering data, click on the “Save” button on the upper right of the data entry window. After you have entered all of the data, proof your data entry. Go through each line of data and insure that you typed it in correctly and fix any errors you come across.

When finished proofing the data you entered, enter your initials and date you finished in the “Entered (name & date)” line at the bottom of the data sheets. Someone else will be checking the data, so do not enter your info in the “Checked” line.

While you are entering data, you may want to periodically click on the “Save” button, especially if you are needing to be away from your computer. If you forget to save or accidentally click on another tab, you will either be told that you must save the data before leaving the tab you are in or asked if you want to save the data depending on where you clicked.



The screenshot shows a software interface titled "Data Entry and Edit Details". At the top, there is a "Picklist" dropdown set to "Local Species". Below the dropdown is a horizontal menu bar with tabs: "Soil", "Fuels", "Cover - Species Composition (metric)", "Density - Quadrats (metric)", "Disturbance History", and "Trees - Individuals (metric)". The "Trees - Individuals (metric)" tab is highlighted with a yellow background. Below the menu, there is a toolbar with buttons for "Save", "Cancel", "Delete", and "Delete Visit". The "Save" button is circled in red. To the right of the toolbar, there are several data entry fields: "Visited" (checkbox, Yes), "Plot Size" (text input, 0.031), "Snag Plot Size" (text input, 0.031), and "Break Pnt. Dia." (text input, 15). At the bottom left of the data entry area, there is a button labeled "Entry All".

Data Entry: PCM 9 (Surface Fuels Data Sheet)

To enter data in FFI, you need to have created a sample event (and added protocols) for the plot in Project Management. With an event ready, you click on the “Data Entry and Edit” navigation button on the right side of the FFI screen (see image to the right). You will then expand the Project Unit (“Park” is what the network is using). Find the macro plot you are entering data for and click on the “+” next to it. Now, select the date for which you wish to enter or edit data.

When you click on the sample event date, you will see a number of tabs across the top of the database window. These tabs correspond to the FFI Protocols you selected when creating the Sample Event. The image below shows the “Surface Fuels” selected. There are three sections for the data entry form: Fine Woody Debris (1 to 100 hour fuels), Coarse Woody Debris (1000 hour fuels), and Duff and Litter (see next page for FFI and data sheet delineations).

171

Data Entry and Edit Details

Surface Fuels Cover - Species Composition [metric] Density - Quadrats [metric] Disturbance History Trees - Individuals [metric]

Visited: No [Click to change to “Yes”](#)

Fine Woody Debris

Num. Transects:	2	10-hr Tran. Len.:	6
1-hr Tran. Len.:	6	100-hr Tran. Len.:	12

View	Transect	Azimuth	Slope	1 Hr Count	10 Hr Count	100 Hr Count	Comment	UV1	PwDFuConSt	UV2	UV3
*											

Coarse Woody Debris

Num. Transects:	2	Tran. Length:	100
-----------------	---	---------------	-----

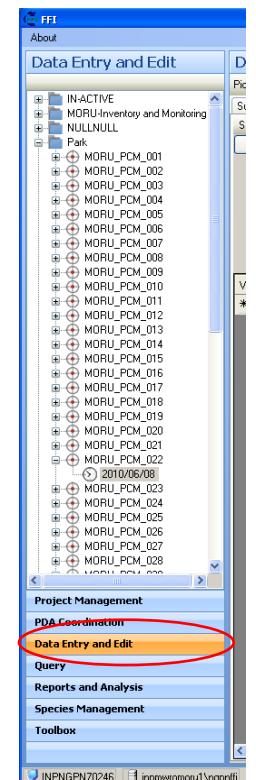
View	Transect	Slope	Log No.	Diameter	Decay Class	Comment
*						

Duff and Litter

Num. Transects:	2
-----------------	---

View	Transect	Samp. Loc.	Off Set	Litter Depth	Duff Depth	Fuelbed Depth
*						

inpnwomoru1\ngpnfli FFI_MORU MORU



Guide to where data in data sheet goes into FFI for surface fuels (Data for MORU 022 - 6/8/2010).
(a note with the Surface Fuels FFI window: you can adjust the size of the data entry windows to see all columns when entering data for each component)

Entering Fine Woody Debris into FFI (refer to data sheet above for data values)

Fine Woody Debris											
Num. Transects: 2				10-hr Tran. Len.: 6				100-hr Tran. Len.: 12			
1-hr Tran. Len.: 6											
View	Transect	Azimuth	Slope	1 Hr Count	10 Hr Count	100 Hr Count	Comment	UV1	FwDFuConSt	UV2	UV3
▶	1	306	-6	1	0	2			Ponderosa pine		
	2	216	31	2	3	0			Ponderosa pine		
*											

Leave blank

Select “Ponderosa pine”

Course Woody Debris (window modified to show all data columns)

Coarse Woody Debris											
Num. Transects: 2				Tran. Length: 100							
View	Transect	Slope	Log No.	Diameter	Decay Class	Comment	UV1	CwDFuConSt	UV2	UV3	
▶	1	-6		11.1	3			Ponderosa pine			
	2	31		12.3	4			Ponderosa pine			
*											

Leave blank

Select “Ponderosa pine”

For “Sound” enter 3
For “Rotten” enter 4

Duff and Litter (window modified to show all data columns)

Num. Transects: 2

View	Transect	Samp. Loc.	Off Set	Litter Depth	Duff Depth	Fuelbed Depth	Comment	UV1	DLFuConSt	UV2	UV3
►	1	3	No	0	0		rock		Ponderosa pine		
	1	8	No	2.3	2.3				Ponderosa pine		
	1	13	No	1.3	1				Ponderosa pine		
	1	23	No	1	2.1				Ponderosa pine		
	1	28	No	1.4	1.8				Ponderosa pine		
	1	73	No	0	0		rock		Ponderosa pine		
	1	78	No	1.1	0.9				Ponderosa pine		
	1	88	No	1.6	1.3				Ponderosa pine		
	1	93	No	1.3	1.1				Ponderosa pine		
	1	98	No	0	0		rock		Ponderosa pine		
	2	3	No	1.6	1				Ponderosa pine		
	2	8	No	1.4	1.1				Ponderosa pine		
	2	13	No	1.5	1.1				Ponderosa pine		
	2	23	No	11	1				Ponderosa pine		
	2	28	No	0	0		rock		Ponderosa pine		
	2	73	No	1.3	1.3				Ponderosa pine		
	2	78	No	1.2	1.2				Ponderosa pine		

174

Sample point

Was the point off set from line?
Use Comment to record direction and distance of off set.

Any comments about the data record including the off set distance and direction.

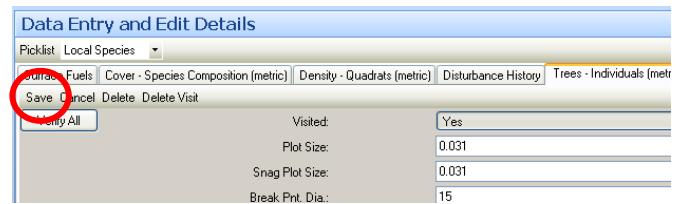
Select "Ponderosa pine"

Leave blank

Once finished entering data, click on the “Save” button on the upper right of the data entry window. After you have entered all of the, proof your data entry. Go through each line of data and insure that you typed it in correctly and fix any errors you come across.

When finished proofing the data you entered, enter your initials and date you finished in the “Entered (name & date)” line at the bottom of the data sheets. Someone else will be checking the data, so do not enter your info in the “Checked” line.

While you are entering data, you may want to periodically click on the “Save” button, especially if you are needing to be away from your computer. If you forget to save or accidentally click on another tab, you will either be told that you must save the data before leaving the tab you are in or asked if you want to save the data depending on where you clicked.



The screenshot shows a software interface titled "Data Entry and Edit Details". At the top, there is a "Picklist" dropdown set to "Local Species". Below the dropdown is a horizontal menu bar with tabs: "Soil", "Fuels", "Cover - Species Composition (metric)", "Density - Quadrats (metric)", "Disturbance History", and "Trees - Individuals (metric)". The "Trees - Individuals (metric)" tab is highlighted with a yellow background. Below the menu, there is a toolbar with buttons: "Save", "Cancel", "Delete", and "Delete Visit". The "Save" button is circled in red. To the right of the toolbar, there are several data entry fields: "Visited" (checkbox, Yes), "Plot Size" (text box, 0.031), "Snag Plot Size" (text box, 0.031), and "Break Pnt. Dia." (text box, 15). At the bottom left of the data entry area, there is a button labeled "Entry All".

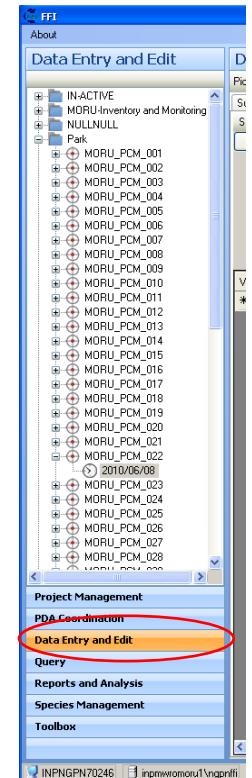
Data Entry: PCM 10 (Site Disturbance Assessment & Target Species Assessment)

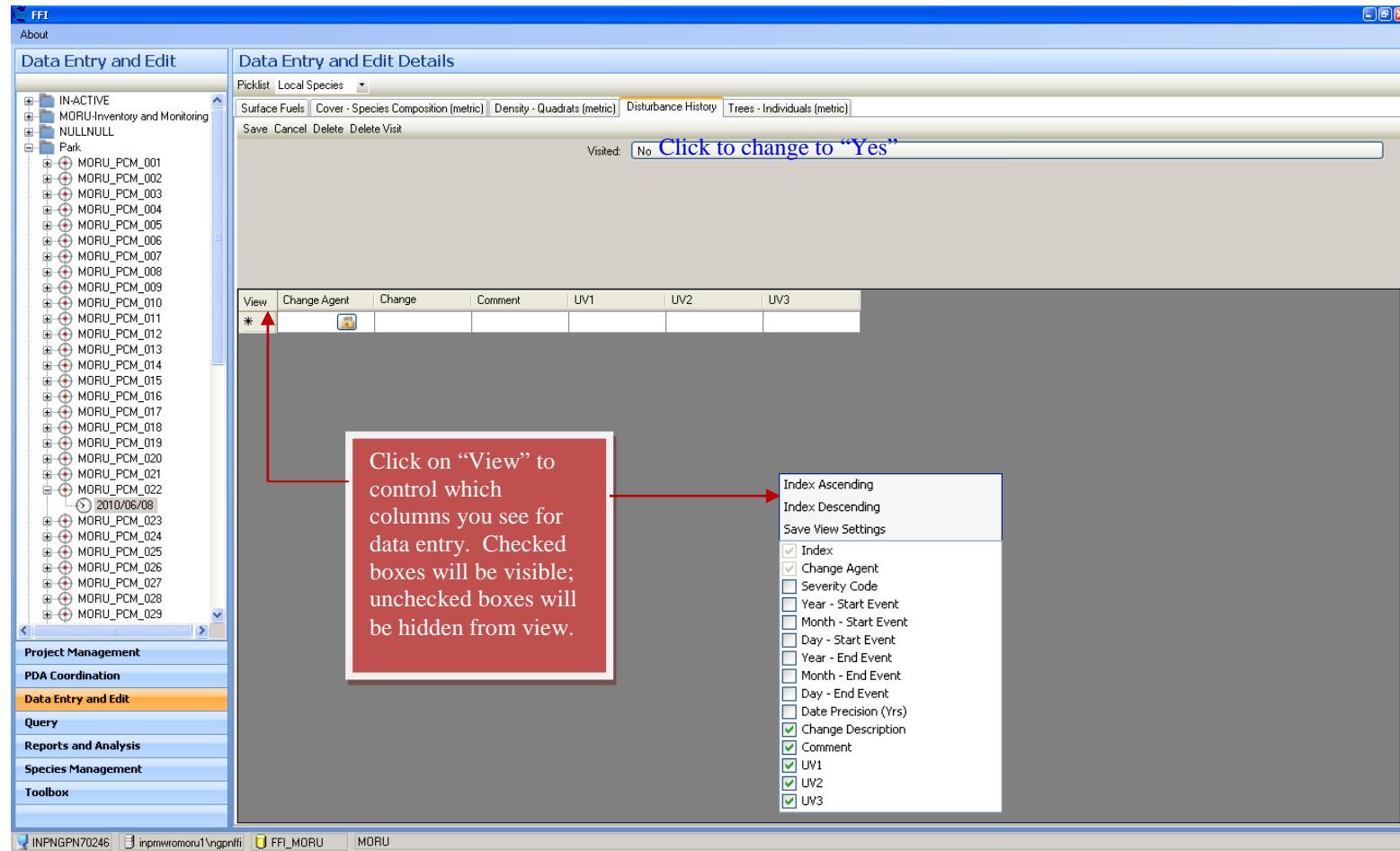
To enter data in FFI, you need to have created a sample event (and added protocols) for the plot in Project Management. With an event ready, you click on the “Data Entry and Edit” navigation button on the right side of the FFI screen (see image to the right). You will then expand the Project Unit (“Park” is what the network is using). Find the macro plot you are entering data for and click on the “+” next to it. Now, select the date for which you wish to enter or edit data.

PCM 10 consists of TWO different data sheets and FFI protocols: Disturbance History (Site Disturbance Assessment) and Cover – Species Composition (metric) (Target Species Assessment)

Site Disturbance Assessment (Disturbance History)

When you click on the sample event date, you will see a number of tabs across the top of the database window. These tabs correspond to the FFI Protocols you selected when creating the Sample Event. The image below shows the “Disturbance History” selected. You only need to see the data columns: Change Agent, Change Description, Comment, UV1, UV2, and UV3.





178

Data Entry and Edit Details

Picklist Local Species ▾

Surface Fuels Cover - Species Composition (metric) Density - Quadrats (metric) **Disturbance History** Trees - Individuals (metric)

Save Cancel Delete Delete Visit

Visited: Yes

Select the Agent that most closely matches Disturbance Type from, data sheet; use “Other” when

View Change Agent Change Description Comment UV1 UV2 UV3

► wFire  Fire Evidence of pre-historic fire: burnt standing snag in Q1 about 11m from center point; burn ... In

* 

Type in, verbatim, the “Disturbance Type” indicated on the data sheet.

Notes field

In/Out of plot

Approximate size (include)

Use the sketch to briefly describe the location of disturbance

View	Change Agent	Change Description	Comment	UV1	UV2	UV3
►	wFire 	Fire	Evidence of pre-historic fire: burnt standing snag in Q1 about 11m from center point; burn ...	In		
*						

Target Species Assessment (Cover – Species Composition (metric)) (below is from MORU-PCM-012)

Data Entry and Edit Details

Picklist Local Species ▾

Surface Fuels Cover - Species Composition (metric) Density - Quadrats (metric) Disturbance History Trees - Individuals (metric)

Save Cancel Delete Delete Visit

Visited: Yes Click to change to from “No”

Min. Cov. Level: ←

Leave Blank

View Item Code Status Size Class Age Class Cover Height Comment UV1 UV2 UV3

View	Item Code	Status	Size Class	Age Class	Cover	Height	Comment	UV1	UV2	UV3
▶	TRHY	L			2		Non-native Clover	Q2, Q3		
*	TRPR2	L			2		Non-native Clover	Q1, Q2, Q3		

Location

Abundance Class (you do not need to select one of the terms in the drop down)

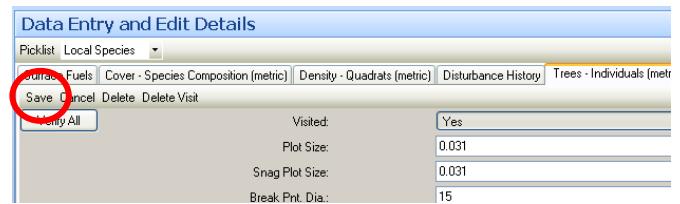
Unless noted in the Comments, select “L”

179

Once finished entering data, click on the “Save” button on the upper right of the data entry window. After you have entered all of the, proof your data entry. Go through each line of data and insure that you typed it in correctly and fix any errors you come across.

When finished proofing the data you entered, enter your initials and date you finished in the “Entered (name & date)” line at the bottom of the data sheets. Someone else will be checking the data, so do not enter your info in the “Checked” line.

While you are entering data, you may want to periodically click on the “Save” button, especially if you are needing to be away from your computer. If you forget to save or accidentally click on another tab, you will either be told that you must save the data before leaving the tab you are in or asked if you want to save the data depending on where you clicked.



The screenshot shows a software interface titled "Data Entry and Edit Details". At the top, there is a "Picklist" dropdown set to "Local Species". Below the dropdown is a horizontal menu bar with several tabs: "Soil", "Fuels", "Cover - Species Composition (metric)", "Density - Quadrats (metric)", "Disturbance History", and "Trees - Individuals (metric)". The "Trees - Individuals (metric)" tab is highlighted with a yellow background. Below the menu, there is a toolbar with buttons for "Save", "Cancel", "Delete", and "Delete Visit". The main area contains several data fields: "Visited" (Yes), "Plot Size" (0.031), "Snag Plot Size" (0.031), and "Break Pnt. Dia." (15). The "Save" button is circled in red.

SOP Data Analysis: Data Analysis and Reporting

Version 1.01

Prev. Version	Revision Date	Revised by	Changes Made	Reasons for Change	New Version
1.00	11/11	IWA	Change to nrps style. Added some corrections to FFI instructions	Style; clarification; new FFI version	1.01

This standard operating procedure (SOP) details the data analysis and reporting components of the plant community composition and structure monitoring protocol of the Northern Great Plains I&M Network (NGPN). Analyses and report writing will be done by the Plant Ecologist with assistance from the Plant Lead Biotech and Quantitative Ecologist. The audience for the reports includes park superintendents and resource managers, NGPN staff, NPS program managers, external scientists, and partners. There are 4 main types of analyses/reports: (1) annual summaries and reports; (2) determination of status and trends; (3) comprehensive syntheses; and (4) variability assessment and sample design review.

1. Annual Reports

Each year an annual report will be produced for each park. This report will be comprised of four main elements:

1. a list of the number and location of plots visited that year;
2. summary data from the intensive plots visited that year;
3. alerts about target species observations, notable disturbances, or other things important for park staff to know; and
4. description of any changes to the protocol or interaction with park staff intended for future years.

Elements 1, 3, and 4 are self-explanatory. For element 2, the annual data summary will, at the minimum, report the mean, median, minimum, and maximum plot-level value for individual strata (where applicable) and the park as a whole for the attributes listed in Table 1 for the intensive plots sampled that year. The annual data summary will also report the standard deviation of each of these attributes from these plots as a measure of spatial variability. These attributes were chosen for their relevance to park management and suspected relationships to internal and external ecosystem stressors. Other attributes may be summarized and reported if requested by park staff or if Network staff believe they would be of interest to the report's audience. Data from extensive plots will be reported in a status and trend report to be completed in the year after a park's extensive woody plots are sampled.

Table 9. Attributes to be summarized and reported in annual reports.

Measure	Attribute	Management or Stressor Relevance
Absolute Percent Cover	Herb-layer total cover Herb-layer graminoid cover Herb-layer forb cover Herb-layer shrub cover Herb-layer cover of target species ^a Ground-layer bare soil cover	Forage availability; climatic trends; erosion potential; habitat for small mammals and birds
Relative Cover	Percentage of herb-layer cover that is exotic (=exotic cover/total cover) Percentage of graminoid cover that is warm-season (=warm-season graminoid cover/graminoid cover)	Effectiveness of exotic species management Climatic trends
Percent Frequency ^b	Targeted individual species ^b	Specific to park
Species Richness ^c (number of species)	Native species richness Exotic species richness Graminoid species richness Forb species richness	Diversity maintenance
Species Diversity (H') and Evenness (J') ^d	All herb-layer species Native herb-layer species	Diversity maintenance
Density	Individual tree species by size class (seedling<1.37 m tall, seedling>1.37 m tall, pole, tree) All tree species combined by size class (seedling<1.37 m tall, seedling>1.37 m tall, pole, tree, snag) All tall shrub species combined by size class (seedling<1.37 m tall, seedling>1.37 m tall, pole) Snag density by size class (<15 cm DBH, >15 cm DBH)	Population potential (recruitment, mortality) of individual tree species; browse pressure Habitat for forest species; potential fire behavior Habitat and forage availability; browse pressure Habitat for cavity-nesting animals
Dead and down woody fuel load	Fine (1, 10, and 100-hr) Coarse (1000-hr) Litter Duff Total	Potential fire behavior; effectiveness of fire management program

^aDetermined for each park or park unit. Examples: a dominant grass species, an invasive species targeted for control.

^bCalculated at the following scales: 0.01 m², 0.1 m², 1 m², 10 m², and plot, where percent frequency at the plot level is the percentage of plots in which the species occurred.

^cCalculated at the following scales: point-transect, 1 m², and 10 m².

^dCalculated at a single scale: point-transect.

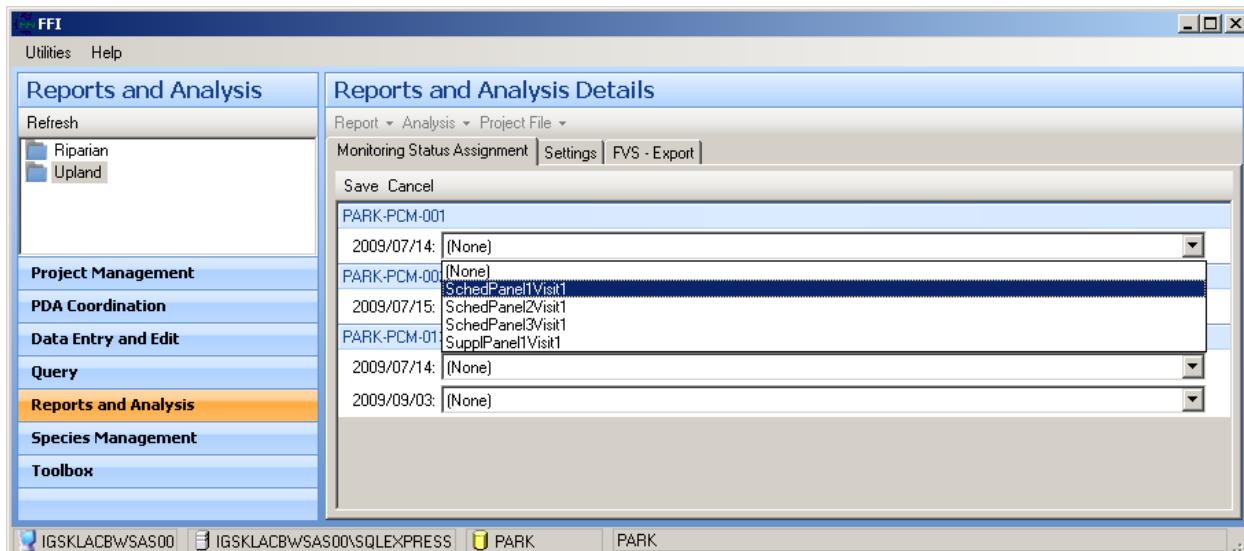
These annual summaries do not provide the basis for evaluating status and trends of these or other attributes measured by this protocol. Analysis methods that incorporate the sampling design (GRTS draws, panels, etc.) are necessary to provide these estimates. Instead, the annual summaries provide park staff with current information from which they can develop questions they would like addressed in other types of reports.

A Query or Report in FEAT/FIREMON Integrated (FFI) is used to for some calculations (e.g., individual species cover, fuel loads) at the plot level. Data are exported from FFI for further processing in another program. The Query and Report processes in FFI are not always intuitive. Consequently, this SOP provides detailed instructions for exporting the necessary data for each attribute. It is assumed that the Plant Ecologist will be proficient in the program and mathematics used for calculating the summary statistics. Therefore, this

SOP does not provide detailed instructions for the use of this program³ but instead focuses on appropriate formulas and dealing with important, but not immediately obvious, issues with the data exported from FFI.

Exporting Data for Summary Calculations

Before data can be exported from FFI, all of the relevant Sample Events must be assigned the proper Monitoring Status. This is done in the Reports and Analysis section of FFI, under the Monitoring Status Assignment tab. For each Sample Event under each Macroplot listed, use the drop-down menu to assign the appropriate Monitoring Status.



If the appropriate Monitoring Status is not available in the drop-down list, it must be created in the Project Management section of FFI following the instructions for creating Project Units given in SOP Data Management.

Generally, when creating queries or reports, it is necessary to work through the FFI form from left to right. This ensures that all of the appropriate selections are available in each section.

Point-Intercept Data

A query of point-intercept data is used to calculate the cover of individual species or designated categories for each selected Sample Event. These data are then exported for further summary.

The cover of designated categories (groups of species) can be calculated from point-intercept data via two different methods, and these two methods of calculation have different implications for interpreting the data. Native, cool-season graminoids will be used as the example category in describing the difference. The first method, which will hereafter be called “category sum”, simply sums the cover of the individual species that fall into that category. For the example, the cover of this category in a plot would be calculated as the sum of the cover of all native, cool-season graminoid species that occurred in that plot. The second method, which will

³ If questions about using the program are not answered in its user guide (available at the FFI web site), they can be posted to the FFI Discussion Group and are usually quickly answered. Contact information for direct support are also on the FFI Web Site

(http://frames.nbii.gov/portal/server.pt?open=512&objID=483&&PageID=2216&mode=2&in_hi_userid=2&cached=true).

hereafter be called “category unique hits”, counts the number of points at which a native, cool-season graminoid occurs.⁴ Cover values resulting from the category sum method may be greater than 100%, since there may be multiple layers of native, cool-season graminoids. (The broader the category, the greater the likelihood that the sum will exceed 100%.) Consequently, changes in the amount of layering of different species are captured when this method of calculation is used. However, it is not possible to distinguish a plot in which a single native, cool-season graminoid occurs at 100 points from a plot in which four native, cool-season graminoids occur at 25 points. In contrast, the category unique hits method never yields a cover value of greater than 100% for a single category, and it clearly shows at how many points a native, cool-season graminoid occurred. Layering of species within the category is not captured, however.

The preferred method for NGPN is the category sum method. Therefore, instructions for data export and summary using this method are given in the main body of this SOP. Instructions for the category unique hits method are given in Attachment 1.

1. Start a Query by selecting the Query bar in the lower left portion of the FFI window.
2. In the top left portion of the FFI window, either select the Project Unit for which you wish to summarize data when “Query All Project Units” is showing in the top white bar, or click on that white bar so that “Query Selected Project Unit” shows to include all project units. (This doesn’t make sense, but it is correct. In the next version of FFI you will select a radio button to indicate whether you want to query all project units or select certain project units.)
3. Begin with the Filter tab. Under Method, use the drop-down list under Protocol to select “Cover – Points (metric)”. This protocol will then appear in the pane below the drop-down menu. Highlight the protocol in this pane, and data from your designated Project Unit(s) will appear in the lower pane. As you select more criteria by which to filter the data, the data in this pane will change to include only those indicated by your selections.
4. Under Macroplot, select “IM_Intensive” and “IM_Dual” in the Plot Purpose box and the appropriate Macroplots from the list to the right of this box. If you don’t select any specific plots, then all in the list will be included in the data export.
5. Under Sample Event, leave the Min Date and Max Date boxes unchecked, and select the appropriate values of Monitoring Status. For annual reports, this will usually consist of scheduled visits of two different panels.
6. Under Species are various options for selecting which entries will be included in the exported data. Usually, little filtering in this section is necessary, as calculations using the categories available here are done in a separate program after the data are exported from FFI.
7. The screen shot below shows an example of a completed “Filter” tab for this protocol.⁵

⁴ Both of these, of course, are corrected for the number of points sampled.

⁵ Note that example data are from the NGP FireEP. Therefore Plot Types, Plot Purpose, Monitoring Status, and plot names do not always follow those of NGPN.

8. Next, go to the Additional / Calculated Fields tab. The first four sections (Sample Event Fields, Monitoring Status Fields, Macroplot Fields, Species Fields) offer additional fields to appear in the exported data. To make the exported data compatible with the summary calculations program, check “Scientific Name”, “Preferred Lifeform”, “Lifecycle”, “Nativity”, and “User Variable 1” under Species Fields and no others. (User Variable 1 under Species Fields provides information on whether a species is warm- or cool-season.)
9. Under Number of Subsamples and Area, select “Num. Transects” in the dropdown list for Num. Transects and “Num. Pts./Tran.” in the Num. Quad./Num. Pts./Tran. Len. dropdown list. The box next to “Calculate Number of Subsamples” will now be white. Click this box to check it. A “NumSubsamples” field will be added to the data pane.

10. Go to the Classify tab. Classification for this protocol separates canopy- from ground-layer hits.

Therefore, under “Field to classify” select “Order”. Fill in two rows as shown in the screenshot below, then click “Apply” to classify by layer. The “Order” field in the data pane will now contain either “Canopy” or “Ground” instead of the numerical value originally entered.

11. Go to the Grouping and Summary Calculations tab. Under Macroplot Group By, click the box next to Macro Plot and click on the circle next to “Date” under Event.

12. Under Method Fields to Group By, in the Method Attributes box, select “Order”. In Species Attributes, select the button next to “Species”.

13. No selections are needed under Method Fields to Sum. Click on Apply Selections to update.

14. Under Calculations, in the Cover box, select “sum_NumSubsamples” from the dropdown list under Number of Subsamples, leave Method Attribute blank, and select “RowCount” from the dropdown list under Cover Field. The box next to Calculate Cover in the Cover box will now be clickable – click it and a Cover field (with values filled in) will appear in the data pane. Click Apply Selection to see the data.

15. If everything you want is in the data pane, you are now ready to export the summarized data. To do this, simply click on Export (top left of Query Details pane) and save the file in the appropriate location and with an appropriate name using the “Save As” window that pops up.

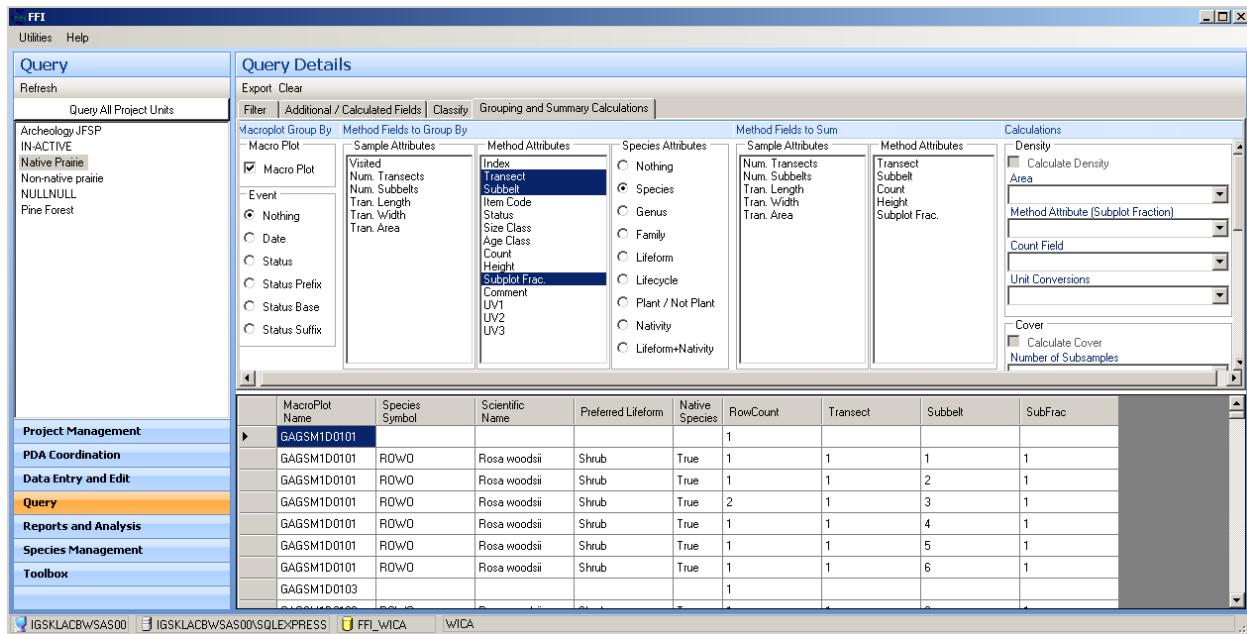
Nested Quadrat Data

A query of nested quadrat data is used to export data for calculating the frequency of individual species and species richness for each selected Sample Event. The exported data require further processing before the calculations can be made.

1. Start a Query by selecting the Query bar in the lower left portion of the FFI window.
2. In the top left portion of the FFI window, either select the Project Unit for which you wish to summarize data when “Query All Project Units” is showing in the top white bar, or click on that white bar so that “Query Selected Project Unit” shows to include all project units. (This doesn’t make sense, but it is correct. It will be fixed in the next version of FFI.)
3. Begin with the Filter tab. Under Method, use the drop-down list under Protocol to select “Density – Belts (metric)”. This protocol will then appear in the pane below the drop-down menu. Click on the protocol in this pane, and data from your designated Project Unit(s) will appear in the lower pane. As you select more criteria by which to filter the data, the data in this pane will change to include only those indicated by your selections.

- Under Macroplot, select “Intensive” in the Plot Purpose box and the appropriate Macroplots from the list to the right of this box. If you don’t select any specific plots, then all in the list will be included in the data export.
- Under Sample Event, leave the Min Date and Max Date boxes unchecked, and select the appropriate values of Monitoring Status. For annual reports, this will usually consist of scheduled visits of two different panels.
- Under “Species” are various options for selecting which entries will be included in the exported data. Generally you will not choose any of these, since all species are needed for the species richness calculations.

- Next, go to the Additional / Calculated Fields tab. The first four sections (Sample Event Fields, Monitoring Status Fields, Macroplot Fields, Species Fields) offer additional fields to appear in the exported data. To make the exported data compatible with the summary calculations program, check “Scientific Name”, “Preferred Lifeform”, “Lifecycle”, “Nativity”, and “User Variable 1” under Species Fields and no others. (User Variable 1 under Species Fields provides information on whether a species is warm- or cool-season.)
- There is no need to define classes for this protocol, so skip the Classify tab and go to the Grouping and Summary Calculations tab. Under Macroplot Group By, select Macro Plot. Click on the circle next to “Date” under Event.
- Under Method Fields to Group By, in the Method Attributes box, select “Transect”, “Subbelt” and “Subplot Frac.”. In the Species Attributes box, select “Species”.



10. No Calculations are done in this protocol, since the data needed for further processing/calculations is captured in the RowCount field.
11. If everything you want is in the data pane, you are now ready to export the summarized data. To do this, simply click on Export (top left of Query Details pane) and save the file in the appropriate location and with an appropriate name using the “Save As” window that pops up.

Tree and Pole Data

A query of individual tree/shrub data is used to calculate density of tree and tall shrub species by species, size class, and status (live vs. dead) for each selected Sample Event. These data are then exported for further summary.

Start a Query by selecting the Query bar in the lower left portion of the FFI window.

1. In the top left portion of the FFI window, either select the Project Unit for which you wish to summarize data when “Query All Project Units” is showing in the top white bar, or click on that white bar so that “Query Selected Project Unit” shows to include all project units. (This doesn’t make sense, but it gets you what you need. This will be fixed in the next version of FFI.)
2. Begin with the Filter tab. Under Method, use the drop-down list under Protocol to select “Trees – Individuals (metric)”. This protocol will then appear in the pane below the drop-down menu. Click on the protocol in this pane, and data from your designated Project Unit(s) will appear in the lower pane. As you select more criteria by which to filter the data, the data in this pane will change to include only those indicated by your selections.
3. Under Macroplot, if you only wish to include one type of plot (Intensive or Extensive) in your calculations, select this type in the Plot Purpose box. If you wish to include both plot types (i.e., in years when extensive plots were visited in the park), no selection is necessary. Select the appropriate

Macroplots from the list to the right of the Plot Type box. If you don't select any specific plots, then all in the list will be included in the data export.

- Under Sample Event, leave the Min Date and Max Date boxes unchecked, and select the appropriate values of Monitoring Status. For annual reports, this will usually consist of the most recent scheduled visits of two different panels for Intensive Plots and, if extensive plots were visited that year, the most recent visit of the extensive panel (PanelE).
- Under "Species" are various options for selecting which entries will be included in the exported data. Generally you will not choose any of these, since density calculations include all species.

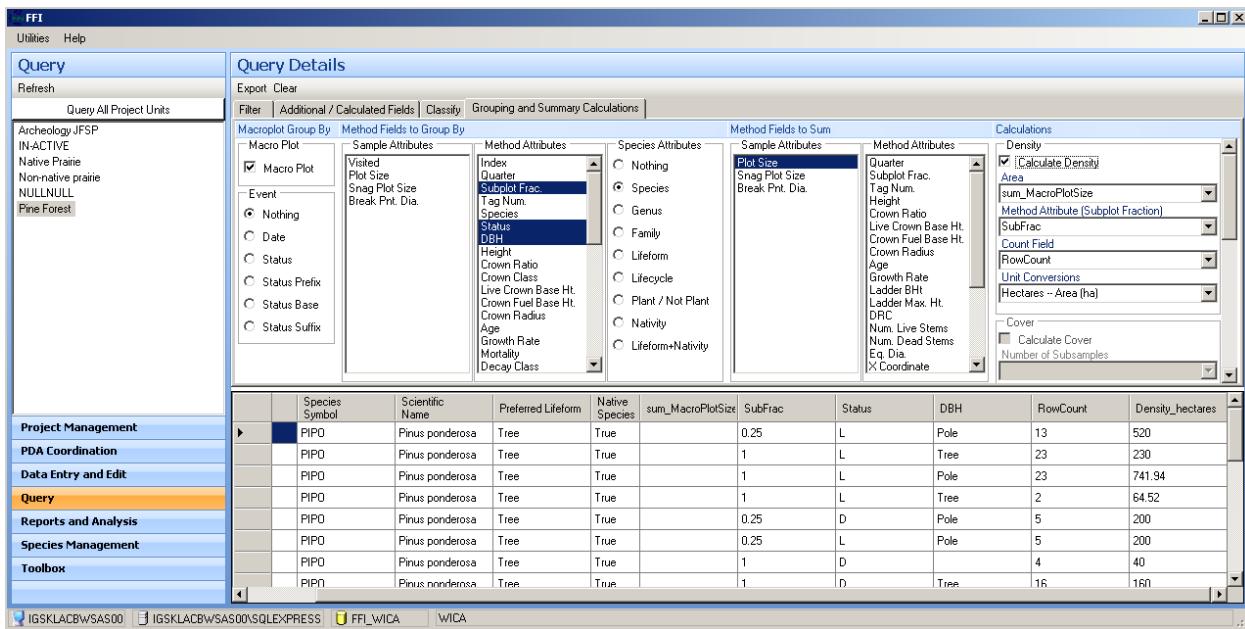
- Next, go to the Additional / Calculated Fields tab. The first four sections (Sample Event Fields, Monitoring Status Fields, Macroplot Fields, Species Fields) offer additional fields to appear in the exported data. Scientific Name, Preferred Lifeform, and Nativity should be checked, but you may check others as you like.

7. Do nothing in Number of Subsamples and Area.

8. Go to the Classify tab. Individuals whose diameter was measured at breast height are classified into trees or poles by their DBH. Therefore, under “Field to classify” select “DBH”. Fill in 3 rows as shown in the screenshot below. The first row in this classification is a check for mistakes, since there should be no entries with DBH<2.5 in this protocol. Click “Apply” and the DBH field in the data pane will now contain either “Pole” or “Tree” instead of the numerical value originally entered.

9. Go to the Grouping and Summary Calculations tab. Under Macroplot Group By, click the box next to Macro Plot and click on the circle next to “Date” under Event.

10. Under Method Fields to Group By, in the Method Attributes box, select “Subplot Frac.”, “Status”, and “DBH”. In the Species Attributes box, select the circle next to “Species” if you want calculations done for species individually.
11. Under Method Fields to Sum, select “Plot Size” in the Sample Attributes box.
12. Under Calculations, in the Density box, select “sum_MacroPlotSize” from the Area dropdown list, “SubFrac” from the Method Attribute (Subplot Fraction) list, “RowCount” from the Count Field list, and “Hectares – Area (ha)” from the Unit Conversions list. Then click the box next to Calculate Density and a Density_hectares field (with values filled in) will appear in the data pane.



13. If everything you want is in the data pane, you are now ready to export the summarized data. To do this, simply click on Export (top left of Query Details pane) and save the file in the appropriate location and with an appropriate name using the “Save As” window that pops up.

Seedling Data

A query of seedling data is used to calculate density of tree and tall shrub seedlings by species and size class for each selected Sample Event. These data are then exported for further summary.

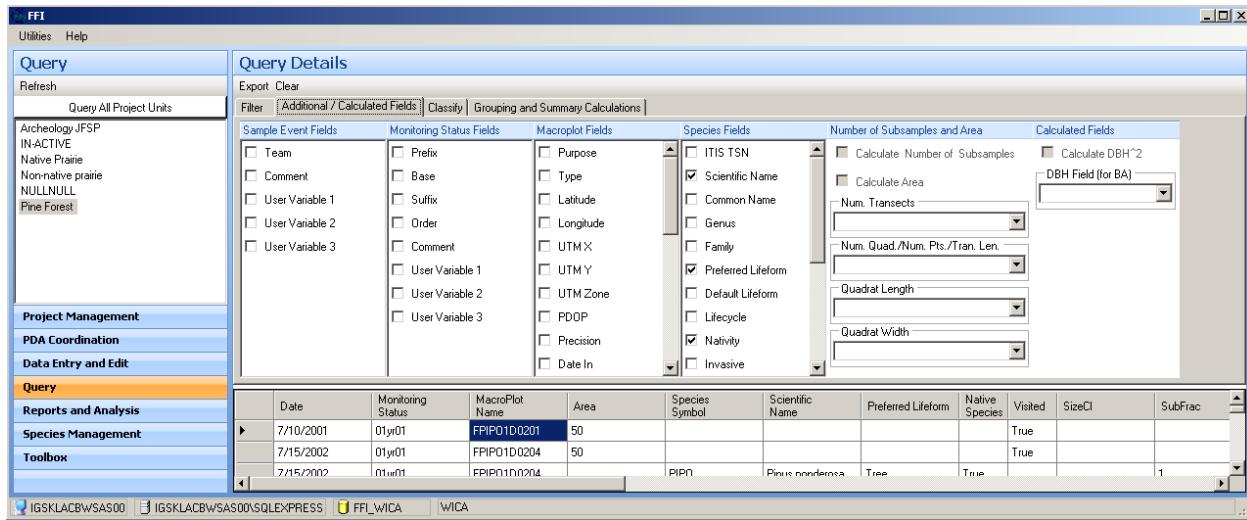
1. Start a Query by selecting the Query bar in the lower left portion of the FFI window.
2. In the top left (Query) portion of the FFI window, either select the Project Unit for which you wish to summarize data when “Query All Project Units” is showing in the top white bar, or click on that white bar so that “Query Selected Project Unit” shows to include all project units. (This doesn’t make sense but it gets you what you need; this will be fixed in the next version of FFI.)
3. Begin with the Filter tab. Under Method, use the drop-down list under Protocol to select “Density - Quadrats (metric)”. This protocol will then appear in the pane below the drop-down menu. Click on the protocol in this pane, and data from your designated Project Unit(s) will appear in the lower pane. As

you select more criteria by which to filter the data, the data in this pane will change to include only those indicated by your selections.

- Under Macroplot, if you only wish to include one type of plot (Intensive or Extensive) in your calculations, select this type in the Plot Purpose box. If you wish to include both plot types (i.e., in years when extensive plots were visited in the park), no selection is necessary. If desired, select the appropriate Macroplots from the list to the right of the Plot Type box. If you don't select any plots, then all in the list will be included in the data export.
- Under Sample Event, leave the Min Date and Max Date boxes unchecked, and select the appropriate values of Monitoring Status. For annual reports, this will usually consist of the most recent scheduled visits of two different panels for Intensive Plots and, if extensive plots were visited that year, the most recent visit of the extensive panel (PanelE).
- Under “Species” are various options for selecting which entries will be included in the exported data. Generally you will not choose any of these, since density calculations include all species.

- Next, go to the Additional / Calculated Fields tab. The first four sections (Sample Event Fields, Monitoring Status Fields, Macroplot Fields, Species Fields) offer additional fields to appear in the exported data. Scientific Name, Preferred Lifeform, and Nativity (under Species Fields) should be checked, but you may check others as you like.

8. Do nothing in Number of Subsamples and Area.

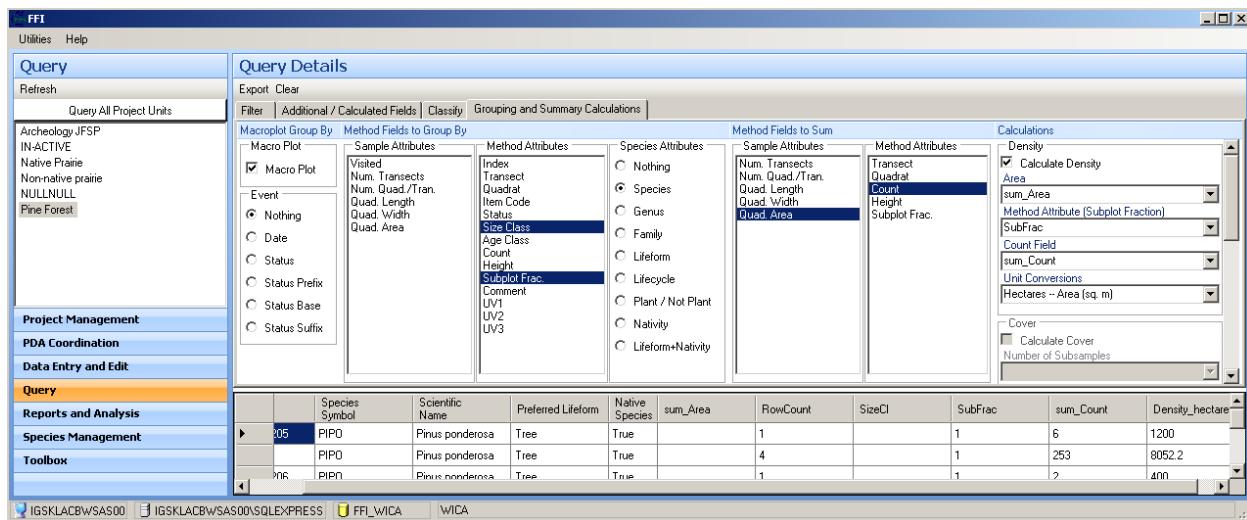


9. There is no need to define classes for this protocol, so skip the Classify tab and go to the Grouping and Summary Calculations tab. Under Macroplot Group By, select Macro Plot. Click on the circle next to “Date” under Event.

10. Under Method Fields to Group By, in the Method Attributes box, select “Subplot Frac.”, and “Size Class”. In the Species Attributes box, select the circle next to “Species”.

11. Under Method Fields to Sum, select “Quad. Area” in the Sample Attributes box and “Count” in the Method Attributes box.

12. Under Calculations, in the Density box, select “sum_Area” from the Area dropdown list, “SubFrac” from the Method Attribute (Subplot Fraction) list, “sum_Count” from the Count Field list, and “Hectares – Area (sq m)” from the Unit Conversions list. Then click the box next to Calculate Density and a Density_hectares field (with values filled in) will appear in the data pane.

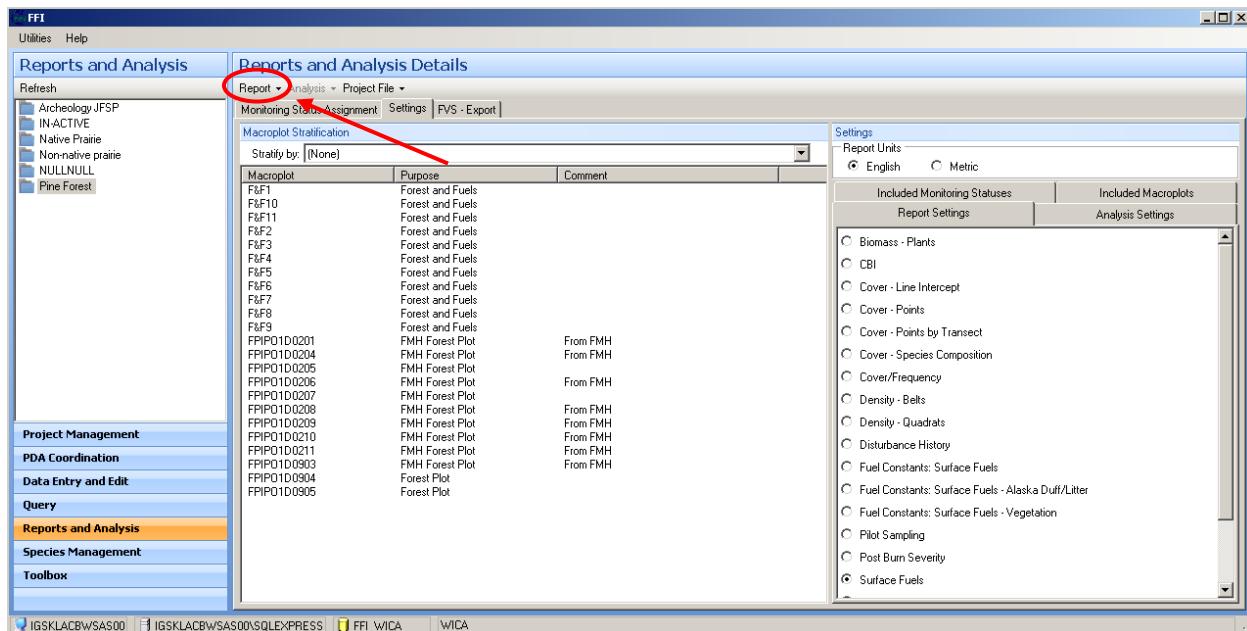


13. If everything you want is in the data pane, you are now ready to export the summarized data. To do this, simply click on Export (top left of Query Details pane) and save the file in the appropriate location and with an appropriate name using the “Save As” window that pops up.

Dead and Downed Woody Fuel Load Data

An FFI report is used to calculate total fuel load and by size class for each selected Sample Event. These data are then exported for further summary.

1. Select the Reports and Analysis bar in the lower left portion of the FFI window.
2. In the top left portion of the FFI window select the appropriate Project Unit.
3. The Monitoring Status Assignment tab should have already been filled in (see the beginning of this section), so go to the Settings tab.
4. Under Macroplot Stratification, leave Stratify by: set to “(None)”.
5. Under Settings, make sure the circle next to “English” is filled in the Report Units box.
6. Select the Included Macroplots tab under the Report Units box. Use the Select All, Unselect All, and check boxes to select the Macroplots you wish to include in the calculations.
7. Select the Included Monitoring Statuses tab. Use the check boxes to select the monitoring status types you wish to include. For annual reports, this will usually consist of the most recent scheduled visits of two different panels for Intensive Plots and the most recent visit of the extensive panel (PanelE).
8. Select the Report Settings tab. Select “Surface Fuels”.
9. While the Report Settings tab is active, click on Report at the top of the Reports and Analysis Details pane (see screen shot below), then click on View Report. In a few seconds, a new window will appear with the Surface Fuels Summary.



10. Export this report into a Microsoft Excel file by clicking on the save (floppy disk) icon in the top center of the report window.

Target Species Assessment Data

An FFI query is used to export information on target species presence by plot.

1. Start a Query by selecting the Query bar in the lower left portion of the FFI window.
2. In the top left (Query) portion of the FFI window, either select the Project Unit for which you wish to summarize data when “Query All Project Units” is showing in the top white bar, or click on that white bar so that “Query Selected Project Unit” shows to include all project units. (This doesn’t make sense but it gets you what you need; this will be fixed in the next version of FFI.)
3. Begin with the Filter tab. Under Method, use the drop-down list under Protocol to select “Cover – Species Composition (metric)”. This protocol will then appear in the pane below the drop-down menu. Highlight the protocol in this pane, and data from your designated Project Unit(s) will appear in the lower pane. As you select more criteria by which to filter the data, the data in this pane will change to include only those indicated by your selections.
4. Under Macroplot, if you only wish to include one or two types of plot in your calculations, select the type(s) in the Plot Purpose box. If you wish to include all plot types (i.e., in years when extensive plots were visited in the park), no selection is necessary. If desired, select the appropriate Macroplots from the list to the right of the Plot Type box. If you don’t select any plots, then all in the list will be included in the data export.
5. Under Sample Event, leave the Min Date and Max Date boxes unchecked, and select the appropriate values of Monitoring Status. For annual reports, this will usually consist of the most recent scheduled visits of two different panels for Intensive Plots and, if extensive plots were visited that year, the most recent visit of the extensive panel (PanelE).
6. Do nothing under “Species”.
7. Next, go to the Additional / Calculated Fields tab. The first four sections (Sample Event Fields, Monitoring Status Fields, Macroplot Fields, Species Fields) offer additional fields to appear in the exported data. For this protocol, Scientific Name, Preferred Lifeform, and Nativity (all under Species Fields) are appropriate. Nothing else need be done in this tab.
8. Skip the Classify tab and go to the Grouping and Summary Calculations tab. Under Macroplot Group By, click the box next to Macro Plot and click on the circle next to “Date” under Event.
9. Under Method Fields to Group By, in the Method Attributes box select “Cover”. In the Species Attributes box, select “Species”.
10. You are now ready to export the summarized data. To do this, simply click on Export (top left of Query Details pane) and save the file in the appropriate location and with an appropriate name using the “Save As” window that pops up.

Disturbance Data

An FFI query is used to export information on disturbances by plot.

1. Start a Query by selecting the Query bar in the lower left portion of the FFI window.
2. In the top left (Query) portion of the FFI window, either select the Project Unit for which you wish to summarize data when “Query All Project Units” is showing in the top white bar, or click on that white bar so that “Query Selected Project Unit” shows to include all project units. (This doesn’t make sense but it gets you what you need; this will be fixed in the next version of FFI.)
3. The Filter tab is the only section in which selections are made. Under Method, use the drop-down list under Protocol to select “Disturbance History”. This protocol will then appear in the pane below the drop-down menu. Highlight the protocol in this pane, and data from your designated Project Unit(s) will appear in the lower pane. As you select more criteria by which to filter the data, the data in this pane will change to include only those indicated by your selections.
4. Under Macroplot, if you only wish to include one or two types of plot in your summary, select the type(s) in the Plot Purpose box. If you wish to include all plot types (i.e., in years when extensive plots were visited in the park), no selection is necessary. If desired, select the appropriate Macroplots from the list to the right of the Plot Type box. If you don’t select any plots, then all in the list will be included in the data export.
5. Under Sample Event, leave the Min Date and Max Date boxes unchecked, and select the appropriate values of Monitoring Status. For annual reports, this will usually consist of the most recent scheduled visits of two different panels for Intensive Plots and, if extensive plots were visited that year, the most recent visit of the extensive panel (PanelE).
6. Do nothing under “Species”.
7. You are now ready to export the summarized data. To do this, simply click on Export (top left of Query Details pane) and save the file in the appropriate location and with an appropriate name using the “Save As” window that pops up.

Summary Calculations

For all attributes reported in annual reports, some post-processing of the data exported from FFI is necessary. In some instances, the only post-processing necessary is to simply calculate the mean, median, etc. from the plot-level values produced by FFI (e.g., fuel loads). In most instances, however, the plot-level values for an attribute must be calculated using another program. This section briefly describes the post-processing needed for each attribute and the formulas and/or programs useful for calculating them. Instructions for using FFI_Summary_Reports.mdb, a Microsoft Access database for summarizing herb-layer data, are on the Network server (N:\Groups\Monitoring\Plant_Community\Protocol\Instructions_not_in_SOPs\ folder).

Summaries from point-intercept data

Data exported from the Cover – Points protocol of FFI are used for calculating four types of attributes:

- absolute percent cover
- relative cover

- species richness
- species diversity and evenness

Absolute Percent Cover

FFI_Summary_Reports.mdb is used for calculating the plot-level absolute percent cover attributes listed in Table 1. The formulas used in this database are as follows:

herb-layer total cover: sum of cover of all species in plot where Order = “Canopy”.

herb-layer graminoid cover: sum of cover of all species in plot where Order = “Canopy” and Preferred Lifeform = “Graminoid” or “Grasslike”

herb-layer forb cover: sum of cover of all species in plot where Order = “Canopy” and Preferred Lifeform = “Forb/herb”

herb-layer shrub cover: sum of cover of all species in plot where Order = “Canopy” and Preferred Lifeform = “Shrub”

herb-layer cover of target species: cover of that species in plot where Order = “Canopy”

ground-layer bare soil cover: cover in plot for Species Symbol = “SOIL”

Absolute cover calculations for other groups are not supported by FFI_Summary_Reports.mdb at this time, but they can be done with Microsoft Excel (or a similar program) using the data exported from FFI.

Relative Cover

Two relative cover values are calculated using FFI_Summary_Reports.mdb according to the following formulas.

The cover of exotic, or non-native, species is reported as a percentage of the total herb-layer cover:

Total herb-layer cover is already calculated.

Exotic herb-layer cover is the sum of cover of all species in the plot where Order = “Canopy” and Native Species = “FALSE”.

percent exotic = exotic herb-layer cover/total herb-layer cover * 100%

The relative abundance of warm- and cool-season graminoids is reported as the percentage of the graminoid cover that is warm-season:

Graminoid herb-layer cover is already calculated.

Warm-season graminoid cover is the sum of cover of all species in the plot where Order = “Canopy” and Species UV1 = “warm”

percent warm-season = warm-season graminoid cover/graminoid cover * 100%

Species Richness

Species richness is the total number of plant species recorded at a certain scale. For the point-intercept data, this scale is 200 points. Thus, species richness for this scale is calculated by FFI_Summary_Reports.mdb simply as the number of unique plant species in a given plot from the point-intercept data. Note that this count includes species recorded on ground hits and does not double-count species from the two Order categories.

Species Diversity and Evenness

Species diversity and evenness can be calculated with a variety of indexes that combine species richness and species abundance. NGPN and FFI_Summary_Reports.mdb use the Shannon index of diversity (H') and evenness (J').

Both include the relative cover of individual species within a plot, where relative cover = cover of that species/total herb-layer cover in that plot.

$$H' = - \sum_{i=1}^n (p_i \times \ln p_i)$$

- p_i is the relative cover of a species
- n = the number of species in the plot

$J' = H' / \ln(S)$, where S = species richness.

- $\ln(S)$ is the maximum possible Shannon diversity for a given number of species (i.e., the Shannon diversity if all species had the same cover). Therefore, J' ranges from 0 (low evenness) to 1 (perfect evenness).

If desired, the effective number of species (H_e) can also be calculated with FFI_Summary_Reports.mdb.

- $H_e = e^{H'}$
- This value is more easily compared to species richness than is H' . If all species have the same cover, $H_e = S$.

Summaries from nested quadrats data

Data exported from the Density - Belts protocol of FFI are used for calculating two types of attributes:

- % frequency of individual species
- species richness

Percent frequency of an individual species at the 0.01, 0.1, 1.0, and 10 m² scales is calculated as the number of times that species appears in a given quadrat size in a plot divided by 10 (the number of quadrat sets) times 100%.

Frequency of a species can act as a surrogate for density of that species. However, frequency is dependent on the quadrat size in which presence/absence of a species is measured. Generally, the larger the quadrat size, the higher the frequency of an individual species. Thus, to track changes in species frequency, the optimal plot frame size for detecting a change must be determined. Population simulation work demonstrated a quadrat size that returns a mean frequency close to 50% is nearly optimal for detecting changes in species over time across a

broad range of spatial structure (Heywood and DeBacker 2007). To be consistent with the Heartland I&M Network (HTLN), NGPN defines the optimal quadrat size for tracking frequency of an individual species as the quadrat size in which the mean frequency is 20-50%, where the mean frequency is calculated from plots within the area (e.g., park, stratum) and time (e.g., one year, one 5-year period, entire data record) of interest.

Although the frequency of a species is reported for all quadrat sizes in annual reports, the frequency in the optimal quadrat size⁶ is highlighted, since this is the most sensitive measure of frequency.

Species richness for an individual quadrat is simply the number of species recorded in that quadrat. Species richness for a given quadrat size (the value reported in annual reports) in a plot is the average species richness of the ten quadrats of that size.

Species richness data must be used in the proper context. Because species richness is strongly affected by the scale of measurement and does not scale linearly with area (richness in the 10 m² quadrats is not expected to be 10 times that of richness in the 1 m² quadrats), it must always be reported as the number of species in each quadrat area (e.g., 5 species per 0.1 m²). Thus, the maximum area for which species richness can be reported from a given sampling unit for the herbaceous vegetation is 100 m² (10 times 10 m²)⁷. Users might be tempted to use the total number of species observed in the ten 10 m² quadrats as an index to total species richness in the 0.1 ha plot and to use this index for assessing changes in species richness at the 0.1 ha scale. However, this would depend on an unverified assumption that the proportion of species present in a plot but not detected in any quadrats remains constant across years, an assumption that should not be made. Assessing changes in total species richness at the 0.1 ha scale is not the focus of this protocol.

Also, it should be acknowledged that the species richness values derived from this protocol (from both the point-intercept and nested quadrats procedures) are in some ways incomplete – species that are dormant, senescent, or very small at the time of sampling may not be recorded. Fluctuations among years in growing conditions could mean that a species that is detectable at the designated sampling time in one year is not detectable at that time in the following year. Resampling a plot later (or earlier) in the same season would help quantify this detectability issue but is not possible given the logistic constraints of the program at this time.

Summaries from tree and pole data

Data exported from the Trees – Individuals protocol of FFI are used only for calculating density. Since the query used for this export has already calculated density (number of individuals divided by area sampled) for each species in each macroplot, the only post-processing necessary is to ensure that all categories appear for each MacroPlot. For example, 6 species of tree/tall shrub (including snags, which are not identified to species) may have been recorded over all plots in a park, but it is rare for all plots to contain both size classes of all species. Indeed, some plots may have no tree/tall shrub species at all, in which case the exported dataset shows no record for this plot (red arrow in example below shows missing KNRI-PCM-003).

⁶HTLN refers to the frequency in the optimal plot size as “optimized frequency”.

⁷ This value is reported with the misleading name of “Plot Richness” in FFI_Summary_Reports.mdb. However, richness at this scale (100 m²) is not an attribute that is standardly reported.

example_tree_pole_output_fabricated.xlsx - Microsoft Excel

A5 KNRI-PCM-001

	A	B	C	D	E	F	G	H	I	J	K
1	MacroPlot Name	sum_Species Symbol	Scientific Name	SubFrac	Status	DBH	RowCount	Density_hectares	Preferred Lifeform	Native Species	
2	KNRI-PCM-001	ACENEG	Acer negundo	0.314	L	Pole	2	63.69	Tree	TRUE	
3	KNRI-PCM-001	ACENEG	Acer negundo	1	L	Tree	3	31.90	Tree	TRUE	
4	KNRI-PCM-001	FRAPEN	Fraxinus pensylvan	0.314	L	Pole	10	318.47	Tree	TRUE	
5	KNRI-PCM-001	FRAPEN	Fraxinus pensylvan	1	L	Tree	22	223.00	Tree	TRUE	
6	KNRI-PCM-002	ACENEG	Acer negundo	0.314	L	Pole	10	318.47	Tree	TRUE	
7	KNRI-PCM-002	ACENEG	Acer negundo	1	L	Tree	19	191.10	Tree	TRUE	
8	KNRI-PCM-002			1	D	Tree	3	31.90	Tree	TRUE	
9	KNRI-PCM-002	ULMAME	Ulmus americana	0.314	L	Pole	1	31.85	Tree	TRUE	
10	KNRI-PCM-004	ACENEG	Acer negundo	0.314	L	Pole	1	31.85	Tree	TRUE	
11	KNRI-PCM-004	ACENEG	Acer negundo	1	L	Tree	6	63.70	Tree	TRUE	
12	KNRI-PCM-004	FRAPEN	Fraxinus pensylvan	1	L	Tree	6	63.70	Tree	TRUE	
13	KNRI-PCM-004	ULMAME	Ulmus americana	0.314	L	Pole	14	445.86	Tree	TRUE	
14	KNRI-PCM-004	ULMAME	Ulmus americana	1	L	Tree	29	286.70	Tree	TRUE	
15	KNRI-PCM-005	POPDEL	Populus deltoides	1	L	Tree	6	63.70	Tree	TRUE	
16	KNRI-PCM-005	SALAME	Salix americanus	1	L	Tree	3	31.90	Tree	TRUE	
17	KNRI-PCM-006	POPDEL	Populus deltoides	1	L	Tree	3	31.90	Tree	TRUE	
18	KNRI-PCM-007	ACENEG	Acer negundo	1	L	Tree	22	223.00	Tree	TRUE	
19	KNRI-PCM-007	FRAPEN	Fraxinus pensylvan	1	L	Tree	16	159.30	Tree	TRUE	

Creating these categories can be done by creating a Pivot Table like that below, then copying and pasting the values to a new sheet.

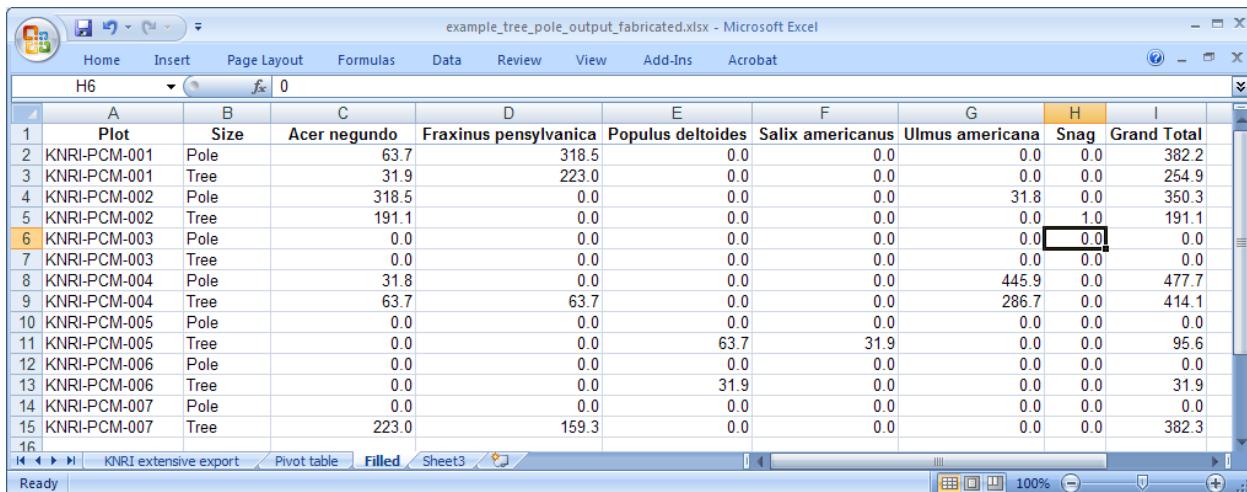
example_tree_pole_output_fabricated.xlsx - Microsoft Excel

PivotTable Tools

PivotTable Name: PivotTable1 Active Field: Sum of Density_hectares

	A	B	C	D	E	F	G	H
1								
2								
3	Sum of Density_hectares	Column Labels						
4	Row Labels	Acer negundo	Fraxinus pensylvanica	Populus deltoides	Salix americanus	Ulmus americana	(blank)	Grand
5	KNRI-PCM-001	95.6		541.5				
6	L	95.6		541.5				
7	Pole	63.7		318.5				
8	Tree	31.9		223.0				
9	KNRI-PCM-002	509.6				31.8	31.9	
10	D							
11	Tree						31.9	
12	L	509.6				31.8		
13	Pole	318.5					31.8	
14	Tree	191.1						
15	KNRI-PCM-004	95.5	63.7			732.6		
16	L	95.5	63.7			732.6		
17	Pole	31.8				445.9		
18	Tree	63.7	63.7			286.7		
19	KNRI-PCM-005			63.7	31.9			
20	L			63.7	31.9			
21	Tree			63.7	31.9			
22	KNRI-PCM-006			31.9				
23	L			31.9				
24	Tree			31.9				
25	KNRI-PCM-007	223.0	159.3					
26	L	223.0	159.3					
27	Tree	223.0	159.3					

It is in this new sheet that the categories (species-size class combinations) for all plots are created and filled with zeroes as appropriate. Once this is done (example below), the data are summarized (i.e., mean, median, etc. calculated over all MacroPlots).



	A	B	C	D	E	F	G	H	I
1	Plot	Size	Acer negundo	Fraxinus pensylvanica	Populus deltoides	Salix americanus	Ulmus americana	Snag	Grand Total
2	KNRI-PCM-001	Pole	63.7	318.5	0.0	0.0	0.0	0.0	382.2
3	KNRI-PCM-001	Tree	31.9	223.0	0.0	0.0	0.0	0.0	254.9
4	KNRI-PCM-002	Pole	318.5	0.0	0.0	0.0	31.8	0.0	350.3
5	KNRI-PCM-002	Tree	191.1	0.0	0.0	0.0	0.0	1.0	191.1
6	KNRI-PCM-003	Pole	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	KNRI-PCM-003	Tree	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	KNRI-PCM-004	Pole	31.8	0.0	0.0	0.0	445.9	0.0	477.7
9	KNRI-PCM-004	Tree	63.7	63.7	0.0	0.0	286.7	0.0	414.1
10	KNRI-PCM-005	Pole	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	KNRI-PCM-005	Tree	0.0	0.0	63.7	31.9	0.0	0.0	95.6
12	KNRI-PCM-006	Pole	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	KNRI-PCM-006	Tree	0.0	0.0	31.9	0.0	0.0	0.0	31.9
14	KNRI-PCM-007	Pole	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	KNRI-PCM-007	Tree	223.0	159.3	0.0	0.0	0.0	0.0	382.3
16									

Summaries from seedling data

Summary of seedling data is essentially the same as that for tree and pole data. Seedling data exported from the Density – Quadrats protocol of FFI are used only for calculating density (number of individuals divided by area sampled) and the query used for this export has already calculated density for each species in each MacroPlot. Thus, the only post-processing necessary is to ensure that all categories appear for each MacroPlot. For seedling data, the categories are species-size class combinations. Although the data entry method for this protocol should prevent skipped plots (i.e., even plots with no seedlings should have a line in the exported data), check for skipped plots anyway as a way to catch data entry errors. Once all categories for all plots have been created and filled with zeroes as appropriate, the data are summarized (i.e., mean, median, etc. calculated over all MacroPlots).

Summaries from fuels data

The formula used for calculating fuel loads of 1-1000 hr fuels in ponderosa pine forest/woodland is

$$\text{fuel load (tons/acre)} = (11.64 * n * d^2 * s * a * c) / N \ell$$

where

n is the number of particles recorded

*d*² is average squared diameter (a constant for each size class except 1000-hr; see below)

s is specific gravity (a constant for each size class; see below)

a is average secant of non-horizontal particle angles (see below)

c is $\sqrt{1 + (\frac{\text{slope}}{100})^2}$ (slope is in %)

N is the number of sampling planes (=1 for a single transect)

ℓ is the length of the sampling plane (in feet)

Size Class	d^2	s	α	ℓ
1-hr	0.036	0.55	1.02	6
10-hr	0.242	0.56	1.03	6
100-hr	3.056	0.48	1.02	12
1000-hr sound	(calculated from data)	0.40	1.00	100
1000-hr rotten	(calculated from data)	0.36	1.00	100

The formula for calculating fuel load of litter or duff is

$$\text{fuel load (tons/acre)} = 1.815 \text{ (ton/acre-in)} * \text{density (lb/ft}^3) * \text{average depth (in)}$$

where

1.815 ton/acre-in is a conversion factor

density of litter is 2.2 lb/ft³ and density of duff is 9.7 lb/ft³

average depth is calculated as the average depth over the 10 readings in a transect

Little post-processing of the fuels report exported from FFI is necessary prior to summary. Two things need to be done: format the column headers so that they are in a single row, and eliminate merged cells.

Surface Fuels Summary														
Macropot	Monitoring Status	1-hr	10-hr	100-hr	1000-hr sound	1000-hr rotten	1-1000-hr	Duff	Litter	Total	Litt	Total		
		1-100-hr						Average Tons per Acre			Avg. Depth (in.)			
8 F&F1	01Pre	0.000	0.136	0.000	0.136	0.000	0.000	0.136	13.732	4.512	18.380	0.78	1.13	1.91
9 F&F10	01Pre	0.041	1.387	0.000	1.427	4.197	0.000	5.624	15.317	3.314	24.255	0.87	0.83	1.70
10 F&F11	01Pre	0.123	2.409	4.494	7.027	0.433	0.000	7.460	13.292	3.853	24.605	0.76	0.97	1.72
11 F&F2	01Pre	0.100	1.239	0.736	2.075	21.146	0.204	23.424	15.933	3.115	42.472	0.91	0.78	1.89
12 F&F3	01Pre	0.353	3.791	4.354	8.498	0.514	0.000	9.012	8.011	1.957	18.979	0.46	0.49	0.95
13 F&F4	01Pre	0.060	0.416	1.472	1.949	11.586	0.000	13.535	26.584	4.352	44.471	1.51	1.09	2.60
14 F&F4	01Post	0.000	0.000	1.472	1.472	5.936	0.000	7.409	11.444	1.977	20.829	0.65	0.50	1.15
15 F&F4	01yr01	0.000	0.279	0.736	1.015	4.829	0.000	5.844	7.482	1.617	14.944	0.43	0.41	0.83
16 F&F4	01vrn?	0.000	0.556	0.000	0.556	6.151	0.000	6.707	3.257	4.632	14.596	0.19	1.16	1.35



1	Macroplot	Monitoring Status	1-hr	10-hr	100-hr	1-100 hr			1000-hr		1000-hr			1-1000 hr			Duff		Litter		Total	Duff depth	Litter depth	Total
						total	sound	rotten	total	sound	rotten	total	Duff	Litter	Total									
2	F&F1	01Pre	0.000	0.136	0.000	0.136	0.000	0.000	0.136	0.000	0.000	0.136	13.732	4.512	18.380	0.78	1.13	1.91						
3	F&F10	01Pre	0.041	1.387	0.000	1.427	4.197	0.000	5.624	15.317	3.314	24.255	0.87	0.83	1.70									
4	F&F11	01Pre	0.123	2.409	4.494	7.027	0.433	0.000	7.460	13.292	3.853	24.605	0.76	0.97	1.72									
5	F&F2	01Pre	0.100	1.239	0.736	2.075	21.146	0.204	23.424	15.933	3.115	42.472	0.91	0.78	1.69									
6	F&F3	01Pre	0.353	3.791	4.354	8.498	0.514	0.000	9.012	8.011	1.957	18.979	0.46	0.49	0.95									
7	F&F4	01Pre	0.060	0.416	1.472	1.949	11.586	0.000	13.535	26.584	4.352	44.471	1.51	1.09	2.60									
8	F&F4	01Post	0.000	0.000	1.472	1.472	5.936	0.000	7.409	11.444	1.977	20.829	0.65	0.50	1.15									
9	F&F4	01yr01	0.000	0.279	0.736	1.015	4.829	0.000	5.844	7.482	1.617	14.944	0.43	0.41	0.83									
10	F&F4	01yr02	0.000	0.556	0.000	0.556	6.151	0.000	6.707	3.257	4.632	14.596	0.19	1.16	1.35									
11	F&F5	01Pre	0.020	0.276	0.000	0.296	1.104	0.000	1.400	18.926	2.795	23.121	1.08	0.70	1.78									
12	F&F5	01Post	0.216	0.138	0.000	0.354	1.965	0.000	2.319	7.218	1.238	10.775	0.41	0.31	0.72									
13	F&F5	01yr01	0.000	0.274	0.000	0.274	0.586	0.000	0.860	4.577	1.158	6.595	0.26	0.29	0.55									
14	F&F5	01yr02	0.020	0.138	0.727	0.885	3.558	0.000	4.443	1.584	3.394	9.421	0.09	0.85	0.94									
15	F&F6	01Pre	0.079	0.272	0.729	1.079	0.374	0.000	1.453	5.546	1.677	8.676	0.32	0.42	0.74									
16	F&F6	01Post	0.098	1.495	0.000	1.594	0.000	0.000	1.594	1.496	1.158	4.248	0.09	0.29	0.38									
17	F&F6	01yr01	0.000	0.544	0.000	0.563	0.220	0.000	0.889	2.112	1.159	4.154	0.12	0.20	0.44									

Summaries from target species assessment and disturbance data

The methods used for describing disturbances and listing target species in plots do not provide statistically robust data. Instead, their intent is to provide qualitative information for park staff about items of special interest, or to understand the summarized data. Thus, the summary from the data exported from these two protocols (Cover – Species Composition and Disturbance History) consists of tallies (e.g., number of plots in which a given target species was recorded; number of plots where grazing was noted) and written descriptions of disturbances or occurrences of target species with the purpose of alerting park staff to important issues. In addition, this information may be used to qualify the summarized data of other attributes (e.g., “Four plots were in a prescribed fire and five were out, which may be why variability in total plant cover and average bare soil cover are higher than usual.”).

2. Determination of Status and Trends

At 5-10 year intervals, current status and trends since the initiation of data collection will be estimated and summarized in status and trend reports. The primary objectives of status and trend reports are:

1. to determine whether systematic changes in focal attributes (Table 1) have occurred at the scale of the entire park or stratum since the previous status and trend report and since the beginning of the monitoring effort.
2. to estimate the status of these focal attributes either at the end of the last cycle of data collection or integrated over all years in the previous cycle at the park and stratum scale.
3. To provide separate estimates of status and trends for subpopulations (domains) of high interest.

This section describes the NGPN's current analytical approach. However, given the complexity of the protocol's spatial-temporal designs and the rapid development and refinement of techniques for analysis of these designs, these analytical approaches likely will be modified and expanded significantly with protocol revisions over the next few years. In addition, many biometricalians would criticize our emphasis on detecting simple trends rather than estimating ecological relationships and evaluating adaptive-management related hypotheses (e.g., Nichols and Williams 2006). Our approach may converge with these after the implemented

protocol provides the data necessary to produce more focused monitoring questions, or as values for thresholds or management trigger points are identified.

Estimation and Detection of Trends in Data from Intensive Plots

If data conform to parametric assumptions, the default approach for estimating the direction and magnitude of trends uses mixed-effects models. The mixed-effects model incorporates a fixed linear or non-linear trend by estimating a regression coefficient for year (treated as a numeric covariate), sensu Urquhart et al. (1998). Other covariates (e.g., precipitation) can also be incorporated as fixed effects. The model incorporates random site effects and random year effects, with site and year effects crossed such that the year effect can be seen as a year-specific, park-wide adjustment to the long-term average value (after accounting for systematic trend), while the site effect is a site-specific adjustment independent of the year effect. The straightforward use of this model-based inferential approach is facilitated by the fact that the GRTS approach and revisit designs used in this protocol do not incorporate unequal probability sampling within parks or strata within parks.

For continuous variables or integer-valued variables that cover a broad range of values, the first step is to examine the appropriateness of normal linear mixed-effects models (e.g., Pinheiro and Bates 2000). This model can be written as:

$$\begin{aligned}
 Y_{ij} &= B_o + (B_{trend}) * (Year_j) + site_i + year_j + residual_{ij} \\
 site_i &\sim N(0, \sigma_{site}^2) \\
 year_j &\sim N(0, \sigma_{year}^2) \\
 residual_{ij} &\sim N(0, \sigma_{residual}^2)
 \end{aligned}$$

Of primary interest is the coefficient B_{trend} and its standard error; this is an estimate of the magnitude and direction of any systematic trend in the indicator. The strength of evidence for a trend is evaluated with an information-theoretic approach, comparing models with and without a trend coefficient. A 95% confidence interval for the trend coefficient is calculated either with a normal Wald-type approximation (i.e.,

$\hat{B}_{trend} \pm 1.96 * S.E.(\hat{B}_{trend})$ or with a Markov Chain Monte Carlo approach that produces credible confidence intervals.

In this basic model, only linear trend is considered. However, the model can be modified to allow non-linear trends (e.g., with polynomial functions of 'Year'), threshold changes (e.g., different trends before and after some temporal break point), etc. Also, the basic model essentially treats the trend effect as homogeneous across all sites in a park. This assumption can be relaxed by incorporating a site x trend random effect, which incorporates site-specific variation in trend (i.e., site-specific modification of the park-wide average trend).

Primary distributional assumptions of this model are that the residuals and random effects are normally distributed and that residuals have homogeneous variance with respect to other factors in the model. Normality of site and year random effects and residuals should be evaluated with quantile-quantile plots. This should be done with no transformation of the response variable first. If the normality assumption is strongly violated then investigate various transformations of the response variable to attempt better adherence to the assumption. Homogeneity of variance should be examined with plots that show the spread of residuals for each site or each year to allow examination of whether there is heterogeneity across sites or years (Pinheiro and Bates 2000).

If approximate normality of residuals is not plausible, non-parametric approaches are not the automatic next step; another probability distribution may be appropriate. Generalized linear mixed-effects models (GLMMs)

use a similar structure as the above model but assume the expected values of the data, conditional on the fixed and random effects in the model, follow a different standard probability distribution for continuous or categorical variables. This distribution is most frequently negative binomial or Poisson for count data, binomial/binary for variables that take on one of two categories, or mixture distributions (e.g., zero-inflated Poisson). Although GLMMs are appropriate for many types of data, some aspects of these models are areas of active statistical research, and options need to be carefully considered. Bolker et al. (2009) outline current recommendations for appropriate options given alternative analytical situations.

The basic mixed-effects model assumes that observations (more accurately, model residuals) from a site are not temporally autocorrelated. This assumption is evaluated by examining plots of the autocorrelation function (estimated correlation vs. time between observations) and through comparison of models with expanded correlation structures. In particular, the model assuming no autocorrelation is compared with (a) a model incorporating AR(1) serial autocorrelation, and (b) a model allowing an unstructured correlation structure in which any pattern of correlation can be modeled. The latter model is not used as the default correlation structure because it is non-parsimonious and estimates a large number of correlation parameters. Incorporation of covariates, such as precipitation, to account for some year-to-year variation may make the assumption of temporal independence more plausible (i.e., if observations show temporal autocorrelation but this is accounted for by multi-year similarities in precipitation amount).

For mixed-effects models, several factors must be considered regardless of whether hypothesis testing or information-theoretic approaches are used for inference. To compare models that differ in fixed-effects parameters, Akaike's Information Criterion (AIC) adjusted for small sample sizes (AICc) or quasi-likelihood forms (QAICc) (Burnham and Anderson 2002) are appropriate if the models are fit using maximum likelihood (ML) rather than restricted maximum likelihood (REML). The latter is usually the default estimation method in statistical packages but ML estimation can be specified instead. For calculating AICc or QAICc, the effective sample size must be incorporated. The default NGPN method is to assume that n = total number of observations, but a qualified statistician must assess whether the number of sites or some intermediate value should be used instead. For comparing models with alternate random effects structures, a conditional AIC should be used (Vaida and Blanchard 2005), but this is not currently implemented into available software packages. How to properly test statistical significance in mixed-effects models is an area of active research, particularly for GLMMs; use of a Markov Chain Monte Carlo (MCMC) strategy to determine credible confidence intervals for parameters of interest may be preferred (Bolker et al. 2009).

Parametric assumptions of mixed-effects models may not be tenable for some variables. Two default alternatives for occasions when this occurs are as follows. First, route regression or derived-variable analysis (Geissler and Sauer 1990) proceeds by estimating a single trend parameter separately for each monitoring site; these point estimates then become response variables in subsequent analyses that can examine whether the average park-wide trend differs from zero. Non-parametric nonlinear functions (e.g., LOESS models) can be applied to each site's data to avoid assumptions of a consistent linear trend. Second, other fully non-parametric approaches (e.g., Mann-Kendall trend test) are examined.

Estimation of Status for Intensive-plot Data

Characteristics of the status of variables in Table 1 will be estimated, either standardized to a single year of monitoring, or as the average status over the last cycle of revisits. Summaries of status will include the average park- or stratum-wide value of an indicator, as well as the median, variance, and overall empirical cumulative distribution function across all plots. The panel designs used in this protocol complicates the estimation of status because, although status estimates are ideally based on all monitoring sites in a park, all sites are not monitored each year. Three alternative approaches for dealing with this complication may be used. Each has their advantages and disadvantages.

Approach 1: Averaging of values across all sites over a revisit cycle (5 or 10 years) so that the status estimate pertains to a recent multi-year window rather than a single year is the simplest non-model-based approach (Figure 1a). With this approach, year-to-year effects may even each other out over the short time period under consideration for the estimate of the mean. However, this approach is more susceptible to one extreme year having an inordinate effect on the estimate of the mean than other approaches. Also, the variance estimate is degraded because it includes a component due to year-to-year variation. NGPN's standard method for this approach is to use functions for program R that produce appropriate design-based status and variance estimates from data generated from a GRTS design (Kincaid 2008, Kindcaid et al. 2008).

Approach 2: The second approach is fully design-based and takes advantage of the 'connectedness' of the rotating panel designs to estimate status for a target year using more than the information collected in that year (Rao and Graham 1964, Skalski 1990). Basically, the approach uses mean values calculated from individual years and estimated year effects to incorporate observations on plots not measured in the target year into the adjusted mean for that target year (Figure 1b). When calculating the adjusted mean, estimated values (i.e., those not measured in the target year) are weighted by the strength of the correlation between observations of sites measured in consecutive years. Although this approach avoids the assumptions about the distribution of residuals, etc. inherent in model-based estimates (third approach, below), estimating the variance of the overall estimate is complex. Comparison of the precision of an estimate derived using this approach to those derived using other approaches is needed to evaluate its utility.

Approach 3: Model-based estimates of park- or stratum-wide averages can be calculated with the mixed-effects models used for trend analysis (Figure 1c). When the 'year' variable is re-scaled so that it is set to zero at the year for which status is desired, the intercept parameter (B_0) and its standard error are estimates of expected status for that year; any random year effect is ignored. That is, the model estimates a park- or stratum-wide trend line for the response variable vs. time; variation about this trend line is produced by yearly, spatial, and residual variability. The intercept parameter is the value along this trend line at the specified year. It can be seen as the expected status for that year given the estimated trend rather than the actual status given the estimated trend and the random year-specific effect. Thus, if the random effect component of the focal year is high (i.e., all sites in a park differ significantly from expected value for that year, perhaps due to high rainfall), this status estimate will be far from the actual status. However, the mixed-effects model produces a Best Linear Unbiased Predictor-type estimate of the deviation of the focal-year's value from its expected position on the long-term trend line. Adding this BLUP to the intercept value produces a status estimate that accounts for year-specific variation. The adequacy of this adjustment needs further examination, as random-effect BLUPs exhibit "shrinkage" – the magnitude of the year-specific effect that the mixed-effects model calculates is less than the magnitude of the year-specific effect calculated from values of just that year (Pinheiro and Bates 2000).

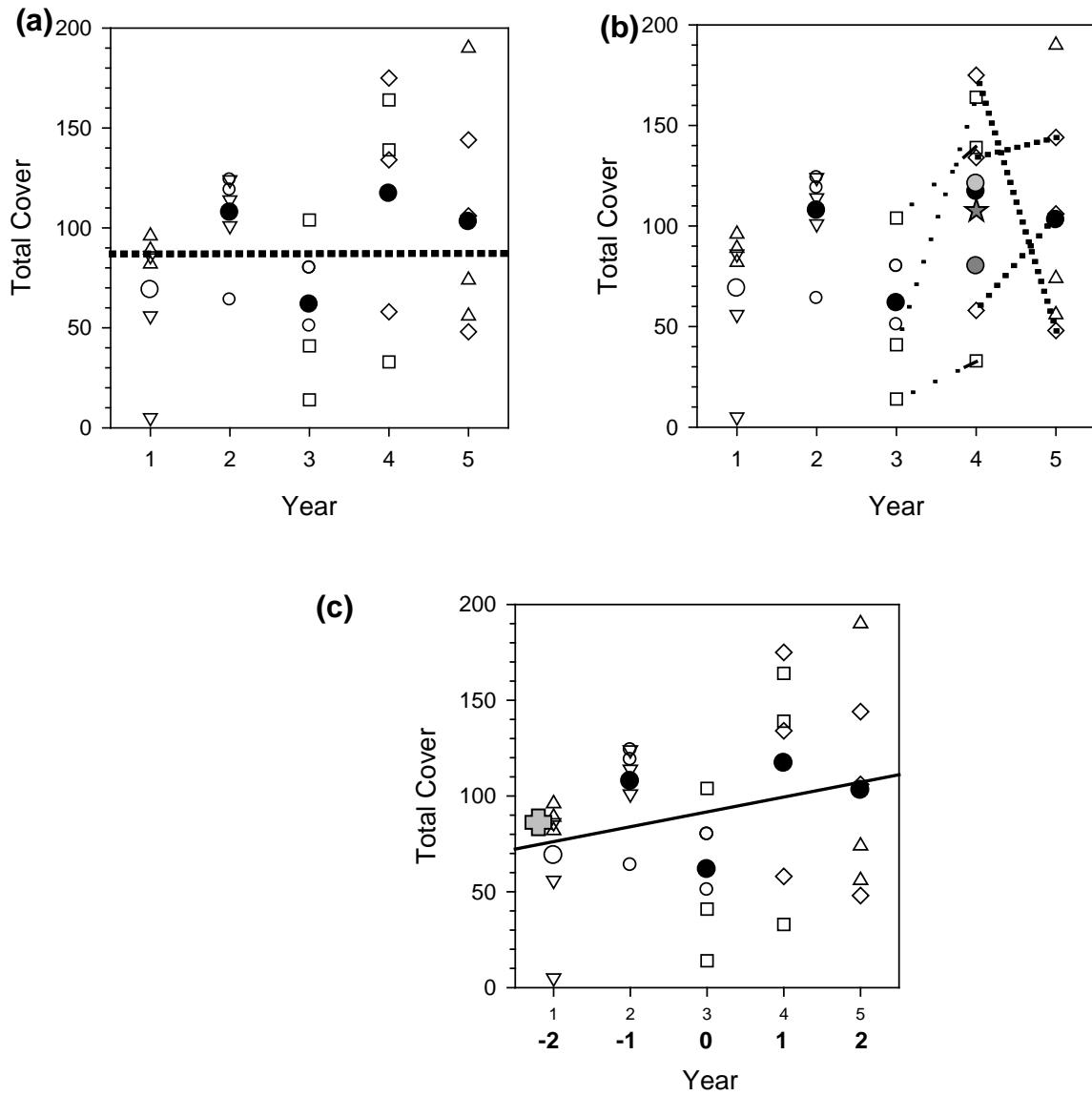


Figure 17. Different approaches for estimating status in a connected, rotating panel [2-3] design. An open symbol is the value from an individual site, with different symbol shapes for each panel (3 sites per panel). A black circle is the simple mean value from sites measured in a given year. (a) Approach 1: Dotted line is simple average of all measurements over the five-year window. (b) Approach 2: Year effects are estimated from differences between values in plots measured in years 3 and 4 (dashed lines) and in years 4 and 5 (dotted lines), then added to the mean values from year 3 and 5, respectively, to get adjusted means for year 4 (gray circles). A weighted average of these three means yields the final estimate of the mean for year 4 (gray star). (c) Solid line shows trend estimated with mixed-effect model. Bold numbers on lower x-axis show re-scaled year variable, and the status estimate for year 2 from this estimate is shown by the gray cross.

Estimating Park- or Stratum-wide Status and Trends for Extensive Plot Data

Measurements of tree densities and other data from extensive woody plots are primarily collected park- or stratum-wide once every 5 years, facilitating straightforward estimation of status and status-related characteristics (e.g., empirical cumulative probability distribution of tree densities). To account for the GRTS design and the effect on survey weights of replacing non-target sites with those from the overdraw sample, these estimates are not based on formulae for equal-probability, simple random sampling (e.g., Cochran 1977).

Instead, the R package 'spsurvey' of Kincaid et al. (2008) or an alternative R or non-R program with similar capabilities is used. Input requirements for this package include the output from the 'spsurvey' package used to generate the GRTS samples that are being analyzed; Kincaid (2008) describes the specific input needed in the 'spsurvey' package.

For tree, tall shrub, and fuel-load data, analyses focus on a) average value of an indicator at each sampling time, and the standard error of this estimate; b) the estimated cumulative distribution function (CDF) for each indicator; and c) changes in these indicators since the last sampling event and since the start of monitoring. The standard error of the estimated average value is based on the local mean variance estimator (Stevens and Olson 2003). In the future, specific threshold values and management targets may be identified; the estimated CDF would then be used to estimate the proportion of sites in the target population that exceed these specified thresholds of interest.

Rather than using linear-model based estimates of trends, changes in extensive-plot data are based on a) graphical exploration of changes in mean values and proportions above some threshold since the beginning of the monitoring program; and b) pairwise comparison of the most recent status or CDF estimate with the previous sampling-event's estimate and with the status at the start of the monitoring program. Pairwise comparisons of point estimates will be based on two-sample *t*-tests or non-parametric analogs, where the input data are the pairs of observations on each sample plot at both time periods.

Park-wide Estimates for Parks with Stratified Designs

At parks in which there are two or more strata, the analytical approaches outlined above are used to calculate independent estimates of status and trend for each stratum. Park-wide estimates are then calculated using standard formulae for stratified designs, which incorporate the stratum weights (the percentage of the target population in each stratum). The overall average is a weighted average of the stratum-specific estimates, and the variance of this estimate is calculated by multiplying each stratum-specific variance by its squared stratum weight, then summing these independent variance components.

Domain Analyses

In addition to park- or stratum-wide estimates, estimates of status and trend for subpopulations (domains) of high ecological and/or management interest are produced and compared. For example, such estimates may be compared between areas at WICA that have or have not burned in the previous five years, or between areas inside and outside the bison range at BADL. The exact delineation of these domains will be identified in the future from discussions with park management staff.

Domain estimates of status can be calculated with 'spsurvey' or other software for analyzing probability surveys; Särndal et al. (1992) outline estimation approaches for domain totals and averages and for associated variance estimators. For an equal-probability sample, the estimate of the domain average is simply the average from the sites within the defined domain, but further discussion with statisticians is needed to determine if replacement of sites from the oversample list necessitates use of alternative estimator. Because not knowing the total domain subpopulation size inflates the variance estimate (Särndal et al. 1992), there likely is utility in determining the size of the subpopulation through land-cover analysis when possible; further consultation with experts is needed on this topic over the next few years.

Estimation of domain-specific trends also necessitates further consultation. The planned approach uses the mixed-effects model specified above but applied only to the sites within a focal domain. However, small sample sizes within a domain may often give this approach low power to detect a trend. Alternative approaches that "borrow" information from sites outside the focal domain (i.e., small population analysis) may be warranted. The simplest such approach would be to fit the mixed-effects model to all sample sites, but to incorporate a binary variable indicating whether or not sites are in the focal domain. By including an

interaction of yearly trend \times this "domain identifier," a domain-specific trend can be estimated. More sophisticated approaches such as Bayesian hierarchical models may also be appropriate.

3. Comprehensive Syntheses

Comprehensive synthesis reports evaluate collected plant community composition and structure data in a more in-depth manner than do the Status and Trends reports. Their purpose is to understand the status and trends of plant community attributes. Their greater depth comes from (1) focusing on specific management issues; (2) relating attributes from this protocol to each other; (3) incorporating data from other Vital Signs; (4) using different analytical techniques; and (5) evaluating status and/or trends with respect to normal range of variability and/or thresholds. This section briefly describes these five sources. The intention of this section is not too provide a comprehensive list of reports or procedures for analyzing data for these reports because the topics of reports and the analyses used in them will depend on the results of the status and trends analyses, as well as on park management priorities.

Focusing on Specific Management Issues

This protocol uses a surveillance monitoring approach; the attributes monitored and the monitoring design were not chosen to address one or a small number of management issues as would be done in a strict adaptive management process (e.g., Nichols and Williams 2006). However, the data from this protocol should be useful for addressing specific management issues, or at least for aiding in the determination of different monitoring approaches or research needed to address such issues. Therefore, comprehensive synthesis reports often will be written to address a high-priority issue identified by park and Network staff. Examples of potential topics include

- forest condition in Black Hills parks with respect to cavity-nesting bird habitat;
- vegetation composition in black-tailed prairie dog towns;
- invasive species trends in all Network parks;
- fire management program effects on forest structure, fuel loads, and invasive species abundance.

Relationships between Plant Community Composition and Structure Attributes

Plant community attributes such as those shown in Table 1 do not vary independently. Therefore, understanding the status or changes in one of these attributes may come from investigating whether and how that attribute and one or more other plant community attributes are related. Some examples of these relationships follow.

- Within a given location through time, herb-layer native species richness is negatively related to exotic species richness or the proportion of cover that is exotic.
- Herb-layer cover in ponderosa pine forests is negatively related to litter depth and tree density.
- Density of tree seedlings in riparian forests is negatively related to total herb-layer cover.

Data from other Vital Signs

Protocols for other NGPN Vital Signs (Gitzen et al. 2010) will quantitatively measure many of the natural processes and anthropogenic stressors expected to affect plant community composition and structure. Table 2 lists the Vital Signs relevant to a variety of plant community attributes.

Using Different Analytical Techniques

Section 2 describes the analytical techniques that will be used to determine the status and trends of a variety of attributes. Analytical techniques for synthesis reports will vary depending on the goal of the report. Recommended and potential techniques are briefly described below, but the list is not comprehensive.

Permanent Network staff will work with a skilled quantitative ecologist or statistician to determine the appropriate techniques and to apply and interpret the results of those techniques.

Exploratory Analyses

Scatter plots, frequency histograms, and box plots are relatively simple graphical tools for exploring relationships between attributes or the course of an attribute through time. (See Elzinga et al. 2001 for some examples.) One or more of these tools should be the first step in any comprehensive analysis. Biologically important relationships or change may be obvious from the graphed data, and these graphics may also be useful in suggesting additional statistical tests.

Table 10. Vital Signs relevant to plant community comprehensive synthesis reports and some of the plant community attributes to which they may be related. Note that the plant community attributes are not necessarily those summarized in annual reports.

NGPN Vital Sign	Related Plant Community Attribute
Ozone	Ponderosa pine condition
Wet and Dry Deposition	Abundance of susceptible species
Weather and Climate	Herb-layer species richness
	Exotic proportion of cover
	Multiple aspects of herb-layer composition and diversity
	Herb-layer cover
	Ponderosa pine seedling abundance
Stream and River Channel Characteristics	Riparian forest structure (size-class density and distribution) and composition
Forest Insects and Diseases	Herb-layer cover and composition in riparian areas
Prairie Dogs	Forest structure and composition
	Dead and down fuel loads
	Herb-layer cover and height
	Multiple aspects of herb-layer composition and diversity
	Bare soil cover
Ungulates	Herb-layer cover and height
	Multiple aspects of herb-layer composition and diversity
	Bare soil cover
	Seedling density of deciduous tree and tall shrub species
Treatments of Exotic Infestations	Multiple aspects of herb-layer composition and diversity
Fire and Fuel Dynamics	Exotic proportion of cover
	Herb-layer cover and height
	Forest structure (especially seedling density)
	Dead and down fuel loads
	Bare soil cover
Land Cover and Use	Forest structure
	Herb-layer species richness and diversity
Extreme Disturbances	Herb-layer cover and composition
	Exotic proportion of cover
	Forest structure
	Bare soil cover

Ordination techniques (Jongman et al. 1995, McCune and Grace 2002) are also useful for exploring patterns in plant community composition data, either alone or with respect to environmental gradients. One of their advantages is the possibility to include data on all species, rather than only a small subset of species or on *a priori* groups of species. Ordinations of composition data from each stratum or targeted domain for each park over time (Figure 2) should be done to explore for patterns not detected with analyses of summary variables such as those in Table 1. Another exploratory technique tracking complex dynamics of species abundance and dominance shifts are rank abundance clocks (Collins et al. 2008). New methods are certain to evolve, and this SOP will be revised accordingly to incorporate them.

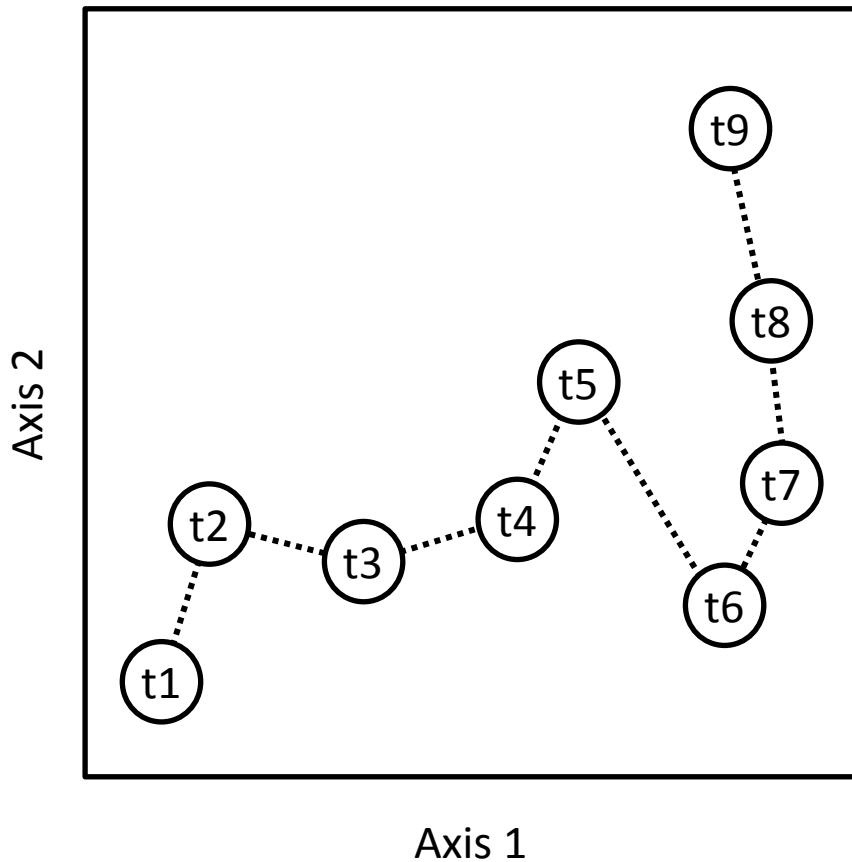


Figure 18. Idealized ordination diagram showing change in species composition through time (t1 to t9).

Inferential Analyses

The strength and direction of pairwise relationships between plant community attributes and between a plant community attribute and another attribute (e.g., from a different Vital Sign) can be statistically evaluated with correlation analyses, either parametric or non-parametric, depending on the distribution of the data (Sokal and Rohlf 1995). A correlation analysis measures the degree of a linear relationship between two variables, but does not infer a causal connection between them. Similarly, multiple regression analysis (linear or non-linear) can be used to identify predictor variables that significantly explain some of the variation in a continuous response variable and the degree to which variability of those predictors accounts for variability of the response (Sokal and Rohlf 1995). As with correlation analyses, however, a causal connection is not necessarily inferred.

Path analysis (Mitchell 2001) and structural equation modeling (Grace 2006) are more sophisticated tools for testing complicated patterns of causation among a set of several predictor variables. Both begin by constructing a diagram that reflects hypothesized relationships among variables based on principles of ecology, not on exploratory analyses of the data to be modeled. Both of these methods are advantageous in that they can be used to detect indirect effects of a predictor on a response variable. Path analysis, however, requires a large number of observations compared to the number of factors included in the path analysis (10-20 times). Bayesian analysis techniques provide another option for evaluating a variety of models (e.g., Gelman et al. 2003, Clark & Gelfand 2006).

Finally, simple *t*-tests or analyses of variance (ANOVA) may be used to determine whether an attribute differs significantly between two (*t*-test) or more (ANOVA) populations (e.g., exotic proportion of cover in riparian vs. upland; tree density over four time periods). Analysis of covariance (ANCOVA) can be used to incorporate covarying variables when testing for differences among populations. The Multi-Response Permutation

Procedure (MRPP) uses multivariate data (i.e., that used in ordination techniques) to test for differences between two or more groups, with the advantage that it has less restrictive assumptions than many other statistical tests (McCune and Grace 2002).

Evaluating with respect to thresholds, etc.

Ideally, normal or acceptable ranges of variability, management critical points, and/or ecological thresholds will be identified for a large number of plant community attributes. Monitoring data could then be compared to these values statistically or graphically using tools such as conformance charts (Beauregard et al. 1992). For example, research is currently being conducted to evaluate variability in species richness and diversity in Great Plains grasslands, as well as to determine a response curve for the effect of atmospheric nitrogen deposition on northern Great Plains grassland vegetation.

Normal ranges of variability for most attributes will not be determined prior to NGPN data collection, however, because of the paucity of data from which to derive them. This paucity of data also makes it difficult to determine ecological thresholds, which may not even exist for many systems or attributes. When pre-determined acceptable values for an attribute are not available, control charts (McBean and Rovers 1998, Manly 2001) can be used to evaluate whether the value of an attribute at a given time warrants further research or management attention.

4. Variability Assessment and Sample Design Review

Assessment of statistical power (and precision in estimating status) for alternative sampling designs considered for this protocol was based on limited data. In most parks for most variables, data collected with this long-term monitoring protocol will be the only comprehensive data for improving previous estimates of variability in the NGPN. These improved estimates are an important part of assessing whether the sampling designs used in this protocol need to be modified to better meet quantitative objectives of the Network. Therefore, analyses and reports focusing on these topics will be a regular component of the analysis process, particularly after the first and second cycles of sampling have been completed.

Refining Estimates of Variance Components

The framework for assessing sources of variation are the same as that described in Appendix A of the protocol.

Three major variance components affect attributes measured with this protocol:

σ^2_{Site} is systematic variation among sites that is consistent across years (e.g., variation in vegetation productivity due to soil type).

σ^2_{Year} is synchronous, among-year variation, apart from effects of any long-term trend; these are year effects that affect all sites in the population of an individual park (e.g., park-wide climatic variation).

$\sigma^2_{\text{Residual}} = \sigma^2_{\text{Site*Year}} + \sigma^2_{\text{Measurement}}$, where

- $\sigma^2_{\text{Site*Year}}$ is non-synchronous, among-year variation among sites (e.g., sites show different short-term reactions to region-wide fire) and/or ephemeral variation (e.g., a pathogen outbreak in a single site); and
- $\sigma^2_{\text{Measurement}}$ is non-systematic measurement error: observer variability, within-site (local) spatial variability due to small inconsistencies in measurement relocation, or within-year temporal variability.

To partition components of the residual variation, either multiple measures of some sites within a year or separate estimates of measurement error are needed. If necessary, the magnitude of some sources of measurement error could be assessed with additional effort (e.g., having teams independently visit the same sites to assess among-personnel variability). In general, though, the residual variance does not need to be partitioned unless the Network is considering changes to the response design that would substantially affect measurement error and significantly change the residual variance magnitude.

In addition, a fourth variance component should be estimated:

$\sigma^2_{\text{Site*Trend}}$ is among-site variability around the population-wide average trend (VanLeeuwen et al. 1996); this variability in site-specific trends is incorporated as a separate random effect in the model outlined in Section 2. The effect of this variance component on power and precision is being investigated, with a publication expected in 2011-2012 [N. Scott Urquhart, Dept. of Statistics (retired), Colorado State University, pers. comm., 2 March 2009].

For data collected only from intensive plots, these variance components are estimated simultaneously as assessment of long-term trends, using the normal or generalized linear mixed-effects model specified above in Section 2. Comparison of models with different fixed effects requires that the mixed-effects models be estimated with Maximum Likelihood specified as an option in the statistical software package. However, when estimating variance components, the models should be fit with Restricted Maximum Likelihood to obtain more accurate estimates of the variance components (e.g., Pinheiro and Bates 2000). Standard errors or credible confidence intervals for these variance-component estimates can be calculated with MCMC approaches that are available in some mixed-effects software packages (e.g., 'nlme4' in program R).

Failure to meet the distributional assumptions required in these mixed-effects models may result in imprecise or biased estimates of variance components. Therefore, these estimates should be compared against estimates not requiring parametric assumptions. First, the same basic model outlined above can be used but with variance components estimated based on expected mean squares and a method-of-moments approach (Kincaid et al. 2004). This avoids any distributional assumptions other than approximate normality of the variance estimates based on the central limit theorem (Urquhart et al. 1998). However, because of the rotating-panel design used for intensive plots (not all sites are measured each year), these calculations likely would require consultation with an appropriate statistician. Second, estimates of spatial variability can be calculated for sites measured each year, and then averaged to produce an overall estimate, or with a design-based approach that uses the connectedness of NGPN panel designs to estimate values for all sites in a single year regardless of whether they were measured that year; variation among these site estimates is then an estimate of spatial variation.

For data collected primarily from extensive plots on a [(1-4)¹] schedule, variance re-assessment will focus on spatial variability as was outlined in Appendix A. Because all sites in a park are measured in a single year, spatial variation can be estimated simply as variability among sites in a year. This estimate will include components of measurement and observer variability, but these are likely to cause only minor positive bias in the estimates of spatial variability.

Quantitative Sample Design Review

To provide useful information to park managers, this protocol needs to have adequate power to detect changes in plant community characteristics and provide suitably precise estimates of the magnitude of these changes and the status of selected indicators. Assuming the measurement design outlined in this protocol is fixed, the primary factors affecting power and precision are the number of monitoring sites and the schedule for revisiting these sites in the context of the degree of spatial and yearly variability within each park. Assessing the

quantitative performance of this sampling design will use the estimates of variance components described earlier in this section and the precision of status and trend estimates calculated as described in Section 2.

One step in this review is to repeat the power analyses outlined in Appendix A using the refined variance estimates. This will allow reassessment of the initial conclusion that yearly variation is the primary constraint on the number of years needed to detect a trend. It will also provide assessment of whether increasing or decreasing the number of monitoring sites would impact the ability of the design to detect long-term changes or the time needed to detect these changes. The magnitude of site-to-site variation in trends, and whether this variation inhibits any meaningful estimation of park-wide average trends without significant increases in sample size, will be evaluated. As in Appendix A, power to detect trend will be evaluated following the approach of Urquhart et al. (1998) and related references, using program R functions written by Tony Olsen, U.S. EPA, Corvallis, OR. Simulation approaches to evaluating power may also be used.

A second step in this review is assessing the precision in status estimates calculated up to the time of the review, discussing with ecologists and managers whether the precision is adequate, and calculating whether alterations in sample sizes are needed to achieve desired precision. If park-wide spatial variability is so high that suitable precision cannot be achieved with feasible increases in sample sizes, the NGPN may evaluate spatial variability within narrower target populations within each park (e.g., specific ecological site types) and determine whether re-allocating monitoring sites to a restricted target population would allow suitable precision to be achieved for that population. If so, extensive discussions would be needed among NGPN staff and collaborators to evaluate whether such a re-allocation would better meet the needs of Network parks.

A third step in this review is the assessment of the precision of estimates for high-interest subpopulations (domains) within each park, and whether these domains are receiving enough sampling effort to allow meaningful inference about status and changes, as well as for detecting different patterns and dynamics in different domains of interest. If domains of interest have too low of sample size for meaningful inference, the NGPN may assess whether adding additional primary sampling sites is feasible.

5. Schedule

Annual reports will be produced each year by January 30th of the year following data collection. These will include information only from intensive plots. Data on tree/tall shrub density and composition and fuel loads collected in extensive woody plots will be combined with that from tree/tall shrub data from intensive plots for analysis and reporting in status and trends reports.

The minimum frequency of status and trends reports will be based on the revisit schedule for the park and the protocol component being summarized. For parks with a [2-3] design for intensive plots, the first status and trend report will be produced after the first cycle of sampling is complete (the 5th year). Thereafter, status and trends reports will be produced every 5 or 10 years. For parks with a [2-8] design, an initial status and trend report will be produced after the first 5 years of monitoring with the understanding that this report is preliminary. A complete report will be completed at the end of the first complete cycle (after 10 years), and every 10 years after that. Status and trend reports on woody vegetation and fuel loads, which is collected in both intensive and extensive woody plots, will be completed in the year following extensive plot sampling. The first woody report for each park will only include status information due to the [(1-4)¹] extensive woody plot revisit schedule. All status and trends reports will be completed by March 30th of the year following completion of the appropriate data collection.

The schedule for comprehensive synthesis reports is unpredictable, as it depends on park priorities and the completion of other Vital Signs monitoring protocols. These reports will not be initiated until after the first

status and trend reports are complete. In general, a maximum of one of these reports will be produced in each year.

Variance estimates from mixed-effects models will be produced after every complete cycle of monitoring for sites in a park. Supplemental estimates of spatial variation will be calculated after the first cycle of monitoring and thereafter as needed. Although estimates of systematic yearly variation will also be produced with each application of the mixed-effects model, data collected during first 5 years of monitoring for parks with [2-3] designs are likely to be too limited in temporal scope to be of much value for re-assessing this variability; presumably estimates after the first 10 years of data collection will be more useful. Quantitative sample design review will take place after 10 years of monitoring, and only as needed thereafter.

Attachment 1: Instructions for Category Unique Hits Calculations

Exporting Data for Summary Calculations

Follow the steps for exporting point-intercept data as described in the main SOP except, in step 12,

- select Transect and Point in addition to Order under Method Attributes;
- in the Species Attributes box, select the character that you are grouping by (e.g., Lifeform+Nativity if you wish to calculate cover of native grasses, native forbs, native shrubs, exotic grasses, exotic forbs, and exotic shrubs); for total cover, select “Nothing”.

In order to calculate the percentage of graminoid cover that is warm-season, you must calculate and export the cover of warm-season graminoids. To do this, follow the steps for exporting point-intercept data as described in the main SOP except

- in step 6 under Species, select “Graminoid” and “Grass-like” in the Lifeform box;
- in step 12 in the Method Attributes box under Method Fields to Group By, select “Transect” and “Point” in addition to Order;
- in step 12 the Species Attributes box under Method Fields to Group By, select “UV1”.

Note that you must do repeat queries (e.g., using Nativity as the grouping Species Attribute for native vs. exotic cover) when using different categorization schemes using this calculation method. Exotic cover using this method is **NOT** the sum of the cover of all the exotic life forms exported using the example above.

Summary Calculations

For absolute cover, no further calculations are needed. Keep in mind, however, that calculations using this method for different categorization schemes (native vs. exotic, forb vs. graminoid, etc.) must be done using separate queries in FFI. Also, categorization schemes not available as a selection in the Grouping possibilities in FFI (step 12 in point-intercept data’s export section above) are not possible with FFI.

For relative cover use Excel or an equivalent program to calculate percent exotic cover and percent warm-season cover as defined in the main SOP text.

SOP Protocol Revisions

Version 1.01

Prev. Version	Revision Date	Revised by	Changes Made	Reasons for Change	New Version
e.g. 1.00	Mar 14, 2011	M. Bynum	added "Adapting to Increased/Decreased Funding" section, page 2	Needed more information for these circumstances.	1.01
1.00	11/11	LEB	Change to nrps style		1.01

Acknowledgement: The “Revision Procedures” section is a slightly modified version of the KLMN’s SOP #16 “Revising the Protocol”.

This document discusses strategies for adapting to changes in resources available for implementing the NGPN Plant Community Composition and Structure Monitoring Protocol and explains how to make and track changes to the protocol and its accompanying SOPs. Although this protocol has gone through an extensive development and testing phase, continued modifications are almost certain to occur, especially during the first few years of implementation. Beyond such initial refinements, all long-term monitoring programs need to be flexible to adapt to changes in resources, technology, methodology, and priorities. Therefore this protocol will be updated as appropriate. Current best practices will be weighed against the continuity of protocol information in determining revisions. Project staff should refer to this SOP whenever edits are necessary and should be familiar with the protocol versioning system in order to identify and use the most current versions of the protocol documents. Project staff should also be thoroughly familiar with previous versions of the protocol and archived protocol evaluations (PCM-13) in order to avoid repeating practices that were changed in the past for good reason

All edits require review for clarity and technical soundness. Small changes to existing documents (e.g., formatting, simple clarification of existing content, small changes in the task schedule or project budget, or general updates to SOPs related to information management) may be reviewed in-house by project cooperators and NGPN staff. However, major changes to data collection, analysis techniques, sampling design, or response design will trigger an outside review and approval by the Network’s board of directors and technical committee. The Plant Ecologist should coordinate with the NGPN Coordinator to determine if outside review is needed.

Long-term monitoring efforts often must assess the trade-offs of making major protocol modifications as new technologies and methodologies become available. However, this protocol uses long-accepted methods and is not heavily dependent on current technology, so major modifications to this protocol would most likely be driven by changes in budgets or NGPN priorities. Therefore, although this SOP pertains to modifications made for any reason, the discussion below focuses on strategies for addressing changes in funding available for implementation of this protocol. When the underlying target population increases due to land acquisition but the funding for this protocol does not increase, expanding the monitoring to include new lands will result in lower resources available for existing sites. Therefore, the discussion also includes strategies for dealing with land acquisition in the context of dealing with changes in funding.

Adapting to Decreased/Increased Funding or Land Acquisition

Changes in the amount of funding and/or person-hours to accomplish the sampling described in this protocol are likely to occur in the future. These may be driven by changes in underlying budgets, Network priorities, or because the Network may find that estimates of what could be accomplished in a given time were overly optimistic or pessimistic. New land may be acquired by parks. In these circumstances, the options for modifying the sampling procedures and/or design must be carefully considered. The list below shows some of these options and their anticipated consequences, but this is neither a complete list nor a thorough, quantitative evaluation or comparison of their consequences.

Options for reducing sampling effort

1. Reduce the number of points sampled on a transect (e.g., from 100 to 50).

The values of seven parameters (total cover, % exotic cover, species richness, forb+shrub cover, graminoid cover, bare ground cover, basal cover of plants, and herbaceous litter ground cover) were compared between sampling two transects with 100 points at 0.5-m intervals and sampling two transects with 50 points at 1-m intervals or sampling one transect with 100 points at 0.5 m intervals ($N=7$, one plot from each of 7 vegetation types) using data from Symstad et al. (2006). There was no significant difference between the values obtained for either 200 vs. 100-point comparison for 6 of these parameters (t-tests; $P \geq 0.15$). The exception, as would be expected, was species richness, with the mean decrease for two 50-point transects being 3.7 (SE = 1.0; $P = 0.009$) and 6.3 species (SE = 1.9; $P=0.02$) for one 100-point transect. Thus, reducing the number of sample points would reduce the number of species for which cover information would be available, with moderately abundant species being the ones for which information would be lost (the rarest species are usually missed by this method with any reasonable number of points).

Therefore, for parameters other than species richness and diversity (which relies on species richness), reducing the sampling effort per transect should not induce any bias. Although the primary sample sizes of interest for detecting trend and estimating status are the total number of years sites are monitored and the total number of plots measured per park, reducing the sampling effort per transect would increase the measurement variance at each site.

The potential effects of such changes in effort on measurement variance can be estimated following the discussion of Skalski (in prep), who noted that the measurement variance for cover estimates from this type of sampling can be approximated by a binomial variance function: If the true proportion cover for a parameter is p , the Coefficient of Variation (CV) = $\sqrt{n*p*(1-p)}/n$, where n is the number of points per plot. With a true proportion cover of 0.50 (cover = 50%), the CV associated with measurement variation on each plot would increase from 5% to 7.1% when the total number of points decreases from 100 to 50. Relative changes would be similar with other potential "true" cover values between 0 and 1. Given that year-to-year variation has a far larger effect than other sources of variability on power to detect trend for this protocol (Appendix A), this small increase in measurement variability almost certainly would have no significant detrimental effect on power. If trend analyses combined data collected with different number of points per transect among years, a statistician should be consulted to assess whether any differential weighting of data based on expected measurement variance is feasible and necessary – it is possible that this minor increase in measurement variance could be ignored during model-based trend analyses. For estimates of status, we also expect that such a small change in expected measurement variability would have very minor effects on expected precision; however, further analyses would be needed to quantify such effects.

Changes in point-intercept effort per plot are more problematic for species richness and diversity, given the reduced average value of richness noted with fewer points. If effort changes across time, these differences would be confounded with any real changes in richness. Although a variety of ad-hoc or model-based methods (e.g., rarefaction, use of effort as a covariate, models for assessing how species detection probability changes

with changes in effort) might be used to adjust for differential sampling effort, the conservative approach would be to rely only on quadrat-sampling data for assessing changes in species richness. However, this is not an option for species diversity.

A simple solution to accounting for changes in effort would be to recalculate summary values for previous data after eliminating observations from transect points that have been dropped in the modified protocol. This may be the most feasible approach for standardizing species richness and diversity data if such a change occurs. However, essentially discarding years of hard-earned data is not recommended if there are alternative feasible approaches for dealing with any bias or increased variance induced by the reduction in effort.

Therefore, the statistical implications of reducing the number of points could be manageable. Cutting the number of points in half would cut the amount of time spent on point-intercept sampling nearly in half (from about an hour per transect to 30 minutes per transect, on average, based on pilot study efforts). This may not be a substantial enough time savings to justify the reduction in information, given the amount of time it takes to complete the rest of the sampling (nested quadrats, woody species if appropriate). However, if this is enough of a reduction to enable the completion of three plots a day vs. two, this would be well worth considering.

2. Eliminate the 10 m² quadrat in the nested quadrats sampling.

Based on data from the HTLN sampling at AGFO and SCBL from 1999 to 2004, the mean number of species in 10 m² is 4.1 (SE = 0.3) above that in 1 m², and the number of species detected at a site in ten 10 m² quadrats is 73% higher (13.1 ± 0.6) than the number detected at a site in ten 1 m² quadrats. Eliminating the 10 m² quadrats would probably reduce the time for quadrat sampling in half. However, the number of species for which frequency information is available would be reduced considerably, and the species for which this information would be lost are likely to be the rarer species. Assuming that rarer species are more likely to be adversely impacted by stressors (e.g., Suding et al. 2005), eliminating the 10 m² quadrats could reduce the protocol's power to detect trends in species richness until the changes in richness are reflected by loss of more abundant species. When this protocol was written, the lack of long-term data collected using 1 m² and 10 m² nested quadrats precluded doing power analyses to test this conclusion. If this option is considered for reducing sample effort, such analyses should be done and the results weighed against the estimated 60 minute time savings per 10 quadrats.

3. Reduce the number of plots sampled in a year.

There are various options for reducing the number of plots sampled in a year if there are multi-year or long-term reductions in available funding. These include reducing the number of sites visited in all panels visiting only one panel per year, designing a new panel design (e.g., a split panel design with a longer return interval for some plots), or dropping an entire park. For the first option, the lowest-hanging fruit are panels with the largest number of replicates (i.e., BADL has 10, uplands in THRO's South Unit has 7, WICA has 7). Parks/strata with only 1 or 2 replicates per panel (e.g., Bodmer Unit at FOUS, uplands at FOLA) are most sensitive to sample size reduction. Dropping an entire panel in any park eliminates the connectivity of the sampling design that is crucial because of the high inter-annual variability in most parameters measured. Dropping an entire park is clean statistically but may not be acceptable to the park and the Network's Board of Directors and Technical Committee. The relative merits of each of these options should be compared using power analyses such as those conducted in the development of this protocol (see Appendix A of the protocol) or simulation software developed for this purpose [e.g., Complex Survey Design Simulator – CSDsim – described in Garman et al. (in review)].

There may be occasions when circumstances arise during the field season that prevent all scheduled plots in a park from being visited. Occasionally skipped observations may not substantially increase the time required to detect a trend, as long as the number skipped is not too large. Garman and colleagues (in review) found that

skipping 2-4 observations over 20 years in a design in which 12 or 15 plots were sampled per year and the total number of plots was 63-77 increased the time to detect a 3.5% annual decline in perennial grass cover over 10 years by only 0.2-0.5 years. This is small compared to the 9-12 years for trend detection when no plots were skipped. This degree of skipping also had a minor effect on the error of the status estimate (0.004 out of 0.12-0.18 for 2 skipped plots, 0.01 for 4 skipped plots). Overall, however, higher annual and total sample size generally does provide higher power to detect trends.

4. Do not sample tree and tall shrub species in some plots.

The density and size structure of tree and tall shrub species provides information on wildlife habitat, fuel loading, and resources available for understory vegetation. However, in some instances the collection of these data can take a very long time (e.g., juniper draws or hillsides at THRO, chokecherry thickets in many parks). The benefits of not collecting tree and tall shrub density data would have to be weighed against the costs of not having those data.

5. Some combination of the above

Options for Increasing Sampling Effort

In this unusual circumstance, it should be kept in mind that the results of power analyses done during the development of this protocol showed that increasing the number of samples in a year (or overall) will have a relatively minimal impact on the time to detect trends. However, it could increase the precision of status estimates. Moreover, the potential effect of increased sample size needs to be reevaluated after monitoring has been implemented long enough to provide more accurate estimates of spatial and temporal variability. Priorities for increasing sample size should be determined by analyzing data already collected in light of their ability to address park natural resource management objectives. For example, if the vegetation in a certain portion of a park has very high priority for management objectives, additional plots may be selected from the overdraw sample only in that area and added to the existing panel structure. Or, a new sampling design that adds new panels on a different sampling schedule might be adopted. As with decreasing sampling effort, power analyses such as those in Appendix A of the protocol or simulation software should be used to evaluate a variety of options.

Options when a Park Acquires New Property

When a park acquires new property but the amount of funding available for monitoring in that park or network does not increase proportionally, sampling effort must be redistributed if monitoring in the new property is desired. Options for reducing sampling effort in the “old” property to free up resources for the new property are discussed above. In those instances where the new property was included in the original GRTS draw, adding new plots is as simple as changing dormant sites to active ones. If the new property was not included in the GRTS draw, it may need to be treated as a separate stratum and an independent sample drawn. A statistician thoroughly familiar with the GRTS method, general sampling theory, and panel designs should be consulted to determine if there are any other options for addressing this change in the target population.

Revision Procedures

The following procedures will ensure that both minor and major revisions to this document will align with the monitoring plan.

1. Consult the Protocol Review Forms stored with the current version of the protocol for suggestions made by previous field crew members.
2. Discuss proposed changes with other project staff prior to making modifications. It is imperative to consult with the Data Manager prior to making changes because certain types of changes may jeopardize

dataset integrity unless they are planned and executed to avoid this. Also, because certain changes may require altering the database structure or functionality, advance notice of changes is important to minimize disruptions to project operations. Consensus should be reached on who will be making the changes and in what timeframe.

3. Make the agreed-upon changes in the appropriate protocol document. Note that the protocol is split into separate documents for each appendix and SOP. Also note that a change in one document may necessitate other changes elsewhere in the protocol. For example, a change in the narrative may require changes to several SOPs; similarly, changing the name of an SOP may mean changing document references in several other documents. Also, project equipment lists, activity timing, or responsibilities for various project tasks may change in several SOPs.
4. Document all edits in the Revision History Log embedded in the protocol narrative and each SOP. Log changes only in the document being edited (i.e., if there is a change to an SOP, log those changes only in that document). Record the date of the changes (i.e., the date on which all changes were finalized), author of the revision, the change and the paragraph(s) and page(s) where changes are made, and briefly the reason for making the changes, and the new version number. Version numbers increase incrementally by hundredths (e.g., version 1.01, 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.00, 3.00). Record the previous version number, date of revision, and author of revision; identify paragraphs and pages where changes are made, rationale for revisions, and the new version number.
5. Circulate the changed document for internal review among project staff and cooperators. Minor changes and clarifications will be reviewed in-house. When significant changes in methodology are suggested, revisions will first undergo internal review by the project staff. Additional external review including, but not limited to, National Park Service staff with appropriate expertise will be required.
6. Upon ratification and finalizing changes:
 - a. Ensure that the version date (last saved date field code in the document header) and file name (field code in the document footer) are updated properly throughout the document.
 - b. Make a copy of each changed file to the protocol archive folder (i.e., a subfolder under the Protocol folder in the project workspace).
 - c. The copied files should be renamed by appending the revision date in YYYYMMDD format. In this manner, the revision date becomes the version number and this copy becomes the “versioned” copy to be archived and distributed. For example, the second minor revision of this document would be named “NGPN_SOP_15_Revising_Protocol_1.02_20120423.docx” in the archive subfolder.
 - d. The current, primary version of the document stored in the SOP subfolder (i.e., not the versioned document just copied and renamed) does not have a date stamp associated with it. Following the example above, this version, which is accessed regularly for consulting, printing, etc., would be named “NGPN_SOP_15_Revising_Protocol_1.02”.
 - e. To avoid unplanned edits to the document, reset the document to read-only by right-clicking on the document in Windows Explorer and checking the appropriate box in the Properties pop-up.

- f. Inform the Data Manager so the new version number(s) can be incorporated into the project metadata.
7. As appropriate, create PDF files of the versioned documents to post to the Internet and share with others. These PDF files should have the same name and be made from the versioned copy of the file.
8. Send a digital copy of the revised document to the Coordinator and Data Manager. The revised document will be forwarded to all individuals who had been using a previous version. Ensure that workers in the field have a hardcopy of the new version.
9. The Data Manager will ensure that revised document files are in the proper folder on the NGPN shared drive and have the correct access protections.
10. The Data Manager will post the revised version and update the associated records in the proper I&M databases, including but not limited to the NGPN Intranet and Internet web sites and the national I&M program's Protocol database.

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Appendix 1: Data Sheets

Copies of all datasheets used in plant community monitoring are included in the following pages to serve as an examples of data collection needs in the field. The original documents and pdfs are stored on the NGPN server. We recommend using these originals, rather than the pages below, to print copies for use in the field.

SITE EVALUATION CHECKLIST

PARK: _____ **SITE ID:** _____ **DATE:** _____

PDOP: _____ **OBSERVERS:** _____

TRANSECT AZIMUTH: _____ **EVALUATION TYPE (CIRCLE ONE):** Field Office

Permanent Rejection Criteria

Yes **No** **Brief Description (See SOP Site Evaluation for full description)**

- (1) Out of park boundary
- (2) Dangerous/prohibitively difficult to work on
- (3) Dangerous/prohibitively difficult to access
- (4) More damage than good would come from working here
- (5) Road or improved trail
- (6) Will not support vegetation
- (13) Park says not to use this site (e.g., archaeological site)

Temporary Rejection Criteria

Yes **No** **Brief Description (See SOP Site Evaluation for full description)**

- (7) >50% of either transect would be in water year-round
- (8) Currently on private land, but might not always be
- (9) Currently dangerous/difficult to work on or access, but could change
- (10) Currently disrupted by temporary construction project; reveg expected
- (11) Does not meet stratum definition

FOR EXTENSIVE PLOTS ONLY:

- (12) No tree or tall shrub species and, in Black Hills Parks, no dead/downed woody fuels, within 38 m of site's center now and, if plot previously active, in last two visits

DETERMINATION: Reject Dormant Active **PLOT ID** _____ **PANEL** _____

Notes

Entered (initial and date): _____ 100% Checked (initial and date): _____ 10% Checked (initial and date): _____

PLOT LOCATION AND DESCRIPTION DATA SHEET

Park Code: _____ Plot ID: _____ Plot Type: Intensive / Extensive / Dual (I&E)

Date Established: _____ Established By: _____

Plot Location Plot Center - UTM Zone: ____ UTM E: _____

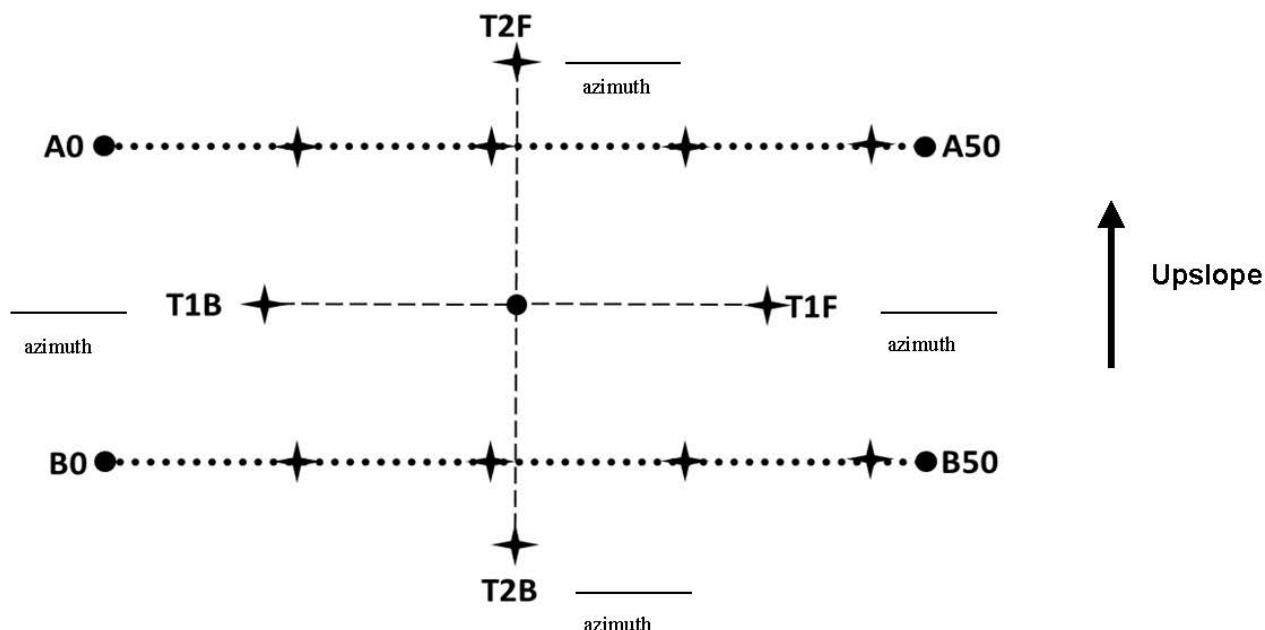
UTM N: _____ Elevation: _____ PDOP: _____

Description of point at which to start walking to plot, including good place to park vehicle:

Description of route to plot from starting point:

Plot Layout Azimuth of herb-layer transects (0 to 50) and/or Tree Transect 1 (B to F) _____

Overall aspect of plot (°) _____



On transects, draw any obstacles (trees, rocks, etc.) to laying tapes straight and where the tape lies with respect to them. If any markers are not in the standard location, clearly indicate their placement (e.g., nail/washer at 10.60 instead of 10.92).

Entered (initial and date): _____ 100% Checked (initial and date): _____ 10% Checked (initial and date): _____

Plot Description (choose only 1 following SOP directions)

Topographic position: level (LV) lower-slope (LS) mid-slope (MS) upper-slope (US) crest (CR) drainage (DR) streambed (SB) rock outcrop (RO)

Surface water: in plot <50m >50m

Hydrologic regime: permanently flooded (PF) semi-permanently flooded (SF) temporarily flooded (TF) seep (SP) upland (UP)

Vegetation type: upland grassland (UG) badlands sparse (BS) shrubland (SH) woody draw (WD) herbaceous riparian (HR) riparian woodland (RW) ponderosa pine woodland/forest (PP)

Notes:**Table 1. GPS coordinates and precision**

Point	Easting	Northing	PDOP	Point	Easting	Northing	PDOP
B0				T1B			
B50				T2B			
A50				T1F			
A0				T2F			

Table 2. Transect Grades (if more than one change point, write “variable”)

Vector	(a) Start to Change Point Slope Grade (%)	(b) Change Point to End Slope Grade (%)	(c) Location of Change Point (m)
(1) B0 → A0			
(2) T2B → T2F			
(3) B50 → A50			
(4) B0 → B50			
(5) T1B → T1F			
(6) A0 → A50			

Entered (initial and date): _____ 100% Checked (initial and date): _____ 10% Checked (initial and date): _____

PHOTOGRAPHIC RECORD SHEET

PARK: _____

PLOT ID (or, if dormant or rejected, SITE ID): _____

Entered (initial and date): _____ 100% Checked (initial and date): _____ 10% Checked (initial and date): _____

POINT-INTERCEPT DATA SHEET (100 cover-points metric)

Park: _____ Plot ID: _____ Transect: 1(A) 2(B) Date: _____
 Reader: _____ Recorder: _____ Number of points/transect: _____

Point	Tape	Height (cm)	Order							Tape	Ground
			Top Hit	Hit 2	Hit 3	Hit 4	Hit 5	Hit 6	Hit 7		
1	0.3									0.3	
2	0.8									0.8	
3	1.3									1.3	
4	1.8									1.8	
5	2.3									2.3	
6	2.8									2.8	
7	3.3									3.3	
8	3.8									3.8	
9	4.3									4.3	
10	4.8									4.8	
11	5.3									5.3	
12	5.8									5.8	
13	6.3									6.3	
14	6.8									6.8	
15	7.3									7.3	
16	7.8									7.8	
17	8.3									8.3	
18	8.8									8.8	
19	9.3									9.3	
20	9.8									9.8	
21	10.3									10.3	
22	10.8									10.8	
23	11.3									11.3	
24	11.8									11.8	
25	12.3									12.3	
26	12.8									12.8	
27	13.3									13.3	
28	13.8									13.8	
29	14.3									14.3	
30	14.8									14.8	
31	15.3									15.3	
32	15.8									15.8	
33	16.3									16.3	
34	16.8									16.8	
35	17.3									17.3	
36	17.8									17.8	
37	18.3									18.3	
38	18.8									18.8	
39	19.3									19.3	
40	19.8									19.8	
41	20.3									20.3	
42	20.8									20.8	
43	21.3									21.3	
44	21.8									21.8	
45	22.3									22.3	
46	22.8									22.8	
47	23.3									23.3	
48	23.8									23.8	
49	24.3									24.3	
50	24.8									24.8	
51	25.3									25.3	

Ground: enter BOL, ROCK, BEDROCK, LIT, WOOD, ROOT, MOSS, CRUST, SCAT, BARE, or VEG.

Entered (initial and date) _____ 100% Check (initial and date) _____ 10% Check (initial and date) _____

Point	Tape	Height (cm)	Order							Tape	Ground
			Top Hit	Hit 2	Hit 3	Hit 4	Hit 5	Hit 6	Hit 7		
52	25.8									25.8	
53	26.3									26.3	
54	26.8									26.8	
55	27.3									27.3	
56	27.8									27.8	
57	28.3									28.3	
58	28.8									28.8	
59	29.3									29.3	
60	29.8									29.8	
61	30.3									30.3	
62	30.8									30.8	
63	31.3									31.3	
64	31.8									31.8	
65	32.3									32.3	
66	32.8									32.8	
67	33.3									33.3	
68	33.8									33.8	
69	34.3									34.3	
70	34.8									34.8	
71	35.3									35.3	
72	35.8									35.8	
73	36.3									36.3	
74	36.8									36.8	
75	37.3									37.3	
76	37.8									37.8	
77	38.3									38.3	
78	38.8									38.8	
79	39.3									39.3	
80	39.8									39.8	
81	40.3									40.3	
82	40.8									40.8	
83	41.3									41.3	
84	41.8									41.8	
85	42.3									42.3	
86	42.8									42.8	
87	43.3									43.3	
88	43.8									43.8	
89	44.3									44.3	
90	44.8									44.8	
91	45.3									45.3	
92	45.8									45.8	
93	46.3									46.3	
94	46.8									46.8	
95	47.3									47.3	
96	47.8									47.8	
97	48.3									48.3	
98	48.8									48.8	
99	49.3									49.3	
100	49.8									49.8	

Park: _____ **Plot ID:** _____ **Transect:** 1(A) 2(B) **Date:** _____
Reader: _____ **Recorder:** _____ **Number of points/transect:** _____

Ground: enter BOL, ROCK, BEDROCK, LIT, WOOD, ROOT, MOSS, CRUST, SCAT, BARE, or VEG.
 Entered (initial and date) _____ 100% Check (initial and date) _____ 10% Check (initial and date) _____

NESTED QUADRATS DATA SHEET (Density-Belts metric)

Park: _____ Plot ID: _____ Transect: 1(A) 2(B) Date _____

Observers Subbelt values: 1, 2, 3, 4, 5 Subplot Fraction: 0.001, 0.01, 0.1, 1

10 m² quadrat locations along transect: 0.00-3.16; 10.92-14.08; 23.42-26.58; 35.92-39.08; 46.84-50.00

Diagonal of 10 m^2 square = 4.47 m. Corners of a 10 m^2 square tape are 0, 3.16, 6.32, 9.48, and 12.64.

Where possible (sites with <27 spp per set), start each new subbelt in a new column.

Entered (initial & date) 100% check (initial & date) 10% check (initial & date)

Park: _____ Plot ID: _____ Transect: 1(A) 2(B) Date _____

Entered (initial & date) 100% check (initial & date) 10% check (initial & date)

TREES DATA SHEET

Visit Type: Extensive Intensive

Park: Plot ID: Date: Observers:

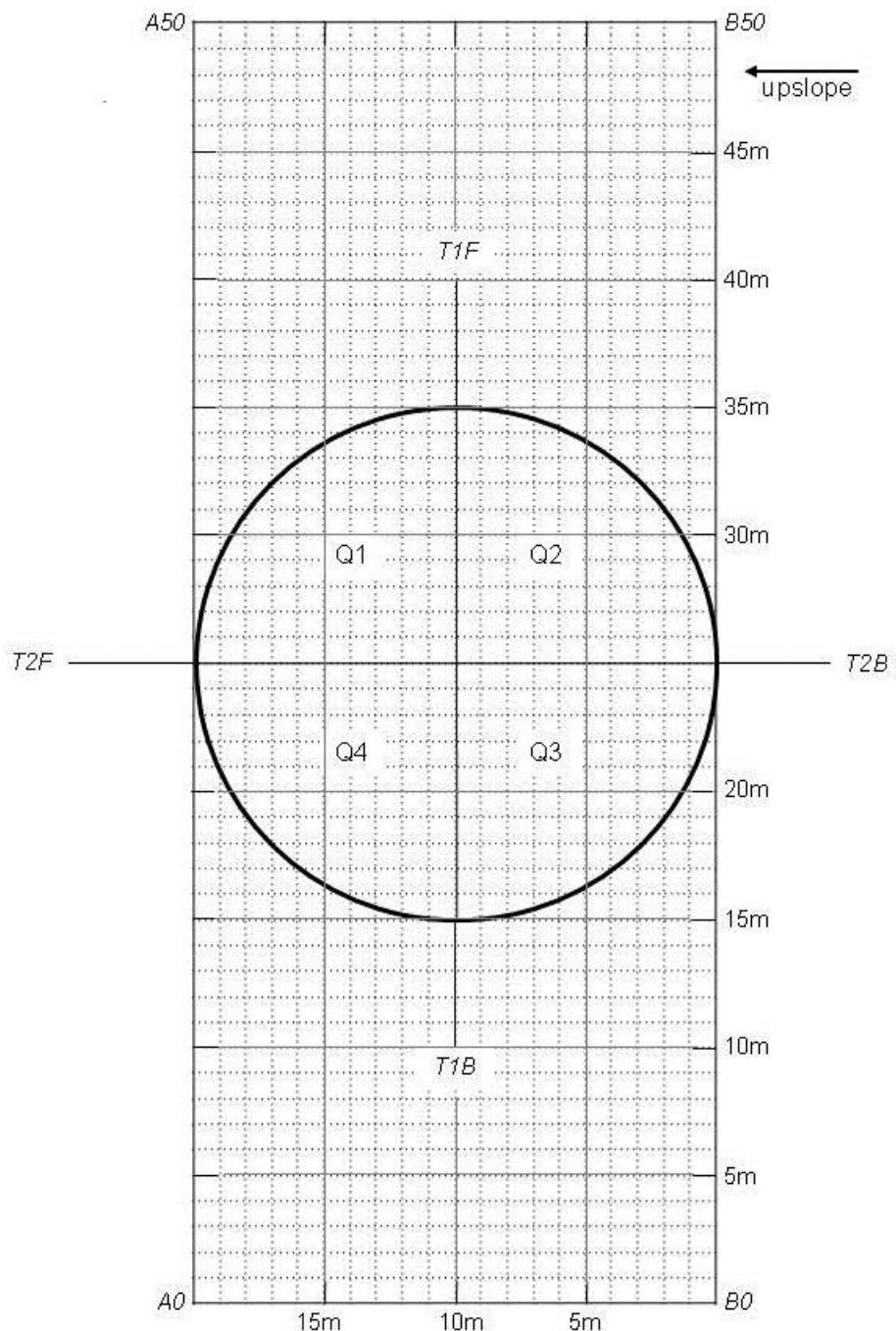
L/D: L = live; D = dead **In/Out** refers to whether the tree is in or out of the central 10-m radius circle.

Condition Codes: Choose the one best. Dead conditions are: **RS** = recent snag (bark intact); **LS** = loose bark snag (bark partially fallen off); **CS** = clean snag (no bark left). Live categories are **SND** = sound (no other codes apply); **DBK** = dieback (dieback occurs in upper and outer portions of tree and comprises >10% of crown); **DIS** = foliage discoloration (at least 30% of the foliage is more than 50% some color other than green); **DEC** = decay (conks, fruiting bodies, bird cavities, punky wood); **INS** = insect signs (piles of frass, pitch tubes, bark beetle galleries).

Multiple stems: after recording the diameters of multiple stems, draw a box around rows for that individual
Comments:

Entered (initial & date) 100% Checked (initial & date) 10% Checked (initial & date)

Park: _____ Plot ID: _____ Date: _____ Observers: _____



Entered (initial & date) _____ 100% Checked (initial & date) _____ 10% Checked (initial & date) _____

POLES DATA SHEET

Park: _____ Plot ID: _____ Date: _____ Observers: _____

Comments:

Entered (initial & date) 100% Checked (initial & date) 10% Checked (initial & date)

SEEDLINGS DATA SHEET

Park: Plot ID: Date: Observers:

Note: Seedlings less than one year old (i.e., those with cotyledons present and/or stem not yet woody) are NOT counted. Only LIVE seedlings are counted. Individual trees that are shorter than BH, and individuals of tall shrub species (or JUSC2) with no stems at least 2.54 cm in diameter 30 cm up from the diameter measurement point are treated as seedlings, regardless of age and diameter.

Continue on second page if necessary.

Record here how many quarters the count was performed in for each species.

Species	# Quarters Counted	Species	# Quarters Counted	Species	# Quarters Counted

Comments:

Entered (initial & date) 100% Checked (initial & date) 10% Checked (initial & date)

PONDEROSA PINE FOREST DEAD & DOWNED SURFACE FUELS DATA SHEET

Park: _____ Plot ID: _____ Date: _____ Observers: _____

Tree Transect 1 Azimuth: _____ Slope (%): _____

# of Intercepts (Tally)			Diameter (inches)		Litter and Duff Depths (inches)									
Diameter Class	0-0.25" (1 hr)	0.25-1" (10 hr)	1-3" (100 hr)	>3" sound (1000 hr)	>3" rotten (1000 hr)	Comments:								
Stretch to Sample	3' – 9'	3' – 9'	3' – 15'	100'	100'	Point (feet)	Litter	Duff	Offset? where to?	Point (feet)	Litter	Duff	Offset? where to?	
						3				73				
						8				78				
						13				88				
						23				93				
Total						28				98				

Tree Transect 2 Azimuth: _____ Slope (%): _____

# of Intercepts (Tally)			Diameter (inches)		Litter and Duff Depths (inches)									
Diameter Class	0-0.25" (1 hr)	0.25-1" (10 hr)	1-3" (100 hr)	>3" sound (1000 hr)	>3" rotten (1000 hr)	Comments:								
Stretch to Sample	3' – 9'	3' – 9'	3' – 15'	100'	100'	Point (feet)	Litter	Duff	Offset? where to?	Point (feet)	Litter	Duff	Offset? where to?	
						3				73				
						8				78				
						13				88				
						23				93				
Total						28				98				

Comments:

Entered (initial & date): _____ 100% Checked (initial & date) _____ 10% Checked (name & date): _____

Brown's Line Guidelines for Dead and Downed Woody Fuels, Litter, and Duff

- Sampling begins at the B (beginning) end of the transect.
- Measure dead and downed woody material first, then litter and duff.
- Downed woody material includes dead twigs, branches, stems, and boles of trees and shrubs that have fallen and lie on or within 6' of the ground surface. Cones, bark, needles, and leaves are not included in this category. Do not count dead materials if: they are still attached to standing trees or shrubs; the part of them under the tape is in the duff layer; they don't cross the entire tape with their central axis; or the material is an undisturbed stump rooted in the soil. In this last case (of a rooted stump), offset your measuring point 1 foot to the right. If this offset does not get past the obstruction, offset 1 foot perpendicular to the left side. Other options include 1 foot offsets on the transect (e.g., at 14 feet instead of 13 feet). **Record on the data sheet what the offset is.** Do the same (offset) if the sampling point hits a tree.
- Sample 1-hr and 10-hr fuels between the 3 foot and 9 foot marks.
- Sample 100-hr fuels between the 3 foot and 15 foot marks.
- Sample 1000-hr fuels between the 0 foot and 100 foot marks.
- **Rotten wood** is obviously deteriorating or punky.
- **Sound wood** is hard and not deteriorating.
- When measuring the **diameter of 1000-hr fuels**: measure to the nearest 0.1 "; ignore materials when they are buried more than halfway into the duff at the sampling point – they are no longer a 1000-hr fuel; estimate the original/intact diameter of a rotten log when encountered at the sampling point.
- **Litter** includes freshly fallen leaves, needles, bark, flakes, fruits (e.g., acorns, cones), cone scales, dead matted grass, and a variety of miscellaneous vegetative parts. Twigs and larger stems are not litter, and should not be included in litter depth measurements.
- **Duff** is defined as the fermentation and humus layers. It does not include the freshly cast material in the litter layer or ash. The top of the duff is where needles, leaves, fruits and other cast-off vegetation material have noticeably begun to decompose. Individual particles usually are bound by fungal mycelia. The bottom of the duff is mineral soil. If the center of a rotten log is in the duff layer at the point of measurement, then it is duff and the duff layer is equal to the diameter of the log.
- If a **stump or large rock** is on the point and litter and duff have accumulated on top of it and this litter/duff is no more than 6 feet above the surrounding ground, record the litter and duff depth as usual. When the litter/duff are >6 feet above the surrounding ground, record the depth for both as 0. If a **tree** occurs at the sampling point, there is no litter or duff to measure – both are zero. (*This is different than with woody material!!!*) If a **log** occurs at the sampling point, offset the point 1 foot to the right and take a measurement. If this offset does not get past the log, offset 1 foot perpendicular to the left side. Other options include 1 foot offsets on the transect. **Record on the data sheet what the offset is.**

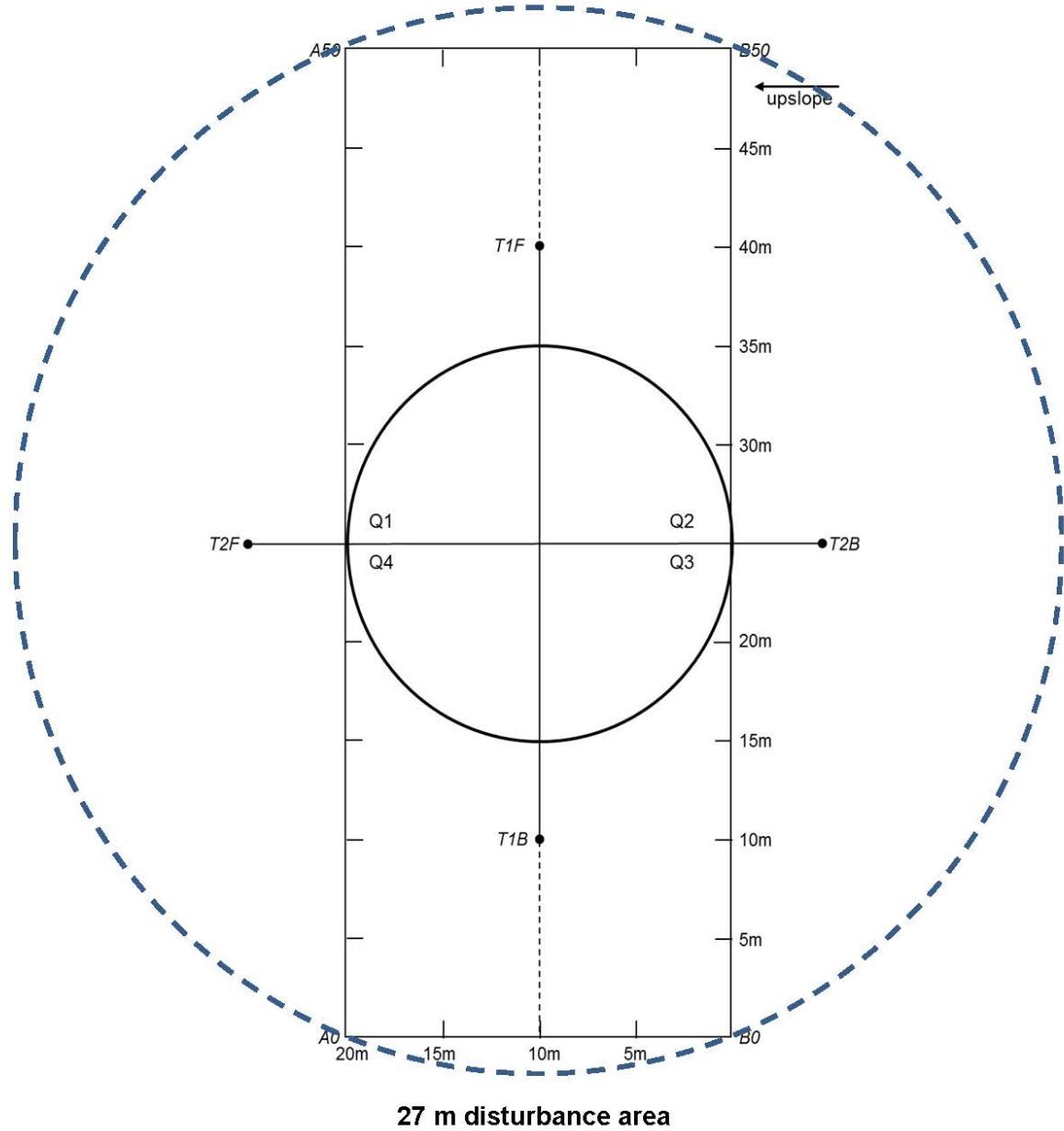
Site Disturbance Assessment: Park:**Plot ID:** _____**Date:** _____**Observers:** _____

Disturbances within 27 m of plot center (the distance from center to A0, B0, A50, and B50). Picture a circle where the plot corners are the circumference. 27m circle=2290m², Whole plot=1000m², quarter plot= 250m²; one nest= 10m²; one meter wide trail through length of plot= 50m²

Change Agent	Change	Description	In, Out, or In/Out of 50 x 20 m plot (UV1)	Approx. Size e.g., 1 m ² 1000m ²	Comments (e.g., more detailed description, time since disturbance, intensity of fire)
Road (Othr)	Road	Dirt or paved road			
Off-road human travel (Othr)	Off-Road	Noticeable vehicle tracks, official or unofficial foot trails, bike activity			
Large animal trail (Othr)	Animal Trail	Trampled or missing vegetation, rutted or compacted ground			
Grazing (Graz)	Graz	Recently grazed vegetation			
Wallow or mineral lick (Othr)	Wallow	Patch of bare ground, often indented where animals spend a lot of time resting or licking soil to get minerals			
Wildland Fire (WFire)	Fire	Burn scars on trees or snags, charcoal, singed plants, blackened litter or herbaceous vegetation			
Prescribed Fire (Pfire)	Fire	Burn scars on trees or snags, charcoal, singed plants, blackened litter or herbaceous vegetation			
Chipping (Chip)	Tree Removal	Usually a park-instigated management action; evidence includes cut stumps and piles of sawdust and chips			
Flood (Flod)	Flood	Recent flooding or inundation denoted by debris piles, scour marks, flattened vegetation, etc.			
Wind (Wind)	Storm	Denoted by uprooted or broken trees and limbs, bent over poles and seedlings, shredded vegetation			
Prairie dog colony (Othr)	Prairie dog	Vegetation clipped close to ground, mounds of dirt surrounding holes			
Other animal excavation (Othr)	Small Mammal	Mounds of dirt other than by prairie dogs (e.g., gophers, badger)			
Tree removal (Scut)	Tree Removal	Usually a park-instigated management action; evidence includes cut stumps and piles of sawdust and chips			
Herbicide (Othr)	Herbicide	Blue dye on plants; yellowing or deformed (growing points twisted) plants-Other factors can cause the latter conditions.			
Insect and Disease (InDi)	InDi	Tree mortality clearly due to insects (Mountain Pine Beetle); defoliation of herbaceous vegetation by grasshoppers			
Other erosion (Othr)	Erosion	Substantial soil loss/movement caused by factors not described above			
Pile Burn (Pile)	Fire	Usually park-instigated management action; evidence includes burned area of piles of branches, and/or logs			
Other (Othr)					

Other Notes:

Entered (initial & date): _____ 100% Checked (initial & date): _____ 10% Check (initial & date): _____

Map for sketching disturbance and target species locations

Park: _____ Plot ID: _____ Date: _____ Observers: _____

Target Species Assessment (Cover-Species Composition metric) Species found within 27m of plot center

Cover classes: 1 = one individual; 2 = few individuals, cover < 1% of site; 3 = cover 1-5% of site; 4 = cover 5-25% of site; 5 = cover >25% of site.

Tips: $10m^2$ nest < 1% of area (class 2); 3 nests of $10m^2$ = 1.3% (class 3); 20x50m plot = 43% (class 5); all Q1 = 11% (class 4)

Location: Give a specific description of where the plants are in the case that they will be removed. This is most important for early detection target species with low cover. For instance: Q1, Q2, Q3, Q4, scattered; A0, B25 & B39.

Comments:

Entered (initial & date): 100% Checked (initial & date): 10% Check (initial & date):

Unknown Plant Data Sheet

Unknown Code: _____ Park: _____ Date: _____ Observer(s): _____

Plot ID, transect, and quadrat/point: _____

Specimen collected? yes no Photographs taken? yes no

Photograph numbers written on site photo log? yes no

Annual or Perennial Resolvable? yes no

Plant Type: forb shrub tree herbaceous vine woody vine grass sedge
other _____

Most Salient Feature:

Leaf Characteristics:

type (compound/simple, arrangement, etc.):

margin:

other (pubescence, including shape of hairs, sap, stipules, etc.):

Stem Characteristics (shape, pubescence, buds, bunched vs. single, branching location, etc.):

Flower Characteristics (color, location, arrangement, # stamens, etc.):

Habitat/Microhabitat:

Other Notes:

Best Guess: _____ Confirmed: _____

Confirmed by: _____

Entered into FFI as _____

Field Season Review Form

Discussion Leader: _____ Recorder: _____ Date: _____

Others Present: _____

1. Data ambiguities, resolution, and reasoning behind resolution:

2. Description of and reasons for missing data:

3. Issues impacting quality of data and ways to resolve them in future:

4. Crew concerns that need addressing before next field season:

5. Park relations and other additional comments:

Protocol Review Form

Discussion Leader: _____ Recorder: _____ Date: _____

Others Present: _____

1. Suggestions for improving written protocol:

2. Equipment suggestions:

3. Training process suggestions:

4. Other comments:

Electronic Metadata Interview

[Note: Please make your responses directly within this word document in "Red" type.]

Your name:

Today's date:

1. Have you already prepared metadata for this dataset?
 - a. If yes, please send a copy of the document or reference to where it can be found and skip to item **18**.
2. What is the title of the dataset?
3. Who is the originator(s)/owner of the dataset? (Include address and telephone number)?
 - a. If someone else should answer question about the data, please list the name, address, and telephone number.
 - b. Are there other organizations or individuals who should get credit for support, funding, or data collection and analysis?
4. Does the dataset contain any sensitive information that should not be released to the public? NPS?
 - a. Explain why the data should not be released to the public.
 - b. Explain why the data should not be released to non-park NPS staff.
5. Is the dataset published or part of a larger publication?
 - a. If so, what is the reference?
6. Include a brief (no more than a few sentences) description of the dataset.
7. Why were the data collected in the first place?
8. What is the time period represented by the dataset?
9. Were the data developed primarily through:
 - a. Field visits?
 - b. Remote instrumentation (e.g., temperature recorders, etc.)?
 - c. Existing data sources?
10. What is the status of the data you are documenting? – *complete, in progress, planned*
 - a. Will the dataset be updated? If so, how frequently?
11. Where were the data collected? Include description and coordinates, if known.
12. List some keywords to help search for this dataset.

- a. Thematic, Place, Temporal, Strata, Taxonomy
- b. If a controlled vocabulary was used, what is the reference?

13. List any related datasets that could be documented for cross-reference.

14. The FGDC Biological Profile includes the means to document tabular datasets, taxonomy, field methods, and the use of analytical tools or models.

- a. Was your dataset developed using a model or other analytical tool?
 - i. If so, what is the reference?
 - ii. If the model or tool is available, include a contact and/or URL.
- b. Does the dataset contain biological information? If no, skip to item 15.
 - i. What species or communities were examined?
 - ii. Did you use a taxonomic authority or field guide for identification? If so, what is the reference?
 - iii. Briefly summarize your field methods (cut and paste from other documents!).
 - iv. If you used existing protocols or methods, list the references.
 - v. If you use a different taxonomic hierarchy than what is available in ITIS, then you need to supply the taxonomic hierarchy for all species within the dataset.

15. Is your dataset archived in a databank or data catalog? If yes, please include a reference to the documentation and skip to item 16. If No:

- a. What measures did you take to make certain that your dataset was as nearly correct as possible?
- b. Were there any things that you excluded from your data collection (e.g., stems less than a certain diameter or streams without surface flow)?
- c. What is the form of your dataset? - *spreadsheet, ASCII file, GIS layer, database, other.*
- d. What is the filename for your dataset?
 - i. For each file or table, list the fields in the dataset and for each field list:
 - The definition of the field.
 - If the data are coded (Enumerated Domain), list the codes and the definitions.
 - If the codes come from a published code set (Codeset Domain), list the reference.

- If the data are measured (Range Domain), list the units and the minimum and maximum allowable values (“no limit” is acceptable).

ii. Otherwise, the domain is unrepresentable. Include a brief description of what is in the field.

16. Is this a GIS dataset? If no, skip to item 17.

a. Include a path to where the data can be accessed over the network or send a copy of the ArcInfo export file, an ArcView shapefile, or an ArcCatalog exported metadata file (txt or xml).

i. Include projection parameters, if necessary.

b. List any source datasets you used. For each source, list:

i. Source name, originator, and publication date.

ii. Source time period and scale.

iii. Source presentation form and media type.

iv. Contribution of source to your analysis.

c. List the processing steps you used to create your dataset, including the approximate date of processing.

17. Is the dataset available for distribution? If no, go to 18.

a. Are there legal restrictions on who may use the data?

b. Do you have any advice for potential users of the dataset?

c. What are your distribution instructions?

18. You are done. Send this completed document with the relevant responses to this interview to your metadata coordinator (Stephen Wilson, Northern Great Plains Network Data Manager Stephen_K_Wilson@nps.gov, 605-341-2804)

Unknown Plant Log

Park: _____

Plot: _____

Date: _____

* photograph numbers should also be placed on the photo log

All unknown samples are accounted for (initial & date) _____

FFI has been updated with final identifications (initial & date).

Species Name Change Log

Name(s):

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 920/112724, February 2012



Natural Resource Stewardship and Science

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