National Park Service
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Natural Resource Stewardship and Science

Plant Community Monitoring Protocol for the San Francisco Bay Area Network of National Parks

Standard Operating Procedures Version 1.0

Natural Resource Report NPS/SFAN/NRR—2016/1284.1



ON THE COVER
Scenes from Pinnacles National Park, John Muir National Historic Site, Golden Gate National Recreation Area, Muir Woods National Monument, and Point Reyes National Seashore (top to bottom).
Photographs by Robert Steers.

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Introduction

This document contains the Standard Operating Procedures (SOPs) that are to be utilized in the implementation of the Plant Community Monitoring Protocol for the San Francisco Bay Area Network (SFAN). The narrative that describes the goals, objectives, and means of carrying out this monitoring effort are contained in a separate companion document (Steers et al. 2016). Both the narrative document, the SOPs contained herein, and additional ancillary maps and documents referenced in these documents but stored on the SFAN Inventory and Monitoring server, must all be consulted in order to properly execute this monitoring protocol.

This document contains 23 separate SOPs that are to be strictly adhered to. However, unforeseen issues or circumstances may require future changes to these SOPs. Extreme caution must be followed when changing any SOP. Sometimes, alterations can render past monitoring data obsolete. It is of the utmost importance to ensure that methodology is not altered in such a way that past efforts cannot be utilized in long term trend analyses. Detail instruction on how to make and record future changes are described in SOP 19.

Lastly, many of these SOPs were based on previously written ones found in protocols used for similar vegetation monitoring purposes, especially from the North Coast Cascade (Acker et al. 2010) and Klamath (Odion et al. 2011) Inventory and Monitoring (I&M) Networks. In addition, many other national park service vegetation monitoring protocols were also consulted.

Literature Cited

Acker, S. A., A. Woodward, J. R. Boetsch, K. Hutten, M. Bivin, R. Rochefort, C. C. Thompson, and L. Whiteaker. 2010. Forest vegetation monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/242. National Park Service, Fort Collins, Colorado.

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

Steers, R., M. Denn, E. Wrubel, A. Forrestel, B. Johnson, L. Parsons, and F. Villalba. 2016. Plant community monitoring protocol for the San Francisco Bay Area Network of National Parks: Narrative Version 1.0. Natural Resource Report NPS/SFAN/NRR—2016/XXX. National Park Service, Fort Collins, Colorado.

SOP 1: Workspace Setup and Data Storage

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP describes how and where project files and records are managed by project staff. Workspace structure, naming conventions, and procedures for handling project files are included. This SOP also explains the procedures for transferring data and products to the San Francisco Bay Area Network (SFAN) Data Manager for storage. This document was adapted from the National Park Service, North Coast Cascade and Klamath Networks' Vegetation Monitoring Protocols (see Acker et al. 2010 and Odion et al. 2011).

Workspace Setup

A section of the Natural Resources Branch networked file server at Golden Gate National Recreation Area (GOGA) is reserved for this project. Prior to each season, the vegetation ecologist should make sure that network accounts are established for each new staff member through the Point Reyes National Seashore (PORE) Information Technology Specialist.

The recommended file structure within this workspace is shown in Figure SOP 1.1. The workspace folder name is "PlantCommunities," found under "\\Inpgogamahe1\Divisions\NetworkIM\VitalSigns" on the GOGA Natural Resources Server. Data and images from the current year should be retained in a separate folder (year_field_crew). This will make it easier to identify and move these files or their final versions to the appropriate archival folder or website at the end of each season (see Table SOP 1.1 for schedule).

All other major subfolders are described as follows:

- Analysis – Contains working files associated with data analysis.
- Data – Contains the front-end and back-end Plant Community Monitoring database. Contains scanned copies of the field forms (data sheets) as pdfs.
- Documents – Contains subfolders to categorize documents as needed for various stages of project implementation.

- Equipment – Contains checklists of equipment, digital receipts, and other documents to help manage field equipment.
- Photos – For storing images associated with the project (SOP 7). Note that this folder contains subfolders to arrange files by year.
- Presentations Figures – Contains PowerPoint presentations and figures used in presentations based on vegetation projects in SFAN.
- Schedule Tasks – Contains spreadsheets and documents describing key deadlines and activities for accomplishing annual work plans relating to this vital sign.
- Spatial info – Contains files related to visualizing and interacting with GPS and GIS data.
- Training Orientation – Contains materials useful for training and orientation purposes.

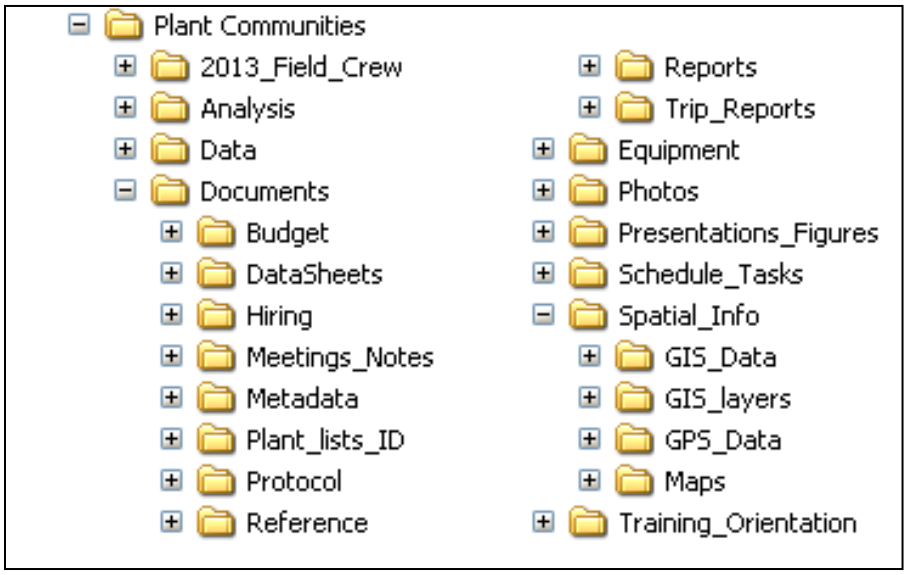


Figure SOP 1.1. Recommended file structure for project workspace.

Folder Naming Standards

In all cases, folder names should follow these guidelines:

- No spaces or special characters in the folder name.
- Use the underbar ("_") character to separate words in folder names.
- Try to limit folder names to 20 characters or fewer.
- Dates should be formatted as YYYYMMDD.

File Naming Standards

In all cases, file names should follow these guidelines:

- No spaces or special characters in the file name.
- Use the underbar ("_") character to separate file name components.

- Try to limit file names to 30 characters or fewer, up to a maximum of 50 characters.
- Dates should be formatted as YYYYMMDD.
- Correspondence files should be named as YYYYMMDD_AuthorName_subject.ext.

Workspace Maintenance Procedures

Prior to each season, the SFAN vegetation ecologist should:

1. Make sure that network accounts are established for each new staff member, or reactivated for returning staff members.
2. Create new folders named by year under the Images and GPS data sections.
3. Create the seasonal workspace, with subfolders for Images and GPS data.

After each season, the vegetation ecologist should:

1. Review the workspace organization and clean up any temporary files and subfolders that are no longer needed.
2. Move files from the seasonal workspace folders into the appropriate permanent folder(s) and archive or delete the seasonal workspace folders as desired.
3. Compare older files against the retention schedule in NPS Director's Order 19 (available at: http://data2.itc.nps.gov/npspolicy/DOrders.cfm). Dispose of files that are beyond their retention schedule if they are no longer needed. As a long-term project, many files associated with this project are likely to be scheduled for permanent retention. This makes it all the more imperative to clean out unneeded files before they accumulate and make it harder to distinguish the truly useful and meaningful ones.
4. Convert older files to current standard formats as needed to maintain their usefulness.

Data Storage

All project deliverables, including but not limited to raw data, processed data, Metadata Interview forms, images with metadata, training logs, datasheets and log books, spatial files, and Certification forms (Appendix SOP 1A) will be transferred to the SFAN Data Manager following the timeline listed in Table SOP 1.1. It is the responsibility of the vegetation ecologist to ensure all products and associated documentation are delivered to the Data Manager following the timeline.

Certification Form

The SFAN will utilize a Certification form submitted by the vegetation ecologist to ensure:

1. The data are complete for the period of time indicated on the form.
2. The data have undergone the quality assurance checks indicated in the Plant Community Monitoring Protocol.
3. Metadata for all data have been provided (when applicable).
4. Project timelines are being followed and all products from the field season have been submitted.
5. The correct level of sensitivity is associated with the deliverables.

A new Certification form should be submitted each time a product is submitted. An example of the Certification form is included at the end of this SOP.

Field Forms

Hardcopy field forms (data sheets) will be provided to the Data Manager following the timeline in Table SOP 1.1. It is the responsibility of the Data Manager to scan the datasheets into PDF documents within 1 month of receiving the hardcopies. The vegetation ecologist should organize the field forms in the order in which they will be scanned before they are transferred to the Data Manager. Datasheets should follow this order:

1. One PDF will be created for all field forms for each stand.
2. For each stand, field forms for each sampling plot should be submitted in order of their "Plot ID."
3. For each unique sampling plot (each unique Plot ID) per stand, field forms should be in the following order: Plot and Photo form, North American Weed Management Association (NAWMA) Subplot form, 3 x 3 m Woody Plant Density form, Point Line Intercept form, Live and Dead Standing Tree form, and Down Wood and Litter (Fuels) form.

For each stand, the scanned document will be named with the sampling plot, the year sampled, the vegetation type, and the Stand ID. For example, the scanned document associated with the Redwood stand 03 sampled in 2015 in the coastal parks sampling frame will be: COAST_2015_REDW_03.

Photos

Images and associated metadata will be transferred to the Data Manager in the format explained in SOP 7 following the timeline in Table SOP 1.1.

GPS/GIS Files

It is the responsibility of the field crew to collect GPS data points at the center of each sampling plot the first time they are visited (SOP 6). At the end of the field season, prior to releasing the field crew, it is the responsibility of the vegetation ecologist to create point shapefiles of all sites that were surveyed along with the GPS files collected by the field crew. The vegetation ecologist will upload these data here: \\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\GIS\.

Metadata

Following the timeline outlined in Table SOP 1.1, the vegetation ecologist should submit a Metadata Interview form (SOP 16) for each GIS layer after the field season. If metadata have not been completed for this project, the form will need to be completed in full. If metadata have been completed, and no updates are needed, just complete question one on the form. The Data Manager should update the full metadata (Parsed XML) and post it to the proper locations (SOP 16).

Log Books

The field crew should maintain an equipment log to record any updates or changes to the equipment being used to measure the various parameters described in this protocol (SOP 2); an event log that describes any unique events that occurred while implementing the protocol (SOP 18); and a training

log that documents the training each person receives as part of this protocol. It is the responsibility of the vegetation ecologist to submit the logs to the Data Manager on time.

Reports

There is the potential for a variety of reports and publications to be developed utilizing data collected as part of this monitoring project, including annual reports, analysis and synthesis reports, and scientific papers (SOP 15).

Annual reports will be the responsibility of the vegetation ecologist and should be submitted in the National Park Service (NPS) Technical Report Series format, unless utilizing another series format for publication. Final annual reports should be submitted following the timeline in Table SOP 1.1.

Analysis and synthesis reports will be the responsibility of the vegetation ecologist and should be submitted in the NPS Technical Report Series format, unless utilizing another series format for publication. Final reports should be submitted following the timeline listed in Table SOP 1.1.

Table SOP 1.1. Deliverable products, responsible individual, due data, and store location for all products developed while implementing the SFAN Plant Community Monitoring Protocol.

Deliverable Product	Primary Responsibility	Target Date for Submission	Store in
GIS Data	Veg. Ecologist	3 weeks prior to the start of the field season	Spatial_Info\GIS_Data[1]
Contact Information	Veg. Ecologist	2 weeks prior to the start of the field season	"2013"_Field_Crew[1] (Year will change each season).
Metadata Interview Form	Veg. Ecologist	Prior to beginning the first field season and immediately after the field season	Documents\Metadata[1]. (Use to create and revise full metadata).
Full Metadata (Parsed XML)	Data Manager	Prior to beginning the first field season and by March 1st of the following year	Documents\Metadata[1] Upload the Parsed XML Record to Reference Applications[2]
Data Certification Report	Veg. Ecologist	Every time a product(s) is submitted	Documents\Reports\Data_Cert[1]
Processed GPS Data Files	Veg. Ecologist	Prior to the field crew members being released from service or by Nov. 15th.	Spatial_Info\GIS_Layers[1]
Training Log Book	Veg. Ecologist	Prior to the field crew members being released from service or by Nov. 15th.	Training_Orientation\Log_Books[1]
Digital Photographs and Metadata	Veg. Ecologist	Prior to the field crew members being released from service or by Nov. 15th.	Photos[1]
Equipment Log	Veg. Ecologist	Prior to the field crew members being released from service or by Nov. 15th.	Equipment\Log[1]
Event Log	Veg. Ecologist	Prior to the field crew members being released from service or by Nov. 15th.	Protocol\Event_Log[1]
Field Data Forms	Veg. Ecologist	Scanned by December 1st	Data[1]
Voucher Specimens	Veg. Ecologist	December 1st	Specimens need to be mailed to herbaria following SOP 18.
Annual Report	Veg. Ecologist	March 1st	Documents\Reports\Annual_Reports[1]

Deliverable Product	Primary Responsibility	Target Date for Submission	Store in
Analyses and Synthesis Report	Veg. Ecologist	Every 3 years on May 1st	Documents\Reports\Synthesis_Reports [1]
Other Publications	Veg. Ecologist	as completed	Documents\Reports[1]
Packaged Data	Data Manager	March 1st	Reference Applications[2]

[1] All folders listed are found under: \\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\

[2] Reference Applications is a clearinghouse for natural resource data and reports.

Literature Cited

Acker, S. A., A. Woodward, J. R. Boetsch, K. Hutten, M. Bivin, R. Rochefort, C. C. Thompson, and L. Whiteaker. 2010. Forest vegetation monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/242. National Park Service, Fort Collins, Colorado.

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

Appendix SOP 1A. SFAN certification form.

This form is located at:
\\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\DOCUMENTS\Reports\Data_Cert.

SFAN Certification Form

1) Certification date: _____

2) Certified by: _____
Title: _____
Affiliation: _____

3) Agreement code: _____
Project title: _____

4) Range of dates for certified data: _____

5) Description of data being certified: _____
_____
_____
_____

6) List the parks covered in the certified data set, and provide any park-specific details about this certification.

Park	Details

7) This certification refers to data in accompanying files. Check all that apply and indicate file names (folder name for images) to the right:

_____ Hardcopy Datasheet(s): _____
_____ PDF Datasheet(s): _____
_____ Database(s): _____

_____ Spreadsheet(s): _____
_____ Spatial data theme(s): _____
_____ GPS file(s): _____
_____ Geodatabase file(s): _____
_____ Photograph(s): _____
_____ Data Logger(s) files: _____
_____ Other (specify): _____
_____ Certified data are already in the master version of a park, KLMN or NPS database.
Please indicate the database system(s): _____

8) Is there any sensitive information in the certified data which may put resources at greater risk if released to the public (e.g., spotted owl nest sites, cave locations, rare plant locations)?

_____ No _____ Yes Details:

_____
_____
_____

9) Were all data processing and quality assurance measures outlined in the protocol followed?

Yes / No

If No, Explain _____
_____
_____

10) Who reviewed the products?
_____

11) Results and summary of quality assurance reviews, including details on steps taken to rectify problems encountered during data processing and quality reviews.
_____
_____
_____

SOP 2: Field Work Preparation

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedures that will be completed prior to the field season, including reviewing the budget; hiring and scheduling the field crew; assembling field supplies, and preparing site description forms, data forms, and maps. This document was adapted from the National Park Service (NPS), North Coast Cascade and Klamath Networks' Vegetation Monitoring Protocols (see Acker et al. 2010 and Odion et al. 2011).

Reviewing the Budget

It is the San Francisco Bay Area Network (SFAN) Program Manager's responsibility to provided adequate funding to conduct this protocol. Funding for this project should be clearly stated in the Annual Work Plan. The vegetation ecologist will meet with the SFAN Program Manager prior to each field season to review the budget and ensure that it meets salary, equipment, mileage, and miscellaneous field expenses.

Hiring the Field Crew

The field crew will consist, at least, of two members, a Field Lead and a Field Technician. Job announcements should be completed in October and posted in early December, so that lists of eligible candidates are received in early January. This will allow permanent staff to review applications and hire crews by late January so that background check paperwork can be submitted by the middle of the month. Adherence to this schedule will increase the probability of hiring a high-quality crew, and completing the required paperwork before the field season begins in March.

Once the lists of eligible candidates have been received, the vegetation ecologist will arrange a time to meet or speak on the phone, to review applications and plan interviews with potential hires and references. The folder Documents\Hiring in the project workspace contains questionnaires which can be used or adapted for interviewing prospective crew members and references. The Department of the Interior maintains a website with useful information on selecting employees, including many aspects of interviewing (http://www.doi.gov/hrm/pmanager/staffing.html).

Field Lead Qualities

The Field Lead will work with the vegetation ecologist, who will be the key contact for planning and logistics. Qualities to seek in Field Leads include the following:

- Proficiency at identifying vascular and non-vascular plants of the central coast of California.
- Ecological survey experience, preferably conducting repeated vegetation sampling in different physiognomies (grasslands, shrublands, forests, etc.).
- Experience with scientific field equipment.
- Backcountry orienteering and backpacking experience.
- High level of physical fitness.
- Familiarity with one or more of the SFAN parks.
- Leadership experience.
- Strong organizational skills.
- Ability to get along well with others in a field crew setting.
- Knowledge of (or preferably, certification in) wilderness first aid.
- Ability to drive a vehicle.

If at all possible, priority consideration should be given to previous years' Field Lead or Field Technician to maximize year-to-year consistency in field operations and methods. Once selected, the Field Lead, whether new or returning, must review the entire protocol and discuss any questions with the vegetation ecologist.

Field Technician Qualities

The Field Technician does not need to have the same level of experience nor all the skills of the Field Lead, however similar general qualities should be sought:

- Proficiency at identifying vascular plants of California's central coast. Successful candidates should at least be able to identify common plant species, and be able to demonstrate enthusiasm and ability to learn to identify new species.
- High level of physical fitness.
- Ability to get along well with others in a field crew setting.
- Ecological survey experience, preferably conducting repetitive vegetation sampling.
- Backcountry orienteering experience. Because orienteering will be emphasized during training, the orienteering requirement may be waived keeping a balance of required skills within the crew.
- Familiarity with one or more of the SFAN parks (desirable but not required).
- Knowledge of (or preferably, certification in) wilderness first aid (desirable but not required).

While the first three of the above qualities should be considered mandatory, the others are desirable but not strictly required, as long as there is a balance of required skills within the crew. As with selection of the Field Lead, priority consideration should be given to returning crew members, to maximize year-to-year consistency in field operations and methods.

Scheduling and Coordinating with Personnel

1. Update the seasonal monitoring schedule (see Table SOP 2.1). We plan to staff the project with one, two-person crew. We estimate that the crew will need 13 pay periods, including training and data entry. When planning field tours keep in mind the time constraints listed below:
    a. Transportation time to and from duty station or campsite
    b. Hiking to and from plot each day
    c. Approximate time to sample a stand (approximately 1/2 day)
    d. Crews may take up to twice as long to establish new plots, if any are needed
    e. A full office day at the end of each week is essential to the well-being of the crew and the data. The crews need time to download photos, maintain equipment, identify plants, and enter data while things are still fresh
2. Create a map for each park with the stands to be sampled that year
3. Send copies of the schedule and map to:
    a. Park plant ecologist/botanists at each park
    b. Crew hires
    c. Point Reyes National Seashore (PORE) Dispatch
4. Secure plans to reserve the vehicle(s) that will be used by the crew during the field season.
5. Make a duplicate set of keys to keep in a designated key drawer or key board should the original set be lost or misplaced.
6. Arrange and confirm scheduled orientation and field training dates with training personnel (i.e., safety officer, radio personnel, database manager, GPS specialist, botanists, and others).
7. Arrange for introduction of crew to key personnel for the first week the crew arrives (as outlined in crew orientation under *Tour of Headquarters*). This sets the groundwork for cooperation among park personnel.
8. Coordinate radio use for that season for each park.
9. Speak with the dispatch office at each park. Let them know our plans for the season, crew member names, and the crew call number, if applicable. Inquire about current dispatch protocol, and operating hours. Obtain current guidelines and tracking documents to be filled out by crew before each tour.
10. Reserve campsites for the season's field tours at Pinnacles National Park by contacting the park botanist
11. Reserve the following for the week of orientation and training:
    a. Conference room (Bldg. 1050, Ft Cronkhite, Golden Gate National Recreation Area [GOGA])
    b. Power point projector
    c. Lap top computer

Informing the Field Crew

Prepare, print, and mail orientation materials to new crew members (See Table SOP 2.1). Items are located in:

\\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\Training_Orientation\Orientation_Package. Some items must be obtained or updated at the beginning of each season.

Table SOP 2.1. Information documents for new seasonal field crew.

File Name	Document Description
Cover_Letter.doc	Cover letter
	Complete job description (update each year)
	Supervisor contact info (update each year)
	Start date, time, and location (TBA each year)
	List of items required to fill out on first day (e.g., driver's license)
20XX_Season_Schedule.doc	Season Schedule – Proposed
Orientation_Schedule.doc	Orientation Schedule
Year_Park_Plot_Map.doc	Map of plots for current year
Map_I&M_FtCronkhite.doc	Map of SFAN headquarters at Ft Cronkhite
(Obtain each year)	Map of each national park unit being sampled (GOGA, Muir Woods National Monument, PINN, and PORE)
Gear_Recommended.doc	Gear recommended for hiking/camping in SFAN
Gear_Supplied_NPS.doc	Gear supplied by NPS for field season

Assembling Field Supplies

Equipment will need to be checked before visiting the field to provide sufficient time for needed repairs or replacement. Electronic equipment (GPS units, cameras, and rangefinders) will need to have the settings checked prior to going into the field (SOPs 3 and 4). With the exception of some basic camping gear, all equipment should be provided by SFAN. It is important to remember that temperatures can range from 30° to 110°F depending on the park. Also be aware that some parks have unique conditions that could be hazardous to field crews if they are not adequately prepared (e.g., poison oak). The following equipment is needed to implement this protocol:

Plot Equipment:

- Trimble GeoExplorer GPS unit (or another unit of similar quality)
- Copy of protocol and supporting documentation
- Quadrat frames
- Laser pointer
- Pin flags (at least 10)
- Hypsometer
- GRS densitometer
- Camera
- Water resistant map of the park with plot locations
- Radios with park frequencies
- Pencils, sharpies
- Datasheets (25% on Rite-in-the-Rain paper)

- Aluminum closable clipboard
- Sighting compass
- Backpacks
- Metric tape measures (four 50 m)
- Loggers' (DBH) tape (metric)
- ~15 cm metric ruler
- Chalk tree marker
- Hand trowel
- 1 m measuring stick
- Fuel size-class tool ("go/no-go")
- Plot monumenting rebar/aluminum stakes
- Hatchet, or hammer
- Flagging (use easily seen colors)
- Clinometer
- Tree tagging equipment (tags, stamps, nails)
- Extra batteries
- Field vests
- Boot brush and spray bottle with dilute bleach solution
- Vehicle brush (for exterior and interior)

Plant ID Gear

- Plant press and newspapers that match cardboard sheet size
- Plastic bags for collecting
- Dissecting scope and tools
- Pruning shears
- Hand lens
- Floristic keys and resources (Jepson Manual, Flora of Marin, park plant species lists, species lists from previously visited plots)

Miscellaneous/safety items:

- First aid kit
- Sun screen
- Insect repellant
- Hat
- Leather gloves
- Gaiters
- Light weight rain gear
- Flashlight, headlamp
- Matches
- Heavy boots (with extra laces)

- Long pants
- Long sleeve shirt
- Technu

Standard camping gear (if housing is not available and for hard to access sites)
Camping will typically not occur at any park except Pinnacles National Park (PINN). At PINN camping will only be necessary for a relatively short portion of each field season. Depending on park needs, sometimes a research cabin or dorm room may be available and camping will not be required at PINN. For camping, the following items are suggested:

- Extra water in vehicle
- Stove, extra fuel
- Pots, pans, other eatery items
- Ground padding
- Tent, ground tarp
- Rope and bag to hang food, or bear proof container (if not car camping)
- Sleeping bag
- Food
- Cooler
- Toiletries for back country use
- Toilet paper

Equipment Log Book

It is expected that equipment to measure parameters and monument locations will improve over the life of this project. It is important to recognize that upgrading equipment can have an effect on the data you are collecting and if not documented correctly can lead a person to believe a trend or pattern is occurring. To ensure the Field Lead knows when equipment has been changed, an equipment log book (Appendix SOP 2A) is used to track these events. It is the Field Lead's responsibility to complete the log and submit it to the Data Manager following the timeline in SOP 1. If no equipment changes occur, the Field Lead should enter their name, position, date, and in the equipment column add "No Changes." No equipment should be substituted without prior approval by the vegetation ecologist except on an emergency basis.

Preparing Data Forms, Databases, GIS Layers, and Maps

The vegetation ecologist will make certain that updated electronic forms, GIS layers, datasheets, and target plot sampling locations are prepared before the start of the field season. The vegetation ecologist will test the GPS units, tablet PC, and laser rangefinder to make sure they are set up and functioning properly prior to orientation and going into the field.

GIS Layers and Maps

The vegetation ecologist should maintain the most up-to-date baseline GIS layers (Roads, Trails, Streams, Lakes, Park Boundary, Imagery, etc.). In addition, shapefiles of the sites that will be

surveyed as part of this monitoring protocol need to be created prior to the field season. A shapefile of the plot locations should be stored in the GIS folder.

Data Forms

- Hardcopy data forms for the season's sampling should be printed or copied using Rite-in-the-Rain paper.
- Data forms from the previous year's field work, stored in the project folder, should be used before printing new forms.
- Care should be taken to ensure that field forms from previous seasons represent the current data collection parameters before using them.

Literature Cited

Acker, S. A., A. Woodward, J. R. Boetsch, K. Hutten, M. Bivin, R. Rochefort, C. C. Thompson, and L. Whiteaker. 2010. Forest vegetation monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/242. National Park Service, Fort Collins, Colorado.

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

Appendix SOP 2A. SFAN equipment log.

This form is located at:
\\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\Equipment\Log.

Equipment Log

Name	Position	Date	Equipment	Event
Eric Wrubel	Botanist	3/15/2015	DBH Tape	Upgraded from Biltmore Stick to DBH tape

Name – The full name of the person using the equipment
Position – Position of the person using the equipment (e.g., Field Crew)
Date – Date the change or issues with the equipment occurred (e.g., 5/15/2007)
Equipment – Name of the equipment (include ID # if applicable)
Event – What occurred to the equipment (e.g., Battery died, Calibration, Lost)

SOP 3: Observer Training

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedures for training observers, including vegetation plot sampling, electronic equipment, databases, data management, site location and monumentation, first aid and safety, emergency procedures, administrative processes, and backcountry rules and ethics. This document was adapted from the National Park Service, Klamath Network Vegetation Monitoring Protocol (Odion et al. 2011).

Survey Training

Two weeks before the start of field sampling, crews will be brought on for training. Prior to working in the field, each crew member will spend the first week working in the San Francisco Bay Area Network (SFAN) office at Ft. Cronkhite reviewing the entire protocol and the SFAN NPS administrative document. The latter part of this document describes safety issues, timesheets, travel status, checkout processes, equipment check-in check-out process, purchase process, vehicle use, computer use, and NPS required trainings. The first week of training will include a presentation of the specifics of the protocol by the vegetation ecologist. The second week, the crew will go into the field at the Marin Headlands practice area and begin training on the items listed below.

Training Observers in Protocol Implementation

Observers will be trained in all aspects of protocol implementation following the vegetation monitoring SOPs (i.e., plot set-up and monumenting, cover estimation techniques, DBH measurements, down woody debris measurements, tree tagging, etc.). The vegetation ecologist, Field Lead, and all observers will set up and collect data from two to three plots as a group to gain proficiency, consistency, and accuracy in all protocol implementation steps.

Training Observers in Navigation

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

1. Basic features of Garmin and Trimble GPS units.

2. Ensuring correct identification of site/plot.
3. Navigation to and from plots.
4. Understanding correspondence between maps, aerial photos, and GPS.
5. Use of map and compass to navigate to and from the site.
6. Use of compass in site set-up.

Training Observers in Plant Identification

Observers are expected to be familiar with plant species encountered in network parks. With the vegetation ecologist, the Field Lead and observers will review how to identify vascular plants using the outreach materials developed by SFAN, and where appropriate, herbarium specimens, keys, and photographs. The vegetation ecologist will accompany the crew for the first few weeks of implementation to provide orientation to local plants and assess field skills. The vegetation ecologist has a reference plant collection that can be utilized. Field botanists/crew members' training will include:

1. Review lists of common park species, and/or site vascular plant lists.
2. Review photographs, taxonomic keys, herbarium sheets, park NPSpecies species list, and other plant identification materials prepared by SFAN.
3. Practice plant identification, making use of herbarium specimens where possible.
4. The vegetation ecologist should work with the field crew members to specifically review how to identify uncommon species in particular parks. This should include:
    a. Which species look similar?
    b. Which habitats uncommon species are most likely to occur in?

Training the Observer in Data Collection Techniques

Data are collected using hardcopy datasheets, GPS units, and digital cameras. The data collection workflow, data to be entered, and entry methods are described throughout the standard operating procedures. Each member of the crew will attend a two-day training on how to use the electronic equipment to collect and manage data. It is the responsibility of the vegetation ecologist to develop the training materials and conduct the training prior to beginning field sampling. At the end of the training, each crew member will be tested to ensure that he/she understands how to collect and store data. If a crew member does not pass the test, the Data Manager will need to work closely with him/her until he/she learns the method. Each member of the field crew should be trained to utilize the following equipment and methods:

1. How to use the hypsometer.
2. How to use the Garmin and Trimble GPS units.
3. How to complete the data entry of a site using the hardcopy datasheets.
4. How to use the GPS camera to photograph the sites.
5. How to store and back up data collected electronically.

Backcountry Rules

The vegetation ecologist should be familiar with the rules and regulations pertaining to working in the backcountry of each park. It is not anticipated that any camping will occur in the backcountry (although see SOP 2). If field sampling is expected to occur in the backcountry, it is the vegetation ecologist's responsibility to make certain all crew members are aware of the rules and regulations. Check with each park to learn about their backcountry rules.

Training Observers in Preventing Spread of Pathogens and Non-native Plant Species

Field crews will be traveling between monitoring locations and could potentially spread disease vectors or other organisms between sites. To minimize this risk, crews will be trained to brush the bottoms of boots and all tool surfaces before re-entering vehicles after fieldwork, and spray soles with a dilute bleach solution after working in an area with known or suspected pathogens. In addition, field crews will inspect shoes, socks, tools, and clothing for attached organisms or parts of organisms (e.g., seeds) and remove these on-site. Field crews will inspect tires, bumpers, interiors, and undercarriages of vehicles and remove visible soil or plant material before leaving field sites. Crews will avoid driving or parking off-road whenever possible.

Operational Leadership

Field crew members, as well as the vegetation ecologist will receive training in Operational Leadership principles to provide better risk management for the monitoring program. This training can consist of the formal two-day OL workshop or a shorter module during job orientation.

Training Log Book

It is the responsibility of the vegetation ecologist to complete the training log book for all members participating on this project. The training log book is used to document that each member of a project has completed sufficient training to implement this protocol. An example of the training log template is provided below (Appendix SOP 3A) and should be submitted to the Data Manager following the schedule in SOP 1.

Literature Cited

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

Appendix SOP 3A. SFAN training log

This form is located at: \\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\Training_Orientation\Log_Books.

Training Log

Trainer	Trainer Position	Trainee	Trainee Position	Date	Training	Equipment
Eric Wrubel	Botanist	Thomas Hamilton	Field Crew	02/15/2019	Photograph Data Entry	Ricoh Camera

Trainer – The person giving the training
Trainer Position – Position of the person giving the training (e.g., vegetation ecologist)
Trainee – The person receiving the training (e.g., Thomas Hamilton)
Trainee Position – The position of the person receiving the training (e.g., Field Crew)
Date – Date or range of dates over which the training occurred
Training – The type of training
Equipment – If the trainee learned to use specific equipment (e.g., light meter, invasive database)

Required trainings

Protocol Training and Implementation

1. Protocol and SOPs
2. Administrative document.
3. Field practice and implementation
4. Plot establishment

Navigation

1. Garmin and Trimble GPS units.

2. Map and compass
3. Navigation to and from plots.

Plant Identification

1. Introduction to SFAN plant identification materials and lab.
2. Plant identification practice
3. Unknown plant protocols
4. Vouchering

Data Collection and management

1. Garmin and Trimble GPS data collection
2. Hypsometer
3. Datasheets
4. Photography
5. Use of Vegetation Database
6. Data entry/upload
7. Quality assurance/quality control

Best field practices

1. Minimizing sampling impacts
2. Resource sensitivity training for threatened/endangered species
3. Reducing impacts to vegetation and soils
4. Reducing spread of pests/pathogens
5. Backcountry rules

Safety

1. Review safety SOPs
2. Communications
3. Operational Leadership Principles

SOP 4: Setting up the Electronic Field Equipment

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the process for setting up the Global Position Systems (GPS), camera, and hypsometer to collect and store data for the Plant Community Monitoring Protocol. This SOP describes the process associated with using a Trimble GeoExplorer 2008 series GPS unit, Garmin 60 and 76 series GPS unit, Ricoh Digital GPS camera, and Haglöf DME Hypsometer. It is expected that this equipment will be updated throughout the life of the protocol and this SOP will need to be updated accordingly. This document was adapted from the National Park Service, Klamath Network Vegetation Monitoring Protocol (Odion et al. 2011).

Review of the Data Collection Methods

As part of this protocol, the SFAN will use paper data sheets as its primary means of data collection. However, this data will be transferred to a database (SOPs 13 and 14). A GPS unit, GPS camera, and a hypsometer will be utilized, which are described in detail below.

Setting up the GPS Units

For the first visit to a site, field crews will use professional grade Trimble GPS units to find the center point of a site and to record the coordinates at the center plus the coordinates 15 m off-center at 30°, 150°, and 270°. If there are not enough signals from satellites while using the Trimble GPS, then recreational grade GPS units will be used instead. After the first visit, a recreational grade Garmin GPS unit will be used to help field crews navigate to the general area of a site where they can search for monumenting stakes. It is the vegetation ecologist's responsibility to set up the GPS units prior to starting the field work. Field crews should not change the setting of the GPS units without prior authorization.

Trimble GeoExplorer 2008 Series

The settings should be completed in the following manner:

1. Go to the following Trimble web site: http://www.trimble.com/geoxt_ts.asp?Nav=Collection-9554 and make certain your computer has the most up-to-date software.
2. Make certain the latest available version of ESRI ArcPad, Trimble GPScorrect, and ActiveSync are loaded onto your computer.
3. Connect the Trimble unit to your computer to automatically update software.

4. Open ArcPad on your Trimble unit and tap the small drop-down arrow next to the GPS Tools button  and tap on [GPS Preferences].
    a. There are several tabs at the bottom of the screen. For the **GPS tab**, set the following:
        i. Protocol = Trimble GPScorrect
        ii. Port = Com3: TSIP Serial Port
        iii. BAUD = 9600
        iv. Make certain "Automatically Active," "Show GPS Activity in System Tray," and "Automatically Pan View" are check marked
    b. On the **Capture tab**, set the following:
        i. "Enable Averaging" should be check marked
        ii. Points = 30
        iii. Vertices = 5
        iv. Position Interval = 1
        v. Distance Interval = 5
    c. On the **Quality tab**, set the following:
        i. "No Warnings" should be check marked
    d. On the **GPS Height tab**, set the following:
        i. Antenna Height = 3
        ii. Geoid Separation = 0
        iii. "Use Map Units for Height Units" should be check marked
        iv. "Use Height in Datum Transformation" should be check marked
    e. On the **Datum tab**, set the following:
        i. GPS Datum = D_WGS_1984
    f. On the **Alerts tab**, set the following:
        i. All the alerts should be turned off
    g. On the **Location tab**, set the following:
        i. Latitude, Longitude, and Altitude will automatically populate
        ii. "Restore Location" should be check marked
        iii. DST Distance Alert = 10 and units should be = m
5. Tap the small drop-down arrow next to the GPS Tools button  and tap on [Trimble GPScorrect]
    a. Tap [Logging Settings] and make certain the settings are correct
        i. Log GPS to SSF = On
        ii. Log H-Star Data = No
        iii. Antenna Height = 3.000 m
    b. Tap [GPS Settings] and make certain the settings are correct
        i. DOP Type = PDOP
        ii. Max PDOP = 15
        iii. Min SNR = 39
        iv. Min Elevation = 15
        v. Velocity Filter = Auto

   c. Tap [Real Time Settings] and make certain the settings are correct
      i. Choice 1 = Integrated SBAS
      ii. Choice 2 = Use Uncorrected GPS
      iii. Real-Time Age Limit = 4 min
6. Go to: Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\GIS\GPS_Data and load a copy of the blank shapefile called: Plant_Comm_Sites_XXXX onto the Trimble unit. Replace the XXXX with the year the survey work is going to be completed.

Setting up the Garmin 60/76 GPS Unit

The Garmin GPS unit is mainly used by the field crews to navigate to the site after it has been monumented. In the event that a GPS coordinate cannot be obtained using the Trimble unit, the Garmin unit may be used to obtain a GPS coordinate for the location. It is the responsibility of the vegetation ecologist to prepare the GPS units for the field crews. The following steps should be used to prepare the Garmin GPS units:

1. Make certain you have the latest version of the program DNR Garmin. This program can be obtained from the following web site:
   a. http://www.dnr.state.mn.us/mis/gis/tools/arcview/extensions/DNRGarmin/DNRGarmin.html
2. Obtain the following layers from Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\GIS\GIS_Layers:
   a. Site locations to be visited that year.
   b. Park boundaries.
   c. All roads, trails, and waterways for the park.
3. Make certain the projection for all the layers is NAD83 Zone 10.
4. Use DNR Garmin and the following steps to load the GPS data onto the Garmin Units.
   a. Open DNR Garmin and go to [file→load from file] and under "Files of type" select [ArcView Shapefile].
   b. Make sure the Garmin is plugged into the computer and is recognized by the DNR Garmin program.
   c. Click on the proper drop-down menu for either routes or waypoints and select upload.
   d. Repeat these steps for all GIS layers.
5. Use the program Topo Pro for ArcGIS to upload background imagery if needed.
6. Once you have the data loaded, go to the main menu in the Garmin Unit and select [Setup].
7. Use the default settings for this unit with the exception of the following changes:
   a. Under [setup→system] make certain WASS / EGNOS is "Enabled."
   b. Under [setup→map] make certain the proper maps are showing for the areas you will be surveying.
   c. Under [setup→time] change the format to [24 hour] and make certain the time zone is [US - Pacific].
   d. Under [setup→units] change the format to lat/long, Map datum should be NAD 83, Zone 10, Distance = Metric, Elevation = Meters (m/min), Temperature = Celsius.

Setting up the Hypsometer

The Haglöf DME 201Cruiser Hypsometer only has one button, which can be used to turn on /off the DME and transponder, and to calibrate for accurate distance measures. Make certain the DME and the transponder units have fresh batteries and then follow these basic steps to set up the unit:

1. To start the transponder, hold the loudspeaker of the DME measuring unit towards the transponder. Press the red button on the DME until 2 short beep signals are heard from the transponder.
2. To turn off the transponder, hold the loudspeaker towards the transponder. Press the red button until 4 short beeps are heard.
3. To calibrate the hypsometer, use a tape to measure a distance of 10 meters between the transponder and the front of the instrument. Then, give repeated short presses on the red button until function F9 is shown. The display should now show 10 m and calibration is ready. The instrument will only approve if the interval is within 9.6 - 10. 4 m. It is important to remember that for calibration, the instruments must be given enough time to adjust to the current outside temperature, which can take up to 10 minutes.

Setting up the Ricoh Camera

The Ricoh camera gives the user the ability to create five picklists that can be used to automatically store metadata. To create the picklist, complete the following steps.

<u>Setting up the Picklist</u>

1. Make certain the camera is plugged into your computer and open the “List Editor” using the Capilo Software.
2. On the “Item 1” tab, under the “Item Name” field, type “Photographer.”
3. Under the same tab, in the “Input” field, type the full name (first, last) of each person that could take a picture using this camera. Be certain the individuals who will take most of the pictures are listed first. If possible, select one crew member to take all of the site pictures and enter their name first in this list.
4. Click on the “Item 2” tab and in the “Input” field type “Site Name.”
5. Enter the names of each site you plan on visiting in the field.
6. Click on the “Item 3” tab and in the “Item Name” field type “Protocol.”
7. Enter the name of the protocol (Plant_Comm) that is associated with these pictures in the “input” field.
8. Click the save button and navigate to the folder on the camera entitled “GPSlog.” Save the file in this folder.
9. You have completed setting up the picklist for the camera.

<u>Camera Settings</u>

Make certain there are no pictures on the camera by pressing the first grey button as shown in Figure SOP 4.1. If there are pictures on the camera, find out whose they are and be certain they are placed in the proper location. Now press the “Menu OK” button and make sure the following settings are correct.

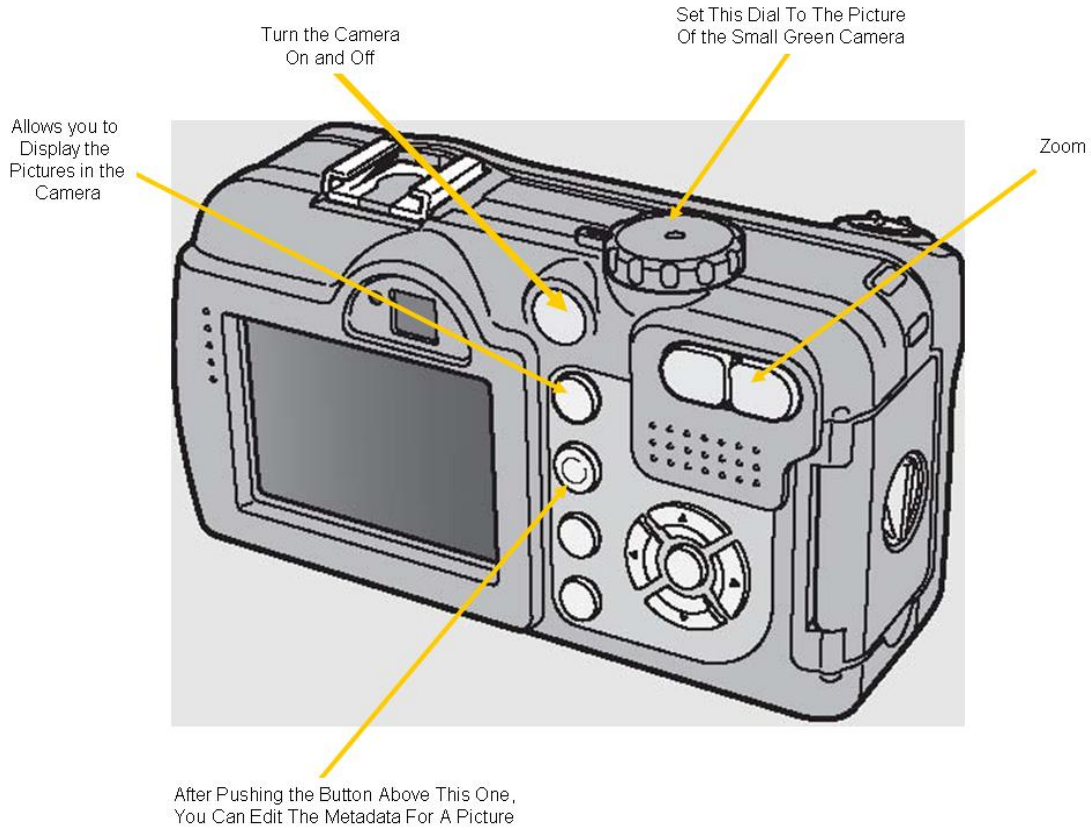


Figure SOP 4.1. Image of the back of the Ricoh camera that will be used to take site pictures at the vegetation monitoring plots.

Setup Tab

1. Select the "Setup" tab and go to LCD Brightness. Make certain the screen is bright enough to see the picture in the view finder.
2. On ADJ BTN Set.1 make certain this is set to "AntiBlur."
3. On ADJ BTN Set.2 make certain this is set to "Quality."
4. On ADJ BTN Set.2 make certain this is set to "Quality."
5. Check to make sure the Auto Power Off is set to "5 minutes."
6. Set the Beep Sound to "Shutter."
7. Turn the Col Setting to "Mute."
8. For the LCD Confirm option, set it to "3 Seconds."
9. Make certain Sequential No. is turned "On."
10. Check to make sure you have the proper date and language set.
11. Set Step Zoom to "Off."
12. Set SHTG STGS WARNG to "On."
13. Set the USB Connection to "Mass Str."
14. Set Cals Pic Quality to N3264.

SHTG STGS Tab

Check the following to make certain they are set correctly.

1. Pic Quality / Size = N3264
2. Antiblur = On
3. Focus = Multi AF
4. Photometry = Multi
5. Sharpness = Sharp
6. Cont. Mode = Off
7. Color Depth = Vivid
8. Time Exposure = off
9. Interval = All 0's (not set)
10. Image with sound = Off
11. Date Imprint = Off
12. Exposure Comp. = -0.3
13. White Balance = Auto
14. ISO Setting = Auto

EXP SET Tab

1. GPS Datum = WGS 84
2. GPS Display Mode = UTM
3. GPS Lock = Off
4. Pass Key = (Not Set)
5. Search Count = 4
6. BT Auto Conn = Off
7. BT Serial (not set)
8. Master / Slave = Slave
9. Auto Del = Off
10. Quick Send Mode = Off
11. Barcode Mode = Mode 1
12. Scan Time = 3 sec
13. GPS Track Time = 5 Sec.

Your camera should now be properly set and ready to go into the field. Make sure you have extra charged batteries and storage cards. You do not need to wait for the camera to acquire a GPS position before taking a picture.

Literature Cited

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

SOP 5: Stand Selection and Plot Placement

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP describes the stand selection processes and how sampling plots were placed within each selected stand.

Stand Selection

For each of the fine-scale vegetation types that were chosen for monitoring, a subset of stands was selected where sampling plots would be placed within (see Appendixes B and C of the companion protocol narrative report [Steers et al. 2016]). To accomplish this, the following steps were implemented:

1. The number of stands per vegetation type that would be monitored was determined based on power analyses to set the minimal sample size and then each plant community's spatial extent so that relatively abundant communities have more sampling plots than the minimum.
2. Certain areas with steep slopes were excluded for the purposes of improving safety and controlling erosion.
3. Stands were selected in a random and spatially balanced manner.

Determining the Number of Stands to be monitored per Vegetation Type

For each of the two sampling frameworks (i.e., coastal parks and Pinnacles National Park [PINN]), the number of stands to be monitored per chosen vegetation type was based on the spatial abundance of each type within the sampling frame (i.e., coastal parks sampling frame and PINN sampling frame). Based on area, abundant vegetation types have more stands being monitored compared to less spatially abundant vegetation types. Based on pilot sampling and power analyses, it was determined that at least 12 stands should be selected per vegetation type to provide reliable data on trends in core parameters that address protocol objectives. However, based on logistics, no more than 18 stands could be monitored for any one plant community. The vegetation types and their respective number of stands being sampled are included in Table SOP 5.1.

Excluded Areas

To ensure safety and reduce erosion, all slopes ≥30° were excluded.

Stand Selection

To select stands for monitoring, all eligible stands after exclusions were lumped into *n* groups, where *n* equals the number of stands that will be sampled per type based on its abundance in a sample sampling frame (e.g., the coastal parks sampling frame). For example, if the total number of eligible stands for vegetation type "X" was 36 and a maximum of 12 stands ($n = 12$) could be sampled for vegetation type X, then 36 was divided by 12. In this calculation, the result is three, which represents the number of stands that had to be lumped together to make 12 equal groups (Figure SOP 5.1).

The stands that were placed in each group were done so based on nearest neighbor analyses, where stands that were closest to one another were placed in the same group. This was done by first calculating the centroid of each mapped vegetation stand or polygon in ArcGIS using the "Feature to Point" tool. This converted the polygons to points. Then, with all of the points per vegetation, a nearest neighbor analysis was performed using the "Point Distance" tool in ArcGIS.

Then, within each group, all of the stands were assigned a number using a random number table. Within each group this is done by starting with the northernmost stand and working south. Within each group, the options for a number lie between 1 and the total number of stands in that group. Once all stands have been assigned a random number, the stand with the lowest number is selected for monitoring (Figure SOP 5.1). If that stand was found to be unsuitable for monitoring upon field validation, it was discarded and the next stand with the lowest number in that group was selected for monitoring, and so on. Stands were keyed out using the field keys to the plant communities used to create the vegetation maps. If the stand did not key out to the target type, then it was misclassified and remove from further consideration. Besides a stand being misclassified, the other reasons for exclusion were:

1. Field measurements of slopes found them to be steeper than 30 degrees
2. Stand is in a marijuana cultivation zone
3. Getting to the stand was unsafe (surrounded by steep slopes, impenetrable vegetation, marijuana, or other problems)

Although it is unlikely to happen, if at a later time it is determined that additional stands will be sampled for a particular vegetation type, then the process above will be repeated with a different number of groups and number of stands per group based on the new total number of stands being sampled. Groupings will still be based on nearest neighbor analyses, just as in the original stand selection procedure, which can be found here: Inpgogamahe1\NetworkIM\VitalSigns\PlantCommunities\GIS\GIS_Data\Stand_Select\Nearest_Neigh_Tables. Next, the new stand(s) to be monitored will be chosen from the group(s) where no previously existing monitored stands occur. The stand to be monitored will be selected following the use of randomly assigned numbers, as described above. This process will ensure that stands previously sampled are not removed but that adding new stands is still random.

If NPS managers and specialists decide to incorporate more vegetation types into this design in the future, new stands and monitoring plot locations can be derived from the baseline vegetation maps

(i.e., Schirokauer et al. 2003 for the coastal sampling frame and Kittel et al. 2012 for the PINN sampling frame) using the procedures described in this SOP.

Although it is unlikely, in the event that future National Park Service (NPS) managers and specialists determine that novel vegetation types should be included in the design (i.e., vegetation types that do not exist at present), the process of incorporating those types into this monitoring program will be more complex. The NPS will create a new classification scheme and associated vegetation map to define and locate new vegetation types within NPS lands. This could be accomplished for one park only, for a set of parks, or for the entire network. A selection of stands can then be drawn from the new vegetation map, as described in this SOP. Observations taken in these novel vegetation types should not be pooled with observations from the existing dataset, as the sampling "universe" from which these samples were drawn is a new framework.

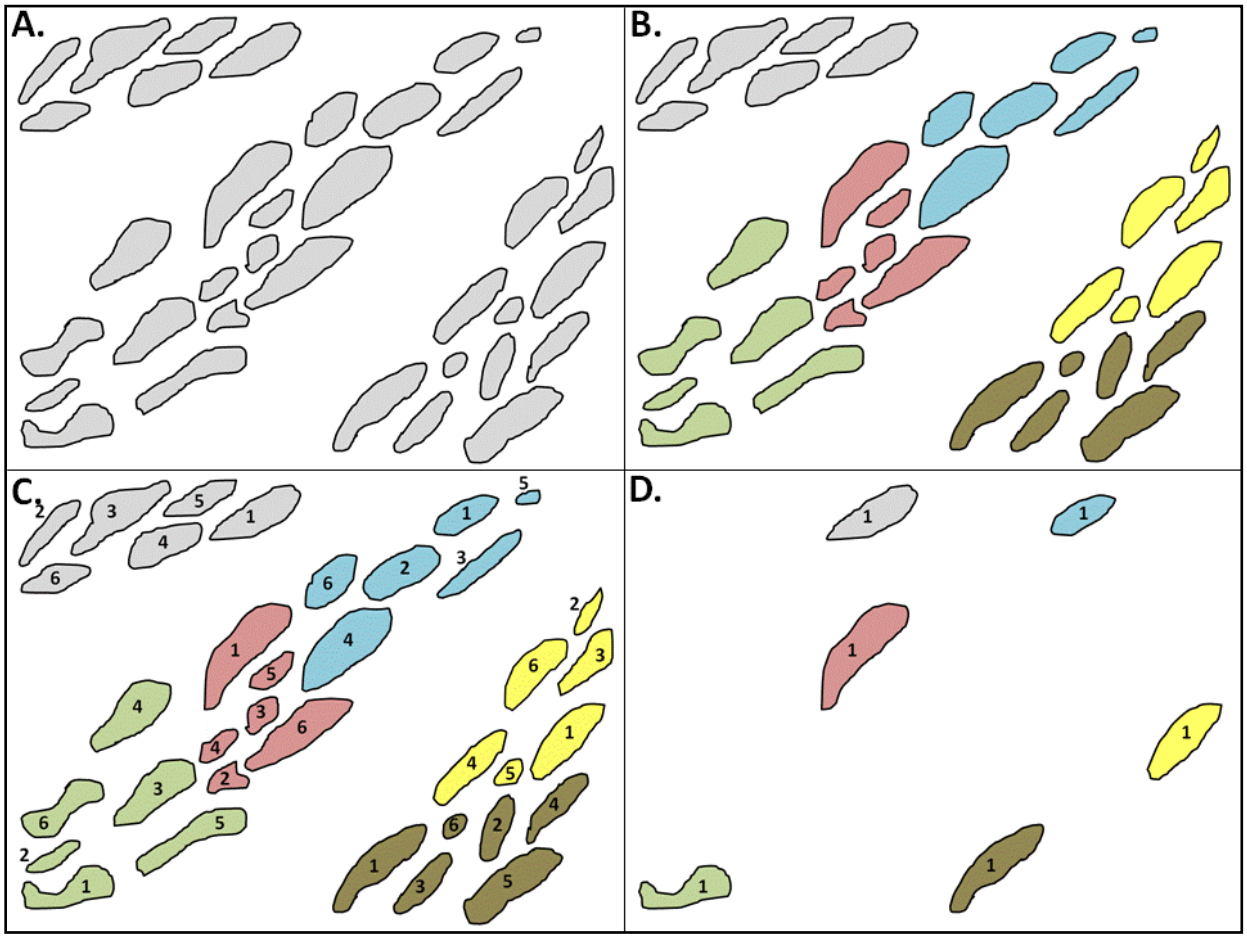


Figure SOP 5.1. A hypothetical stand selection procedure where six stands out of 36 must be chosen for monitoring. Starting with all 36 stands of a specific vegetation type (A), all stands are split into six groups based on nearest neighbor analyses (B), then each stand per group is assigned a number from one to six using a random number table (C), and finally, each stand that was assigned the number one in every group is chosen for long-term term monitoring (D). Upon field validation, if stand one is unsuitable, then stand number two from that subset will be sampled instead, and so on.

Sampling Plot Placement

One sampling plot per stand is randomly selected using the following procedure. A set of ten random points is generated and numbered within each polygon representing a target vegetation stand, using the Sampling Design Tool for ArcGIS (NCCOS – National Centers for Coastal Ocean Science, 2007-2015). The points are located within a 20m interior buffer of each polygon to accommodate the 17.95 m radius of the circular sampling plot. Sampling plots are established in the field at the coordinates of the first numbered random point per stand (SOP 6). In the event that this point does not meet plot establishment criteria then the next nearest random point is selected and assessed for plot establishment. From pilot sampling, the reasons for plot rejection to date are:

1. Slope of plot is too steep (greater than 30 degrees).
2. Unsafe access or hazardous conditions within plot.
3. Road or trail intersects plot.
4. Vegetation within the circular plot would not classify as the target vegetation.

In the future, plots may be rejected for other reasons. Plot rejection is documented along with the rationale(s) for rejection.

For each plot selected, there must be an adequate spatial extent of the target plant community to fill the entire sampling plot. The radius of a circular sampling plot is 17.95 m and the surface area of a sampling plot is 1,012.23 m^2, which is much smaller than the minimum mapping unit used to create the vegetation maps. All sampling plot locations are stored at: \\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\GIS\GIS_Data\1.Plots_Final_Locations.

Literature Cited

Kittel, G., E. Reyes, J. Evens, J. Buck and D. Johnson. 2012. Vegetation classification and mapping project report, Pinnacles National Monument. Natural Resource Report NPS/SFAN/NRR—2012/574. National Park Service, Fort Collins, Colorado.

Schirokauer, D., T. Keeler-Wolf, J. Meinke, and P. van der Leeden. 2003. Plant community classification and mapping project: Point Reyes National Seashore, Golden Gate National Recreation Area, San Francisco Water Department watershed lands, Mount Tamalpais, Tomales Bay, and Samuel P. Taylor state parks. National Park Service Unpublished Report, Point Reyes, California. Available at http://biology.usgs.gov/npsveg/pore_goga/pore_gogarpt.pdf (accessed 21 December 2011).

Steers, R., M. Denn, E. Wrubel, A. Forrestel, B. Johnson, L. Parsons, and F. Villalba. 2016. Plant community monitoring protocol for the San Francisco Bay Area Network of National Parks: Narrative Version 1.0. Natural Resource Report NPS/SFAN/NRR—2016/XXX. National Park Service, Fort Collins, Colorado

SOP 6: Plot Set-up, Monumentation, and Description

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP describes the set-up, monumentation, and collection of basic sampling plot description data. This document was adapted from the National Park Service, Klamath Network Vegetation Monitoring Protocol (Odion et al. 2011).

Supply Requirements

Monumenting a plot will require the following supplies and equipment:

- Flagging tape
- 4 chaining pins
- 12 pin flags
- Hammer/hatchet
- 4 1’5” long rebar stakes
- 4 aluminum rebar caps, pre-stamped with veg code and plot number
- 1 Witness tree tag, pre-stamped with veg code and plot number
- Nails
- Compass
- Clinometer
- Three 100 ft. (or 30 m) metric transect tapes
- Trimble and Garmin GPS
- Camera
- Pencils
- Clipboard
- Specimen collecting bags

Sampling Plot Establishment/Reestablishment

Establishment

All sampling plots locations will be established using a Trimble unit (unless satellite reception is limited, then the Garmin unit should be used) to locate the coordinates that were randomly selected within the stand to serve as plot center.

The Field Lead has the authority to reject the plot if it does not occur within the targeted vegetation, although this is highly unlikely to happen since stands are checked prior to field sampling. Sampling plots are established in the field at the coordinates of the first numbered random point per stand (SOP 5). In the event that this point does not meet plot establishment criteria then the next nearest random point is selected and assessed for plot establishment. Plot establishment criteria are as follows:

1. Vegetation within the 17.95 circular plot keys to the target vegetation.
2. Slope of plot < 30 degrees.
3. Safe access and plot conditions (see SOP 22: Safety and Job Hazard Analysis).
4. No roads or trails intersect plot.

Prior to field work at a given plot, stamp one aluminum cap with the four-digit letter veg code and two-digit plot number (e.g., REDW0302; Figure SOP 6.1). Stamp the other three caps with the cardinal direction it will be from the center plot (i.e., 30, 150, 270). Four digit vegetation type codes, stand and plot codes are found in each study site location manual. Once plot center is located, hammer the rebar stake with the aluminum cap into the ground at the center point. Also, mark the stake with a wire flag and/or tie a piece of flagging above the center point if the area has thick vegetation. Record a new UTM coordinate for the center point, preferably with the Trimble, and record the UTMs and the PDOP (for Trimble) or Est Error (for Garmin) at this point. Then, at 15 m away from center at 30, 150, and 270 degrees, hammer a rebar stake into the ground at each of these three points and cap with the appropriate aluminum cap. In total, four rebar stakes should be inserted per sampling plot (Figure SOP 6.3).



Figure SOP 6.1. Rebar stake with stamped aluminum cap.

To install the three markers at 15 m off center, set the compass to account for **magnetic** declination. Depending on where you are in each park unit, the declination will be slightly different. Check the following website to adjust your compass prior to field work as declination can change over time:

http://www.ngdc.noaa.gov/geomag-web/#declination. Refer to Figure SOP 6.2 for setting declination:



Figure SOP 6.2. Setting declination on a compass; the compass in this image has a declination set at 14 E, approximately the offset needed in SFAN parks. See http://www.ngdc.noaa.gov/geomag-web/#declination for the exact offset needed at specific field sites.

When you reach the 15 m end of each line, face back towards the center stake and recheck the compass readings to make sure you are still 30, 150, or 270 degrees away from plot center.

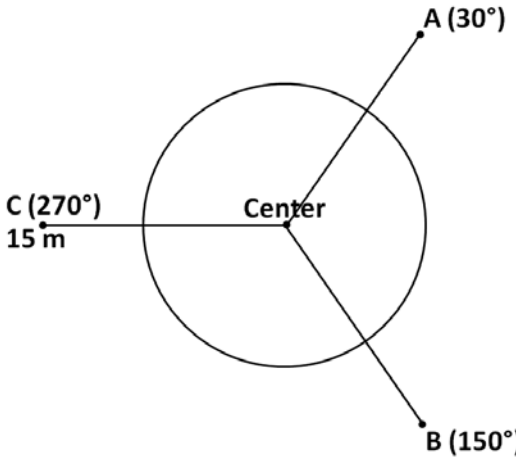


Figure SOP 6.3. Plot center showing the 7.32 m radius North American Weed Management Association (NAWMA) circular plot and the three, 15 m lines that radiate from the center at 30, 150, and 270 degrees. Several components of the sampling plot utilize these lines. Not shown is the 17.95 m radius that encompasses these components of the sampling plot. Monument stakes are placed at the center of the plot and at the 15 m ends of the three lines.

Selecting and Establishing a Witness Tree or T-Post

1. Witness trees are used to relocate the stake at the center of a sampling plot. The closest tree to the center stake that is within the 7.32 m radius will be utilized as the witness tree. If a suitable witness tree does not occur within 7.32 m of the center stake, this step is eliminated, but must be noted. Only overstory trees that are likely to remain alive and standing between surveys should be selected. Trees should show no evidence of significant crown dieback or heart rot. Short-lived species should be avoided, if possible.
2. Once selected, witness trees should be tagged at 1.37 m height with the tag FACING plot center. The tag should include the veg code, and stand and plot numbers (e.g., REDW0302) stamped to the tag using the stamp set.
3. The distance from the witness tree to the stake is measured to the nearest 0.01 meter and recorded on the Plot Information datasheet.
4. The bearing FROM the witness tree TO the center stake should be determined and recorded on the Plot Information datasheet.
5. The DBH and species of each witness tree should be recorded on the Plot Information field form (Appendix SOP 6A).
6. A photo of the witness tree will be included in the associated manual documenting site locations.
7. For some locations, particularly with heavy duff accumulation or shifting sand or sediment, a T-Post may be installed in lieu of a witness tree. Before installation, check with park managers about any concerns (wilderness boundaries, archeological sites, etc.). After installation of the T-Post document similar to a witness tree.

Plot Set-up

Once a center point is located, complete the following steps to establish the plot (Figure SOP 6.4). To limit the impact on the vegetation at the site as much as possible, the crew should stay outside of, and not walk within places where quadrats and line transects will be laid (see SOPs 8-12).

1. Use a measuring tape and compass to set the 30, 150, and 270 degree transects that radiate out from plot center. **Be sure that the compass used to find these directions is set for the correct declination** (Figure SOP 6.2). From the center stake, pull the tape 15 m in each of these three directions to where the 15 m stakes are located. Use the chaining pins to help keep the lines straight and tight.
2. Along each transect, place pin flags at the 2.57 m mark and the 5.57 m mark. Then place additional pin flags 3 m out and perpendicular from these two locations to form a 3 x 3 m box on the right side of the line facing outward from plot center where woody plant density will be measured.
3. Place a 1 x 1 m quadrat along each transect so that one side is flush with the line and the rest of the quadrat lays on the right side of the line when facing outward from plot center. Along the side of the quadrat that is flush with the line, one corner of the quadrat should start at the 4.57 m mark and the other corner should be at the 5.57 m mark.

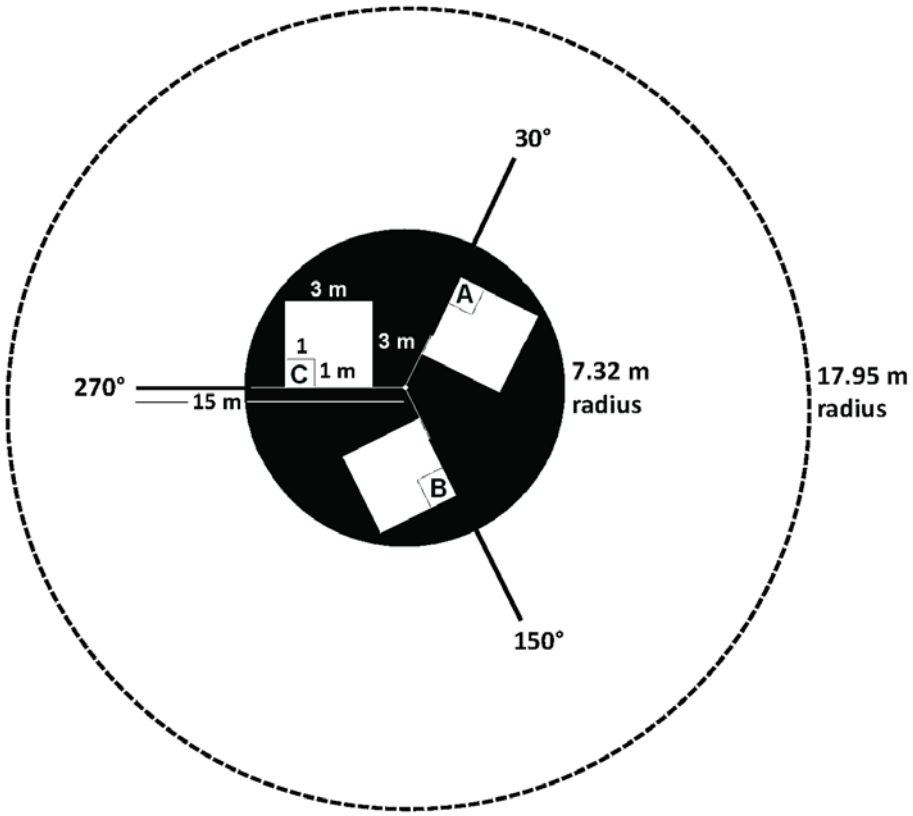


Figure SOP 6.4. Sampling plot overview showing major components used for sampling vegetation.

Measuring Plot Parameters

The following measurements are taken on the **first** plot visit:

Slope

The slope in degrees will be recorded at the center of the plot facing uphill, and also at the center facing downhill.

Slope is determined by sighting the clinometer along a line parallel to the incline or decline. To measure slope, it is helpful if one crew member stands uphill and downhill of the observer at plot center who is taking the readings. Read the slope directly from the degree scale of the clinometer.

Aspect

Record the aspect at the center of the plot to the nearest 1 degree. Aspect is determined for land surfaces with at least 5 percent slope in a generally uniform direction. Aspect is measured with a hand compass along the same direction used to determine slope.

If aspect changes across the plot, but the aspect is predominately in one direction, record the predominant direction rather than the average. If the plot falls on or straddles a canyon bottom or

narrow ridge top, code the aspect of the ridgeline or canyon bottom. If the plot falls on a canyon bottom or on a narrow ridge top, but most of the area lies on one side hill, record the aspect of the side hill.

Disturbance

On each visit, disturbances within the plot should be recorded on the Plot Information field form (Appendix SOP 6A). Disturbance should not be recorded if it occurs outside the plot but there is no evidence that it occurs in the plot. To record disturbance, place a checkmark in the appropriate box for each type of disturbance that occurs on the plot. If a disturbance type is not listed, check "other" and describe the disturbance in the description field.

Plot Reestablishment

The first step in resampling a plot is to locate the center stake and/or witness trees. Use the Garmin GPS unit to navigate to the vicinity of the center stake. If the center stake is gone, or difficult to find, locate the witness trees and measure to the center point and use the metal detector at this point. If the metal detector cannot locate the center point, reestablish the center point with an accurate measurement from the witness tree. If there is no witness tree or it cannot be relocated, reestablish it, if possible, after determining a center point. If the center stake and witness tree is missing, try to locate peripheral stakes 15 m away from plot center at 30, 150, and 270 degrees, respectively. If no stakes can be located, use the geographic coordinates of the center point and the GPS to reestablish the center stake. Attach a tag with the stake number and plot number on the stake. Also replace any of the permanent stakes missing from the plot.

Literature Cited

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

Appendix SOP 6A. Data sheet for entering plot and photograph information.

This sheet is located at:
\\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\Documents\DataSheets.

Data Sheet _1_ of ____ Per Plot

Date: _____
Observer / Recorder: _____

Park: _____
Veg Type: _____
Stand ID: _____
Plot ID: _____

Plot Variables

At Plot Center:
- GPS Coordinates - Latitude: _____ Longitude: _____
- Aspect (degrees): _____
- Slope (degrees) Facing Uphill: _____
- Slope (degrees) Facing Downhill: _____

Witness Tree:
Species: _____
DBH: _____ (cm)
Distance from center stake:_____ (0.00 m)
Bearing from WT to Center:_____(deg)

Plot Disturbances or Other Notes:

Sampling Plot Photos:

Photo Direction From Center	Name/ID	Photographer	Notes
A			
B			
C			

Incidental Photos:

Name/ID	Photographer	Latitude	Longitude	Description

SOP 7: Photographing Plots and Photo Management

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP provides the details on how to photograph plots and how to process photographic images collected by the field crew during the course of protocol implementation. In addition, metadata for the photographs is described (Appendix SOP 7A). This document was adapted from the National Park Service, Klamath Network Vegetation Monitoring Protocols (Odion et al. 2011).

Care should be taken to distinguish data photos from incidental or opportunistic photos. Data photos are those taken for at least one of the following reasons:

1. To document a particular feature or perspective for the purpose of site relocation.
2. To capture site habitat characteristics and to indicate gross structural changes over time.
3. To document species detection.
4. To document field crew activities during surveys and site set-up.

It is the responsibility of the vegetation ecologist to ensure images are properly named and stored in their proper location along with the image metadata as described in this SOP.

Camera Set-up

The camera currently being used by the Network is the Ricoh Caplio 500SE (Figure SOP 7.1). No matter what hardware is selected to take pictures of the site, it should have the capability to withstand harsh environments.

It is the responsibility of the vegetation ecologist to work with the Field Crew to make certain the camera is properly set up before going into the field. The camera settings should follow the instructions defined in SOP 4.

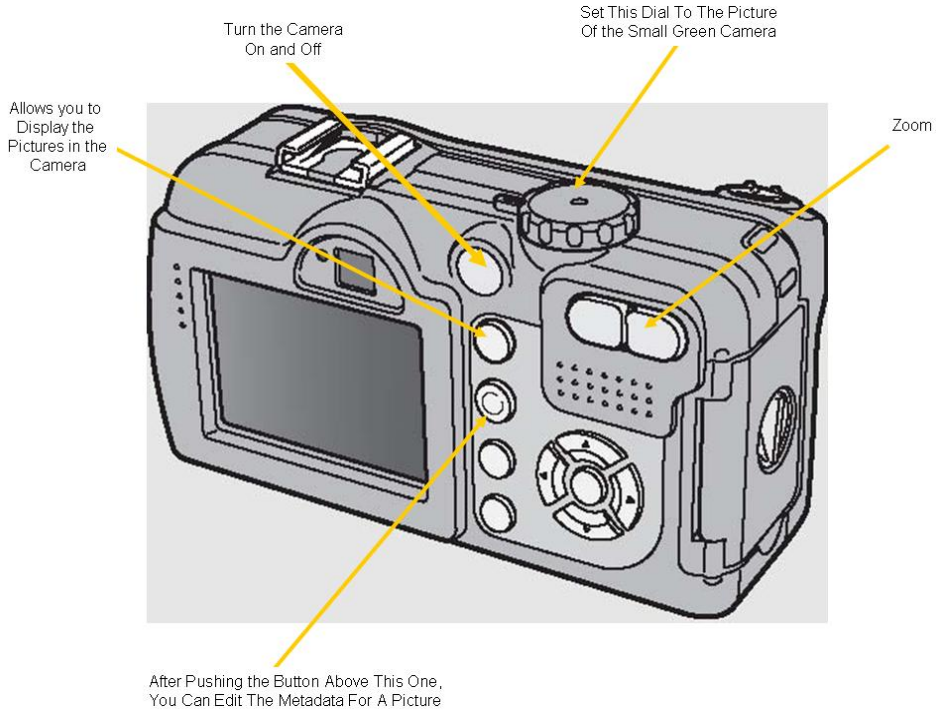


Figure SOP 7.1. Back of the Ricoh Caplio 500SE Camera.

Photographing Plots

Each plot will be photographed at least three times (Figure SOP 7.2): from the center of each plot facing 30, 150, and 270 degrees from plot center, even if vegetation is blocking the view. Photographs will be taken at eye level, approximately 5 feet from the ground. The photographer should review images in the LCD screen of the digital camera, to ensure an image of good quality has been recorded, before rotating to the next image location. Due to vegetation directly in front of the camera blocking the view, an extra photograph can be taken in the same direction by moving outward along the line transect until the vegetation is more open. If this is done, then specify that it is an extra photograph and record what distance away from the center it was taken, and what line/transect (A, B, or C) it was taken along. The following discussion assumes that all photographs are taken from the center of each sampling plot and have not been moved.

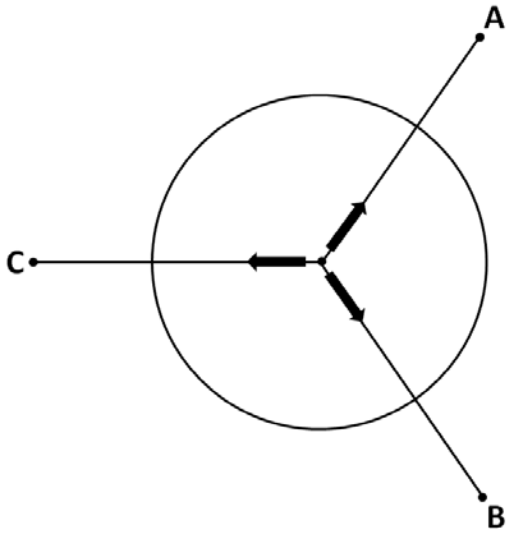


Figure SOP 7.2. Location and orientation of plot photographs. The arrows indicate the direction of the photographs when the images are taken from plot center.

When taking a picture of a vegetation plot, complete the following steps:

1. Turn the camera on as soon as you get to the site so it can acquire the maximum number of satellites.
2. In a few instances, GPS coverage may not be possible. If the camera was turned on upon arriving at the site and you are ready to take photos but do not have satellite coverage, take the images anyway. If the camera was not turned on upon arriving at the site, or has powered down, try for at least 3 minutes to get proper coverage, then take photos regardless of satellite coverage (Figure SOP 7.3).
3. Make sure the dial on top of the camera is set to the picture of the small green camera.
4. Press halfway down on the photograph button to make sure the picture is in focus.
5. Press all the way down to take the picture.
6. Push the first grey button so you can see the picture (Figure SOP 7.3). If the quality is bad, repeat steps 1-6.
7. In the upper right corner of the display screen is the name of the photograph (format exp: 100-00295). Enter the name of the photograph into the field form along with the photographer's name and photo date (Appendix SOP 7A).
8. Push the first grey button.
9. If the picture is blurry or washed out (from the flash), delete the picture and retake until a good image is captured. For all good pictures, record the required information on the site photo field form (data sheet).
10. Repeat steps 3-9 for each picture you take.

Incidental Photographs

When on the way to or from the site, if you see something you want to take a picture of, follow the steps above but record the required metadata on the sampling plot field form (Appendix SOP 7A).

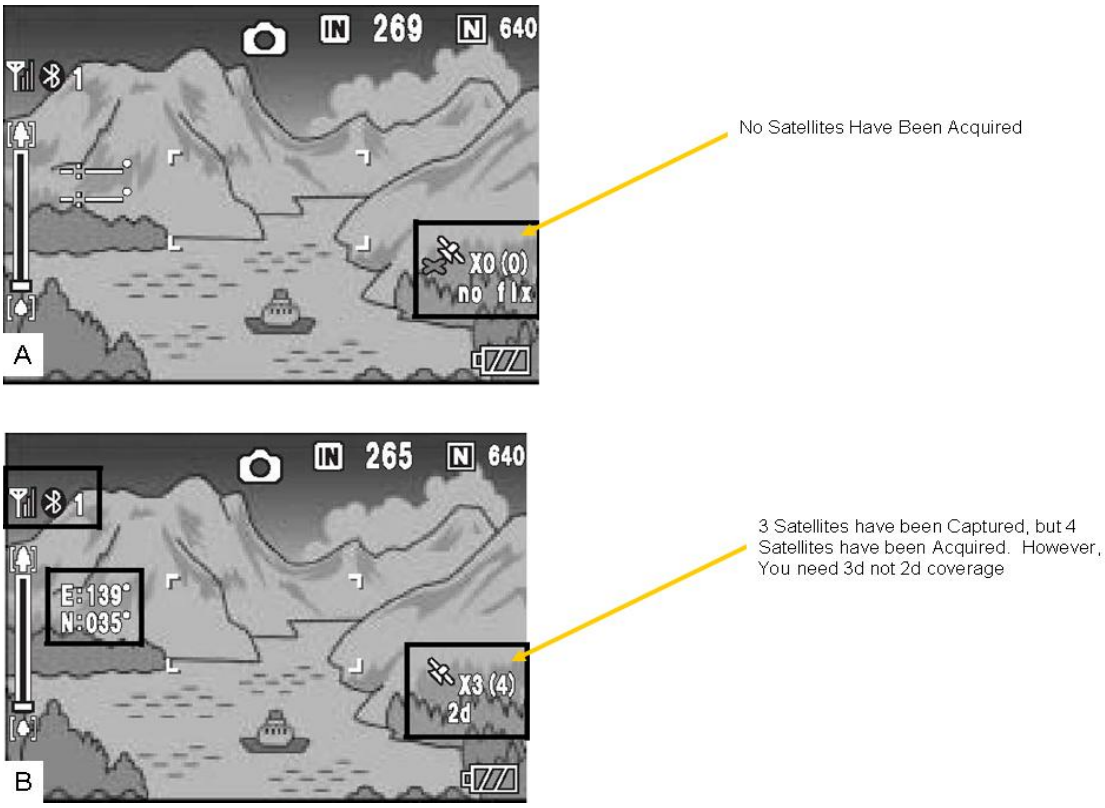


Figure SOP 7.3. The display of the Ricoh camera showing (A) no satellite coverage and (B) 2d satellite coverage.

Download, Backup, and Processing Procedures

Any crew member who takes photographs while in the field should complete the following procedures for downloading and processing those photographs at the end of each day.

1. At the end of the day, place a copy of the images you have taken THAT DAY into this folder: \\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\Photos.
2. Make certain you have completed a metadata record for each image (SOP 16).
3. The SFAN I&M server is backed up regularly throughout the day

Literature Cited

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

Appendix SOP 7A. Data sheet for entering plot and photograph information.

This sheet is located on the GOGA server at: \\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\Documents\DataSheets.

Data Sheet _1_ of ____ Per Plot

Date: _____
Observer / Recorder: _____

Park: _____
Veg Type: _____
Stand ID: _____
Plot ID: _____

Plot Variables

At Plot Center:
- GPS Coordinates - Latitude: _____ Longitude: _____
- Aspect (degrees): _____
- Slope (degrees) Facing Uphill: _____
- Slope (degrees) Facing Downhill: _____

Witness Tree:
Species: _____
DBH: _____ (cm)
Distance from center stake:_____ (0.00 m)
Bearing from WT to Center:_____(deg)

Plot Disturbances or Other Notes:

Sampling Plot Photos:

Photo Direction From Center	Name/ID	Photographer	Notes
A			
B			
C			

Incidental Photos:

Name/ID	Photographer	Latitude	Longitude	Description

SOP 8: North American Weed Management Association Subplot Sampling

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedure for reading the 1 x 1 m quadrats within the North American Weed Management Association (NAWMA) subplot or inner circle (7.32 m radius) of the sampling plot. Litter depth, plant cover, and species richness are measured within three 1 m² quadrats that are placed along each of the lines that radiate from the center of the plot. Species richness is also measured within the entire circular NAWMA subplot. This design follows the modified North American Weed Management Standards (Stohlgren et al. 2003) except a point quadrat intercept technique is used to estimate cover within the 1 x 1 m quadrats instead of using visual estimation.

Supply Requirements

Setting up and sampling the NAWMA subplot and its three 1 m² quadrats will require the following supplies and equipment:

- 4 chaining pins
- Compass
- Ruler with cm and mm
- Metal detector (only needed for site revisit)
- Three 100 ft. (~30 m) metric transect tapes
- Trimble and Garmin GPS to find plot center
- Haglof plot center staff/Monopod with transponder and hand-held DME
- 1 x 1 m PVC quadrat with legs and sliding line
- One pin flag with a diameter of 2 mm or less, or other similar pointer or laser device
- Vertical and horizontal level
- Pencils
- Clipboard
- Data sheets

Subplot Setup

This procedure assumes plots have already been setup following the process outlined in SOP 6.

1. For consistency, the 1 x 1 m quadrats should be completed in a specific order: A, B, and C. ***Be careful not to trample the 1 x 1 m quadrats or the vegetation in the surrounding 3 x 3 m quadrat that are used to measure woody plant density.*** When traveling between sampling modules, walk along the module boundaries or off-site when possible.
2. Using the line transects that are already installed, place the corner of a quadrat at the 4.57 m mark so that the quadrat is flush with the line and the next corner further away ends at 5.57 m (Figure SOP 8.1). Quadrats are always placed on the right side of a line if one is standing at plot center.
3. The quadrat is made from PVC pipe and is used for estimating cover via the point quadrat method (Figure SOP 8.2). Depending on the vegetation, the PVC quadrat can be installed with 0.5 m, 1.0 m, or other sized legs, or none at all (laying on the ground). In forests and grasslands, the 0.5 m legs typically work best. In tall, dense shrublands or woodlands where it is impossible to take readings above the quadrat, you can take apart the quadrat and piece it back together through the branches.

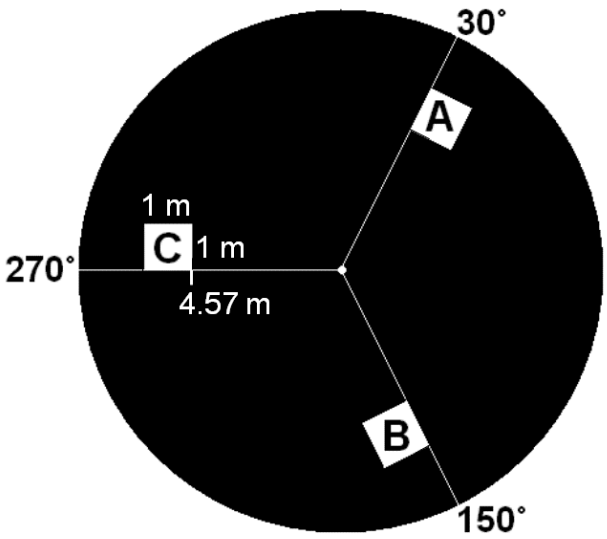


Figure SOP 8.1. Arrangement of the modified NAWMA circular subplot, which includes three 1 x 1 m nested quadrats. Not shown are the other components of the sampling plot, including the larger, encompassing 17.95 m radius USFS Forest Inventory Analysis circular plot.

Species Cover

The 1 x 1 m quadrat is used to estimate cover by species using the point quadrat method (Goodall 1952). Within the quadrat, there are 50 regularly dispersed points where species "hits" are recorded. Hits are determined by either dropping a small diameter (<2 mm) pin flag vertically at each point or by using a fine laser-pointer that projects a beam vertically downward and upward at each point. Both methods have been used successfully in pilot work and do not result in measurable differences in species cover. Across the top of the quadrat, an additional PVC pipe has been designed to slide across the plot frame at specific intervals. The sliding PVC bar has 10 marks where all points or "hits" are recorded (Figure SOP 8.3). Since there are five positions for the sliding PVC bar, 50 point are measured per quadrat. In cases where sliding the marker bar is not possible, use the DBH tape to

string across the frame at the set intervals and record hits every 10 cm along the tape, just as you would if it were the sliding bar. The quadrat frame has a hole drilled at each of the five positions where the DBH tape hook can attach and the tape can be pulled across for making measurements in the same places as the sliding bar.



Figure SOP 8.2. Botanist Eric Wrubel taking cover readings by species via the point quadrat method.

A hit is recorded for each species that is in the direct path of the pointer or laser (Appendix SOP 8A). Record a hit for every different species that overlaps a sampling point. On the datasheet, indicate the species with a four-letter code, then on the other side of the sheet write the code and full species name. If woody plant material is dead but still standing as if it were in a life position, then record the code and write "- D" afterwards (e.g., BAPI-D). It is not necessary to write "LIVE" or "ALIVE" after a species name when the hit plant part is considered alive. If herbaceous plant material is dead but still standing as if it were in a live position, record it as litter if it was from the prior growing season and record it as live if it was grown in the current season. If no vascular plant species overlap a point, then record the first object, from the following options, that the pin or laser hits:

1. Bare ground: bare soil, fine rocky material <3" on long axis
2. Lichen

3. Litter: Organic material not attached to live or dead plant, including leaves and twigs <3" diameter
4. Moss
5. Rock: Cobble, boulder, or bedrock >3" on long axis
6. Water: standing or running water (not saturated soils) associated with a permanent to semi-permanent feature, like a stream or vernal pool (do not count as water if it is a puddle or rill that only exists for a very short time after rain)
7. Wood: twigs and woody debris >3" diameter

If a plant species is present at a point (even if dead), then do not record any of these variables as a "hit" if they are found under the plant species. If one of the variables listed above is actually positioned above the plant, then record the variable as a hit and then record whatever plant species is/are underneath the variable. After recording an X for each hit of the plant in the appropriate box on the datasheet, tally up all the Xs for each target in the column marked "Total."

Lastly, cover of woody vegetation that enters the plot frame at a height >3 m should not be estimated by use of the point quadrat method but should be estimated by use of visual estimation to the nearest 1%. Also, if a species has plant parts inside the quadrat that are ≤ 3 m height but is also inside the quadrat at a distance above 3 m height, then enter the species on the datasheet twice, once with its recorded hits (e.g., tally the number of hits) and once with its actual cover based on visual estimation for the parts that are above 3 m height (e.g., 23%). For tree canopies that are above quadrats at heights much greater than 3 m and it is difficult to determine how much they cover the quadrat, you can use the laser pointer and level to determine if foliage is above the quadrat. The point-quadrat cover data will be used primarily to asses herbaceous plant cover. The cover of plants above 3 m in height could potentially be useful for correlational purposes, but not for use in trend detection. Thus, do not spend a considerable amount of time figuring out precisely how much tall plant cover occupies quadrat space above 3 m height, especially since tall plants will be measured using other methods (SOP 11).

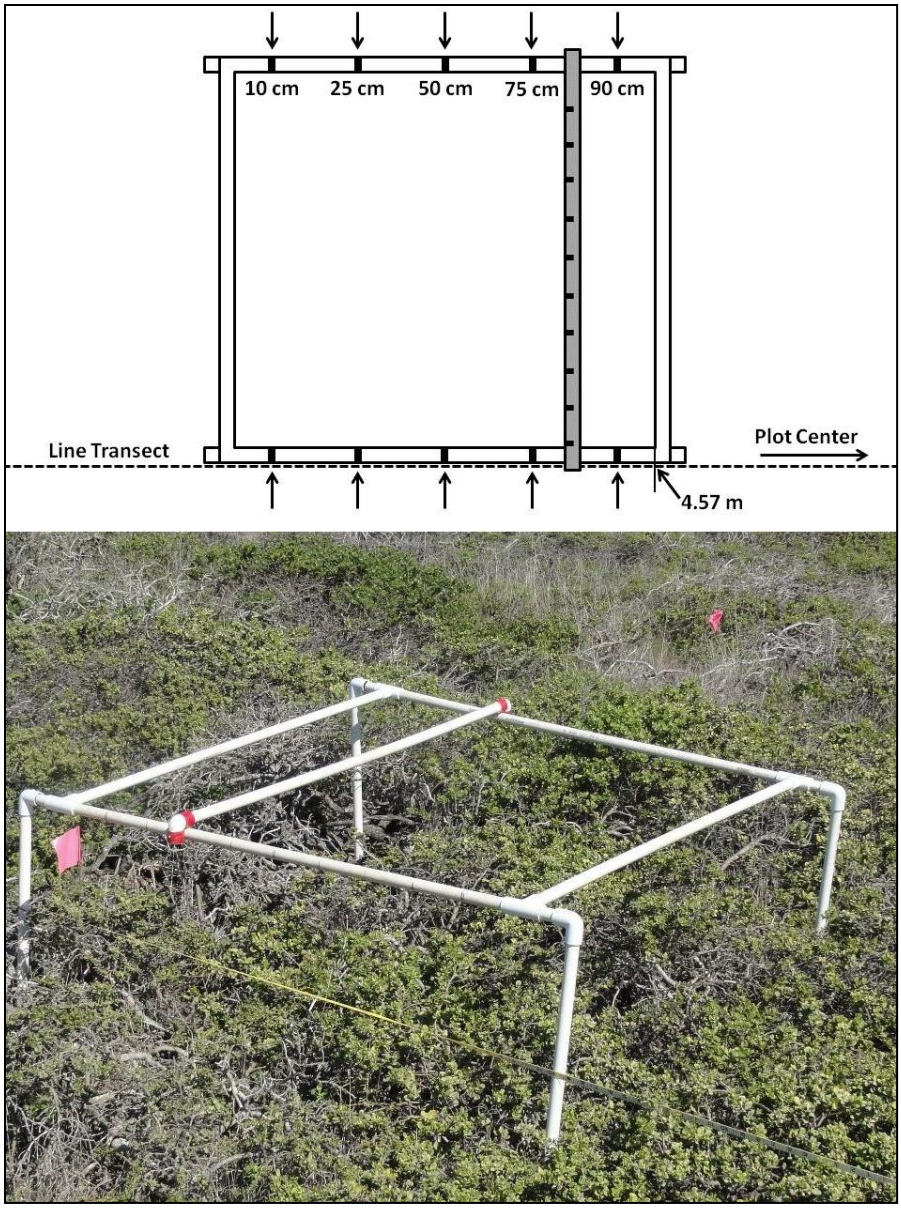


Figure SOP 8.3. Diagram above represents the top-view of the 1 x 1 m quadrat used for the point quadrat method. The grey bar represents the sliding PVC "line" that is moved into the five different positions (shown with arrows). The sliding line contains 10 point intercept marks where measurements are made. This results in 50 points per quadrat. The bottom photograph shows the setup of a quadrat and sliding line (PVC pipe with red tape at ends).

Litter Depth

Litter depth is measured in five places per quadrat; at the center, and half way to each corner of the quadrat from the center. A pin flag is placed at each of the five points and the distance from the soil surface to the tallest portion of duff, litter, or small woody debris at that point is recorded.

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Species Richness

Quadrats (1 m²)

After vascular plant cover and litter depth are each measured in the 1 x 1 m quadrat, record all vascular plant species rooted inside the quadrat or with overhanging foliage or live material within ≤ 3 m height above the quadrat. To record species richness in a quadrat, each time a new species not previously entered for the percent cover measures is found, write its full name on the front of the datasheet.

Circular NAWMA Subplot

Presence is recorded for all vascular plant species rooted in or overhanging the circular 7.32 m NAWMA subplot at any height. Use the Haglof DME and transponder attached to the center-stake Monopod to measure which species are inside the NAWMA subplot. If a species is on the border, first look to see if another individual is found elsewhere inside the subplot. If not, then use a measuring tape to determine precisely if it is inside or outside the subplot.

See SOP 17 for instruction on how to handle unknown species.

Literature Cited

Goodall, D.W. 1952. Some considerations in the use of point quadrats for the analysis of vegetation. Australian Journal of Biological Sciences 5:1–41.

Stohlgren, T.J., D.T. Barnett, and S.E. Simonson. 2003. Beyond North American weed management standards. North American Weed Management Association, Granby, Colorado. 10 p.

Appendix SOP 8A. Data sheets for subplot (NAWMA) sampling.

Data sheet location is on the GOGA network at:
\\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\Documents\DataSheets.

Data Sheet ____ of ____ Per Plot

1 by 1 m Quadrat Point Cover Sampling and Species Richness

Each transect 7.32 m long, each quadrat starts 4.57 m from plot center on right side of line

Quadrat: A B C

Date: **Sample Frame:**

Observer: **Veg Type:**

Recorder: **Stand ID:**

Litter Depth:					

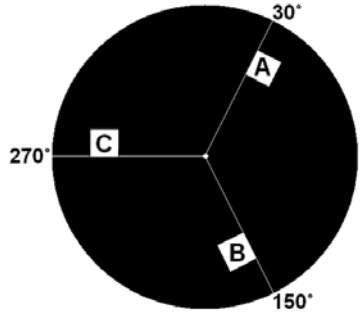
Bare: Bare soil, fine particles <3" on long axis

Litter: Organic matter not attached to a live or dead plant, including leaves and twigs < 3" dia.

Rock: Cobble, boulder, bedrock >3" on long axis

Water: Standing or flowing permanent surface water

Wood: Twigs and woody debris > 3" diameter



Key to Species Codes

Code	Full Species Name	Code	Full Species Name	Code	Full Species Name

Vascular Plants in the 1 m by 1 m Quadrats but not Encountered via Point Cover Sampling

1 by 1 m Quadrat Data

	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Bare																																																			
Lichen																																																			
Litter																																																			
Moss																																																		
Rock																																																		
Water																																																		
Wood																																																		

	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50

	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50

Data Sheet 1 of 11 Per Plot

1 by 1 m Quadrat Point Cover Sampling and Species Richness

Each transect 7.32 m long, each quadrat starts 4.57 m from plot center on right side of line

Quadrat: (A) B C

Date: 4/13/14 **Sample Frame:** PINN

Observer: Wrubel **Veg Type:** SCRB

Recorder: Steers **Stand ID:** Ø3

Litter Depth:	Ø	Ø	6	13	33

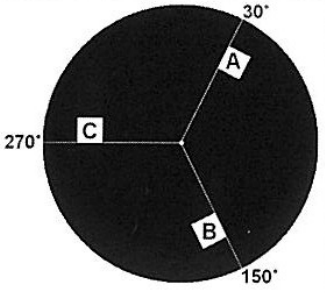
Bare: Bare soil, fine particles <3" on long axis

Litter: Organic matter not attached to a live or dead plant, including leaves and twigs < 3" dia.

Rock: Cobble, boulder, bedrock >3" on long axis

Water: Standing or flowing permanent surface water

Wood: Twigs and woody debris > 3" diameter



Key to Species Codes

Code	Full Species Name	Code	Full Species Name	Code	Full Species Name
ARCA	Artemesia californica				
GAAN	Galium angustifolium				
BRHO	Bromus hordeaceous				
FEMY	Festuca myuros				
CEME	Centaurea melitensis				
AVBA	Avena barbata				
LOFI	Logfia filaginoides				
LUAR	Lupinus arboreus				

Vascular Plants in the 1 m by 1 m Quadrats but not Encountered via Point Cover Sampling

Daucus pusillus		
Erodium cicutarium		
Acmispon glaber		
Pterostegia drymarioides		
Calochortus venustus		
Clarkia unguiculata		
Eriastrum virgatum		
Avena fatua		
Lupinus bicolor		
Bromus diandrus		
Logfia gallica		
Eriogonum elongatum		
Calystegia collina. venusta		
Thysanocarpus curvipes		

1 by 1 m Quadrat Data

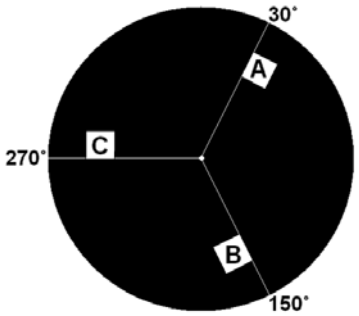
	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Bare	7		X	X								X	X												X	X																		X							
Lichen																																																			
Litter	2														X	X																																			
Moss																																																			
Rock																																																			
Water																																																			
Wood																																																			
ARCA	28	X			X	X	X			X				X			X	X	X		X	X		X			X	X	X			X	X	X	X	X	X		X	X					X	X	X	X			X
ARCA-D	11	X									X						X	X											X				X	X			X					X	X			X					
GAAN	12					X		X			X			X						X			X					X		X	X				X			X			X				X						
GAAN-D	6					X												X		X			X						X																		X				
BRHO	7	X					X										X											X											X			X	X								
FEMY	3							X	X																																				X						
CEME	1										X																																								
AVBA	10																X		X	X		X						X	X	X							X					X						X			
LOFI	4																														X					X													X	X	
LUAR	2																																								X										X

Sample Frame: PINN Veg Type: SCRB Stand ID: 03

Data Sheet ____ of ____ Per Plot

NAWMA Species Richness

All plant species rooted in the 7.32m radius circular plot that were not observed within the 1 by 1 m quadrats



Date: _____ **Sample Frame:** _____

Observer: _____ **Veg Type:** _____

Recorder: _____ **Stand ID:** _____

SOP 9: Woody Plant Density Sampling in 3 m x 3 m Quadrats

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedure for establishing the 3 m x 3 m quadrats within the North American Weed Management Association (NAWMA) subplot (7.32 m radius) and how to record woody plant density within them.

Supply Requirements

Setting up the 3 m x 3 m woody plant density quadrats require the following supplies and equipment:

- 4 chaining pins
- Compass
- Collapsible meter stick
- Diameter at breast height (DBH) tape
- Metal detector (only needed for site revisit)
- Three 100 ft. (~30 m) metric transect tapes
- Trimble and Garmin GPS to find plot center
- Four pin flags
- Pencils
- Clipboard
- Data sheets

Subplot Setup

This procedure assumes plots have already been setup following the process outlined in SOP 6.

1. For consistency, the 3 m x 3 m quadrats should be completed in a specific order: A, B, and C. ***Be careful not to trample the nested 1 x 1 m quadrats or the vegetation in any other portion of the sampling plot that will be measured.*** When traveling between sampling modules, walk along the module boundaries or off-site, when possible.

2. Using the line transects that are already installed, place the corner of a quadrat at the 2.57 m mark so that the quadrat is flush with the line and the next corner further away ends at 5.57 m (Figure SOP 9.1). Quadrats are always placed on the right side of a line if one is standing at plot center.
3. The border of the quadrat is marked along one side by the line transect that radiates from the center and on all four corners with pin flags.
4. The other three borders of the quadrat are determined using a combination of compass bearing at 90° from the radiating transect and tape stretched 3 m from the transect.

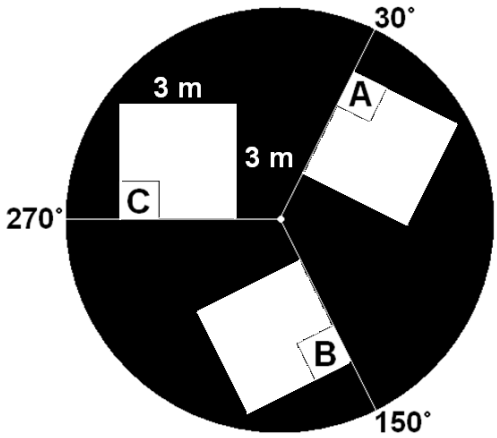


Figure SOP 9.1. Arrangement of the three 9 m² (3 m x 3 m) quadrats that start at 2.57 m and end at 5.57 m along one side, encompassing the 1 x 1 m quadrats that were described in SOP 8. Not shown are the other components of the sampling plot, including the larger, encompassing 17.95 m radius USFS Forest Inventory Analysis circular plot.

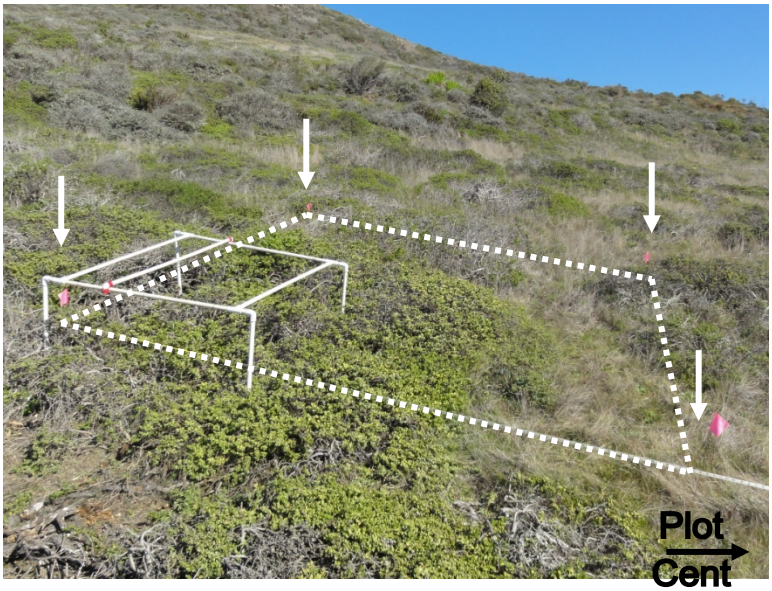


Figure SOP 9.2. Woody plant density quadrat (3 m x 3 m). Arrows show where pin flags are located. The 1 m x 1 m point quadrat frame is also shown in the bottom left-hand corner.

Woody Plant Density

The 3 m x 3 m quadrat is used to measure woody plant density. All live and dead tree stems are counted. Observers will use the list in SOP 21: Life Form Master List to determine whether a plant encountered should be considered a tree or not. If an encountered plant does not occur on the list, observers will classify the species as either a tree the purpose of this monitoring program using field references. The Field Lead will ensure that the list found in SOP 21 is up-to-date with the current species list and life form classification.

Stems must be at least half way rooted inside the 3 m x 3 m quadrat to be counted.

Saplings and seedlings are recorded separately. Trees have stems ≥1.37 m height and ≥5 cm diameter at breast height (DBH). Saplings have stems ≥1.37 m height and <5 cm DBH. Tree seedlings have stems <1.37 m tall. For instruction on how to measure DBH, please refer to SOP 11. To measure tree stem density, count every stem by species, lifeform (seedling, sapling, or tree), and by dead or alive. Only count tree stems that qualify to be sampled for DBH (refer to SOP 11). Only count stand-alone or solitary seedlings unless they are stump sprouts off of a dead bole. Only count stand-alone or solitary saplings unless they are stump sprouts off of a dead bole. Never count seedling- or sapling-sized sprouts coming off of the base of live trees. Indicate if seedlings or saplings are stump sprouts. Sprouts are only seedling- or sapling-sized stems that are growing adventitiously off the base of a dead mother tree (Figure SOP 9.3).

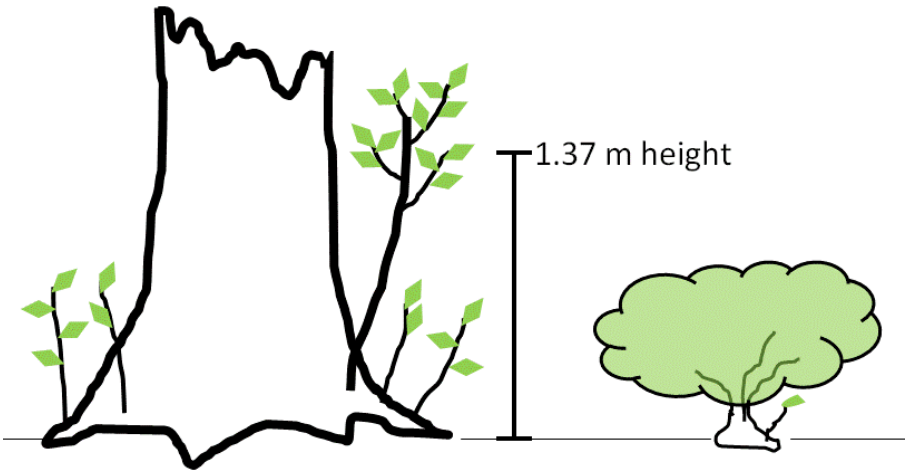


Figure SOP 9.3. One large, dead stem with four live, seedling stump sprouts plus one live sapling stump sprout (DBH on sapling not shown but is less than 5 cm). Although there is a stem sprouting from the base of the mature shrub on the right-side, sprouts are never measured when growing from the base of live plants, or from any shrub or sub-shrub species, dead or alive. If this shrub's canopy was dead but the sprout was live, then it would only count as one live shrub.

Any dead stem, whether tree-, sapling-, or seedling-sized, must be standing to count as dead (Figure SOP 9.4). Dead stems that are tilted more than 45° from vertical are not counted. Dead trees supported by other trees or by their own branches that meet these requirements are considered standing. This includes broken tree tops stuck in the ground. Dead trees do not have to be self-

supporting. This is in contrast to live stems, which are still counted even though they may be tilted more than 45° from vertical.

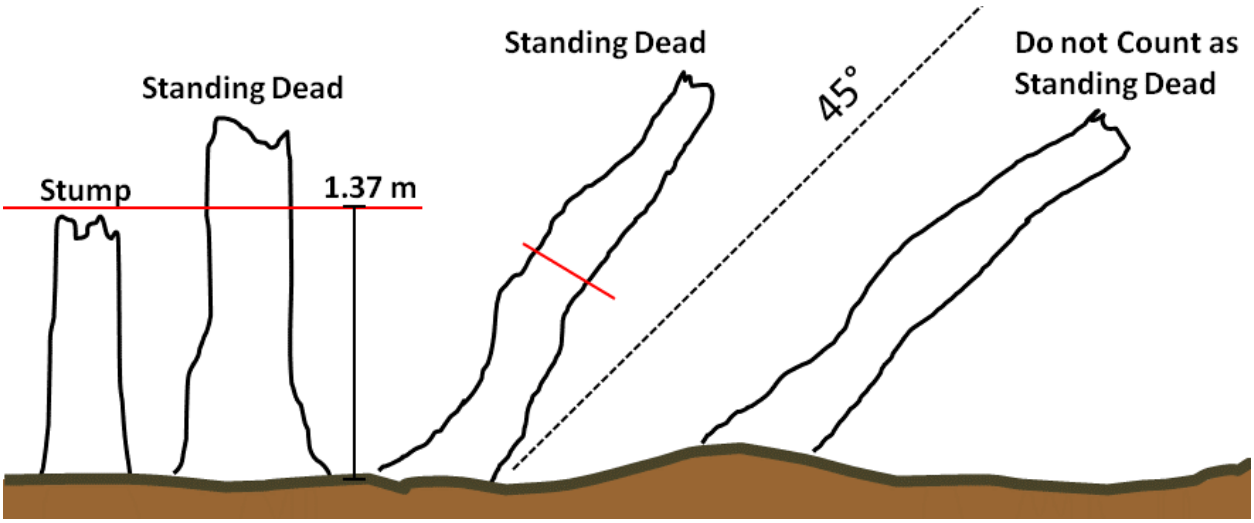


Figure SOP 9.4. Diagram of dead boles. Shown is one stump, which is shorter than 1.37 m so it is never counted. Also, two examples of a standing dead stem, and one example of a dead stem that is not counted because it has more than 45 degrees of lean from vertical.

On rare occasions, you may encounter fully mature trees that are stunted due to exposure or possibly due to genetic- or disease-related reasons (Figure SOP 9.5). Even though these tree species have the appearance of shrubs, they have dimensions that would place them into the seedling category. Do not mark them as seedlings but write down "DWARF" next to their name on the data sheet (e.g., *Quercus kelloggii* DWARF).

The data sheet will have multiple entries for one species depending on whether there are dead, live, seedlings, sapling, etc. of that species. Examples are shown on the data sheet below.



Figure SOP 9.5. A dwarf black oak (*Quercus kelloggii*) that is fully mature yet has dimensions that would not place it in the tree category. Write down “DWARF” after the species name on the data sheet.

Appendix SOP 9A. Data sheet for the woody plant density quadrats.

Data sheets can also be found on the GOGA server at: \\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\DOCUMENTS\DataSheets.

Data Sheet ____ of ____ Per Plot

Woody Plant Density in 3 x 3 m Quadrat

Each quadrat starts 2.57 m from plot center, always laid on right side of line.

Date:_______________

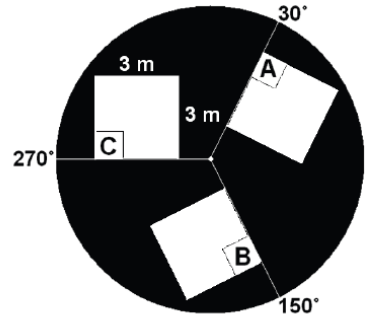
Observer / Recorder: ____________________

Park: __________

Veg Type: ____________

Stand ID: ______________

Plot ID: ______________



Tally woody plant density
Seedling sub-shrubs are < (less than) 10 cm height and < 5 cm wide
Seedling shrubs are < 15 cm height and < 10 cm wide
Seedling trees are < 1.37 m tall
Saplings are tree spp. ≥ 1.37 m height and < 5 cm dbh
Trees are ≥ 1.37 m height and ≥ 5 cm dbh

Species:	Live	Dead	Seedling	Sapling	Sprout	Thicket	Box A - 30°	Box B - 150°	Box C - 270°

SOP 10: Point Line Intercept Transects for Vegetation Cover

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedure for measuring cover along three 15 m point line intercept transects that radiate out form the center of the sampling plot at 30, 150, and 270 degrees.

Supply Requirements

Setting up the 3 m x 3 m woody plant density quadrats require the following supplies and equipment:

- 4 chaining pins
- Compass
- Collapsible meter stick
- Metal detector (only needed for site revisit)
- Three 100 ft. (~30 m) metric transect tapes
- Trimble and Garmin GPS to find plot center
- One pin flag with a diameter of 2 mm or less, or other similar pointer or laser device
- GRS Densitometer (http://www.grsgis.com/densitometer.html)
- Vertical and horizontal level
- Pencils
- Clipboard
- Data sheets

Subplot Setup

This procedure assumes plots have already been setup following the process outlined in SOP 6.

1. For consistency, measurements on each line transect should be completed in a specific order: A, B, and C (Figure SOP 10.1). ***Be careful not to trample the area occupied by the 3 m x 3 m woody plant density quadrats and their nested 1 x 1 m quadrats, or disturb any of the ground or fallen wood directly below the line transects.*** When traveling between sampling modules, walk along the module boundaries or off-site, when possible.

2. Use the line transects that are already installed (see SOP 6).

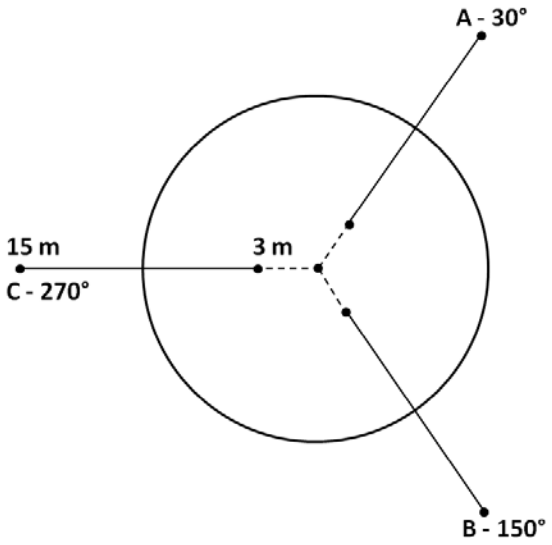


Figure SOP 10.1. Point line intercept transect layout. Begin sampling at 3 m and then every 25 cm till the 14.75 m mark.

Cover Measurements

The purpose of the point line intercept transects, is to capture the cover of shrubs and other shrub-sized species, hereafter referred to as target species. All plant parts ≤3 m height belonging to sub-shrub, shrub, and tree species should be observed with pin flags. Plant parts >3 m should be observed with the densitometer. Observers will use the list indicate whether a species is considered a tree, shrub, or sub-shrub found in SOP 21.

Because woody and herbaceous vine species can also take up spatial area similar to many shrub species canopies, they will also be recorded using the methods described herein. A list of all vine species that should be monitored using this method is included in the same folder mentioned above. Lastly, because sword-fern (*Polystichum munitum*) is an important component of many shrublands and woodlands in the coastal parks sampling frame, is perennial and does not die-back to its base like many angiosperm herbaceous perennials, and occupies similar spatial coverage as many shrubs, this species of fern will also be monitored using the point line intercept method described herein. No other ferns will be monitored, however. Thus, the species being monitored by use of the point-line intercept method include all sub-shrub, shrub, tree, and vine species plus *P. munitum*. The abundance of all other species will be captured using different methods described in other SOPs.

The point line intercept method for estimating cover (Heady et al. 1959) will be utilized along three 12 m segments of line transect that radiate out from the center of each sampling plot at 30, 150, and 270 degrees. Vegetation sampling begins at the 3.00 m mark and then every 0.25 m till the 14.75 m mark. At each mark, drop a small-diameter pin (<2 mm diameter) vertically downward. If any plant parts from *P. munitum* or any of the species recognized as vines, sub-shrubs, shrubs, or trees, based on the species lists, overlap with the sampling point, then they are recorded by species and by

whether they are dead or alive. Also, only vegetation ≤3 m in height is recorded. Vegetation >3 m is observed at each point using the GRS densitometer.

Along the 12 m length of the line transect that will be utilized, there are 48 regularly dispersed points where species "hits" are recorded. Hits are determined by either dropping a small diameter (<2 mm) pin flag vertically at each point or by using a fine laser-pointer that projects a beam vertically downward and upward at each point. Both methods have been used successfully in pilot work and do not result in measurable differences in species cover. A hit is recorded for each target species that is in the direct path of the pointer or laser. Record a hit for every different species that overlaps a sampling point. If woody plant material is dead but still standing as if it were in a live position, then record the species name and write "DEAD" afterwards (e.g., *Baccharis pilularis* DEAD). If no target species overlap a point, then record the first object that does, only from the following options:

1. Ground (bare soil, rock, gravel, lichen, moss, or scat)
2. Down and dead vegetation (litter, duff, or wood)
3. Herbaceous plants
4. Other (please specify on data sheet)

Count "herbaceous plants" as all non-woody, non-target species. If a woody tree, shrub, or sub-shrub, is encountered, or a woody or herbaceous vine is encountered at a sampling point that is not on the target species list, do not record it as "herbaceous plants," instead record it by species and make a note to add it to the respective target species list. Also, if non-vine herbaceous plant material is dead but still standing as if it were in a live position, record it as "herbaceous plants" if it was alive sometime in the current growing season. If it was not alive in the current growing season but left-over from a previous growing season, then count the dead herbaceous plant material as "down and dead" vegetation.

Only record the variables, "ground," "down and dead," and "herbaceous plant," one time per sampling spot if a dead or alive target plant species is absent. However, if one of these variables is actually positioned above the target plant(s), then record the top variable as a hit plus record whatever target plant species there is/are underneath the variable. Enter "hits" on the datasheet in the respective column where they were measured (Appendix SOP 10A).

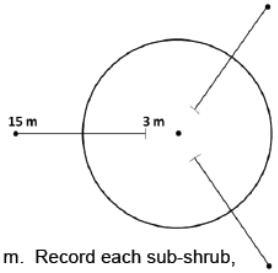
To estimate cover >3 m tall the observer positions him/herself at the sampling point and raises the densitometer to one eye. Then the observer levels the densitometer using the bubble levels in the sighting device while covering the sampling "point" on the device with a finger. When the instrument is level, the observer exposes the sampling point by removing the finger and notes if there is canopy cover at that point, by species. Any "hits" in the canopy recorded with the densitometer should be noted on a new line the datasheet, denoted as canopy (e.g., "QUEAGR – canopy") (Appendix SOP 10.A).

Literature Cited

Heady, H. F., R. P. Gibbens, and R. W. Powell. 1959. A comparison of the charting, line intercept, and line point methods of sampling shrub types of vegetation. Journal of Range Management 12:180-188.

Appendix SOP 10.A. Datasheet for implementing point line intercept cover estimates.

This data sheet can also be found on the GOGA network at:
\\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\DOCUMENTS\DataSheets.



Data Sheet ____ of ____ Per Plot
Point Line Intercept for Shrub, Sub-Shrub, and Vine Cover

Date: _____ Observer / Recorder: _____ Park: _____
Stand ID: _____ Plot ID: _____ Veg. Type: _____

Transect ID - Choose A (30°), B (150°), or C (270°): _____

At 30°, 150°, and 270° from plot center, stretch tape out to 15 m. Begin sampling at 3.00 m and then every 25 cm till the 14.75 m. Record each sub-shrub, shrub, tree, and vine species, plus *Polystichum munitum* (sword fern), per sampling point up to 3 m height.

Species:	**3.00**	**3.25**	**3.50**	**3.75**	**4.00**	**4.25**	**4.50**	**4.75**	**5.00**	**5.25**	**5.50**	**5.75**	**6.00**	**6.25**	**6.50**	**6.75**	**7.00**	**7.25**	**7.50**	**7.75**	**8.00**	**8.25**	**8.50**	**8.75**
Ground																								
Down and Dead																								
Herbaceous Spp.																								

	9.00	**9.25**	**9.50**	**9.75**	**10.00**	**10.25**	**10.50**	**10.75**	**11.00**	**11.25**	**11.50**	**11.75**	**12.00**	**12.25**	**12.50**	**12.75**	**13.00**	**13.25**	**13.50**	**13.75**	**14.00**	**14.25**	**14.50**	**14.75**
Ground																								
Down and Dead																								
Herbaceous Spp.																								

SOP 11: Live and Dead Tree Sampling

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedure for measuring the number of alive and dead tree and sapling stems in the circular sampling plot (17.95 m radius) and subplot (7.32 m radius) and how to record disease symptoms or decay stage on trees. This document was adapted from the National Park Service, North Coast Cascade and Klamath Networks' Vegetation Monitoring Protocols (see Acker et al. 2010 and Odion et al. 2011).

Supply Requirements

Setting up the sampling plot and taking measurements following this SOP requires the following items:

- 1 chaining pin
- Metal detector (only needed for site revisit)
- One 100 ft. (~30 m) metric transect tape
- Trimble and Garmin GPS
- Haglof plot center staff/Monopod with transponder and hand-held DME
- Diameter at breast height (DBH) tape (10 m size recommended)
- Meter stick/Biltmore Stick (metric) (only needed for trees that cannot be measured with a DBH tape)
- Pencils
- Clipboard
- Data sheets
- Chalk tree marker

Subplot Setup

This procedure assumes plots have already been setup following the process outlined in SOP 6.

1. To better keep track of which trees have been sampled or too break up work between two field personnel, use the chalk tree marker and/or have one person work inside the 7.32 m radius subplot while another person works outside the subplot out to 17.95 m radius.

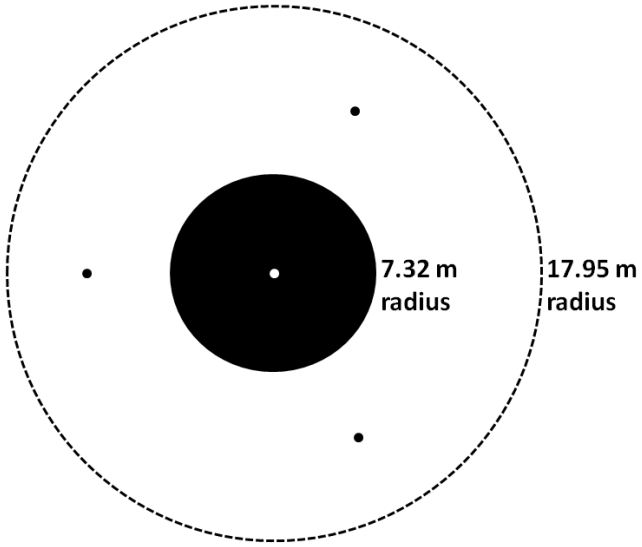


Figure SOP 11.1. The 17.95 m radius circular USFS Forest Inventory Analysis sampling plot (marked by the dashed line) and the nested 7.32 m radius circular NAWMA subplot (black circle). Also shown are the center point and the 15 m ends of the three line transects.

Tree and Sapling Density and Tree Size

The circular plot and subplot (Figure SOP 11.1) are used to measure tree stem density and diameter at breast height (DBH), and sapling density. All live and dead tree and sapling stems are recorded by species. Tree seedlings are not measured using this SOP. For tree seedling measures, please see SOP 9. A list that indicates whether a species is considered a tree is found in SOP 21.

The 7.32 m radius circular subplot is used to count the number of all tree and saplings by species. Also, the DBH of all tree-sized species is recorded inside the 7.32 m radius. Outside of the subplot and out to 17.95 m radius, only tree stems ≥20 cm DBH are counted and their DBH recorded. Every other tree rooted on the boundary is counted as "in" the plot. Details on how to count stems and how to measure DBH follow.

Stem Density Measures

Inside the 7.32 m radius North American Weed Management Association (NAWMA) subplot, count the number of all trees and saplings by species. Trees have stems ≥1.37 m height and ≥5 cm diameter at breast height (DBH). Saplings have stems ≥1.37 m height and <5 cm DBH. Tree seedlings have stems <1.37 m tall, but are not counted. To measure stem density, count every stem by species, lifeform (sapling or tree), and by dead or alive. To indicate a sapling on the data sheet (Appendix SOP 11A), place a check mark in the "Sapling" column on the appropriate row and tally the number present. Also for saplings, indicate if they are stump sprouts. For this SOP, stump sprouts are only

sapling-sized stems that are growing adventitiously off the base of a dead mother tree (Figure SOP 11.2). To indicate a stump sprout on the data sheet, check the "Sapling" and "Sprout" columns on the appropriate row and tally the number present. **Do not count saplings that have sprouted from the base of a live tree. Again, do not count seedlings when executing this SOP.**

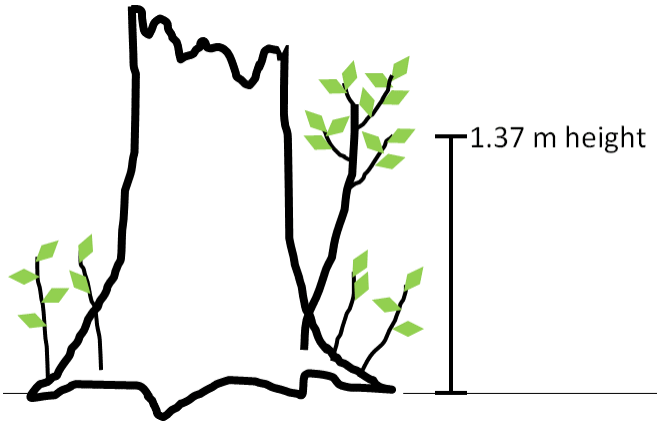


Figure SOP 11.2. One large, dead stem with four live, seedling sprouts plus one live sapling stump sprout (DBH on sapling not shown but is less than 5 cm). For this SOP, only count the dead stem and the sapling stump sprout.

Any dead stem, whether tree- or sapling-sized, must be standing to count as dead (Figure SOP 11.3). Dead stems that are tilted more than 45° from vertical are not counted. Dead trees supported by other trees or by their own branches that meet these requirements are considered standing. This includes broken tree tops stuck in the ground. Dead trees do not have to be self-supporting. This is in contrast to live stems, which are still counted even though they may be tilted more than 45° from vertical.

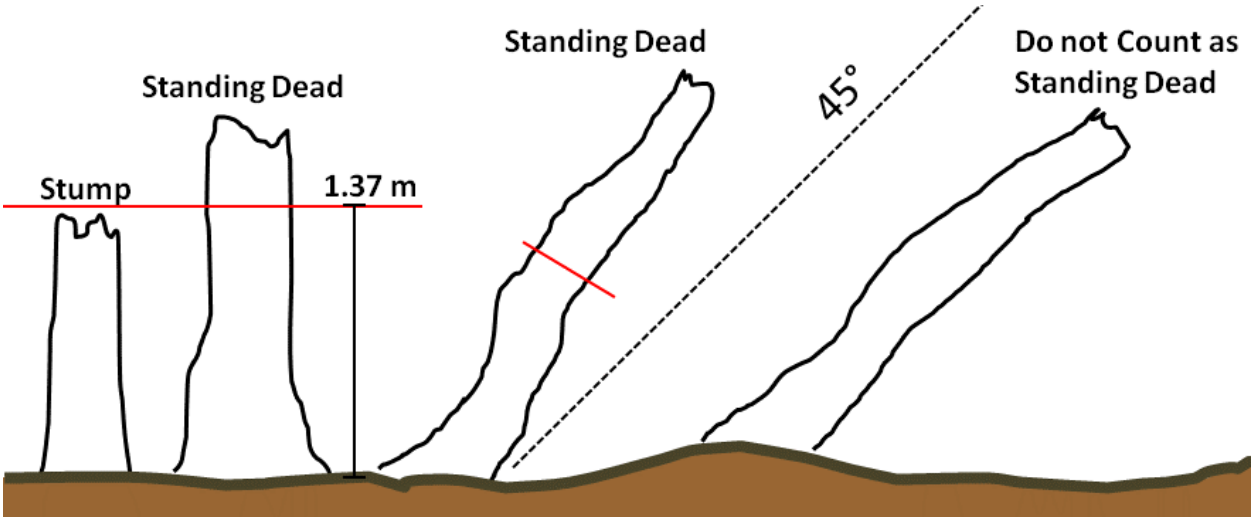


Figure SOP 11.3. Diagram of dead boles. Shown is one stump, which is shorter than 1.37 m so it is never counted by itself. Also, two examples of a standing dead stem, and one example of a dead stem that is not counted because it has more than 45 degrees of lean from vertical.

On the rare occasion that you encounter fully mature trees that are stunted due to exposure or possibly genetic- or disease-related reasons (Figure SOP 11.4): Even though these tree species have the appearance of shrubs, they have dimensions that would classify them as seedlings. Write down "DWARF" next to their name on the data sheet (e.g., *Quercus wislizeni* DWARF") and provide explanation in the notes section.

The data sheet will have multiple entries for one species depending on whether there are dead or alive, saplings, or trees of that species. On the data sheet, tally the number of saplings. For trees, enter each of them on a separate row and record their DBH and any other notes. Examples are shown on the data sheet below (Appendix SOP 11B).



Figure SOP 11.4. A dwarf black oak (*Quercus kelloggii*) that is fully mature yet has dimensions that would place it in the seedling category. Write down "DWARF" after the species name on the data sheet.

Measuring Tree Diameter at Breast Height

Diameter at breast height (DBH) is measured 1.37 m above the ground surface. The methods for measuring DBH follows the United States Forest Service, Forest Inventory Analysis (FIA) field manuals, specifically, the FIA National Core Field Guide, Version 5.1 (USFS 2011). When measuring DBH, always make sure that the diameter tape is at a right angle to the lean of the tree. The observer must stand on the uphill side of the tree. With the Biltmore stick (only to be used if the tree cannot be measured with a DBH tape), two measurements are required: one on the uphill and one sidehill; these measurements are averaged and then recorded. Always round each measurement down to the last 0.1 cm (e.g., a reading of 13.68 cm is recorded as 13.6 cm).

Special DBH situations:

<u>Forked trees</u>

In order to qualify as a fork, the stem in question must be at least 1/3 the diameter of the main stem 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 0.31 m (1 foot), between 0.31 m and 1.37 m (4.5 feet), or above 1.37 m.

- Trees forked below 0.31 m
  Trees forked below 0.31 m are treated as distinctly separate trees (Figure 4.A, B, and C). DBH is measured for each stem at 1.37 m above the ground. If stems originating from forks that occur below 0.31 m fork again between 0.31 and 1.37 m (Figure 4.B), the rules in the next paragraph apply.
- Trees forked between 0.31 and 1.37 m
  Trees forked between 0.31 and 1.37 m are also counted as separate trees (Figure 4.B, D, E, and F). The DBH of each fork is measured at a point 1.07 m (3.5 ft.) above the pith intersection. 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 1.07 m above the common pith intersection (Figure SOP 11.5.B, D, E, and F).
  - Once a stem is recognized as a fork that originated from a pith intersection between 0.31 and 1.37 m, do not recognize any additional forks that may occur higher up on that stem. And, measure the diameter of such stems just below the base of stem separation (Figure 4.E). In other words, do not move the point of diameter the entire 1.07 m above the first fork.
- Trees forked at or above 1.37 m
  Trees forked at or above 1.37 m count as one single tree. If a fork occurs at or immediately above 1.37 m, measure diameter below the fork just beneath any swelling that would inflate DBH.

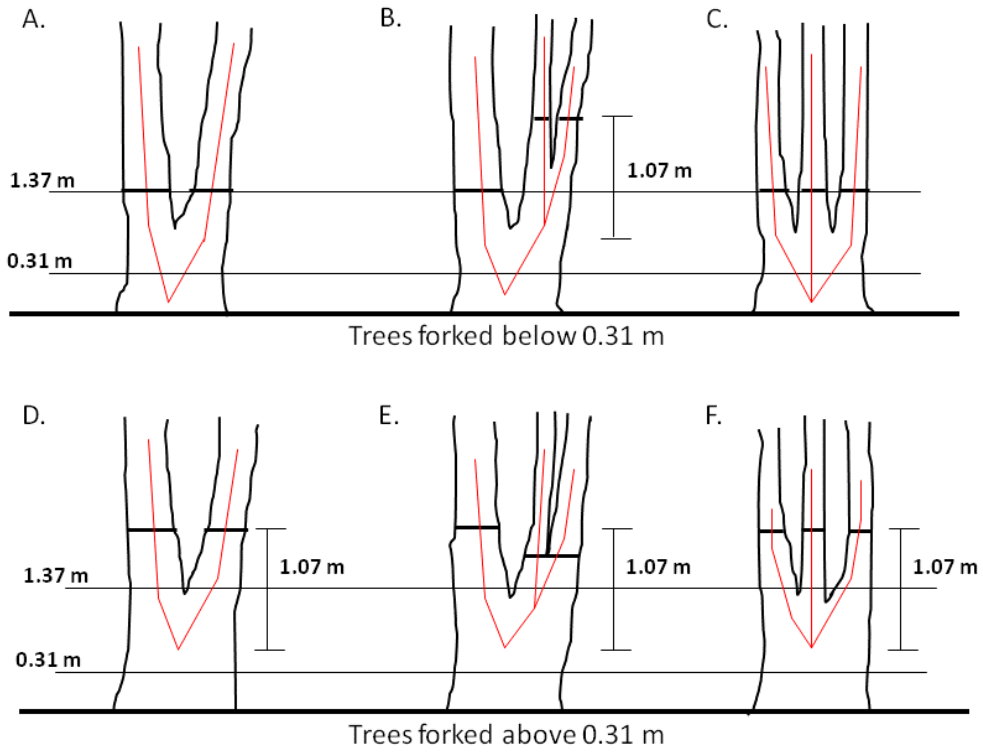


Figure SOP 11.5. Variations on tree forking and where to measure diameter at breast height (thick horizontal black line). Red lines inside trees indicate stem pith. Modified from USFS (2011).

Stump Sprouts

Stump sprouts originate between ground level and 1.37 m 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 0.31 m are measured at 1.37 m from ground line. Stump sprouts originating between 0.31 and 1.37 m are measured at 1.07 feet above their point of occurrence. For multi-stemmed woodland species, treat all new sprouts as part of the same new tree. To indicate a stump sprout on the data sheet, write "SPROUT" after the species name (e.g., "*Notholithocarpus densiflorus* SPROUT").

1) Tree with Butt-swell or Bottleneck
   Measure these trees 0.46 m (1.5 ft.) above the end of the swell or bottleneck only if the swell or bottleneck extends 0.91 m (3 ft.) or more above the ground.

2) Tree with Irregularities at DBH
   On trees with swellings, bumps, depressions, and branches at DBH, diameter will be measured immediately above the irregularity at the place it ceases to affect normal stem form.

3) Leaning Tree

Measure diameter at 1.37 m from the ground along the bole. The 1.37 m distance is measured along the underside face of the bole.

4) Independent Trees that Grow Together
If two or more independent stems have grown together at or above the point of DBH, continue to treat them as separate trees.

5) Missing Wood or Bark
Do not reconstruct the DBH of a tree that is missing wood or bark or at the point of measurement. Record the diameter of the wood and bark that is still attached to the tree. If a tree has a localized abnormality (gouge, depression, etc.) at the point of point of DBH, apply the procedure described for "Trees with Irregularities at DBH."

6) Live Windthrown Tree
Measure from the top of the root collar along the length to 1.37 m.

7) Down Live Tree with Tree-form Branches Growing Vertical from Main Bole
When a down live tree, touching the ground, has vertical (less than 45 degrees from vertical) tree-like branches coming off the main bole, first determine whether or not the pith of the main bole (averaged along the first log of the tree) is above or below the duff layer.
   - If the pith of the main bole is above the duff layer (Figure SOP 11.6A), use the same forking rules specified for a forked tree, and take all measurements accordingly.
   - If the pith intersection of the main down bole and vertical tree-like branch occurs below 1.37 m (4.5 ft.) from the stump along the main bole, treat that branch as a separate tree, and measure DBH 1.07 m (3.5 ft.) above the pith intersection for both the main bole and the tree-like branch.
   - If the intersection between the main down bole and the tree-like branch occurs beyond the 1.37 m point from the stump along the main bole, treat that branch as part of the main down bole and do not count/record it separately.
   - If the pith of the main tree bole is below the duff layer (Figure SOP 11.6B), ignore the main bole, and treat each tree-like branch as a separate tree; take DBH 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 (Figure SOP 11.6B), then treat that portion of that top as an individual tree originating where the pith leaves the duff layer.

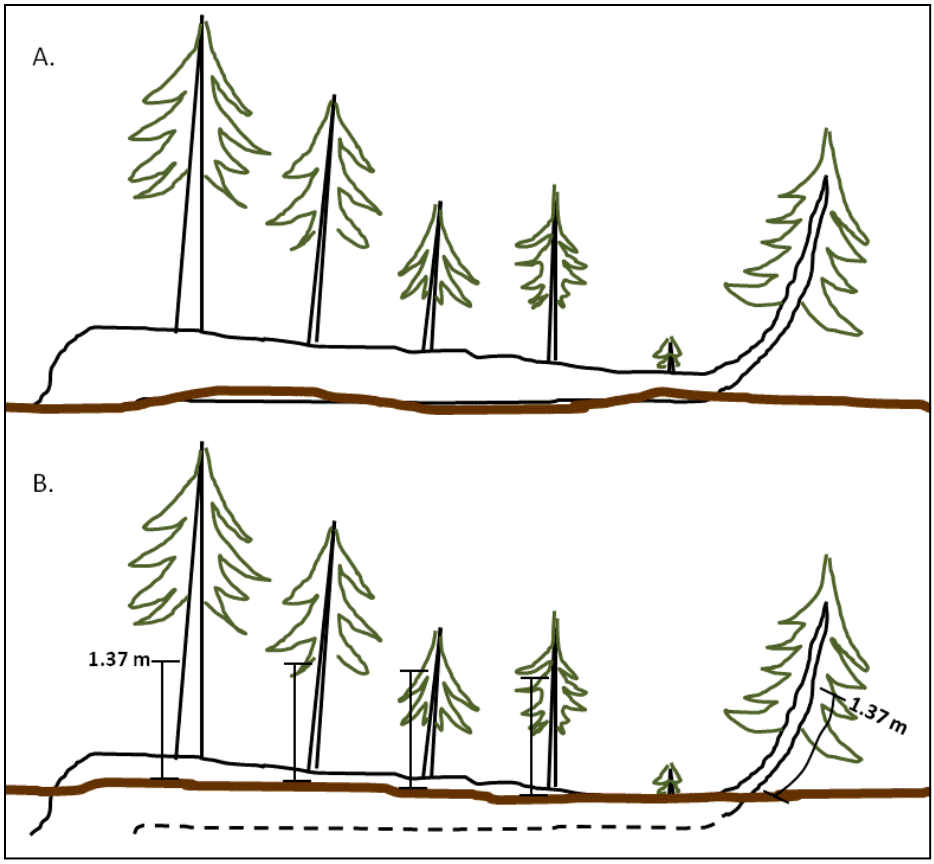


Figure SOP 11.6. Down live tree above duff (A) and below (B) with tree-form branches growing vertical from main bole. Modified from USFS (2011).

Disease Symptoms

There are two exotic tree diseases that are causing major alterations to forests in the coastal parks sampling frame. These are Sudden Oak Death (SOD) and Pine Pitch Canker (PPC). Currently, there is no known presence of SOD or PCC at Pinnacles National Park. Regardless, symptoms of these diseases should be searched for on all Fagaceae and *Pinus* species, respectively, in each sampling plot.

Sudden Oak Death

For all species in the family Fagaceae, examine the main stem and branch to the greatest extent possible for four symptoms (Table SOP 11.1).

Table SOP 11.1. Sudden Oak Death (SOD) symptoms* and codes.

Symptom	Code
Structural Failure	SF
Bleeding	BL
Beetle Boring Dust	DU
Hypoxylon thouarsianum	HT

*Symptoms as defined by McPherson et al. (2005).

Descriptions of each symptom are included below and are taken from McPherson et al. (2005). If the Fagaceae tree sp. has one or more symptoms, then write down "SOD" plus the applicable code(s) from Table SOP 11.4 in the notes section of the data sheet (e.g., SOD-BL-HT for an assumed SOD-infected tree that has bleeding and *Hypoxylon thouarsianum* present). **Only record symptoms from trees. Do not record symptoms from saplings or seedlings.**

- Structural failure:
  Structural failure (break) on the main bole (Figure SOP 11.7)



http://cnr.berkeley.edu/stephens-lab/travis_proj.jpg

Figure SOP 11.7. Structural failure of *Quercus agrifolia*.

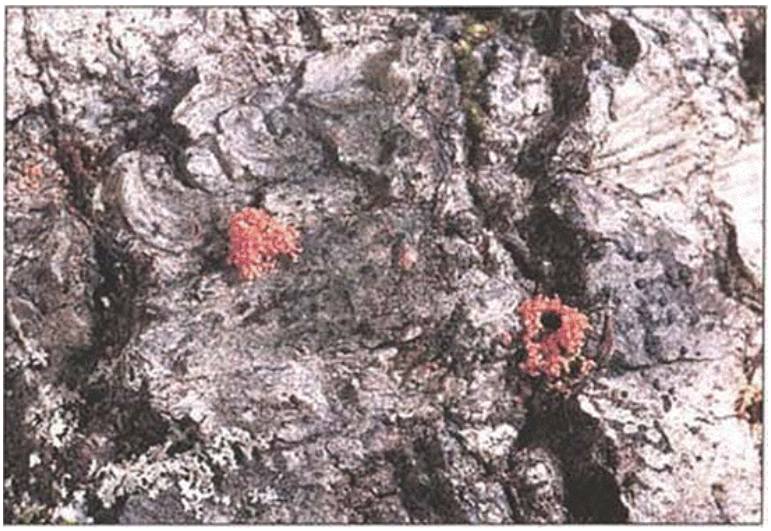
- Bleeding:
  The most consistent symptom of *P. ramorum* infection is bleeding; look for the presence of the exudate. Although heavy rain can remove the exudate, the bark below bleeding areas often remains stained for months. Also, mosses and lichens below bleeding zones may be stained dark brown by this exudate, signaling the presence of a bleeding canker (Figure SOP 11.8).



Joseph O'Brien (USFS) http://gis.uncc.edu/projects/suddenoak/index.htm

Figure SOP 11.8. Bleeding on bole resulting from SOD. On left, moss is stained from bleeding.

- Beetle Boring Dust:
  The tunneling of bark and ambrosia beetles was detected by the presence of white and reddish brown boring dust on the bark surface (Figure SOP 11.9). Within the first year following the appearance of bleeding, beetle tunneling is restricted to the bark directly overlying bleeding cankers. The tunneling activity of these insects occurs primarily during two periods, from March through June and from August through October. When boring dust is not fresh, its presence from previous flight seasons can often be observed matted in moss, bark crevices, and spider webs. Also, entrance and exit holes (approximately 1 mm diameter) produced by these beetles can be seen with careful observation.



http://ucce.ucdavis.edu/files/repository/calag/img5501p17a.jpg

Figure SOP 11.9. Boring dust on the outer bark of a *Quercus* sp. bole.

- *Hypoxylon thouarsianum:*
  The ecology of this endophyte is not well understood. The presence of reproductive structures is the only reliable way to confirm the presence of this otherwise cryptic fungus. In

the absence of SOD, sporophores are typically observed on standing dead and fallen trees, dead branches on living trees, and the dead portions of the stems of standing, live trees (Figure SOP 11.10).



Michael Wood Doug Schmidt/Matteo Garbelotto

Figure SOP 11.10. *Hypoxylon thouarsianum*. Fruiting body of the fungus that may cause ultimate mortality in SOD inflicted trees. The fruiting body is generally 1 to 5 cm broad and up to 3 cm in height (Hsieh et al. 2005)

Pine Pitch Canker

For all *Pinus* species, examine as much of a tree as possible for two symptoms (Table SOP 11.2).

Table SOP 11.2. Pine Pitch Canker (PPC) symptoms* and codes.

Symptom	Code
Canker	CA
Branch End Dieback	DB

*Symptoms as defined by the California Pitch Canker Task Force (CPCTF 2012).

Descriptions of each symptom are included below and are taken from the California Pitch Canker Task Force (CPCTF 2012). If the *Pinus* tree has one or more symptoms, then write down "PPC" plus the applicable code(s) from Table SOP 11.2 in the notes section of the data sheet (e.g., PPC-DB for an assumed PPC-infected tree that has branch end dieback). Only record symptoms on trees; do not record symptoms from saplings or seedlings.

- Canker:
  Cankers can occur on any portion of the tree (Figure SOP 11.11). They are lesions that indicate infection sites and are usually associated with high amounts of resin.



Andrew Storer David Adams

Figure SOP 11.11. Cankers and associated heavy resin flows.

- Branch end dieback:
  Typically, branches throughout the crown are affected. Needles turn yellow then orange/red, and then fall off. Yellow to red needles at distal ends of branches or completely dead and leafless distal ends of branches indicate branch end die-back.



Bill Ruskin

Figure SOP 11.12. Branch end dieback on a Monterey pine (*Pinus radiata*).

Decay Stage of Dead Trees

Record the decay stage of all dead trees (Table SOP 11.3 and Figure SOP 11.13). Do not record the decay stage on saplings or seedlings.

Table SOP 11.3. Decay classification for standing dead trees. Characteristics are for Douglas-fir. Snags of other species may vary somewhat; use this table as a guide.

Stage	Limbs & Branches	Top	% Bark Remaining	Sapwood* Presence	Sapwood* Condition	Heartwood Condition
1	All present	Pointed	100	Intact	Sound, incipient decay, hard, original color	Sound, hard, original color
2	Few limbs, no fine branches	Broken	Variable ~80%	Sloughing	Advanced decay, fibrous, firm to soft, light brown	Sound at base, incipient decay in outer edge of upper bole, hard, light to red brown
3	Limb stubs	Broken	Variable ~60%	Sloughing	Fibrous, soft, light to reddish brown	Incipient decay at base, advanced decay throughout upper bole, fibrous, hard to firm, reddish brown
4	Few or no stubs	Broken	Variable ~40%	Sloughing	Cubical, soft, reddish to dark brown	Advanced decay at base, sloughing from upper bole, fibrous to cubical, soft, dark reddish brown
5	None	Broken	Less than 40%	Gone	Gone	Sloughing, cubical, soft, dark brown, OR fibrous, very soft, dark reddish brown, encased in hardened shell

*The outermost, lighter colored wood of a tree bole. Found inside the cork (bark).

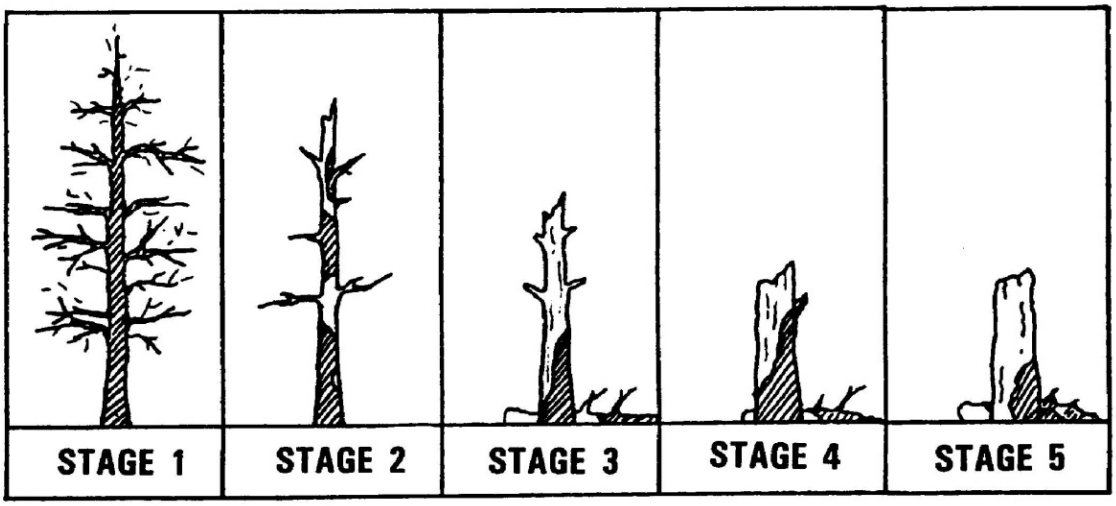


Figure SOP 11.13. Decay stages for Douglas fir. Others species may vary somewhat; use this as a guide. (From KLMN Vegetation Protocol).

Lastly, a dead oak tree with structural failure will not fit into the decay stages shown above since bark and sapwood can still be relatively intact. Therefore, choose the closest category from Table 3

and Figure 8 but also write SOD-SF for structural failure in the notes section, plus any other symptoms observed.

Causes of Death

Cause of Death

Write the cause of death in the notes section from the options provided in Table SOP 11.14.

Table SOP 11.4. Causes of death for trees.

Cause of Death
Insect
Disease
Fire
Animal
Weather
Vegetation (suppression, competition, vines)
Unknown/not sure/other- includes death from human activity not related to silviculture or land clearing activity (accidental, random, etc.)

If a completely dead tree is either a *Pinus* sp. or a species in the Fagaceae, and symptoms of SOD or PPC are present, then write “Disease-SOD” or “Disease-PPC” in the notes sections.

Literature Cited

Acker, S. A., A. Woodward, J. R. Boetsch, K. Hutten, M. Bivin, R. Rochefort, C. C. Thompson, and L. Whiteaker. 2010. Forest vegetation monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/242. National Park Service, Fort Collins, Colorado.

California Pitch Canker Task Force (CPCTF). 2012. Identification. Available from http://frap.cdf.ca.gov/pitch_canker/ (accessed 15 February 2102).

Hsieh, H.M., Y.M. Ju, and J.D. Rogers. 2005. Molecular phylogeny of Hypoxylon and closely related genera. Mycologia. 97(4):844-865.

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

McPherson, B.A., S.R. Mori, D.L. Wood, A.J. Storer, P. Svihra, N.M. Kelly, and R.B. Standiford. 2005. Sudden Oak Death in California: Disease progression in oaks and tanoaks. Forest Ecology and Management 213:71-89.

United States Forest Service (USFS). 2011. Forest Inventory and Analysis National Core Field Guide. Volume I: Field Data Collection Procedures for Phase 2 Plots. Version 4.0. Available at http://www.fia.fs.fed.us/library/field-guides-methods-proc/ (accessed 14 February 2012):

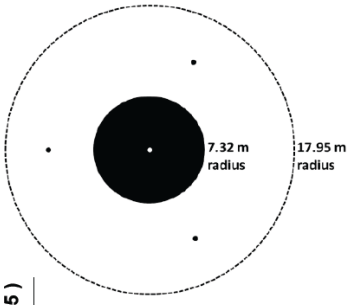
Appendix SOP 11A. Datasheet for recording live and dead trees and saplings.

This sheet can also be found on the GOGA server at: \\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\DOCUMENTS\DataSheets.

Data Sheet ____ of ____ Per Plot
Standing Tree and Sapling Stem Density
& Tree Diameter at 1.37 m Height

Date:_____ Park: _____ Veg Type: _____
Observer / Recorder: Stand ID: _____
_____ Plot ID: _____

Record all trees and saplings inside the 7.32 m radius
Only record trees ≥ 20 cm dbh outside the 7.32 m radius
Do not record DBH, Decay Stage, Symptoms, etc… for Saplings and Sprouts



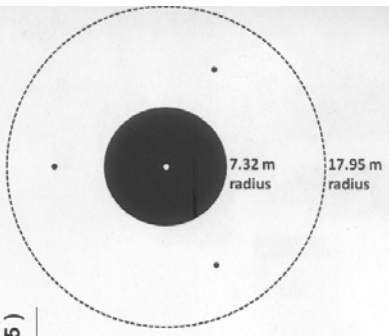
Species	Inside the 7.32 m	Outside the 7.32 m	Live	Dead Standing	Sapling	Sprout	DBH (cm)	Tally	Decay Stage (1- 5)	Symptoms / Cause of Death / Notes

Appendix SOP 11B. Example of entered data.

There is no need to tally trees, just record their DBH. Only saplings are tallied.

Data Sheet ____ of ____ Per Plot
Standing Tree and Sapling Stem Density
& Tree Diameter at 1.37 m Height

Date:_____ Park: _____ Veg Type: _____
Observer / Recorder: Stand ID: _____
_____ Plot ID: _____



Record all trees and saplings inside the 7.32 m radius
Only record trees ≥ 20 cm dbh outside the 7.32 m radius
Do not record DBH, Decay Stage, Symptoms, etc... for Saplings and Sprouts

Species	Inside the 7.32 m	Outside the 7.32 m	Live	Dead Standing	Sapling	Sprout	DBH (cm)	Tally	Decay Stage (1- 5)	Symptoms / Cause of Death / Notes
Sequoia sempervirens	X		X		X	X		IIII		
Sequoia sempervirens	X			X			17.2		2	Unknown
Sequoia sempervirens		X	X				120.7			
Quercus agrifolia		X	X				22.5			SOD-HT-BL
Umbellularia californ.	X			X	X			III		

SOP 12: Litter, Duff, and Down Wood Sampling

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP describes the procedure for measuring dead and detached, down wood as well as duff and litter depths along the three 15 m long line transects. Most of the information in this chapter is taken from the NPS Fire Monitoring Handbook (NPS 2003) and was adapted from the National Park Service, Klamath Network Vegetation Monitoring Protocol (Odion et al. 2011).

Supply Requirements

Setting up the sampling plot and taking measurements following this SOP requires the following items:

- Four chaining pins
- Compass
- Metal detector (only needed for site revisit)
- Four 100 ft. (~30 m) metric transect tape
- Trimble and Garmin GPS to find plot center
- Diameter at breast height (DBH) tape (5 m size recommended)
- Go-no-go gauge
- Trowel
- Ruler (collapsible meter stick)
- Pencils
- Clipboard
- Data sheets

Subplot Setup

This procedure assumes plots have already been setup following the process outlined in SOP 6.

1. For consistency, transect measurements should be completed in a specific order: A, B, and C. ***Be careful not to trample the area occupied by the 3 m x 3 m woody plant density quadrats***

and their nested 1 x 1 m quadrats, or disturb any of the ground or fallen wood direct below the line transects. When traveling between sampling modules, walk along the module boundaries or off-site, when possible.

2. Use the line transects that are already installed (see SOP 6).

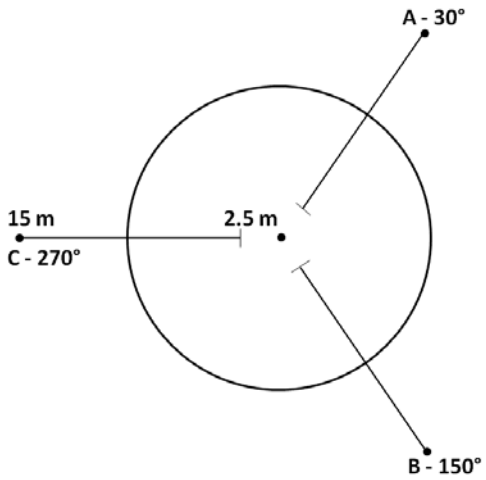


Figure SOP 12.1. The 7.32 m radius NAWMA subplot with extending 15 m transects radiating out from center at 120 degrees apart from each other. Litter, duff and down wood are sampled on the A (30 degree) transect only, while large woody material is sampled on all three transects from the 2.5 m to the 15 m marks.

Dead and Detached Wood

To record the amount of dead and detached down wood, complete the steps listed below:

1. Tally each particle intersected along the tape (Figure SOP 12.1), categorized by diameter size class 0-0.62 cm (0-0.25 inch), 0.63-2.54 cm (>0.25-1.00 inch), 2.55-7.60 (>1.00-3.00 inch), and >7.60 cm (>3.00 inch), using a go-no-go gauge. Record the tally on the data sheet for down wood, duff, and litter (Appendix SOP 12A).
2. Particles that are 0-0.62 and 0.63-2.54 cm are tallied separately on the following segment of transect A: 13-15 m. **Do not record these size classes on any other transect.**
3. Particles that are 2.55-7.60 cm are tallied on the following segment of transect A: 11-15 m. **Do not record these size classes on any other transect.**
4. Particles that are larger than 7.60 cm are tallied from the 2.5 to 15 m mark along transects A, B, and C. In addition, their diameter (in centimeters) where they cross the line is recorded. All particles in this size range are identified to species when possible and assigned to one of two decay classes, solid or rotten. Rotten wood is that which is obviously deteriorating or punky (Table SOP 12.1).
5. Measurement of all particles is taken perpendicular to the point where the tape crosses the central axis (Figure SOP 12.2). Count intercepts along the transect plane up to 1.8 m from the ground.
6. When determining if you should include down wood in the sample, observe the following:
   - Do not count stems and branches attached to standing shrubs or 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 a curved piece more than once, tally each intersection.
- Tally uprooted stumps and roots not encased in dirt. Do not tally undisturbed stumps.
- For rotten logs that have fallen apart, visually construct a cylinder containing the rotten material and estimate its diameter. Measure through rotten logs whose central axis is in the duff layer.
- Tally dead trees IF they are leaning >45 degrees from vertical and <1.37 m from the ground. Do not tally live trees or standing dead trees and stumps that are still upright and leaning <45 degrees from vertical.
- If a transect intersects a large pile of material such as a wood rat's nest or a recently fallen tree (with many attached fine branches), crews should estimate a count but note the reason for the high count.
- Broken logs should be measured their entire length and the spaces between sections subtracted.
- Do not tally cones, bark, needles, or leaves.
- **Only execute this SOP in forested or wooded vegetation types.** In non-forested vegetation types that are becoming colonized by trees, only execute this SOP when the densitometer readings have ≥55 canopy hits total from all sampling points (272) per plot. Otherwise, while in vegetation types that are treeless or have low tree cover, do not execute any of the directives in this SOP. If a plot was formerly wooded or forested and this SOP had been previously implemented, then keep executing this SOP in that plot until there is no longer any discernable down tree material that can be recorded following these guidelines.

Table SOP 12.1. Decay classes for pieces >3 inches diameter (modified from Odion et al. 2011).

Decay Class	Structural Integrity	Texture of Rotten Portions	Invading Roots	Branches and Twigs
Solid	Sound, freshly fallen, intact logs	Intact, no rot; conks of stem decay absent	Absent	If branches are present, fine twigs are still attached and have tight bark
Solid	Sound	Mostly intact; sapwood partly soft but can't be pulled apart by hand	Absent	If branches are present, many fine twigs are gone and remaining fine twigs have peeling bark
Solid	Heartwood sound; piece supports its own weight	Hard, large pieces; sapwood can be pulled apart by hand or sapwood absent	Sapwood only	Branch stubs will not pull out
Rotten	Heartwood rotten; piece does not support its own weight but maintains its shape	Soft, small blocky pieces; a metal pin can be pushed into heartwood	Throughout	Branch stubs pull out

Decay Class	Structural Integrity	Texture of Rotten Portions	Invading Roots	Branches and Twigs
Rotten	None, piece no longer maintains its shape; spread on ground	Soft; powdery when dry	Throughout	Branch stubs and pitch pockets have rotten down

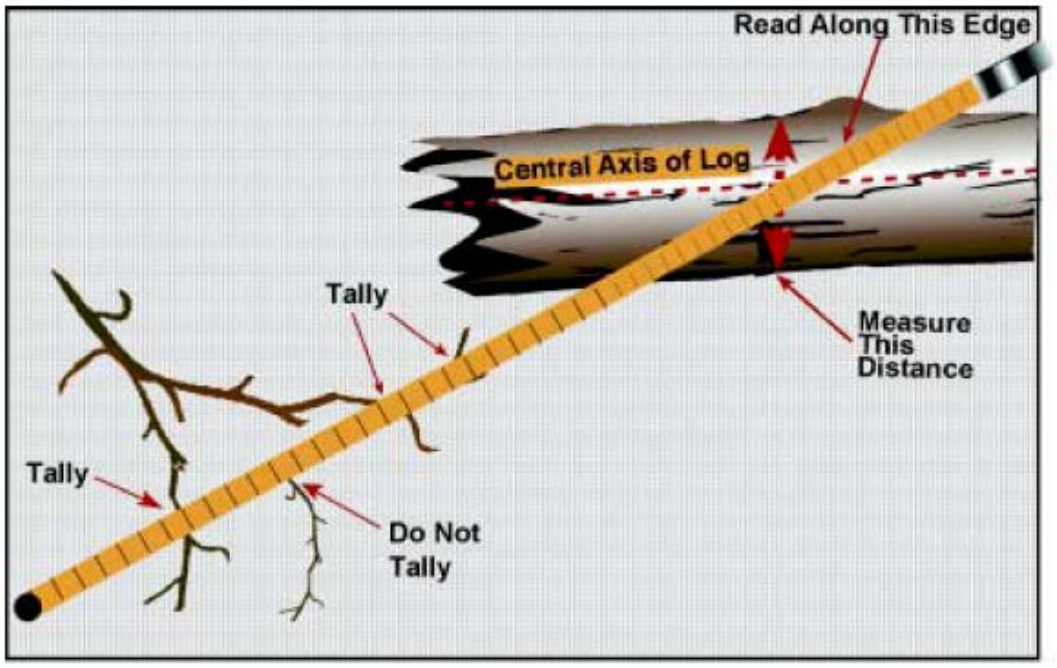


Figure SOP 12.2. Tally rules for dead and down fuel. Count all intersections, even curved pieces. All intersections must include the central axis in order to be tallied (source: National Park Service Fire Monitoring Handbook [USDI 2003]).

Litter, Duff, and Surface Height Measurements

As part of this protocol, litter, duff, and surface height will be sampled following the processes listed below. Field crew members should be familiar with and abide by the definitions provided at the end of this section.

Procedure

a. Take depth measurements for litter, duff, and surface height at the 2.5 and 8 m marks on transect A only. Take the measurement from anywhere within 1 m of the transect. Also, if a log or rock is along the transect at a sampling point, relocate the sample place to within 1 m of the obstruction.
b. Gently insert a trowel or knife into the ground until you hit mineral soil, and then carefully pull it away exposing the litter/duff profile. Locate the boundary between the litter and duff layers. Vertically measure the litter, duff, and surface height (if applicable) to the nearest millimeter.
c. Refill holes created by this monitoring technique.
d. Do not include twigs and larger stems in litter depth measurements.

e. Occasionally, moss, a tree trunk, stump, log, or large rock will occur at a measuring point. If a log is in the middle of the measuring point, move the point 0.5 m perpendicular to the sampling plane in a random direction.
f. If moss is present, measure the duff from the base of the green portion of the moss.
g. Lastly, record surface height if twigs and larger stems excluded by the litter measure are present.

Definitions

Litter—the layer of freshly fallen leaves, needles, twigs (<6 mm in diameter), cones, detached bark chunks, dead moss, dead lichens, detached small chunks of rotted wood, dead grasses, dead herbaceous stems, and flower parts (detached and not upright). Litter is the loose plant material found on the top surface of the forest floor. Litter does not include animal manure. Litter is defined as undecomposed or only partially decomposed organic material that can be readily identified (e.g., plant leaves, twigs, etc.).

Duff—the layer just below litter. It consists of decomposing leaves and other organic material. You should see NO recognizable plant parts. The duff layer is usually dark decomposed organic matter. This layer is distinguished from the litter layer in that the original organic material has undergone sufficient decomposition that the source of this material (e.g., individual plant parts) can no longer be identified. The bottom of this layer is the point where mineral soil (A horizon) begins. If unsure of the bottom of the duff layer, crews should feel the texture of the suspect material in their hand. Rub the soil between your fingers. Does it crumble (duff) or feel more like modeling clay (mineral).

Surface height—the layer that includes the duff and litter layers plus the larger twigs (>6 mm in diameter) and stems that were not recorded for litter depth. Surface height = Duff depth + Litter Depth + Twig and Stem height.

Literature Cited

National Park Service (NPS) 2003. Fire Monitoring Handbook. Boise (ID): Fire Management Program Center, National Interagency Fire Center. 274pp.

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

Appendix SOP 12A. Dead and down wood and litter data sheet.

Also located on the GOGA server at:
\\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\DOCUMENTS\DataSheets.

Data Sheet ____ of ____ Per Plot
Fuels Transects

Date: _____ Park: _____ Veg. Type_____
Observer / Recorder: Stand ID: _____
_____ Plot ID: _____

Tally 1 hr fuels from **13-15 m**; 10 hr from **13-15 m**; 100 hr from **11-15 m**. Measure 1000 hr from **2.5-15 m**
For 1000 hr fuels, indicate if down stem is solid (S) or rotten (R). Surface Height = Litter + Duff + Woody Fuels

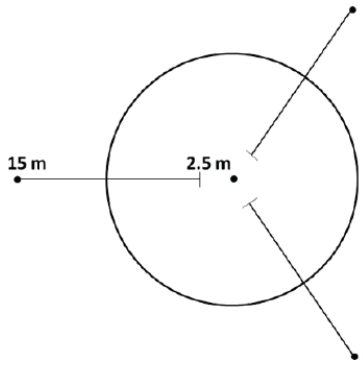
Transect A (30°)

1 hr Fuels (0 - 0.25") **0 - 0.62 cm**	10 hr Fuels (>0.25 - 1") **0.63 - 2.54 cm**	100 hr Fuels (>1 - 3") **2.55 - 7.60 cm**	1000 hr Fuels (> 3") **> 7.60 cm**			Litter & Duff Depth (cm)		
			Species	Diameter (cm)	S/R		2.5 m	8 m
						Litter		
						Duff		
						Surface Height		

Transect B (150°)

1000 hr Fuels (> 3")		
Species	Diam (cm)	S/R

Transect C (270°)



1000 hr Fuels (> 3")		
Species	Diam (cm)	S/R

SOP 13: Vegetation Database

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP provides the details on the design and set-up of the database that is to be used to enter data for the plant community monitoring program including the relationship diagram. To learn how to use the database to enter data, see SOP 14. This document was adapted from the National Park Service, Klamath Network Vegetation Monitoring Protocol (Odion et al. 2011).

Database Set-up

There are a variety of databases that have been developed to store and manage vegetation data. San Francisco Bay Area Network (SFAN) considered several of these databases, but we were unable to find a database that could meet the majority of the needs of our project. Therefore, we have developed a database using the Natural Resource Database Template (NRDT) developed by the National Park Service (NPS). The NRDT:

- Provides both a data interchange standard and a standard MS Access database core that allow flexibility in application design.
- Serves as a starting point for application development that can be extended as necessary to accommodate any inventory or monitoring field sampling protocol.
- Standardizes location and observation data to facilitate the integration of datasets.
- Acts as a design platform for developing database applications in MS Access allowing users to enter, edit, display, summarize, and generate reports for inventory or monitoring datasets.
- Integrates with other inventory and monitoring data management systems and data standards including the NPS Data Store, Geographic Information System (GIS) tools and data, the NPS GIS Committee Data Layers Standard, and the NPS Metadata Profile.

The NRDT Front-end Application Builder (FAB) is a Microsoft Access file (Figure SOP 13.1) that is intended to be used by developers of NRDT applications to create a front-end (user-interface) to an NRDT v.3.2 back-end (database). Both the FAB and the database are stored on the network server

here: \\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\DATA\Database\. The FAB comes with many built-in features, including:

- table linking utility
- data backup
- compaction
- lookup table management
- main menu
- standardized data entry forms for core NRDT v.3.2 tables
- standardized data "gateway" form for retrieving records



Figure SOP 13.1. Main screen of the SFAN plant community monitoring database.

Database Structure

Updating Database Structure

A Metadata Interview form and updated data dictionary are submitted at the end of the year which should indicate if any changes to the database are needed. In addition, it is always a good idea to check with the vegetation ecologist prior to the start of the field season to see if there are additional changes needed. At this point, you should make any necessary changes to the structure of the

database. Brief descriptions of the database elements are provided in the tables (Table SOP 13.1 and 13.2), and relational diagram (Appendix SOP 13A) provided below.

Tables, Queries, Forms, Reports, Modules, and Macros

There are a variety of tables, queries, forms, reports, modules, and macros in this database. Tables are located in the back-end database while the other object types are located in the FAB. A brief description of the tables is provided in Table SOP 13.1.

Table SOP 13.1. A brief description of the tables that are in the SFAN backend vegetation database.

Table Name	Description
tbl_Db_Meta	Database description and links to I&M metadata tools.
tbl_Db_Revisions	Revision history of the database.
tblDBHDensityCircles	Tree and sapling density and tree DBH in the 7.32 m radius subplot plus the larger USFS FIA 17.95 m radius sampling plot.
tblDensitometer	Densitometer readings.
tblDensitySquares	Woody plant Density in 3m x 3m Quadrats.
EventContacts	Cross-reference table between events and contacts.
EventGroups	Event aggregations (e.g., season, trip).
tblEvents	Sampling events – general information about a visit to the site.
tbl_Fuels	Fuels data - down woody debris plus litter and duff.
tblLocations	Location of sample sites.
tblNAWMA	NAWMA plot data: litter depth and soil disturbance in 1 x 1 m subplots.
tbl_NAWMASpecies	Species cover and richness in circular NAWMA plot and 1 x1 m subplots.
tbl_PlotInfo	Environmental attributes of a plot.
tbl_PointLineIntercept	Point-line intercept data.
tbl_PointLineInterceptDetail	Links point line intercept data to specific sampling locations along each transect.
tluContacts	Contact data for project-related personnel.
tluDeathCauses	Values for all tree mortality causes
tluLifeStages-DBH	Life stage drop-down menu for tblDBHDensityCircles.
tluLifeStagesDensity	Life stage drop-down menu for tblDensitySquares.
tluLocTypes	Location type codes and descriptions (e.g., REDW = Redwoods).
tluMasterLookups	Master lookups.
tluSampleFrames	Sample frame descriptions.
tluSpecies	Species taxonomic information.
tluTransectDistances	Transect Distance Values.
tluUnits	Park unit information.
tluVegCodes	Vegetation type codes.

Data Dictionary

The core of the database is centered on the visits (tbl_events) to a site. Location and site specific data are linked to the visit using the unique identifiers labeled “Event_ID.” The fields in each table and

lookup table are presented in table format in Table SOP 13.2 below. A graphical representation of the relationships between tables and lookup tables is presented in Appendix SOP 13A.

Table SOP 13.2. A brief description of the forms that are in the SFAN backend vegetation database.

TABLE NAME: tbl_Db_Meta

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Database description and links to I&M metadata tools.

FORMAT: Microsoft Access

NO. OF FIELDS: 4

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
Db_Meta_ID	dbText	50	Local primary key.
Db_Desc	dbMemo	0	Description of the database purpose.
Meta_MID	dbText	50	Link to NR-GIS Metadata Database.
DSC_GUID	dbText	50	Link to I&M Dataset Catalog desktop metadata tool.

TABLE NAME: tbl_Db_Revisions

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Revision history of the database.

FORMAT: Microsoft Access

NO. OF FIELDS: 6

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
Revision_ID	dbText	50	Database revision (version) number or code.
Revision_Contact_ID	dbText	50	Link to tlu_Contacts.
Db_Meta_ID	dbText	50	Link to tbl_DB_Meta.
Revision_Date	dbDate/Time	8	Database revision date.
Revision_Reason	dbMemo	0	Reason for the database revision.
Revision_Desc	dbMemo	0	Revision description.

TABLE NAME: tblDBHDensityCircles

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Tree and sapling density and tree DBH in the 7.32 m radius subplot plus the larger USFS FIA 17.95 m radius sampling plot.

FORMAT: Microsoft Access

NO. OF FIELDS: 7

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
DBH	dbNumber	Integer	DBH (CM).
Tally	dbNumber	Integer	Sapling tally.
DecayStage	dbText	5	Decay Stage (1,2,3,4,5).
DeathCause	dbText	5	Cause of Death.
Notes	dbMemo	0	Notes.
CreatedDate	dbDate	8	Date created.
LastModifiedDate	dbDate	8	Date last modified.

TABLE NAME: tblDensitometer

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Densitometer readings.

FORMAT: Microsoft Access

NO. OF FIELDS: 9

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
DensitometerID	AutoNumber	4	Densitometer record ID.
EventID	dbNumber	Long Integer	Event identifier.
LocationDens	dbText	7	Location Center (A, B, C,Center).
HitsN	dbNumber	Long Integer	Canopy Hits North.
HitsE	dbNumber	Long Integer	Canopy Hits East.
HitsS	dbNumber	Long Integer	Canopy Hits South.
HitsW	dbNumber	Long Integer	Canopy Hits West.
CreatedDate	dbDate	8	Date created.
LastModifiedDate	dbDate	8	Date modified.

TABLE NAME: tblDensitySquares

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Woody plant Density in 3m x 3m Quadrats.

FORMAT: Microsoft Access

NO. OF FIELDS: 9

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
DensitySquaresID	AutoNumber	Long Integer	Density squares record ID.
EventID	AutoNumber	Long Integer	Event identifier.
TransectID	dbText	5	Transect ID.
SpeciesID	dbNumber	Long Integer	Species ID Code.
Dead	Yes/No	True/False	Check when dead.
LifeStage	dbText	20	Life stage.

Density	dbNumber	Integer	Density.
CreatedDate	dbDate	8	Date created.
LastModifiedDate	dbDate	8	Date last modified.

TABLE NAME: EventContacts

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Cross-reference table between events and contacts.

FORMAT: Microsoft Access

NO. OF FIELDS: 2

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
Event_ID	Number	Long Integer	Link to tbl_Events (Event_ID).
Contact_ID	Number	Long Integer	Link to tlu_Contacts (Contact_ID).
ContactRole dbText	dbText	50	The contact's role in the protocol (Cnt_Role).

TABLE NAME: EventGroups

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Event aggregations (e.g., season, trip).

FORMAT: Microsoft Access

NO. OF FIELDS: 9

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventGroupID	AutoNumber	Long Integer	Event group record ID.
StartDate	dbDate	8	M Starting date of the event group (Start_Date).
EndDate	dbDate	50	Ending date of the event group (End_Date).
EventGroupName	dbText	50	Event group (e.g., season, trip) name (Ev_Gp_Name).
EventGroupDesc	dbText	50	Event group description (Ev_Gp_Desc).
EventGroupNotes	dbMemo	0	Event group notes (Ev_Gp_Note).
EventGroupReport	dbText	255	Trip report, link to trip report or trip report name (Ev_Gp_Rept).
CreatedDate	dbDate	8	Date created.
LastModifiedDate	dbDate	8	Date last modified.

TABLE NAME: tblEvents

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Sampling events – general information about a visit to the site.

FORMAT: Microsoft Access

NO. OF FIELDS: 10

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	AutoNumber	Long Integer	Event identifier.
LocationID	Number	Long Integer	Link to tbl_Locations.
Event_GroupID	dbText	4	Link to tbl_Event_Group (Ev_Gp_ID).
ProtocolName	dbText	100	The name or code of the protocol

			governing the event (Protcl_Nam).
StartDate	dbDate	8	Starting date for the event (Start_Date).
StartTime	dbDate	8	Starting time for the event (Start_Time).
EndTime	dbDate	8	Ending time for the event (End_Time).
EventNotes	dbMemo	0	Event Notes.
CreatedDate	dbDate	8	Date created.
LastModifiedDate	dbDate	8	Date last modified.

TABLE NAME: **tbl_Fuels**

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Fuels data - down woody debris plus litter and duff.

FORMAT: Microsoft Access

NO. OF FIELDS: 17

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
FuelsID	AutoNumber	Long Integer	Fuels record ID.
EventID	AutoNumber	Long Integer	Event identifier.
TransectID	dbText	5	Transect ID.
1hrFuels	dbNumber	Integer	1 Hour Fuels.
10hrFuels	dbNumber	Integer	10 Hour Fuels
100hrFuels	dbNumber	Integer	100 Hour Fuels.
1000hrSpeciesID	dbNumber	Long Integer	1000hr_Species ID Code.
1000hrDiameter	dbNumber	Long Integer	1000 Hour Diameter (CM).
SolidRotten	dbText	8	Solid or Rotten.
2_5LitterDepth	dbNumber	Integer	2.5 CM Litter Depth.
2_5DuffDepth	dbNumber	Integer	2.5 CM Duff Depth.
2_5SurfaceDepth	dbNumber	Integer	2.5 CM Surface Depth.
8SurfaceDepth	dbNumber	Integer	8 CM Surface Depth.
8LitterDepth	dbNumber	Integer	8 CM Litter Depth.
8DuffDepth	dbNumber	Integer	8 CM Duff Depth.
CreatedDate	dbDate	8	Date created.
LastModifiedDate	dbDate	8	Date last modified.

TABLE NAME: tblLocations

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Location of sample sites.

FORMAT: Microsoft Access

NO. OF FIELDS: 19

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
LocationID	AutoNumber	Long Integer	Data location identifier (Data_Loc_ID).
UnitCode	dbText	10	Park, Monument or Network code (Unit_Code).
LocName	dbText	100	Name of the location (Loc_Name).
LocType	dbText	25	Location type category (Loc_Type).
GISLocationID	dbText	50	Link to GIS feature, equivalent to NPS_Location_ID (GIS_Loc_ID).
MetaMID	dbText	50	Link to NR-GIS Metadata Database (Meta_MID).
XCoord	dbDouble	8	X coordinate (X_Coord).
YCoord	dbDouble	8	Y coordinate (Y_Coord).
CoordUnits	dbText	10	Coordinate distance units (Coord_Unit).
CoordSystem	dbText	20	Coordinate system (Coord_Syst).
UTMZone	dbText	2	UTM Zone (UTM_Zone).
Datum	dbText	5	Datum of mapping ellipsoid (Datum).
EstHError	dbSingle	4	Estimated horizontal accuracy (Est_H_Error).
AccuracyNotes	dbText	255	Positional accuracy notes (Acc_Notes).
LocNotes	dbMemo	0	General notes on the location (Loc_Notes).
GPSDate	dbDate	8	GPS or digitized date of coordinates (GPS_DATE).
UpdatedDate	dbDate	8	Date of entry or last change (Upd_Date).
CreatedDate	dbDate	8	Date created.

LastModifiedDate	dbDate	8	Date last modified.

TABLE NAME: tblNAWMA

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: NAWMA plot data: litter depth and soil disturbance in 1 x 1 m subplots.

FORMAT: Microsoft Access

NO. OF FIELDS: 11

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
NAWMAID	AutoNumber	Long Integer	NAWMA plot ID.
EventID	AutoNumber	Long Integer	Event identifier.
TransectID	dbText	5	Transect ID.
LitterDepth1	dbNumber	Decimal	Litter depth at point 1.
LitterDepth2	dbNumber	Decimal	Litter depth at point 2.
LitterDepth3	dbNumber	Decimal	Litter depth at point 3.
LitterDepth4	dbNumber	Decimal	Litter depth at point 4.
LitterDepth5	dbNumber	Decimal	Litter depth at point 5.
SoilDistDensity	dbNumber	Byte	Density of small mammal disturbance.
CreatedDate	dbDate	8	Date created.
LastModifiedDate	dbDate	8	Date last modified.

TABLE NAME: tbl_NAWMASpecies

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Species cover and richness in circular NAWMA plot and 1 x1 m subplots.

FORMAT: Microsoft Access

NO. OF FIELDS: 9

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
NAWMASpeciesID	AutoNumber	Long Integer	Unique identifier for species/plot.
NAWMAID	dbNumber	Integer	NAWMA plot ID.
SpeciesID	dbNumber	Long Integer	Species ID code.
Dead	Yes/No	True/False	Check for dead.

HitsInQuadrat	dbNumber	Byte	Number of hits.
RootedInQuadrat	Yes/No	True/False	Species is rooted in 1m^2 quadrat.
RootedInNAWMA	Yes/No	True/False	Species is rooted in NAWMA plot.
CreatedDate	dbDate	8	Date created.
LastModifiedDate	dbDate	8	Date last modified.

TABLE NAME: **tbl_PlotInfo**

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Environmental attributes of a plot.

FORMAT: Microsoft Access

NO. OF FIELDS: 9

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
PlotInfoID	AutoNumber	Long Integer	Plot information record ID.
EventID	dbNumber	Integer	Event identifier.
VegCode	dbText	10	Vegetation Code.
Aspect	dbNumber	Long Integer	Aspect.
SlopeUphill	dbNumber	Long Integer	Slope Uphill (Degrees).
SlopeDownhill	dbNumber	Long Integer	Slope Downhill (Degrees).
DisturbancesNotes	dbMemo	0	Disturbance and Notes.
CreatedDate	dbDate	8	Date created.
LastModifiedDate	dbDate	8	Date last modified.

TABLE NAME: **tbl_PointLineIntercept**

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Point line intercept data.

FORMAT: Microsoft Access

NO. OF FIELDS: 7

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION

PointLineInterceptID	AutoNumber	Long Integer	Point line intercept record ID.
EventID	dbNumber	Integer	Event identifier.
TransectID	dbText	5	Transect ID.
Aspect	dbNumber	Long Integer	Species ID code.
Dead	Yes/No	True/False	Check for dead.
CreatedDate	dbDate	8	Date created.
LastModifiedDate	dbDate	8	Date last modified.

TABLE NAME: **tbl_PointLineInterceptDetail**

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Links point line intercept data to specific sampling locations along each transect.

FORMAT: Microsoft Access

NO. OF FIELDS: 5

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
PointLineInterceptDetailID	AutoNumber	Long Integer	Point line intercept detail record ID.
PointLineInterceptID	AutoNumber	Long Integer	Point line intercept record ID.
TransectDistance	dbText	5	Transect Distance (Meters).
CreatedDate	dbDate	8	Date created.
LastModifiedDate	dbDate	8	Date last modified.

TABLE NAME: tluContacts

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Contact data for project-related personnel.

FORMAT: Microsoft Access

NO. OF FIELDS: 17

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
ContactID	AutoNumber	Long Integer	Contact identifier.
LastName	dbText	50	Last name (Cnt_Last).
FirstName	dbText	50	First name (Cnt_First).
MiddleInit	dbText	4	Middle initial (Cnt_MI).
Organization	dbText	50	Organization or employer (cntorg).
PositionTitle	dbText	50	Title or position description (cntpos).
AddressType	dbText	50	Address (mailing, physical, both) type (addrtype).
Address	dbText	50	Street address (cntaddr).
Address2	dbText	50	Address line 2, suite, apartment number (Cnt_Addr2).
City	dbText	50	City or town (city).
StateCode	dbText	8	State or province (state).
ZipCode	dbText	50	Zip code (postal).
Country	dbText	50	Country (country).
EmailAddress	dbText	50	E-mail address (cntemail).
WorkPhone	dbText	50	Phone number (cntvoice).
WorkExtension	dbText	50	Phone extension (Work_Ext).
ContactNotes	dbMemo	0	Contact notes (Cnt_Notes).

TABLE NAME: tluDeathCauses

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Values for all tree mortality causes

FORMAT: Microsoft Access

NO. OF FIELDS: 1

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
DeathCause	dbText	25	Cause of Death - DBHDensityCircles.

TABLE NAME: tluLifeStages-DBH

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Life stage drop-down menu for tblDBHDensityCircles.

FORMAT: Microsoft Access

NO. OF FIELDS: 2

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
LifeStage	dbText	25	Life Stage – Mature, Sapling, Sprout
RecordDBH	Yes/No	True/False	Was DBH recorded?

TABLE NAME: **tluLifeStagesDensity**

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Life stage drop-down menu for tblDensitySquares.

FORMAT: Microsoft Access

NO. OF FIELDS: 1

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
LifeStage	dbText	20	Life Stage – Sapling, Seedling, Sprout, Thicket.

TABLE NAME: **tluLocTypes**

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Location type codes and descriptions (e.g., REDW = Redwoods).

FORMAT: Microsoft Access

NO. OF FIELDS: 2

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
LocType	dbText	25	Location Type (e.g., REDW).
LocTypeDesc	dbText	255	Locationan Type Description (e.g., Redwoods.

TABLE NAME: **tluMasterLookups**

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Master lookups.

FORMAT: Microsoft Access

NO. OF FIELDS: 4

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
LUCode	dbText	50	Code or ID for that category of lookup.
LUValue	dbText	50	Value for the look up code.
LUCategory	dbText	50	The field or category that the codes and values link up to.
LUOrder	dbNumber	Integer	Sort Order.

TABLE NAME: **tluSampleFrames**

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Sample frame descriptions.

FORMAT: Microsoft Access

NO. OF FIELDS: 2

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
SampleFrameCode	dbText	10	Sample Frame Code.
Description	dbText	255	Description.

TABLE NAME: tluSpecies

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Species taxonomic information.

FORMAT: Microsoft Access

NO. OF FIELDS: 16

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
SpeciesID	dbNumber	Long Integer	Species ID code.
Species	dbText	255	Full species name
IsGroundCover	Yes/No	True/False	Is the species a groundcover.
Family	dbText	255	Family.
Genus	dbText	255	Genus.
SpecificEpithet	dbText	255	Specific Epithet.
SpeciesAuthor	dbText	255	Species Author.
InfraSpecificRank	dbText	255	Infraspecific Rank.
InfraSpecificEptithet	dbText	255	Infraspecific Epithet.
InfraSpecificAuthor	dbText	255	Infraspecific Author.
NamePlusAuthors	dbText	255	Name Plus Authors.
ExpandedName	dbText	255	Expanded Name.
TJM1TJM2	dbText	255	TJM1 = taxonomy is unrevised since Jepson Manual 1st edition, TJM2 = taxonomic revision published in the Jepson Manual 2nd edition.
CommonNames	dbText	255	Common Names.
synonyms	dbText	255	Synonyms.
OtherSpeciesID	dbNumber	Long Integer	Other Species ID.

TABLE NAME: tluTransectDistances

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Transect Distance Values.

FORMAT: Microsoft Access

NO. OF FIELDS: 1

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
TransectDistance	dbText	5	The distances (cm.) where point line intercept measurements are taken along the woody vegetation transects.

TABLE NAME: **tluUnits**

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Park unit information.

FORMAT: Microsoft Access

NO. OF FIELDS: 16

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
UnitCode	dbText	10	Unit Code.
SampleFrameCode	dbText	10	Sample Frame Code.
PARENTCODE	dbText	10	Parent Code.
PARKNAME	dbText	255	Park Name.
PARKTYPE	dbText	255	Park Type.
NPSUnit	dbText	255	NPS Unit.
OFFICE	Yes/No	Yes/No	Office.
InCareOf	dbText	50	In Care Of.
ADDRESS1	dbText	255	Address 1.
ADDRESS2	dbText	255	Address 2.
CITY	dbText	255	City.
STATE	dbText	255	State.
ZIPCODE	dbText	255	Zip Code.
ORGCODE	dbText	255	Org Code.
HqtrPhone	dbText	255	Headquarters Phone.
SuptPhone	dbNumber	255	Support Phone.
TDDPhone	dbText	255	TDD Phone.
FaxPhone	dbText	255	Fax Phone.
InfoPhone	dbText	50	InfoPhone.
NPSEmail	dbText	50	NPS Email.
REGIONCODE	dbText	255	Region Code.
REGIONNAME	dbText	255	Region Name.

CLUSName	dbText	255	CLUS Name.

TABLE NAME: **tluVegCodes**

FILENAME: SFAN_PlantCC_be.accdb

DESCRIPTION: Vegetation type codes.

FORMAT: Microsoft Access

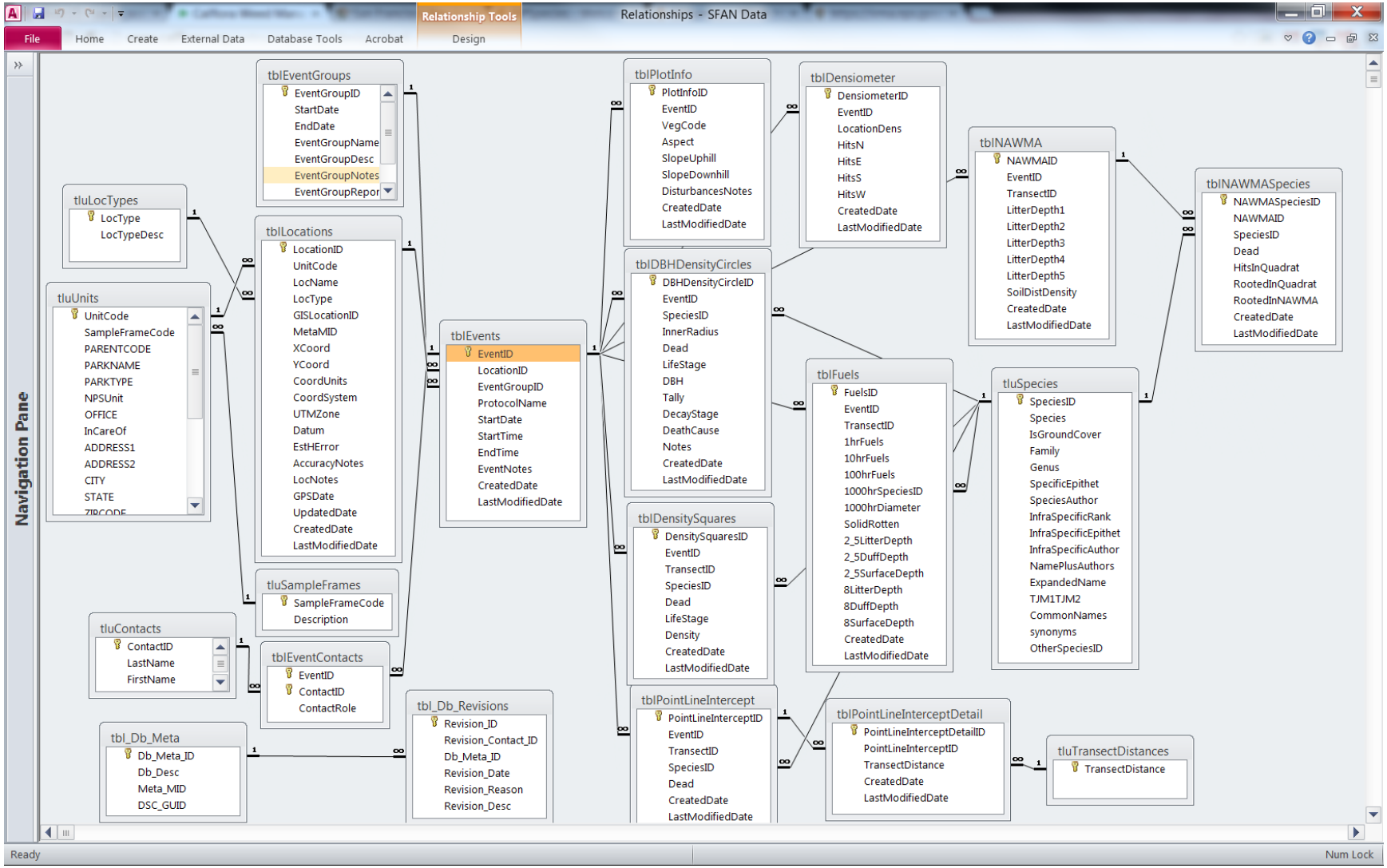
NO. OF FIELDS: 1

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
VegCode	dbText	10	Vegetation Type Code (e.g., REDW).

Literature Cited

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

Appendix SOP 13A. Relational diagram of the back-end database used to record plant community monitoring data.



SOP 14: Data Entry, Quality Assurance, and Quality Control

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP provides the details of how to enter data into the plant community monitoring database. All crews will enter data on paper datasheets and transfer the written data into the database. This document was adapted from the National Park Service, North Coast Cascade and Klamath Networks' Vegetation Monitoring Protocols (see Acker et al. 2010 and Odion et al. 2011).

From Field to Database

Hardcopy paper field forms or data sheets will be carried to the site and used for all data recording. Crews should be sure to complete all of the forms required per sampling plot. At the top of the form, be sure to enter the number of pages for all datasheets collected per sampling plot. For example, if 12 datasheets were populated at a sampling plot, the third datasheet would say 3 of 12 at the top of the datasheet. Following each day in the field and after error checking, data sheets will be scanned into an electronic Adobe pdf file format and stored in a shared Google Drive folder. An electronic copy of all scanned data sheet will also be stored on the SFAN network drive, here: \\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\DATA\Scanned_Field_Forms. The original paper data sheets will be stored in the file cabinet of the San Francisco Bay Area Network (SFAN) vegetation ecologist within the SFAN office. The following are general guidelines for entering data from field forms into the database:

1) Data should be entered as soon after data collection as possible so that field crews remain current with data entry tasks, and identify any errors or problems as close to the time of data collection as possible.
2) The front-end database application is a Microsoft Access file maintained in the project workspace (SOP 13). This front-end copy may be considered "disposable" because it does not contain any data, but rather acts as an interface with data residing in the back-end database. It contains the forms and formatted report objects for interacting with the data in the back-end.

3) Each data entry form is patterned after the layout of the field form, and has built-in quality assurance components such as pick lists and validation rules to test for missing data or illogical combinations. Although the database permits users to view the raw data tables and other database objects, users are strongly encouraged only to use the pre-built forms as a way of ensuring the maximum level of quality assurance.
4) As data are being entered, the person entering the data should visually review each data form to make sure that the data on screen match the field forms. This should either be done for each record prior to moving to the next form for data entry, or as a separate step after all of the data for a sampling trip have been entered. **It is a requirement that all events must be entered and verified before the end of the field season**.
5) At regular intervals and at the end of the field season the Field Lead should inspect the data that have been entered to check for completeness and errors.

Database Entry

Once you have the front-end database opened (SFAN_PlantCommunities_DB_FE.accdb) and it is linked to the backend database (SFAN_PlantCommunities_DB_BE.accdb), both of which are stored here: \inpgogamahe1\NetworkIM\VitalSigns\PlantCommunities\DATA\Database, then you will be ready to enter data. Follow the steps below to complete the database entry portion of this protocol.

1. Click on the “Enter / edit data” button.
2. Using the drop down list in the “User” field, select your name. If your name is not in the list, click the “New User” button and populate all the information and hit “Close.” Make certain the additional fields on the “Set application default values” form match the list below.
    a. Network = The Park Where You Are Working
    b. Datum = NAD83
    c. UTM Zone = 10S
    d. Project = SFAN Plant CC
    e. Activity = enter
3. Once these fields are properly populated, click “OK.”
4. You will be directed to the Data Gateway form. You may or may not see a list of all the records that have already been entered. Do not alter these records unless you are doing an edit. If you are entering new data for a stand sampled that year, go to step 5. If you are editing a previously entered data, in the filter box enter the park which has the data you want to edit. Find the record you want to edit and double click on the “Visit Date” field. Make any necessary edits.
5. At the top of the screen, click the “Add a New Record” button.
6. Using the drop down list in the “Location” field, select the name of your sampling plot.
7. Next to the “Location” field, click the “Edit” button.
8. Some of this record should already be completed; however, you will need to populate the following fields:
    a. If this is the first time, then enter the X and Y coordinates for the center of the plot.
    b. Date.

   c. Add any visit notes that may be necessary.
   d. Contact; a drop down menu will provide crew member names. If you need to add a new contact, click on “Add a person” button and enter their name and contact information.
   e. Role; a drop down menu will give options (Field Lead, Observer, etc.) to choose from.
9. Click on the “Plot_Info” tab and record the data following the methods outlined in SOP 6: Plot Set-up, Monumentation, and Description and SOP 7: Photographing Plots and Photo Management.
10. Click on the “NAWMA Richness” tab and record the data following the methods outlined in SOP 8: North American Weed Management Association Subplot Sampling.
11. Click on the “Woody Density” tab and record the data following the methods outlined in SOP 9: Woody Plant Density Sampling in 3m x 3m Quadrats.
12. Click on the “Pt. Line Intrcpt” tab and record the data following the methods outlined in SOP 10: Point Line Intercept Transects for Vegetation Cover.
13. Click on the “Tree Sapling Density” tab and record the data following the methods outlined in SOP 11: Live and Dead Tree Sampling.
14. Click on the “Densitometer” tab and record the data following the methods outlined in SOP 10: Point Line Intercept Transects for Vegetation Cover and SOP 11: Live and Dead Tree Sampling.
15. Click on the “Fuels” tab and record the data following the methods outlined in SOP 12: Litter, Duff, and Down Wood Sampling.
16. When you are finished, click the “Close” button.
17. Make certain the new record shows up in the list on the Data Gateway Form and if it does, click the “Close” button.
18. Click the “Exit” button. NOTE: Do not click the small X in the upper right corner of the screen to close this application. Clicking the “Exit” button is a safer process to end this application.

Data Validation, Verification, and Archival

To ensure the data collected by SFAN is as accurate as possible, multiple reviews of the data are completed by a variety of staff. First, prior to leaving a site, a field crew member (preferable the one who did not enter the data) should review all the data sheets to make certain they are complete and accurate. Crew members should look for fields that should have been populated but were missed, data values that appear to be extreme, and any other potential errors. As mentioned previously, the person entering the data should visually review each data form to make sure that the data on screen match the field forms. This should either be done for each record prior to moving to the next form for data entry, or as a separate step after all of the data for a sampling trip have been entered.

At the end of the field season, it is the responsibility of the vegetation ecologist to review all data collected by the field crew. In addition to looking for errors similar to the ones described above,

techniques such as outlier detection and automated data analysis should be done to look for additional errors. This task should be completed prior to releasing field crews from service.

After the data have gone through the validation and verification process and the data, along with a certified datasheet, have been submitted to the Data Manager, it is the Data Manager's responsibility to conduct an additional review of the data to look for any potential errors missed by the field crew or vegetation ecologist. Once complete and discrepancies addressed, the data are ready for summarizations and analyses (SOP 15).

All electronic forms of data that are stored on the SFAN network drive are housed in a separate building than the I&M office. This network drive, which is located in Ft Cronkhite, GOGA, is backed up monthly to a hard disk stored at Pinnacles National Park. Paper hard copies of field forms will be kept in a file cabinet in the vegetation ecologist's office. After each vegetation type is resampled and the analysis and synthesis reports are completed for those types (SOP 15), these hard copies can be sent to the archives at Golden Gate National Recreation Area (GOGA), which is located in San Francisco in a stable, museum-like environment. Contact the GOGA archivist to arrange depositions.

Literature Cited

Acker, S. A., A. Woodward, J. R. Boetsch, K. Hutten, M. Bivin, R. Rochefort, C. C. Thompson, and L. Whiteaker. 2010. Forest vegetation monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/242. National Park Service, Fort Collins, Colorado.

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

SOP 15: Power Analyses, Data Analyses, and Reporting

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP reports the methods used to conduct power analyses on pilot vegetation data that follows this version of the protocol. This SOP also details the reporting and analysis components of the plant community monitoring protocol. There are two main elements to reporting: (1) annual reports, which focus on status, and (2) synthesis reports, which focus on trends and environmental relationships. These reports will be authored by the network vegetation ecologist with assistance from the Data Manager. The audience for the reports includes resource managers, San Francisco Bay Area Network (SFAN) staff, service-wide program managers, external scientists, and partners.

Power Analyses

Power analyses were performed on the key parameters that are to be summarized in annual reports and examined for trends in the synthesis reports. The results of these power analyses are shown in Table 7 of the Narrative (Steers et al. 2016). Data used to perform these power analyses were untransformed pilot data collected from grassland, shrubland, and forested plant communities, all mapped and found within the coastal sample frame (Schirokauer et al. 2003). The grassland sampled was the native component grassland mapping unit restricted to chert soils as described in Steers and Spaulding (2013). The shrubland sampled was the *Baccharis pilularis* / *Artemisia californica* / *Toxicodendron diversilobum* / *Monardella villosa* Association. The forest sampled was the *Sequoia sempervirens* Alliance. Nine, six, and five stands were sampled, respectively, to acquire the grassland, shrubland, and forest pilot data from the specified plant communities. These data were collected in 2012 and used in the power analyses described below.

As mentioned in the Narrative, A 20% change in a parameter was used for these power analyses based on subjective reasons. First, a 20% change in one of the parameters is not so large that it would never take place. Second, this level of change is not too small that it would lack practical significance. It is clear that major disturbances, like wildfires, alter the majority of plant biomass and change vegetation parameters greatly. However, more subtle changes need to be detected by this

protocol. On the central coast of California, physiognomic shifts in vegetation types over 25-year periods have been recorded (Hsu et al. 2012). We are not sure what the minimum time-scale for type conversion is; although, the ability to detect 20% changes every five years over a 25-year period would allow us to detect successional shifts before type-conversion takes places and in time for management actions to alter successional trajectories, if necessary. And, this level of detection is not so small that it forces an unachievable number of sampling plots to be utilized for each of the diverse plant communities of interest.

The data from each of these plant communities were collected following the sample design and sampling plot surveying methods outlined in this version of the protocol. The software used to perform the power analyses was G*Power version 3.1.7 (Faul et al. 2007). G*Power is power analyses software package that has been recommended for use in ecological studies (Thomas and Krebs 1997). The power analyses utilized were based on two-tailed, paired t-tests and were conducted by the network vegetation ecologist. Power analyses were done at varying levels of alpha (α) and beta (β) to detect 20 % changes (see Narrative, Table 6 in Steers et al. 2016).

When evaluating the sample design, power analyses on herbaceous plant cover were performed with data collected from the grassland stands since herbaceous cover is the main parameter that characterizes this plant community. Likewise, shrub cover and shrub density data that were assessed for power came from the shrubland stands and not form the other two plant communities. Also, all tree-related parameters analyzed with the power analyses were derived from the forested stands sampled.

For many key parameters, a sample size of 12 was adequate to detect the desired level of change (20 percent) at relatively strict error probabilities: α at 0.05 and β at 0.05. However, for the following parameters, dead shrub density, shrub seedling density, dead tree density, sapling density, dead sapling density, and tree seedling density, a sample size of 12 was not adequate to detect a 20 percent change at acceptable error probabilities: α at 0.05 and β at 0.20. However, because these are parameters that are typically variable and/or infrequent in healthy and mature vegetation types, we are not concerned they did not perform at the minimum acceptable error probabilities. Although, we will evaluate their power in the future following events that we expect would change their relative importance in the vegetation, like after wildfires, pathogen outbreaks, or other disturbances or stressors.

Overall, based on the power analyses, we determined that the minimum sample size should be 12 for any one plant community (based on detecting a 20% change with an α of 0.05 and a β of 0.20). This sample size will be utilized for the least abundant plant communities being monitored. Although, most plant communities being monitored have >12 sampling plots since they are relatively more abundant.

Approach to Data Reporting

The primary monitoring objective of this protocol is to detect changes in vegetation structure and species composition in selected SFAN vegetation types. There will be at least two different types of reports that summarize the status and trends of the plant communities sampled. Annual reports will

focus on summarizing the structure and composition for plant communities each time one is sampled. Synthesis reports will summarize the changes in structure and composition between sampling times for each plant community. Both of these reports will be specific to only one distinct plant community within each sampling frame (one plant community per report).

Another type of synthesis report will examine the relationships among biotic and abiotic parameters for each sample frame. It will be completed less frequently (once every five years starting at year ten) than the former trend-based synthesis report described above.

Annual reports will be formatted using the Natural Resource Data Series template. Synthesis reports will be formatted using the Natural Resource Technical Report template. Both templates can be downloaded here: http://www.nature.nps.gov/publications/nrpm/nrrnrtr.cfm. More information about these templates and documentation of the NPS publication standards are available at: http://www.nature.nps.gov/publications/NRPM/index.cfm.

Annual Reports

The purposes of annual reports are to summarize structure and composition parameters for each plant community sampled per field season. There are two sample frames covered by this protocol: the coastal parks sample frame that includes Golden Gate National Recreation Area/Muir Woods National Monument/Point Reyes National Seashore and the Pinnacles National Park (PINN) sample frame. Each of these frames is geographically and environmentally unique and the plant communities found within them have no analog within the other frame, at least at finer scales of classification. In addition, not all vegetation types in a sample frame are monitored at the same frequency or during the same year. Therefore, to ensure that managers can easily find information on each of the target plant communities, a separate annual report should be completed for each plant community monitored once the field season is complete.

Annual reports will be due to park managers and other interested parties and recipients on March 1st. For example, if four plant communities were sampled in the prior field season, then four annual reports, one for each community sampled, would be due the following March. For each annual report, after initial screening and quality control, data will be presented using summary statistics (mean and standard error) in a user-friendly format (data summarization tables). For every plant community, the same parameters should be summarized at the sample frame scale. The suggested parameters and corresponding metrics to report are outlined in Table SOP 15.1.

Table SOP 15.1. Suggested parameters to be summarized in annual reports.

Sampling Plot Sub-Component	Optimal for Measuring	No. of Times Sampled per Plot	Parameter to Report	Metric
1 m² Quadrats	Herbaceous Cover	3	Total Vegetated Cover	Cover (%)
			Total Non-vegetated Cover	
			Total Herbaceous Cover	
			Native Herbaceous Cover	
			Exotic Herbaceous Cover	
1 m² Quadrats	Herbaceous Species Richness	3	Total Richness	Richness per 1 m²
			Native Richness	
			Exotic Richness	
			Total Herbaceous Richness	
			Native Herbaceous Richness	
			Exotic Herbaceous Richness	
9 m² Quadrats	Shrub and Seedling Density	3	Live Shrub and Subshrub Density	Density per ha
			Native Shrub and Subshrub Density	
			Exotic Shrub and Subshrub Density	
			Dead Shrub and Subshrub Density	
			Live Shrub and Subshrub Seedling Density	
			Native Shrub and Subshrub Seedling Density	
			Exotic Shrub and Subshrub Seedling Density	
			Live Tree Seedling Density	
			Native Tree Seedling Density	
			Exotic Tree Seedling Density	
Point Line Intercept	Shrub and Vine Cover	3	Total Live Woody Plant and Vine Cover	Cover (%)
			Total Dead Woody Plant and Vine Cover	
			Total Non-Woody Cover	
			Live Shrub and Subshrub Cover	
			Native Shrub and Subshrub Cover	
			Exotic Shrub and Subshrub Cover	
			Live Vine Cover	

*see Jennings et al. 1999

Table SOP 15.1 (continued). Suggested parameters to be summarized in annual reports.

Sampling Plot Sub-Component	Optimal for Measuring	No. of Times Sampled per Plot	Parameter to Report	Metric
7.32 m radius	Species Richness	1	Total Richness	Richness per 168.3 m²
			Native Richness	
			Exotic Richness	
			Total Tree Richness	
			Native Tree Richness	
			Exotic Tree Richness	
			Total Shrub and Subshrub Richness	
			Native Shrub and Subshrub Richness	
			Exotic Shrub and Subshrub Richness	
			Total Herbaceous Richness	
			Native Herbaceous Richness	
			Exotic Herbaceous Richness	
17.95 m radius Circle	Tree and Sapling Density	1	Total Tree (Live plus Dead) Density	Density per ha
			Live Tree Density	
			Native Tree Density	
			Exotic Tree Density	
			Dead Tree Density	
			Native Tree Density	
			Exotic Tree Density	
			Total Sapling (Live plus Dead) Density	
			Live Sapling Density	
			Native Sapling Density	
			Exotic Sapling Density	
			Dead Sapling Density	
17.95 m radius Circle	Tree Basal Area	1	Live Tree Basal Area	m² per ha
			Native Tree Basal Area	
			Exotic Tree Basal Area	
			Dead Tree Basal Area	
			Native Tree Basal Area	
			Exotic Tree Basal Area	
Densitometer	Canopy Closure	4	Live and Dead Canopy Closure	Closure (%)*
Fuels Transects	Down and Dead Woody Debris	3	1 hour Fuels	Tons per acre
			10 hour Fuels	
			100 hour Fuels	
			1000 hour Fuels – Solid	
			1000 hour Fuels – Rotten	

*see Jennings et al. 1999

While very little to no data on tree parameters will be collected from grasslands, we still recommend reporting out every parameter listed above (even if zero values) so that the multiple vegetation types can be easily compared using the reports. In terms of how to display the parameters in each annual report, we suggest utilizing a table that lists the mean value and standard error per parameter based on all sampling plots per plant community. This table should be included in the body of the annual report. In terms of how to graphically display the parameters, we suggest referring to existing reports on grassland (Steers and Spaulding 2013), shrubland (Steers et al. 2011), and forest plant communities (Steers et al. 2014) that were based on pilot phase activities and utilized identical to similar methods as described in this version of the protocol. The annual reports should not be discursive. Each plant community being sampled per year will have a corresponding annual report; thus, a simple and straight-forward report is needed since many annual reports will be generated each year. For creating useful graphs, refer to the existing reports mentioned above for examples of how to portray the key parameters.

Each annual report should include one map that displays each sampling plot location and a table that lists their geographic coordinates. Additional tables that display data for each parameter listed in Table SOP 15.1 by sampling plot are also required in addition to the table reporting parameters by sample frame. Lastly, tables that list the species recorded and their abundance by sampling plot are required. Summarizing data by sampling plot is necessary so that status can be ascertained. Furthermore, land managers want to know where invasive plants, rare plants, or new species to the park were encountered (which sampling plot they were recorded from). Thus, displaying a map of plot locations and the actual values and species abundances for each plot is required.

Noteworthy Findings

Any noteworthy findings recorded from the sampling plots (e.g., new species documented for a park, natural disturbances like a wildfire or pathogen impacts, human disturbances like marijuana cultivation or new social trails) should be highlighted in annual reports. At the beginning and end of each field season, the vegetation ecologist should request information on the spatial location and extent (e.g., GIS shapefiles) of known disturbances or management actions within park unit where monitoring takes place, regardless of whether vegetation was sampled at that park unit that year. This will improve the ability of the monitoring program to document disturbances or management actions in the database and in the annual report beyond what is discernable by the crew in the field.

Invasive Plant Species Early Detection

As mentioned previously, there are high numbers of exotic species that occur in the SFAN park units. The Invasive Plant Early Detection Protocol (Williams et al. 1999) monitors populations of high priority weeds, but only along roads and trails. High priority weeds that are monitored by the Early Detection Protocol and are encountered in the plant community sampling plots need to be indicated in the annual report in a separate section (heading).

Protocol Refinement

A section of the annual report will be devoted to describing changes to the protocol and SOPs suggested by the field crew and vegetation ecologist as a result of implementation. If necessary, specific protocol revisions will be proposed for formal consideration (see SOP 19).

Synthesis Reports

There are two types of synthesis reports. One evaluates trends and the other evaluates the relationships among the biotic and abiotic parameters sampled. Each synthesis report should include a map that displays every sampling plot location that was utilized in the analyses.

Trend synthesis reports are primarily used to summarize vegetation trends. They should be produced each time a plant community is resurveyed. These reports should be distributed by May 1st of each year. For the coastal parks and the PINN sampling frames, the first synthesis report will be produced following the 2018 field season, which is the first time plant communities will be resampled. Trend analyses should also be performed for forest and woodland vegetation types even when just the subset of the stands is resurveyed (see Table 5 in Narrative [Steers et al. 2016]). Trend analyses, however, do not need to be conducted on the subset of grasslands that are being monitored annually during the first ten years of protocol implementation. Those data are simply being utilized to create a profile of interannual variability (the observed year-to-year range in values for different plant parameters), which will provide context for trend analyses on grassland plant communities. Also, no trend analyses are required following disturbances, like wildfires where burned plots would be monitored for the first three post-fire years, then at year five and every fifth year thereafter until 20 years postfire. This heightened sampling cycle is mainly used to inform managers if actions are required to assist native plant recovery and to improve our understanding of fire succession in the park units.

A second type of synthesis report is used to assess the relationships among vegetation and environmental parameters (Environmental Relationships). These reports should be based on data from all of the plant communities monitored per sample frame and not done individually by plant community like the synthesis reports that focus on vegetation trends. They should be created every five years starting with the second time all plant communities in each sample frame have been surveyed (starting at year ten and then every five years thereafter). These reports should be distributed by May 1st of each year. While correlations do not imply causation, assessing the inter-relatedness of the abiotic and biotic parameters measured will be helpful in the context of published experimental studies to understand vegetation dynamics. These analyses may also help improve park managers' general understanding of important environmental relationships in their park unit. These types of analyses are exploratory and the results should be interpreted under that context. They should be performed at least once for the reasons stated above, but ideally every five years as important relationships may change over time or turn out to be inconsistent.

Vegetation Trends

Trend synthesis reports on multi-year data are created separately for each unique plant community type per sampling frame. Determination of significant trends in the trend synthesis reports will depend on the degree of variance and the magnitude of change for each parameter measured. The first time a vegetation type is resurveyed, we recommend using paired t-tests, which the power analyses were based on, to assess changes in each vegetation parameter. Also, paired t-tests will be useful to assess significant changes in each parameter measured throughout the length of the monitoring program by comparing the first sample date with the most recent and also comparing the

last two sample dates. Trend synthesis reports should include a table that lists the parameters analyzed (similar to those listed in Table SOP 15.1). This table should report the mean and standard error of the two values (years) being analyzed per parameter, and include the t-value, p-value, and degrees of freedom. Parameters that were significantly different between years should be graphically displayed using box plots.

By the time each vegetation type has been surveyed at least three times, multi-year approaches should also be utilized. Specific statistical analyses are general linear models available in widely used statistical packages like R and SAS. The linear model should have the form:

$$St = b0 + b1^* t \quad (3)$$

where;

St = estimate of status at time 't'.

b0 = the derived intercept parameter;

b1 = the derived slope parameter;

t = the most recent time period of the data

Time units must match the sample interval used to generate b0 and b1

The derived slope (b1) and intercept (b0) parameters can be attained from the statistical analysis.

Separate graphs that display the values for each parameter over time and the fitted line resulting from the linear models should be produced. The equation of the line and the R^2 value should be included with these graphs. The statistics and significance levels generated from these analyses, including the b1 value should also be reported in a table, similar to the one made for the results of the paired t-tests. These analyses are based on the assumption that trends will be linear. While that may be the case for some parameters and for some plant communities, it will not be the case for many of the key parameters of interest. Thus, an additional option is to utilize nonlinear models and nonlinear mixed models as performed by van Mantgem et al. (2009) to assess tree morality trends in the western USA. Details on these analyses are provided in the supporting online material for this publication.

Environmental Relationships

After each sample frame has been sampled two times, vegetation and environmental data should be analyzed to explain fundamental vegetation and environmental relationships in the sampling frames. These analyses are distinct from the trend analyses described above and should be reported in distinct documents, referred to as environmental synthesis reports. Their purpose is to detect the interrelationships among environmental factors (e.g., litter depth, soil disturbance density, slope, aspect, etc.) and specific vegetation parameters (e.g., invasive species abundance, native herbaceous plant richness, shrub cover, etc.).

In the environmental synthesis reports, correlation matrices between environmental variables and vegetation parameters should be included. These matrices can be conducted with linear or non-linear regression analyses and should report the R^2 and *p*-values. Interactive effects among environmental variables, vegetation parameters, and time should be explored using multiple regression approaches to identify the most parsimonious predictive model [Akaike's information criterion (AIC) (Burnham and Anderson 1998)]. Tables that list the most parsimonious model and the parameters they include should be prepared and presented in the report following Rao et al. (2011) or Stephens et al. (2013).

Although statistically significant relationships may be uncovered, correlations do not imply causation. Interpretation of relationships should not be misleading. However, while these types of analyses are exploratory, they will still be helpful for developing an understanding of how species assemblages are shaped. These results can also be used in conjunction with published experimental studies to better understand mechanisms driving vegetation dynamics.

Analyzing the Performance of the Protocol Design

As mentioned previously in the annual report section, each report should include a section that allows the crew and vegetation ecologist to weigh in on what parts of the protocol need updating. This provides an opportunity for logistical, operational, and equipment issues to be improved annually. Exploring improvements to sampling methods or the study design should also be examined annually. Power analyses should be conducted for each plant community to assess how well the monitoring program can capture 20% changes to the key structural and compositional parameters, similar to the power analyses that were performed with the pilot data. In addition, the network should collaborate with a statistician to perform multi-year power analyses when the data become available to assess performance of the protocol design. These future analyses could be reported in a distinct power synthesis report.

Lastly, the types of plant communities that are most important to land managers may change over time. Currently, the senior staff who manage vegetation resources in each park unit have determined what plant communities should be monitored by this program. While these decisions were primarily based on which plant communities were the most abundant, there was still some subjectivity that influenced the selection of a few communities (see Appendix A in the Narrative [Steers et al. 2016]). We recommend holding a meeting every five years that coincides with the completion of a monitoring cycle in each sample frame. The meeting should be between the network program leads and the park vegetation managers. The purpose should be to discuss how the data is being utilized, what improvements could be made in execution and reporting, and what new revelations in management or power analyses warrant adding a new community to the monitoring schedule or removing one. Overall, caution must be taken in changing the target plant communities. Doing so is problematic because it disrupts the data cycle and result in a significant delay in trend determination.

Literature Cited

Burnham, K. P. and D. R. Anderson. 1998. Model selection and inference: a practical information-theoretic approach. Springer-Verlag, New York, New York, USA. 353 pp.

Faul, F., E. Erdfelder, A.-G. Lang, and A. Buchner. 2007. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior Research Methods 39:175-191.

Hsu, W., A. Remar, E. Williams, A. McClure, S. Kannan, R. Steers, C. Schmidt, and J. Skiles. 2012. The changing California coast: relationships between climatic variables and coastal vegetation succession. Pp. 247-258. Proceedings of the 2012 American Society for Photogrammetry and Remote Sensing Conference, Sacramento, California.

Jennings, S.B., N.D. Brown, and D. Sheil. 1999. Assessing forest canopies and understory illumination: Canopy closure, canopy cover and other measures. Forestry 72(1): 59–74.

Rao, L. E., R. J. Steers, and E. B. Allen. 2011. Effects of natural and anthropogenic gradients on native and exotic winter annuals in a southern California Desert. Plant Ecology 212:1079-1089.

Schirokauer, D., T. Keeler-Wolf, J. Meinke, and P. van der Leeden. 2003. Plant community classification and mapping project: Point Reyes National Seashore, Golden Gate National Recreation Area, San Francisco Water Department watershed lands, Mount Tamalpais, Tomales Bay, and Samuel P. Taylor state parks. National Park Service Unpublished Report, Point Reyes, California. Available at http://biology.usgs.gov/npsveg/pore_goga/pore_gogarpt.pdf (accessed 21 December 2011).

Steers, R., M. Denn, E. Wrubel, A. Forrestel, B. Johnson, L. Parsons, and F. Villalba. 2016. Plant community monitoring protocol for the San Francisco Bay Area Network of National Parks: Narrative Version 1.0. Natural Resource Report NPS/SFAN/NRR—2016/XXX. National Park Service, Fort Collins, Colorado.

Steers, R. J., and H. L. Spaulding. 2013. Native component grasslands of the Marin Headlands. Natural Resource Technical Report NPS/SFAN/NRTR—2013/832. National Park Service, Fort Collins, Colorado.

Steers, R. J., H. L. Spaulding, and E. C. Wrubel. 2011. A comparison of vegetation sampling methods in coastal dune scrub at Point Reyes National Seashore. Natural Resource Technical Report NPS/SFAN/NRTR—2011/516. National Park Service, Fort Collins, Colorado.

Steers, R. J., H. L. Spaulding, and E. C. Wrubel. 2014. Forest structure in Muir Woods National Monument: Survey of the redwood canyon old-growth forest. Natural Resource Technical Report NPS/SFAN/NRTR—2014/878. National Park Service, Fort Collins, Colorado.

Stephens, J. L., S. R. Mohren, F. L. Newell, J. D. Alexander, and D. A. Sarr. 2013. Bird-habitat associations at five national park units in southern Oregon and northern California. Natural Resource Technical Report NPS/KLMN/NRTR—2013/793. National Park Service, Fort Collins, Colorado.

Thomas, L., and C. J. Krebs. 1997. A review of statistical power analysis software. Bulletin of the Ecological Society of America 73:126-139.

Williams, A.E., S. O'Neil, E. Speith, and J. Rodgers. 2009. Early detection of invasive plant species in the San Francisco Bay Area Network: A volunteer-based approach. Natural Resource Report NPS/SFAN/NRR—2009/136. National Park Service, Fort Collins, Colorado.

van Mantgem, P. J., N. L. Stephenson, J. C. Byrne, L. D. Daniels, J. F. Franklin, P. Z. Fulé, M. E. Harmon, A. J. Larson, J. M. Smith, A. H. Taylor, and T. T. Veblen. 2009. Widespread increase of tree mortality rates in the western United States. Science 323:521-524.

SOP 16: Metadata Guidelines

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedures for completing metadata for products developed using this protocol. This includes, but is not limited to databases, documents, and GPS and GIS data. Details on metadata for photographs can be found in SOP 7. Abbreviations are defined at the end of this document (Appendix SOP 16A). This document was adapted from the National Park Service (NPS), Klamath Network Vegetation Monitoring Protocol (Odion et al. 2011). Please see that document for a more detailed discussion on the expectations and NPS tools available for managing metadata.

Introduction

Documentation is a critical step towards ensuring that products collected as part of this monitoring effort are usable for their intended purposes now and in the future. This involves the development of metadata, 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, collection and analysis methods, time of collection, originator, access/use constraints, and distribution. Metadata provide the means to catalog products, within Intranet and Internet systems, making them available to a broad range of potential users. While most frequently developed for geospatial data, metadata describing non-geospatial datasets are also important.

Timelines

It is the responsibility of the vegetation ecologist to submit metadata or metadata products (e.g., Metadata Interview form (Appendix SOP 16B) to the San Francisco Bay Area Network (SFAN) Data Manager, in the proper format, when he or she submits the product with which the metadata are associated. SOP 1 provides the details on the products to be delivered to the Data Manager, the due dates for those products, and the persons responsible for those products.

Responsibilities and Standards

Metadata are among the most important pieces of documentation to help guarantee the long-term usability of data. The degree of documentation will vary depending on the product, but a few standards will always hold true.

1. Metadata for spatial data collected through inventory and monitoring funded projects will meet Federal Geographic Data Committee (FGDC), National Biological Information Infrastructure (NBII), and NPS standards.
2. The vegetation ecologist will be expected to submit a Metadata Interview form (for spatial data) prior to the start of the first field season.
3. The vegetation ecologist will be expected to review and revise all Metadata Interview forms at the end of each field season and report changes following the timeline listed in SOP 1.
4. It is the responsibility of the Data Manager to develop the official metadata based on the Metadata Interview form provided by the vegetation ecologist.
5. It is the Data Manager's responsibility to parse and transfer metadata to the NPS Data Store (found on IRMA: https://irma.nps.gov), if applicable.
6. The Data Manager will work with the vegetation ecologist and park staff to determine the sensitivity level of any data.

Reports

Three main types of reports are expected to be developed during this monitoring effort, including annual reports, analysis and synthesis reports, and scientific publications (SOP 15). These reports will follow the NPS Natural Resources Publications Management guidelines (available at http://www.nature.nps.gov/publications/nrpm/) It is the responsibility of the individual creating the reports to ensure that the following guidelines are met:

1. First and last name of all authors are included on the reports.
2. Affiliations of the authors are included on the report.
3. Version numbers are used on all drafts of the report.
4. The date the report was completed is included on the report.
5. The date representing the information presented in the report is included in the report.
6. Series number is included in the report when applicable.
7. The report has been uploaded, including its metadata, to the IRMA website.

Spatial Data, Databases, and Spreadsheets

The Data Manager is responsible for creating and maintaining the official metadata for all GIS and GPS products. She/he is also responsible for creating the metadata for the relational databases and spreadsheets. It is the responsibility of the vegetation ecologist to provide Metadata Interview forms and data dictionaries to the Data Manager prior to implementing the field work as described in SOP 1. The Data Manager will use the Metadata Interview form and protocol to develop complete metadata for each product. Each year that field work occurs, the vegetation ecologist must submit a Metadata Interview form following the timeline in SOP 1.

Steps for Metadata Creation

Step 1: Metadata Interview Form and Information Gathering

A. The vegetation ecologist should obtain and complete the SFAN Metadata Interview form at project onset to facilitate compiling the information required to create compliant metadata.
    1. The SFAN Metadata Interview form is located at the end of this SOP (Appendix SOP 16B) and on the SFAN server: \\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\DOCUMENTS\Metadata.
    2. Best attempts should be made to populate the Metadata Interview form as completely as possible prior to starting field work. However, it is recognized that changes to the form will occur throughout the project.

B. The vegetation ecologist should send a copy of any additional information that might be valuable for the development of metadata to the Data Manager.

Step2: Sensitivity Review: Sensitive Data (Species Locations, Site Locations, Etc.) May Not Be Subject for Release to the Public

A. The Network Data Manager will be responsible for posting sensitive data on the IRMA website. Status of the data will be based on comments provided by the vegetation ecologist under the "Sensitivity" question in the Metadata Interview and Certification forms. In addition, the SFAN will consult with park staff if the sensitivity status of any data is questionable. See SOP 20 for further details on handling sensitive information.

Step 3: Additional Requirements

A. Along with the required metadata, the SFAN requires the following information be included in the metadata document.
    1. Standard language for NPS liability should be inserted into the Distribution Liability metadata element of the Distribution Information (FGDC Section 6). This can be found at: http://www.nps.gov/gis/liability.htm.

Step 4: Metadata Review

The Data Manager should review metadata for quality control prior to posting to the NPS Data Store (IRMA: https://irma.nps.gov).

Literature Cited

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

Appendix SOP 16A. Metadata definitions and acronyms

ArcCatalog	Module in ESRI's ArcGIS software within which metadata for spatial datasets (coverages, shapefiles) can be created.
Biological Data Profile	Set of definitions for the documentation of biological data through the creation of extended elements to the FGDC Content Standard for Digital Geospatial Metadata (CSDGM).
CSDGM	Content Standard for Digital Geospatial Metadata. The FGDC-promulgated metadata standard established to provide a common set of terminology and definitions for documenting digital geospatial data.
ESRI®	Environmental Systems Research Institute. A GIS software company.
FGDC	Federal Geographic Data Committee. The interagency committee that promotes the coordinated development, use, sharing, and dissemination of geographic data.
GIS	Geographic Information System. A computer system for capturing, manipulating, analyzing, and displaying data related to positions on the Earth's surface.
IRMA	Integrated Resource Management Products. A web-based "one-stop" for data and information related to National Park Service natural and cultural resources. Houses the NPS Data Store.
ISO	International Organization for Standardization. A network of national standards institutes of 150 countries, responsible for the "ISO 19115" international metadata standard.
Metadata	Data about the content, quality, condition, and other characteristics of a dataset, documented in a standardized format.
NBII	National Biological Information Infrastructure. Collaborative program instrumental in developing the Biological Data Profile of the FGDC's CSDGM.
NPS Profile	The NPS Natural Resource and GIS Metadata Profile extends the FGDC CSDGM to incorporate NPS-specific elements such as park and project details. The NPS Profile includes the Biological Data Profile and the ESRI Profile.

NPS Data Store	The NPS Natural Resource, GIS, and I&M Programs' web-based system (incorporating a database, data server, and secure web interface) to integrate data dissemination and metadata maintenance for Natural Resource, GIS, and other program data sets, digital documents, and digital photos.
SGML	Standard Generalized Markup Language. An ISO standard flexible markup language (predecessor to XML) used in many applications, including electronic publishing on the Web.
XML	Extensible Markup Language. A simple and flexible text format (a profile, or subset, of SGML) that facilitates large-scale electronic publishing and exchange of data on the Web.

Appendix SOP 16B. Electronic metadata interview form.

Also located on the GOGA server at:
\\Inpgogamahe1\Divisions\NetworkiM\VitalSigns\PlantCommunities\DOCUMENTS\Metadata.

Electronic Metadata Interview Form

[**Note: Please make your responses directly within this word document in "Red" type**.]

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 (SFAN Data Manager).

SOP 17: Collecting and Identifying Unknown Plants

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains the procedures for handling unknown plant species encountered within sampling plots. This document was adapted from the National Park Service, Klamath Network Vegetation Monitoring Protocol (Odion et al. 2011).

Collection and Identification of Unknown Plants

To improve the quality of vegetation profile data, a formal procedure is followed to identify as many of the unknown plant species that are tallied as possible. While in a sampling plot, the crew should not spend an inordinate amount of time trying to identify an unknown plant. If the plant can be keyed out quickly using a plant guide and species list, identification should be attempted. If the crew is confident the stand can be finished being sampled on schedule, they can spend more time trying to identify unknown plants while sampling its plots. In most cases, it will be more effective to collect unknown plants for later identification. After the initial visit to a site, a plant list for each site will be provided to the crew. These lists will be included inside the Plot Location Manuals (see SOP 23) and can be useful for narrowing down unknown plants; however, all unknown plants should be keyed out to ensure correct identification.

If the plant cannot be identified to family or genus, it qualifies for tally as a generic life form record (shrub, forb, fern, grass, or graminoid) on the datasheet and in the database. Record the plant accordingly (e.g., *Carex* sp1; if more than one unknown *Carex* is collected, then name the second unknown *Carex* sp2 and so on. If the species cannot be identified to family or genus, then use the generic life form name [e.g., forb1, etc.].). The numbering process should be restarted at each stand.

When making a collection, gather as much of the complete plant as possible. Make sure to collect roots, flowers, and seed-heads. **Collect the plant off-plot if possible**. Never collect a plant from a local population of <20 individuals. If the population is <20 individuals, collect several photograph vouchers rather than a vegetative specimen. Place the sample in a plastic bag and label the specimen with the same name as recorded on the datasheet: park name, date (year-month-day), veg type, stand number, and plot number. If you have a hunch what family or genus it belongs to and time permits,

look in a field guide to see what characters are important to identify members of that group; record any observations related to those important features.

Once back at the office, try to identify the collected specimens the same day that the plot was visited. Use whatever plant guides are available. Other field crew members who might be familiar with the species and/or are good at plant identification should be consulted. Twenty minutes is the recommended maximum amount of time that should be spent on one plant. If the specimen cannot be identified, contact the vegetation ecologist. If the same plant is collected several times and identification attempts are unsuccessful, the vegetation ecologist should consult park personnel to see if they are familiar with the species.

If no attempt can be made to key out a plant the same day it is collected, or if it cannot be identified, the specimen should be placed in a plant press, and labeled with the same name as recorded on the datasheet: park name, date (year-month-day), veg type, stand number, and plot number. Do not leave the specimen in a plastic bag for more than a day; specimens left bagged may mildew and mold. If a plant is successfully identified, the vegetation profile data for that plot should be updated accordingly (see updating the datasheet/database below). When a datasheet is updated to a proper species name, the person that updates the datasheet shall initial and date their change.

Updating the Datasheet and Database

Datasheet

Once a plant has been identified, the datasheet and database records will need to be updated. On the datasheet, find the record for that species (e.g., Unknown 1, *Carex* Unknown 1, etc.). Place a single red line through the name and write the actual name of the species on the datasheet using a red pencil or pen. Rescan the datasheet and replace the older, uncorrected copy on the I&M server (SOP 14).

Database

To correct the record in the database, click the “enter/edit” command button. On the next form, make sure your name is selected and click “OK.” Find the record that matches the site and date where the unknown species was collected and double click on the date. Click on the species tab and find the unknown species. Change the name from “unknown” to the correct name. Close out of the database.

Voucher Specimens

Voucher specimens will be needed for new or important species collected at a park. These species will need to be sent to a herbarium for official determination and holding. Voucher specimens can be left in newspaper sheets when sent to regional herbaria (e.g., Jepson, California Academy of Sciences, California Department of Food and Agriculture); however they must be properly labeled (Figure SOP 17.1).

Date: 7/18/16	**Collector:** Eric C. Wrubel	**Collection#:** 534
Species: Gilia capitata ssp. tomentosa	**Author:** (Brand) V.E. Grant	
Family: Polemoniaceae	**Common Name:** Wooly-headed Gilia	
Distinctive Features: Calyx densely hairy		
Habitat: Coastal scrub		
Location Description: PORE Palomarin near Abalone Point		
Numeric Location/lat-long: 37.939955° -122.764720°		
Slope: 15°	**Aspect:** S	**Elev.:** 381ft
Comments: Pop of about 62 individuals in shrub openings		
Determined by: Eric C. Wrubel		

Figure SOP 17.1. Fictitious example of a properly filled out label.

When sending material to a herbarium, make sure there is enough plant material that also contains plant parts crucial for its identification (flowers, fruits, etc.). If possible, refer to the key in the Jepson Manual 2nd Edition (Baldwin et al. 2012) if unsure what parts are critical (e.g., some ferns require roots when using the taxonomic key). Also, carefully brush or clean soil from roots, if included. Two herbarium sheets may be needed for larger specimens. Send a list of all herbarium specimens accessioned in a herbarium to the Data Manager for IRMA record keeping. Include all information on the herbarium label, which herbaria they were submitted to, and when they were submitted.

Literature Cited

Baldwin, B. G., D. H. Goldman, D. J. Keil, R. Patterson, T. J. Rosatti, and D. H. Wilken, editors. 2012. The Jepson manual: Vascular plants of California, second edition. University of California Press, Berkeley.

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

SOP 18: Post Field Season

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains procedures that will be completed after the field season, which include handling equipment, completing data management tasks, communicating with National Park Service (NPS) personnel, and reporting. Field crew members will assist the vegetation ecologist in completing post season field tasks. This document was adapted from the NPS, Klamath Network Vegetation Monitoring Protocol (Odion et al. 2011).

Inventory, Clean, and Store Field Equipment

1. All equipment should be checked-in following the San Francisco Bay Area Network (SFAN) property guidelines maintained by the vegetation ecologist.
2. Record broken or missing equipment on the SFAN equipment inventory sheet. Label the equipment with sufficient information so that someone else will understand the specific problem. The equipment inventory sheet can be found here: \\Inpgogamahe1\Divisions\NetworkiM\VitalSigns\PlantCommunities\Equipment
3. Report missing or faulty equipment and/or equipment needing repairs to the vegetation ecologist, so that equipment can be repaired or replaced before the following field season. It is the vegetation ecologist's responsibility to account for all equipment and have it repaired or replaced at the end of the field season. Keep in mind other projects may be relying on the availability of this equipment, so it should be repaired or replaced as soon as the problem is identified.
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, and winterizing when applicable. Project data should be removed before turning in the equipment.

Interviews

Prior to ending the field technician's seasonal employment, the vegetation ecologist (or SFAN Program Manager if vegetation ecologist is not available) should meet with the seasonal employees to discuss the field season. The following should be discussed:

- Determine how the field season went overall.
- Review what was accomplished and what did not get completed.
- Discuss options to improve upon any aspect of the protocol.
- Determine whether the field crew has any concerns that should be addressed prior to the next field season.
- Discuss field equipment (e.g., repairs needed, software updates, additional equipment, etc.).
- Review the training schedule and see if there are any areas for improvement or if there is additional training the field crew needs.
- Review of crew safety practices/procedures.

This information should be summarized and included in a briefing report that should be saved here: \\Inpgogamahe1\Divisions\NetworkiM\VitalSigns\PlantCommunities\DOCUMENTS\Reports. Also, final performance appraisals should be conducted by the vegetation ecologist with each member of the field crew. In addition to the field crews, the vegetation ecologist should contact the Network Program Manager to accomplish the following:

- Discuss the field season and determine if the park staff had any concerns or areas for improvement.
- Ensure that all park keys have been returned.
- If park housing was used, make certain it was left in proper order.
- Examine ways to improve relationships between park and network staff (e.g., improved communication, periodic meetings, etc.).

These items should also be included in the annual briefing report.

Raw Data and Deliverables

There are a variety of deliverables associated with this project that should be stored in their proper location by the end of the field season. See SOP 1 for a list of deliverables, where they should be stored, and who is responsible completing this task.

Finalize Data Collection

1. Before field crews are released from active duty, make sure that all unknown plants are identified and the identification entered into the database.
2. Make sure that any remaining plant vouchers have been processed before the crew departs.
3. Make sure that all other outstanding missing data issues are resolved before the crew retires for the season.
4. Be certain any data not previously entered into the database has been entered.
5. Check to ensure training, event, and equipment logs are complete.

6. Do a quick follow up with the Data Manager to ensure he/she has everything he/she needs prior to crews being released.

Back in the Office

Once you have all the field crew's data, complete the following steps:

1. Place a copy of the final images (the one on the camera) in the following location: \\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\MEDIA\Photos
2. Place a copy of the unprocessed GIS layers (the one on the Garmin and Trimble units) in the following location: \\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\GIS\GIS_Data
3. The Data Manager should run a QA/QC process to make sure the data in the database are accurate. If there are still problems with the data, work with the vegetation ecologist to resolve any issues and then repeat steps 3-6.
4. You are finished. You should now have this year's validated and verified data loaded into the master database. You should also have the annual data stored in the proper location.

Event Log Book

Consistency in implementing this protocol is crucial to ensure the integrity of a long-term dataset that can be used to develop reports. It is important that project staff understand all situations that have occurred throughout the life of this project that may have an effect on the consistency of the data collection methods. In an effort to track these situations, it is the vegetation ecologist's responsibility is to complete the event log (Appendix SOP 18A) and submit it to the Data Manager following the timeline in SOP 1. One event log book can be used throughout the life of this project. If no significant events occur, the vegetation ecologist should enter their name, position, date, and in the event column, add "No Events."

Literature Cited

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

Appendix SOP 18A. Event log.

Also located on the GOGA server at:\\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\DOCUMENTS\Protocol\Event_Log.

Event Log

Name	Position	Date	Event	Reason
Caleb Caswell-Levy	Field Leader	08/15/2013	Stopped sampling coastal bluff scrub	Budget cuts

Name – The full name of the person reporting the event (e.g., Coz McRay).
Position – Position of the person reporting the event (e.g., Field Leader).
Date – Data the event occurred (e.g., 08/15/2013).
Event – Explain what is the event (Stopped sampling coastal bluff scrub).
Reason – Explain why the event occurred (e.g., Budget cuts).

SOP 19: Revising the Protocol

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP explains how to make and track changes to the San Francisco Bay Area Network (SFAN) Plant Community Monitoring Protocol, including its accompanying SOPs. This document was adapted from the National Park Service, Klamath Network Vegetation Monitoring Protocol (Odion et al. 2011).

Introduction

Although the SFAN Plant Community Monitoring Protocol was developed using current standardized methodology, all long-term monitoring programs need to be flexible to adapt to changes. As new technologies, methods, and equipment become available, this protocol will be updated as appropriate. The revision of the protocol will be the responsibility of the vegetation ecologist, who will consider input from the other team members, as well as statisticians. All changes will be made in a timely manner with the appropriate level of review.

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 information management handling SOPs) may be reviewed in-house by project cooperators and SFAN staff. However, major changes to data collection, analysis techniques, sampling design, or response design will trigger an outside review. The vegetation ecologist should coordinate with the SFAN Program Manager to determine if outside review is needed.

Revision Procedures

The following procedures will ensure that both minor and major revisions to this document will align with the monitoring plan.

1. The Network Program Manager will 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.

2. 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, renumbering an SOP may mean changing document references in several other documents.
3. 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 2.21, 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0). 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.
4. 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.
5. 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.
    d. The current, primary version of the document (i.e., not the versioned document just copied and renamed) does not have a date stamp associated with it.
    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 popup.
    f. Inform the Data Manager so the new version number(s) can be incorporated into the project metadata.
6. 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.

7. Send a digital copy of the revised monitoring plan to the Network Contact and Network Data Manager. The revised protocol will be forwarded to all individuals who had been using a previous version of the affected document. Ensure that surveyors in the field have a hardcopy of the new version.
8. The Network Data Manager will place a copy of the revised protocol in the proper folder on the SFAN shared drive. In addition, the Network Data Manager will archive the previous version in the SFAN archive drive.
9. The Network Data Manager will post the revised version and update the associated records in the proper I&M databases, including but not limited to SFAN Internet web sites, and the IRMA Protocol database.

Literature Cited

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

SOP 20: Sensitive Data

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP includes instructions for handling sensitive data. This document was adapted from the National Park Service (NPS), North Coast Cascade and Klamath Networks' Vegetation Monitoring Protocols (see Acker et al. 2010 and Odion et al. 2011).

Introduction

Although it is the general NPS policy to share information widely, the NPS also realizes that providing information about the location of park resources may sometimes place those resources at risk of harm, theft, or destruction. This can occur, for example, with regard to caves, archeological sites, tribal information, and rare plant and animal species. Therefore, information will be withheld when the NPS foresees that disclosure would be harmful to an interest protected by an exemption under the Freedom of Information Act (FOIA). The National Parks Omnibus Management Act, Section 207, 16 U.S.C. 5937, is interpreted to prohibit the release of information regarding the "nature or specific location" of certain cultural and natural resources in the national park system. Additional details and information about the legal basis for this policy can be found in the NPS Management Policies (NPS 2006), and in Director's Order #66 (NPS 2005). These guidelines apply to all San Francisco Bay Area Network (SFAN) staff, cooperators, contractors, and other partners who are likely to obtain or have access to information about protected NPS resources. The NPS contact has primary responsibility for ensuring adequate protection of sensitive information related to this project.

The following are highlights of our strategy for protecting this information:

1. *Protected resources*, in the context of the SFAN Inventory and Monitoring Program, include species that have State- or Federally-listed status and other species deemed rare or sensitive by local park taxa experts.
2. *Sensitive information* is defined as information about protected resources which may reveal the "nature or specific location" of protected resources. Such information must not be shared outside the National Park Service, unless a signed confidentiality agreement is in place.

3. In general, if information is withheld from one non-NPS requesting party, it must be withheld from anyone else who requests it, and if information is provided to one requesting party without a confidentiality agreement, it must be provided to anyone else who requests it.
4. To share information as broadly as legally possible and to provide a consistent, tractable approach for handling sensitive information, the following shall apply if a project is likely to collect and store sensitive information:
    a. Random coordinate offsets of up to 2 km for data collection locations, and
    b. Removal of data fields from the released copy that is likely to contain sensitive information.

What Kinds of Information Can and Cannot Be Shared?

Do Not Share

Project staff and cooperators should not share any information outside NPS that reveals details about the "nature or specific location" of protected resources, unless a confidentiality agreement is in place. Specifically, the following information should be omitted from shared copies of all data, presentations, reports, or other published forms of information.

1. *Exact coordinates* – Instead, public coordinates are to be generated that consist of rare and sensitive species locations being documented with the centroid coordinate of the park.
2. *Other descriptive location data* – Examples may include travel descriptions, location descriptions, or other fields that contain information which may reveal the specific location of the protected resource(s).
3. *Protected resource observations at disclosed locations* – If specific location information has already been made publicly available, the occurrence of protected resources at that location cannot be shared outside NPS without a confidentiality agreement. For example, if the exact coordinates for a monitoring station location are posted to a web site or put into a publication, then at a later point in time a spotted owl nest is observed at that monitoring station, that nest cannot be mentioned or referred to in any report, presentation, dataset, or publication that will be shared outside NPS.

Do Share

All other information about the protected resource(s) may be freely shared, so long as the information does not reveal details about the "nature or specific location" of the protected resource(s) that are not already readily available to the general public in some form (e.g., other published material). Species tallies and other types of data presentations that do not disclose the precise locations of protected resources may be shared, unless by indicating the presence of the species the specific location is also revealed (i.e., in the case of a small park).

Details for Specific Products

Whenever products such as databases and reports are being generated, handled, and stored, they should be created explicitly for one of the following purposes:

1. *Public or general use* – Intended for general distribution, sharing with cooperators, or posting to public web sites. They may be derived from products that contain sensitive information so long as the sensitive information is either removed or otherwise rendered in a manner consistent with other guidance in this document.
2. *Internal NPS use* – These are products that contain sensitive information and should be stored and distributed only in a manner that ensures their continued protection. These products should clearly indicate that they are solely for internal NPS use by containing the phrase: "Internal NPS Use Only – Not for Release." These products can only be shared within NPS or in cases where a confidentiality agreement is in place. They do not need to be revised in a way that conceals the location of protected resources.

When submitting products to the Network Data Manager, a Certification Form is required. If the submitted product was not meant for public use, it should be clearly noted on question 8 of the Certification Form (SOP 1) and / or question 4 of the Metadata Interview Form (SOP 16).

Datasets

To create a copy of a dataset that will be posted or shared outside NPS, the Data Manager can provide technical assistance as needed to apply coordinate offsets or otherwise edit data products for sensitive information.

Maps and Other GIS Output

General use maps and other geographic representations of observation data that will be released or shared outside NPS should be rendered using offset coordinates (for sensitive species) and should only be rendered at a scale that does not reveal their exact position (e.g., 1:100,000 maximum scale).

If a large-scale, close-up map is to be created using exact coordinates (e.g., for field crew navigation, etc.), the map should be clearly marked with the following phrase: "Internal NPS Use Only – Not For Release."

The Network Data Manager and/or GIS Specialist can provide technical assistance as needed to apply coordinate offsets or otherwise edit data products for sensitive information.

Presentations and Reports

Public or general-use reports and presentations should adhere to the following guidelines:

1. Do not list exact coordinates or specific location information in any text, figure, table, or graphic in the report or presentation. If a list of coordinates is necessary, use only offset coordinates and clearly indicate that coordinates have been purposely offset to protect the resource(s) as required by law and NPS policy.
2. Use only general use maps, as specified in the section on maps and other GIS output.

If a report is intended for internal use only, these restrictions do not apply. However, each page of the report should be clearly marked with the following phrase: "Internal NPS Use Only – Not for Release."

Voucher Specimens

Specimens of protected taxa should only be collected as allowed by law. As with any sensitive information, a confidentiality agreement should be in place prior to sending these specimens to another non-NPS cooperator or collection.

Sharing Sensitive Information

No sensitive information (e.g., information about the specific nature or location of protected resources) may be posted to the NPS Data Store or another publicly-accessible web site, or otherwise shared or distributed outside NPS without a confidentiality agreement between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. Only products that are intended for public/general use may be posted to public web sites and clearinghouses; these may not contain sensitive information.

Responding to Data Requests

If requests for distribution of products containing sensitive information are initiated by the NPS, by another federal agency, or by another partner organization (e.g., a research scientist at a university), the unedited product (e.g., the full dataset that includes sensitive information) may only be shared after a confidentiality agreement is established between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared.

Once a confidentiality agreement is in place, products containing sensitive information may be shared following these guidelines:

1. Prior to distribution, talk to the Project Manager and Park Resource Specialist to make sure they know the data are being distributed.
2. Always clearly indicate in accompanying correspondence that the products contain sensitive information and specify which products contain sensitive information.
3. Indicate in all correspondence that products containing sensitive information should be stored and maintained separately from non-sensitive information and protected from accidental release or re-distribution.
4. Indicate that NPS retains all distribution rights; copies of the data should not be redistributed by anyone but NPS.
5. Include the following standard disclaimer in a text file with all digital media upon distribution: “The following files contain protected information. This information was provided by the National Park Service under a confidentiality agreement. It is not to be published, handled, re-distributed, or used in a manner inconsistent with that agreement.” The text file should also specify the file(s) containing sensitive information.
6. If the products are being sent on physical media (e.g., CD or DVD), the media should be marked in such a way that clearly indicates that media contains sensitive information provided by the National Park Service.

Confidentiality Agreements

Confidentiality agreements may be created between the NPS and another organization or individual to ensure that protected information is not inadvertently released. When contracts or other

agreements with a non-federal partner do not include a specific provision to prevent the release of protected information, the written document must include the following standard

Confidentiality Agreement:

Confidentiality Agreement - I agree to keep confidential any protected information that I may develop or otherwise acquire as part of my work with the National Park Service. I understand that with regard to protected information, I am an agent of the National Park Service and must not release that information. I also understand that by law I may not share protected information with anyone through any means except as specifically authorized by the National Park Service. I understand that protected information concerns the nature and specific location of endangered, threatened, rare, commercially valuable, mineral, paleontological, or cultural patrimony resources such as threatened or endangered species, rare features, archeological sites, museum collections, caves, fossil sites, gemstones, and sacred ceremonial sites. Lastly, I understand that protected information must not be inadvertently disclosed through any means, including web sites, maps, scientific articles, presentation, and speeches.

If mailing or directly providing data that contains sensitive information, follow the procedures described above. In addition, have the individual sign a confidentiality agreement which is provided on the SFAN server at:
\\Inpgogamahe1\Divisions\NetworkIM\VitalSigns\PlantCommunities\DOCUMENTS\Reference.

Freedom of Information (FOIA) Requests

All official FOIA requests will be handled according to NPS policy. The NPS Contact will work with the Data Manager and the park FOIA representative(s) of the park(s) for which the request applies.

Literature Cited

Acker, S. A., A. Woodward, J. R. Boetsch, K. Hutten, M. Bivin, R. Rochefort, C. C. Thompson, and L. Whiteaker. 2010. Forest vegetation monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/242. National Park Service, Fort Collins, Colorado.

National Park Service. 2006. Management policies. Available at http://www.nps.gov/policy/MP2006.pdf (accessed 17 February 2012).

Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks. Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.

National Park Service. 2005. Director's Order Number 66. Freedom of Information Act and the protection of exempted information. National Park Service, Washington, D.C.

SOP 21: Life forms master list

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP includes a list of vegetation expected to be encountered during monitoring under this protocol and the life form each species should be coded as. This list is incomplete, and does not include all species that could be encountered. The list should be updated as new species are encountered. Species on this list have been assigned to a life form; this should not ever change, as this would alter how the data are collected and degrade the ability of this program to track long-term changes.

Appendix SOP 21A. Life Forms Master List

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Lycophytes	Isoetaceae	Isoetes nuttallii					X
Ferns	Azollaceae	Azolla filiculoides					X
Ferns	Blechnaceae	Blechnum spicant					X
Ferns	Blechnaceae	Woodwardia fimbriata					X
Ferns	Dennstaedtiaceae	Pteridium aquilinum var. pubescens					X
Ferns	Dryopteridaceae	Dryopteris arguta					X
Ferns	Dryopteridaceae	Dryopteris expansa					X
Ferns	Dryopteridaceae	Polystichum munitum		X			
Ferns	Equisetaceae	Equisetum telmateia ssp. braunii					X
Ferns	Marsileaceae	Marsilea vestita					X
Ferns	Ophioglossaceae	Sceptridium multifidum					X
Ferns	Polypodiaceae	Polypodium californicum					X
Ferns	Polypodiaceae	Polypodium calirhiza					X
Ferns	Polypodiaceae	Polypodium scouleri					X
Ferns	Pteridaceae	Adiantum aleuticum					X
Ferns	Pteridaceae	Adiantum jordanii					X
Ferns	Pteridaceae	Pellaea andromedifolia					X
Ferns	Pteridaceae	Pentagramma triangularis					X
Ferns	Woodsiaceae	Athyrium filix-femina var. cyclosorum					X
Ferns	Woodsiaceae	Cystopteris fragilis					X
Gymnosperms	Cupressaceae	Hesperocyparis macrocarpa	X				
Gymnosperms	Cupressaceae	Sequoia sempervirens	X				
Gymnosperms	Pinaceae	Pinus muricata	X				
Gymnosperms	Pinaceae	Pinus radiata	X				
Gymnosperms	Pinaceae	Pseudotsuga menziesii var. menziesii	X				
Nymphaeales	Nymphaeceae	Nymphaea alba					X
Nymphaeales	Nymphaeceae	Nymphaea odorata					X
Magnoliids	Aristolochiaceae	Aristolochia californica				X	
Magnoliids	Aristolochiaceae	Asarum caudatum					X
Magnoliids	Lauraceae	Umbellularia californica	X				
Ceratophyllales	Ceratophyllaceae	Ceratophyllum demersum					X
Eudicots	Adoxaceae	Sambucus nigra ssp. caerulea		X			
Eudicots	Adoxaceae	Sambucus racemosa var. racemosa		X			
Eudicots	Aizoaceae	Carpobrotus chilensis			X		
Eudicots	Aizoaceae	Carpobrotus edulis			X		
Eudicots	Aizoaceae	Conocosia pugioniformis			X		
Eudicots	Aizoaceae	Drosanthemum floribundum			X		
Eudicots	Aizoaceae	Tetragonia tetragonioides					X
Eudicots	Anacardiaceae	Toxicodendron diversilobum		X			
Eudicots	Apiaceae	Angelica hendersonii					X
Eudicots	Apiaceae	Cicuta maculata var. bolanderi					X
Eudicots	Apiaceae	Conium maculatum					X
Eudicots	Apiaceae	Daucus carota					X
Eudicots	Apiaceae	Daucus pusillus					X
Eudicots	Apiaceae	Eryngium armatum					X
Eudicots	Apiaceae	Foeniculum vulgare					X
Eudicots	Apiaceae	Heracleum maximum					X
Eudicots	Apiaceae	Ligusticum apiifolium					X

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Eudicots	Apiaceae	Lilaeopsis occidentalis					X
Eudicots	Apiaceae	Lomatium dasycarpum ssp. dasycarpum					X
Eudicots	Apiaceae	Lomatium utriculatum					X
Eudicots	Apiaceae	Oenanthe sarmentosa					X
Eudicots	Apiaceae	Osmorhiza berteroi					X
Eudicots	Apiaceae	Perideridia gairdneri ssp. gairdneri					X
Eudicots	Apiaceae	Perideridia kelloggii					X
Eudicots	Apiaceae	Sanicula arctopoides					X
Eudicots	Apiaceae	Sanicula bipinnatifida					X
Eudicots	Apiaceae	Sanicula crassicaulis					X
Eudicots	Apiaceae	Sanicula laciniata					X
Eudicots	Apiaceae	Sanicula tuberosa					X
Eudicots	Apiaceae	Scandix pecten-veneris					X
Eudicots	Apiaceae	Tauschia kelloggii					X
Eudicots	Apiaceae	Torilis arvensis					X
Eudicots	Apiaceae	Torilis nodosa					X
Eudicots	Apocynaceae	Vinca major				X	
Eudicots	Aquifoliaceae	Ilex aquifolium	X				
Eudicots	Araliaceae	Aralia californica					X
Eudicots	Araliaceae	Hedera canariensis				X	
Eudicots	Araliaceae	Hedera helix				X	
Eudicots	Araliaceae	Hydrocotyle ranunculoides					X
Eudicots	Araliaceae	Hydrocotyle verticillata					X
Eudicots	Asteraceae	Achillea millefolium					X
Eudicots	Asteraceae	Achyrachaena mollis					X
Eudicots	Asteraceae	Adenocaulon bicolor					X
Eudicots	Asteraceae	Ageratina adenophora			X		
Eudicots	Asteraceae	Agoseris apargioides var. eastwoodiae					X
Eudicots	Asteraceae	Agoseris grandiflora					X
Eudicots	Asteraceae	Agoseris hirsuta					X
Eudicots	Asteraceae	Ambrosia chamissonis					X
Eudicots	Asteraceae	Anaphalis margaritacea					X
Eudicots	Asteraceae	Anisocarpus madioides					X
Eudicots	Asteraceae	Anthemis cotula					X
Eudicots	Asteraceae	Arctotheca calendula					X
Eudicots	Asteraceae	Artemisia californica		X			
Eudicots	Asteraceae	Artemisia douglasiana					X
Eudicots	Asteraceae	Artemisia pycnocephala					X
Eudicots	Asteraceae	Baccharis glutinosa					X
Eudicots	Asteraceae	Baccharis pilularis		X			
Eudicots	Asteraceae	Bellis perennis					X
Eudicots	Asteraceae	Blennosperma nanum					X
Eudicots	Asteraceae	Calendula arvensis					X
Eudicots	Asteraceae	Calycadenia multiglandulosa					X
Eudicots	Asteraceae	Carduus pycnocephalus					X
Eudicots	Asteraceae	Carthamus lanatus					X
Eudicots	Asteraceae	Centaurea melitensis					X
Eudicots	Asteraceae	Centaurea solstitialis					X
Eudicots	Asteraceae	Cirsium andrewsii					X
Eudicots	Asteraceae	Cirsium brevistylum					X

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Eudicots	Asteraceae	Cirsium occidentale var. occidentale					X
Eudicots	Asteraceae	Cirsium quercetorum					X
Eudicots	Asteraceae	Cirsium vulgare					X
Eudicots	Asteraceae	Corethrogyne filaginifolia					X
Eudicots	Asteraceae	Cotula australis					X
Eudicots	Asteraceae	Cotula coronopifolia					X
Eudicots	Asteraceae	Deinandra corymbosa					X
Eudicots	Asteraceae	Delairea odorata				X	
Eudicots	Asteraceae	Ericameria ericoides		X			
Eudicots	Asteraceae	Erigeron canadensis					X
Eudicots	Asteraceae	Erigeron foliosus var. franciscensis					X
Eudicots	Asteraceae	Erigeron glaucus			X		
Eudicots	Asteraceae	Erigeron karvinskianus					X
Eudicots	Asteraceae	Erigeron reductus var. angustatus					X
Eudicots	Asteraceae	Erigeron sumatrensis					X
Eudicots	Asteraceae	Eriophyllum confertiflorum			X		
Eudicots	Asteraceae	Eriophyllum lanatum					X
Eudicots	Asteraceae	Eriophyllum staechadifolium			X		
Eudicots	Asteraceae	Filago pyramidata var. pyramidata					X
Eudicots	Asteraceae	Gamochaeta ustulata					X
Eudicots	Asteraceae	Gnaphalium palustre					X
Eudicots	Asteraceae	Grindelia hirsutula					X
Eudicots	Asteraceae	Grindelia stricta var. angustifolia			X		
Eudicots	Asteraceae	Grindelia stricta var. platyphylla			X		
Eudicots	Asteraceae	Gutierrezia californica			X		
Eudicots	Asteraceae	Hedypnois cretica					X
Eudicots	Asteraceae	Helenium puberulum					X
Eudicots	Asteraceae	Helminthotheca echioides					X
Eudicots	Asteraceae	Hemizonia congesta ssp. congesta					X
Eudicots	Asteraceae	Hemizonia congesta ssp. lutescens					X
Eudicots	Asteraceae	Hesperevax sparsiflora var. brevifolia					X
Eudicots	Asteraceae	Hesperevax sparsiflora var. sparsiflora					X
Eudicots	Asteraceae	Heterotheca sessiliflora ssp. bolanderi					X
Eudicots	Asteraceae	Hieracium albiflorum					X
Eudicots	Asteraceae	Hypochaeris glabra					X
Eudicots	Asteraceae	Hypochaeris radicata					X
Eudicots	Asteraceae	Iva axillaris					X
Eudicots	Asteraceae	Jaumea carnosa					X
Eudicots	Asteraceae	Lactuca saligna					X
Eudicots	Asteraceae	Lactuca serriola					X
Eudicots	Asteraceae	Lactuca virosa					X
Eudicots	Asteraceae	Lasthenia californica ssp. californica					X
Eudicots	Asteraceae	Lasthenia californica ssp. macrantha					X
Eudicots	Asteraceae	Lasthenia glaberrima					X
Eudicots	Asteraceae	Lasthenia maritima					X
Eudicots	Asteraceae	Lasthenia minor					X
Eudicots	Asteraceae	Layia carnosa					X
Eudicots	Asteraceae	Layia platyglossa					X
Eudicots	Asteraceae	Leontodon saxatilis					X
Eudicots	Asteraceae	Leucanthemum maximum					X

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Eudicots	Asteraceae	Leucanthemum vulgare					X
Eudicots	Asteraceae	Logfia filaginoides					X
Eudicots	Asteraceae	Logfia gallica					X
Eudicots	Asteraceae	Madia exigua					X
Eudicots	Asteraceae	Madia gracilis					X
Eudicots	Asteraceae	Madia sativa					X
Eudicots	Asteraceae	Matricaria discoidea					X
Eudicots	Asteraceae	Matricaria discoidea					X
Eudicots	Asteraceae	Micropus californicus					X
Eudicots	Asteraceae	Microseris bigelovii					X
Eudicots	Asteraceae	Microseris douglasii ssp. douglasii					X
Eudicots	Asteraceae	Microseris paludosa					X
Eudicots	Asteraceae	Pseudognaphalium beneolens					X
Eudicots	Asteraceae	Pseudognaphalium biolettii					X
Eudicots	Asteraceae	Pseudognaphalium californicum					X
Eudicots	Asteraceae	Pseudognaphalium luteoalbum					X
Eudicots	Asteraceae	Pseudognaphalium ramosissimum					X
Eudicots	Asteraceae	Pseudognaphalium stramineum					X
Eudicots	Asteraceae	Psilocarphus chilensis					X
Eudicots	Asteraceae	Psilocarphus tenellus					X
Eudicots	Asteraceae	Rafinesquia californica					X
Eudicots	Asteraceae	Rigiopappus leptocladus					X
Eudicots	Asteraceae	Senecio aronicoides					X
Eudicots	Asteraceae	Senecio glomeratus					X
Eudicots	Asteraceae	Senecio minimus					X
Eudicots	Asteraceae	Senecio sylvaticus					X
Eudicots	Asteraceae	Senecio vulgaris					X
Eudicots	Asteraceae	Silybum marianum					X
Eudicots	Asteraceae	Solidago elongata					X
Eudicots	Asteraceae	Solidago lepida var. salebrosa					X
Eudicots	Asteraceae	Solidago spathulata					X
Eudicots	Asteraceae	Solidago velutina ssp. californica					X
Eudicots	Asteraceae	Soliva sessilis					X
Eudicots	Asteraceae	Sonchus asper					X
Eudicots	Asteraceae	Sonchus oleraceus					X
Eudicots	Asteraceae	Stebbinsoseris heterocarpa					X
Eudicots	Asteraceae	Stephanomeria virgata					X
Eudicots	Asteraceae	Symphytotrichum chilense					X
Eudicots	Asteraceae	Taraxacum officinale					X
Eudicots	Asteraceae	Tragopogon porrifolius					X
Eudicots	Asteraceae	Uropappus lindleyi					X
Eudicots	Asteraceae	Wyethia angustifolia					X
Eudicots	Asteraceae	Xanthium spinosum					X
Eudicots	Berberidaceae	Berberis pinnata		X			
Eudicots	Berberidaceae	Vancouveria planipetala					X
Eudicots	Betulaceae	Alnus rubra	X				
Eudicots	Betulaceae	Corylus cornuta ssp. californica		X			
Eudicots	Boraginaceae	Amsinckia intermedia					X
Eudicots	Boraginaceae	Amsinckia spectabilis var. spectabilis					X
Eudicots	Boraginaceae	Cryptantha leiocarpa					X

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Eudicots	Boraginaceae	Cynoglossom grande					X
Eudicots	Boraginaceae	Eriodictyon californicum		X			
Eudicots	Boraginaceae	Eriodictyon tomentosum		X			
Eudicots	Boraginaceae	Heliotropium curassavicum					X
Eudicots	Boraginaceae	Myosotis discolor					X
Eudicots	Boraginaceae	Myosotis latifolia					X
Eudicots	Boraginaceae	Nemophila heterophylla					X
Eudicots	Boraginaceae	Nemophila menziesii var. atomaria					X
Eudicots	Boraginaceae	Nemophila menziesii var. menziesii					X
Eudicots	Boraginaceae	Nemophila parviflora var. parviflora					X
Eudicots	Boraginaceae	Phacelia californica					X
Eudicots	Boraginaceae	Phacelia distans					X
Eudicots	Boraginaceae	Phacelia divaricata					X
Eudicots	Boraginaceae	Phacelia insularis var. continentis					X
Eudicots	Boraginaceae	Phacelia malvifolia					X
Eudicots	Boraginaceae	Phacelia ramosissima					X
Eudicots	Boraginaceae	Plagiobothrys bracteatus					X
Eudicots	Boraginaceae	Plagiobothrys nothofulvus					X
Eudicots	Boraginaceae	Plagiobothrys reticulatus var. rossianorum					X
Eudicots	Boraginaceae	Plagiobothrys trachycarpus					X
Eudicots	Brassicaceae	Arabis blepharophylla					X
Eudicots	Brassicaceae	Barbarea orthoceras					X
Eudicots	Brassicaceae	Barbarea verna					X
Eudicots	Brassicaceae	Brassica oleracea					X
Eudicots	Brassicaceae	Brassica rapa					X
Eudicots	Brassicaceae	Cakile maritima					X
Eudicots	Brassicaceae	Capsella bursa-pastoris					X
Eudicots	Brassicaceae	Cardamine californica					X
Eudicots	Brassicaceae	Cardamine oligosperma					X
Eudicots	Brassicaceae	Caulanthus lasiophyllus					X
Eudicots	Brassicaceae	Erysimum concinnum					X
Eudicots	Brassicaceae	Erysimum franciscanum			X		
Eudicots	Brassicaceae	Hirschfeldia incana					X
Eudicots	Brassicaceae	Lepidium didymum					X
Eudicots	Brassicaceae	Lepidium lasiocarpum ssp. lasiocarpum					X
Eudicots	Brassicaceae	Lepidium nitidum					X
Eudicots	Brassicaceae	Lepidium strictum					X
Eudicots	Brassicaceae	Lobularia maritima					X
Eudicots	Brassicaceae	Nasturtium officinale					X
Eudicots	Brassicaceae	Planodes virginicum					X
Eudicots	Brassicaceae	Raphanus raphanistrum					X
Eudicots	Brassicaceae	Raphanus sativus					X
Eudicots	Brassicaceae	Rorippa curvisiliqua					X
Eudicots	Brassicaceae	Rorippa palustris ssp. palustris					X
Eudicots	Brassicaceae	Sinapis arvensis					X
Eudicots	Brassicaceae	Sisymbrium altissimum					X
Eudicots	Brassicaceae	Sisymbrium officinale					X
Eudicots	Brassicaceae	Streptanthus glandulosus ssp. pulchellus					X
Eudicots	Brassicaceae	Turritis glabra					X
Eudicots	Campanulaceae	Campanula californica					X

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Eudicots	Caprifoliaceae	Lonicera hispidula		X			
Eudicots	Caprifoliaceae	Lonicera involucrata var. ledebourii		X			
Eudicots	Caprifoliaceae	Symphoricarpos albus var. laevigatus		X			
Eudicots	Caprifoliaceae	Symphoricarpos mollis		X			
Eudicots	Caryophyllaceae	Cardionema ramosissimum					X
Eudicots	Caryophyllaceae	Cerastium arvense ssp. strictum					X
Eudicots	Caryophyllaceae	Cerastium glomeratum					X
Eudicots	Caryophyllaceae	Cerastium viride					X
Eudicots	Caryophyllaceae	Minuartia douglasii					X
Eudicots	Caryophyllaceae	Paronychia franciscana					X
Eudicots	Caryophyllaceae	Polycarpon tetraphyllum					X
Eudicots	Caryophyllaceae	Sagina apetala					X
Eudicots	Caryophyllaceae	Sagina decumbens ssp. occidentalis					X
Eudicots	Caryophyllaceae	Sagina maxima ssp. crassicaulis					X
Eudicots	Caryophyllaceae	Sagina procumbens					X
Eudicots	Caryophyllaceae	Silene gallica					X
Eudicots	Caryophyllaceae	Silene scouleri ssp. scouleri					X
Eudicots	Caryophyllaceae	Spergula arvensis					X
Eudicots	Caryophyllaceae	Spergularia bocconi					X
Eudicots	Caryophyllaceae	Spergularia macrotheca					X
Eudicots	Caryophyllaceae	Spergularia media					X
Eudicots	Caryophyllaceae	Spergularia rubra					X
Eudicots	Caryophyllaceae	Spergularia villosa					X
Eudicots	Caryophyllaceae	Stellaria borealis ssp. sitchana					X
Eudicots	Caryophyllaceae	Stellaria crispa					X
Eudicots	Caryophyllaceae	Stellaria littoralis					X
Eudicots	Caryophyllaceae	Stellaria media					X
Eudicots	Caryophyllaceae	Stellaria nitens					X
Eudicots	Chenopodiaceae	Atriplex leucophylla			X		
Eudicots	Chenopodiaceae	Atriplex prostrata					X
Eudicots	Chenopodiaceae	Chenopodium album					X
Eudicots	Chenopodiaceae	Chenopodium californicum					X
Eudicots	Chenopodiaceae	Chenopodium macrospermum					X
Eudicots	Chenopodiaceae	Chenopodium murale					X
Eudicots	Chenopodiaceae	Dysphania ambrosioides					X
Eudicots	Chenopodiaceae	Extriplex californica					X
Eudicots	Chenopodiaceae	Salicornia depressa					X
Eudicots	Chenopodiaceae	Salicornia pacifica			X		
Eudicots	Cistaceae	Helianthemum scoparium			X		
Eudicots	Convolvulaceae	Calystegia occidentalis				X	
Eudicots	Convolvulaceae	Calystegia purpurata ssp. purpurata				X	
Eudicots	Convolvulaceae	Calystegia purpurata ssp. saxicola				X	
Eudicots	Convolvulaceae	Calystegia soldanella					X
Eudicots	Convolvulaceae	Calystegia subacaulis ssp. subacaulis					X
Eudicots	Convolvulaceae	Convolvulus arvensis				X	
Eudicots	Convolvulaceae	Cuscuta californica var. californica				X	
Eudicots	Convolvulaceae	Cuscuta pacifica var. pacifica				X	
Eudicots	Convolvulaceae	Cuscuta salina				X	
Eudicots	Convolvulaceae	Dichondra donelliana					X
Eudicots	Cornaceae	Cornus sericea ssp. sericea		X			

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Eudicots	Crassulaceae	Crassula aquatica					X
Eudicots	Crassulaceae	Crassula connata					X
Eudicots	Crassulaceae	Dudleya cymosa ssp. cymosa					X
Eudicots	Crassulaceae	Dudleya farinosa					X
Eudicots	Crassulaceae	Sedum spathulifolium					X
Eudicots	Cucurbitaceae	Marah fabacea				X	
Eudicots	Cucurbitaceae	Marah oregana				X	
Eudicots	Dipsacaceae	Dipsacus fullonum					X
Eudicots	Dipsacaceae	Dipsacus sativus					X
Eudicots	Ericaceae	Arbutus menziesii	X				
Eudicots	Ericaceae	Arctostaphylos glandulosa ssp. cushingiana		X			
Eudicots	Ericaceae	Arctostaphylos glandulosa ssp. glandulosa		X			
Eudicots	Ericaceae	Arctostaphylos sensitiva		X			
Eudicots	Ericaceae	Arctostaphylos uva-ursi		X			
Eudicots	Ericaceae	Arctostaphylos virgata		X			
Eudicots	Ericaceae	Gaultheria shallon		X			
Eudicots	Ericaceae	Rhododendron columbianum		X			
Eudicots	Ericaceae	Rhododendron macrophyllum		X			
Eudicots	Ericaceae	Rhododendron occidentale		X			
Eudicots	Ericaceae	Vaccinium cespitosum		X			
Eudicots	Ericaceae	Vaccinium ovatum		X			
Eudicots	Euphorbiaceae	Croton setigerus					X
Eudicots	Euphorbiaceae	Euphorbia lathyris					X
Eudicots	Euphorbiaceae	Euphorbia peplus					X
Eudicots	Euphorbiaceae	Euphorbia spathulata					X
Eudicots	Fabaceae	Acacia dealbata	X				
Eudicots	Fabaceae	Acacia melanoxylon	X				
Eudicots	Fabaceae	Acmispon americanus var. americanus					X
Eudicots	Fabaceae	Acmispon brachycarpus					X
Eudicots	Fabaceae	Acmispon glaber			X		
Eudicots	Fabaceae	Acmispon heermannii var. orbicularis					X
Eudicots	Fabaceae	Acmispon junceus var. biolettii					X
Eudicots	Fabaceae	Acmispon parviflorus					X
Eudicots	Fabaceae	Acmispon strigosus					X
Eudicots	Fabaceae	Acmispon wrangelianus					X
Eudicots	Fabaceae	Astragalus gambelianus					X
Eudicots	Fabaceae	Astragalus nuttallii var. nuttallii					X
Eudicots	Fabaceae	Astragalus pycnostachyus var. pycnostachyus					X
Eudicots	Fabaceae	Cytisus scoparius		X			
Eudicots	Fabaceae	Genista monspessulana		X			
Eudicots	Fabaceae	Hoita orbicularis					X
Eudicots	Fabaceae	Hosackia gracilis					X
Eudicots	Fabaceae	Lathyrus angulatus				X	
Eudicots	Fabaceae	Lathyrus latifolius				X	
Eudicots	Fabaceae	Lathyrus vestitus var. vestitus				X	
Eudicots	Fabaceae	Lotus angustissimus					X
Eudicots	Fabaceae	Lotus corniculatus					X
Eudicots	Fabaceae	Lotus tenuis					X
Eudicots	Fabaceae	Lupinus albifrons var. albifrons		X			
Eudicots	Fabaceae	Lupinus albifrons var. collinus			X		

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Eudicots	Fabaceae	Lupinus arboreus		X			
Eudicots	Fabaceae	Lupinus bicolor					X
Eudicots	Fabaceae	Lupinus chamissonis		X			
Eudicots	Fabaceae	Lupinus formosus var. formosus					X
Eudicots	Fabaceae	Lupinus nanus					X
Eudicots	Fabaceae	Lupinus polyphyllus var. polyphyllus					X
Eudicots	Fabaceae	Lupinus succulentus					X
Eudicots	Fabaceae	Lupinus tidestromii					X
Eudicots	Fabaceae	Lupinus variicolor			X		
Eudicots	Fabaceae	Medicago arabica					X
Eudicots	Fabaceae	Medicago lupulina					X
Eudicots	Fabaceae	Medicago polymorpha					X
Eudicots	Fabaceae	Melilotus albus					X
Eudicots	Fabaceae	Melilotus indicus					X
Eudicots	Fabaceae	Pickeringia montana		X			
Eudicots	Fabaceae	Thermopsis californica					X
Eudicots	Fabaceae	Trifolium albopurpureum					X
Eudicots	Fabaceae	Trifolium angustifolium					X
Eudicots	Fabaceae	Trifolium barbigerum					X
Eudicots	Fabaceae	Trifolium bifidum					X
Eudicots	Fabaceae	Trifolium campestre					X
Eudicots	Fabaceae	Trifolium cernuum					X
Eudicots	Fabaceae	Trifolium depauperatum var. truncatum					X
Eudicots	Fabaceae	Trifolium dichotomum					X
Eudicots	Fabaceae	Trifolium dubium					X
Eudicots	Fabaceae	Trifolium fragiferum					X
Eudicots	Fabaceae	Trifolium fucatum					X
Eudicots	Fabaceae	Trifolium glomeratum					X
Eudicots	Fabaceae	Trifolium gracilentum					X
Eudicots	Fabaceae	Trifolium grayi					X
Eudicots	Fabaceae	Trifolium hirtum					X
Eudicots	Fabaceae	Trifolium longipes ssp. hansenii					X
Eudicots	Fabaceae	Trifolium macraei					X
Eudicots	Fabaceae	Trifolium microcephalum					X
Eudicots	Fabaceae	Trifolium microdon					X
Eudicots	Fabaceae	Trifolium repens					X
Eudicots	Fabaceae	Trifolium subterraneum					X
Eudicots	Fabaceae	Trifolium tomentosum					X
Eudicots	Fabaceae	Trifolium variegatum					X
Eudicots	Fabaceae	Trifolium willdenovii					X
Eudicots	Fabaceae	Trifolium wormskioldii					X
Eudicots	Fabaceae	Ulex europaeus		X			
Eudicots	Fabaceae	Vicia americana ssp. americana					X
Eudicots	Fabaceae	Vicia benghalensis					X
Eudicots	Fabaceae	Vicia gigantea				X	
Eudicots	Fabaceae	Vicia hirsuta					X
Eudicots	Fabaceae	Vicia sativa ssp. nigra					X
Eudicots	Fabaceae	Vicia sativa ssp. sativa					X
Eudicots	Fabaceae	Vicia tetrasperma					X
Eudicots	Fabaceae	Vicia villosa ssp. varia					X

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Eudicots	Fagaceae	Chrysolepis chrysophylla var. chrysophylla	X				
Eudicots	Fagaceae	Chrysolepis chrysophylla var. minor		X			
Eudicots	Fagaceae	Notholithocarpus densiflorus var. densiflorus	X				
Eudicots	Fagaceae	Quercus agrifolia var. agrifolia	X				
Eudicots	Fagaceae	Quercus chrysolepis	X				
Eudicots	Fagaceae	Quercus parvula var. shrevei	X				
Eudicots	Fagaceae	Quercus wislizeni	X				
Eudicots	Frankeniaceae	Frankenia salina			X		
Eudicots	Garryaceae	Garrya elliptica		X			
Eudicots	Gentianaceae	Centaurium tenuiflorum					X
Eudicots	Gentianaceae	Cicendia quadrangularis					X
Eudicots	Gentianaceae	Gentiana affinis var. ovata					X
Eudicots	Gentianaceae	Zeltnera davyi					X
Eudicots	Gentianaceae	Zeltnera muehlenbergii					X
Eudicots	Geraniaceae	Erodium botrys					X
Eudicots	Geraniaceae	Erodium cicutarium					X
Eudicots	Geraniaceae	Erodium moschatum					X
Eudicots	Geraniaceae	Geranium core-core					X
Eudicots	Geraniaceae	Geranium dissectum					X
Eudicots	Geraniaceae	Geranium molle					X
Eudicots	Geraniaceae	Geranium potentilloides					X
Eudicots	Geraniaceae	Geranium solanderi					X
Eudicots	Geraniaceae	Pelargonium grossularioides					X
Eudicots	Grossulariaceae	Ribes divaricatum var. pubiflorum		X			
Eudicots	Grossulariaceae	Ribes malvaceum		X			
Eudicots	Grossulariaceae	Ribes menziesii		X			
Eudicots	Grossulariaceae	Ribes sanguineum var. glutinosum		X			
Eudicots	Haloragaceae	Myriophyllum aquaticum					X
Eudicots	Haloragaceae	Myriophyllum hippuroides					X
Eudicots	Haloragaceae	Myriophyllum sibiricum					X
Eudicots	Hydrangeaceae	Whipplea modesta			X		
Eudicots	Hypericaceae	Hypericum anagalloides					X
Eudicots	Hypericaceae	Hypericum perforatum					X
Eudicots	Hypericaceae	Hypericum scouleri					X
Eudicots	Juglandaceae	Juglans hindsii	X				
Eudicots	Lamiaceae	Clinopodium douglasii			X		
Eudicots	Lamiaceae	Lamium purpureum					X
Eudicots	Lamiaceae	Lepechinia calycina		X			
Eudicots	Lamiaceae	Marrubium vulgare			X		
Eudicots	Lamiaceae	Mentha arvensis					X
Eudicots	Lamiaceae	Mentha canadensis					X
Eudicots	Lamiaceae	Mentha pulegium					X
Eudicots	Lamiaceae	Monardella purpurea			X		
Eudicots	Lamiaceae	Monardella undulata					X
Eudicots	Lamiaceae	Monardella villosa ssp. franciscana			X		
Eudicots	Lamiaceae	Monardella villosa ssp. villosa			X		
Eudicots	Lamiaceae	Pogogyne serpylloides					X
Eudicots	Lamiaceae	Prunella vulgaris					X
Eudicots	Lamiaceae	Salvia columbariae					X
Eudicots	Lamiaceae	Scutellaria californica					X

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Eudicots	Lamiaceae	Stachys ajugoides					X
Eudicots	Lamiaceae	Stachys bergii					X
Eudicots	Lamiaceae	Stachys chamissonis					X
Eudicots	Lamiaceae	Stachys rigida var. quercetorum					X
Eudicots	Limnanthaceae	Limnanthes douglasii					X
Eudicots	Linaceae	Hesperolinon congestum					X
Eudicots	Linaceae	Linum bienne					X
Eudicots	Lythraceae	Lythrum hyssopifolia					X
Eudicots	Malvaceae	Malva nicaeensis					X
Eudicots	Malvaceae	Malva parviflora					X
Eudicots	Malvaceae	Malva pseudolavatera					X
Eudicots	Malvaceae	Modiola caroliniana					X
Eudicots	Malvaceae	Sidalcea calycosa ssp. rhizomata					X
Eudicots	Malvaceae	Sidalcea malviflora ssp. laciniata					X
Eudicots	Malvaceae	Sidalcea malviflora ssp. malviflora					X
Eudicots	Montiaceae	Calandrinia ciliata					X
Eudicots	Montiaceae	Claytonia exigua					X
Eudicots	Montiaceae	Claytonia parviflora ssp. parviflora					X
Eudicots	Montiaceae	Claytonia perfoliata ssp. perfoliata					X
Eudicots	Montiaceae	Claytonia sibirica					X
Eudicots	Montiaceae	Montia fontana					X
Eudicots	Myricaceae	Morella californica	X				
Eudicots	Myrsinaceae	Anagallis arvensis					X
Eudicots	Myrsinaceae	Anagallis minima					X
Eudicots	Myrsinaceae	Glaux maritima					X
Eudicots	Myrsinaceae	Trientalis latifolia					X
Eudicots	Myrtaceae	Eucalyptus globulus	X				
Eudicots	Myrtaceae	Leptospermum laevigatum		X			
Eudicots	Nyctaginaceae	Abronia latifolia					X
Eudicots	Nyctaginaceae	Abronia umbellata var. breviflora					X
Eudicots	Oleaceae	Fraxinus latifolia	X				
Eudicots	Oleaceae	Olea europaea	X				
Eudicots	Onagraceae	Camissonia contorta					X
Eudicots	Onagraceae	Camissoniopsis cheiranthifolia ssp. cheiranthifolia					X
Eudicots	Onagraceae	Camissoniopsis micrantha					X
Eudicots	Onagraceae	Circaea alpina ssp. pacifica					X
Eudicots	Onagraceae	Clarkia amoena ssp. amoena					X
Eudicots	Onagraceae	Clarkia concinna ssp. concinna					X
Eudicots	Onagraceae	Clarkia davyi					X
Eudicots	Onagraceae	Clarkia purpurea ssp. purpurea					X
Eudicots	Onagraceae	Clarkia rubicunda					X
Eudicots	Onagraceae	Clarkia unguiculata					X
Eudicots	Onagraceae	Epilobium brachycarpum					X
Eudicots	Onagraceae	Epilobium ciliatum ssp. watsonii					X
Eudicots	Onagraceae	Epilobium minutum					X
Eudicots	Onagraceae	Ludwigia peploides ssp. montevidensis					X
Eudicots	Onagraceae	Ludwigia peploides ssp. peploides					X
Eudicots	Onagraceae	Oenothera elata ssp. hookeri					X
Eudicots	Onagraceae	Taraxia ovata					X
Eudicots	Orobanchaceae	Castilleja affinis ssp. affinis					X

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Eudicots	Orobanchaceae	Castilleja affinis ssp. neglecta					X
Eudicots	Orobanchaceae	Castilleja ambigua ssp. ambigua					X
Eudicots	Orobanchaceae	Castilleja attenuata					X
Eudicots	Orobanchaceae	Castilleja densiflora					X
Eudicots	Orobanchaceae	Castilleja exserta ssp. latifolia					X
Eudicots	Orobanchaceae	Castilleja foliolosa			X		
Eudicots	Orobanchaceae	Castilleja latifolia					X
Eudicots	Orobanchaceae	Castilleja rubicundula ssp. lithospermoides					X
Eudicots	Orobanchaceae	Castilleja subinclusa ssp. franciscana					X
Eudicots	Orobanchaceae	Castilleja wightii					X
Eudicots	Orobanchaceae	Chloropyron maritimum ssp. palustre					X
Eudicots	Orobanchaceae	Orobanche californica ssp. californica					X
Eudicots	Orobanchaceae	Parentucellia latifolia					X
Eudicots	Orobanchaceae	Pedicularis densiflora					X
Eudicots	Orobanchaceae	Triphysaria eriantha ssp. rosea					X
Eudicots	Orobanchaceae	Triphysaria floribunda					X
Eudicots	Orobanchaceae	Triphysaria pusilla					X
Eudicots	Orobanchaceae	Triphysaria versicolor ssp. versicolor					X
Eudicots	Oxalidaceae	Oxalis corniculata					X
Eudicots	Oxalidaceae	Oxalis incarnata					X
Eudicots	Oxalidaceae	Oxalis micrantha					X
Eudicots	Oxalidaceae	Oxalis pes-caprae					X
Eudicots	Oxalidaceae	Oxalis pilosa					X
Eudicots	Papaveraceae	Dicentra formosa					X
Eudicots	Papaveraceae	Eschscholzia californica					X
Eudicots	Papaveraceae	Meconella californica					X
Eudicots	Papaveraceae	Platystemon californicus					X
Eudicots	Phrymaceae	Mimulus aurantiacus var. aurantiacus		X			
Eudicots	Phrymaceae	Mimulus guttatus					X
Eudicots	Phrymaceae	Mimulus moschatus					X
Eudicots	Pittosporaceae	Pittosporum undulatum	X				
Eudicots	Plantaginaceae	Callitriche heterophylla var. bolanderi					X
Eudicots	Plantaginaceae	Callitriche marginata					X
Eudicots	Plantaginaceae	Collinsia heterophylla					X
Eudicots	Plantaginaceae	Collinsia sparsiflora					X
Eudicots	Plantaginaceae	Digitalis purpurea					X
Eudicots	Plantaginaceae	Gratiola ebracteata					X
Eudicots	Plantaginaceae	Nuttallanthus texanus					X
Eudicots	Plantaginaceae	Plantago coronopus					X
Eudicots	Plantaginaceae	Plantago elongata					X
Eudicots	Plantaginaceae	Plantago erecta					X
Eudicots	Plantaginaceae	Plantago lanceolata					X
Eudicots	Plantaginaceae	Plantago major					X
Eudicots	Plantaginaceae	Plantago maritima					X
Eudicots	Plantaginaceae	Plantago subnuda					X
Eudicots	Plantaginaceae	Veronica americana					X
Eudicots	Plantaginaceae	Veronica arvensis					X
Eudicots	Plantaginaceae	Veronica peregrina ssp. xalapensis					X
Eudicots	Plantaginaceae	Veronica persica					X
Eudicots	Plantaginaceae	Veronica scutellata					X

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Eudicots	Plumbaginaceae	Armeria maritima ssp. californica					X
Eudicots	Plumbaginaceae	Limonium californicum					X
Eudicots	Polemoniaceae	Collomia heterophylla					X
Eudicots	Polemoniaceae	Gilia capitata ssp. chamissonis					X
Eudicots	Polemoniaceae	Gilia capitata ssp. tomentosa					X
Eudicots	Polemoniaceae	Gilia clivorum					X
Eudicots	Polemoniaceae	Gilia millefoliata					X
Eudicots	Polemoniaceae	Leptosiphon androsaceus					X
Eudicots	Polemoniaceae	Leptosiphon grandiflorus					X
Eudicots	Polemoniaceae	Leptosiphon parviflorus					X
Eudicots	Polemoniaceae	Leptosiphon rosaceus					X
Eudicots	Polemoniaceae	Microsteris gracilis					X
Eudicots	Polemoniaceae	Navarretia squarrosa					X
Eudicots	Polygalaceae	Polygala californica					X
Eudicots	Polygonaceae	Bistorta bistortoides					X
Eudicots	Polygonaceae	Chorizanthe cuspidata var. cuspidata					X
Eudicots	Polygonaceae	Chorizanthe cuspidata var. villosa					X
Eudicots	Polygonaceae	Chorizanthe valida					X
Eudicots	Polygonaceae	Eriogonum elongatum			X		
Eudicots	Polygonaceae	Eriogonum fasciculatum		X			
Eudicots	Polygonaceae	Eriogonum latifolium			X		
Eudicots	Polygonaceae	Eriogonum nudum					X
Eudicots	Polygonaceae	Persicaria amphibia					X
Eudicots	Polygonaceae	Persicaria maculosa					X
Eudicots	Polygonaceae	Persicaria punctata					X
Eudicots	Polygonaceae	Polygonum aviculare ssp. depressum					X
Eudicots	Polygonaceae	Polygonum marinense					X
Eudicots	Polygonaceae	Polygonum paronychia		X			
Eudicots	Polygonaceae	Pterostegia drymarioides					X
Eudicots	Polygonaceae	Rumex acetosella					X
Eudicots	Polygonaceae	Rumex conglomeratus					X
Eudicots	Polygonaceae	Rumex crassus					X
Eudicots	Polygonaceae	Rumex crispus					X
Eudicots	Polygonaceae	Rumex fueginus					X
Eudicots	Polygonaceae	Rumex obtusifolius					X
Eudicots	Polygonaceae	Rumex occidentalis					X
Eudicots	Polygonaceae	Rumex pulcher					X
Eudicots	Polygonaceae	Rumex salicifolius					X
Eudicots	Primulaceae	Dodecatheon hendersonii					X
Eudicots	Ranunculaceae	Actaea rubra					X
Eudicots	Ranunculaceae	Anemone oregana					X
Eudicots	Ranunculaceae	Aquilegia formosa					X
Eudicots	Ranunculaceae	Delphinium californicum ssp. californicum					X
Eudicots	Ranunculaceae	Delphinium decorum ssp. decorum					X
Eudicots	Ranunculaceae	Ranunculus aquatilis var. diffusus					X
Eudicots	Ranunculaceae	Ranunculus californicus					X
Eudicots	Ranunculaceae	Ranunculus flammula var. ovalis					X
Eudicots	Ranunculaceae	Ranunculus lobbii					X
Eudicots	Ranunculaceae	Ranunculus muricatus					X
Eudicots	Ranunculaceae	Ranunculus orthorhynchus var. bloomeri					X

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Eudicots	Ranunculaceae	Ranunculus orthorhynchus var. orthorhynchus					X
Eudicots	Ranunculaceae	Ranunculus repens					X
Eudicots	Ranunculaceae	Ranunculus uncinatus					X
Eudicots	Ranunculaceae	Thalictrum fendleri var. polycarpum					X
Eudicots	Rhamnaceae	Ceanothus cuneatus		X			
Eudicots	Rhamnaceae	Ceanothus foliosus var. foliosus		X			
Eudicots	Rhamnaceae	Ceanothus gloriosus var. exaltatus		X			
Eudicots	Rhamnaceae	Ceanothus gloriosus var. gloriosus		X			
Eudicots	Rhamnaceae	Ceanothus jepsonii		X			
Eudicots	Rhamnaceae	Ceanothus masonii		X			
Eudicots	Rhamnaceae	Ceanothus oliganthus var. sorediatus		X			
Eudicots	Rhamnaceae	Ceanothus thyrsiflorus		X			
Eudicots	Rhamnaceae	Frangula californica		X			
Eudicots	Rosaceae	Acaena pinnatifida var. californica					X
Eudicots	Rosaceae	Adenostoma fasciculatum		X			
Eudicots	Rosaceae	Amelanchier utahensis		X			
Eudicots	Rosaceae	Aphanes occidentalis					X
Eudicots	Rosaceae	Cotoneaster lacteus		X			
Eudicots	Rosaceae	Cotoneaster pannosus		X			
Eudicots	Rosaceae	Crataegus monogyna	X				
Eudicots	Rosaceae	Drymocallis glandulosa var. glandulosa					X
Eudicots	Rosaceae	Duchesnea indica					X
Eudicots	Rosaceae	Fragaria chiloensis					X
Eudicots	Rosaceae	Fragaria vesca					X
Eudicots	Rosaceae	Heteromeles arbutifolia		X			
Eudicots	Rosaceae	Holodiscus discolor		X			
Eudicots	Rosaceae	Horkelia californica var. californica					X
Eudicots	Rosaceae	Horkelia marinensis					X
Eudicots	Rosaceae	Malus pumila	X				
Eudicots	Rosaceae	Oemleria cerasiformis		X			
Eudicots	Rosaceae	Physocarpus capitatus		X			
Eudicots	Rosaceae	Potentilla anserina ssp. pacifica					X
Eudicots	Rosaceae	Prunus cerasifera	X				
Eudicots	Rosaceae	Pyracantha angustifolia		X			
Eudicots	Rosaceae	Rosa californica		X			
Eudicots	Rosaceae	Rosa canina		X			
Eudicots	Rosaceae	Rosa gymnocarpa		X			
Eudicots	Rosaceae	Rosa rubiginosa		X			
Eudicots	Rosaceae	Rosa spithamea		X			
Eudicots	Rosaceae	Rubus armeniacus		X			
Eudicots	Rosaceae	Rubus parviflorus		X			
Eudicots	Rosaceae	Rubus spectabilis		X			
Eudicots	Rosaceae	Rubus ursinus		X			
Eudicots	Rubiaceae	Galium aparine					X
Eudicots	Rubiaceae	Galium angustifolium			X		
Eudicots	Rubiaceae	Galium californicum			X		
Eudicots	Rubiaceae	Galium porrigens			X		
Eudicots	Rubiaceae	Galium trifidum ssp. columbianum					X
Eudicots	Rubiaceae	Galium triflorum					X
Eudicots	Rubiaceae	Sherardia arvensis					X

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Eudicots	Rutaceae	Ruta graveolens			X		
Eudicots	Salicaceae	Salix laevigata	X				
Eudicots	Salicaceae	Salix lasiandra var. lasiandra	X				
Eudicots	Salicaceae	Salix lasiolepis	X				
Eudicots	Salicaceae	Salix sitchensis	X				
Eudicots	Sapindaceae	Acer macrophyllum	X				
Eudicots	Sapindaceae	Acer negundo	X				
Eudicots	Sapindaceae	Aesculus californica	X				
Eudicots	Saxifragaceae	Heuchera micrantha					X
Eudicots	Saxifragaceae	Lithophragma affine					X
Eudicots	Saxifragaceae	Lithophragma heterophyllum					X
Eudicots	Saxifragaceae	Micranthes californica					X
Eudicots	Saxifragaceae	Tellima grandiflora					X
Eudicots	Scrophulariaceae	Limosella acaulis					X
Eudicots	Scrophulariaceae	Myoporum laetum		X			
Eudicots	Scrophulariaceae	Scrophularia californica					X
Eudicots	Solanaceae	Cestrum parqui		X			
Eudicots	Solanaceae	Solanum americanum			X		
Eudicots	Solanaceae	Solanum aviculare		X			
Eudicots	Solanaceae	Solanum douglasii			X		
Eudicots	Solanaceae	Solanum furcatum			X		
Eudicots	Solanaceae	Solanum nigrum			X		
Eudicots	Solanaceae	Solanum xanti			X		
Eudicots	Tropaeolaceae	Tropaeolum majus				X	
Eudicots	Ulmaceae	Ulmus parvifolia	X				
Eudicots	Urticaceae	Hesperocnide tenella					X
Eudicots	Urticaceae	Urtica dioica ssp. gracilis					X
Eudicots	Urticaceae	Urtica dioica ssp. holosericea					X
Eudicots	Urticaceae	Urtica urens					X
Eudicots	Valerianaceae	Plectritis ciliosa					X
Eudicots	Valerianaceae	Plectritis congesta ssp. brachystemon					X
Eudicots	Violaceae	Viola adunca					X
Eudicots	Violaceae	Viola glabella					X
Eudicots	Violaceae	Viola pedunculata					X
Eudicots	Violaceae	Viola sempervirens					X
Eudicots	Vitaceae	Vitis californica				X	
Monocots	Agavaceae	Camassia leichtlinii ssp. suksdorfii					X
Monocots	Agavaceae	Chlorogalum pomeridianum					X
Monocots	Alismataceae	Alisma triviale					X
Monocots	Alismataceae	Sagittaria rigida					X
Monocots	Alliaceae	Allium dichlamydeum					X
Monocots	Alliaceae	Allium triquetrum					X
Monocots	Alliaceae	Allium unifolium					X
Monocots	Amaryllidaceae	Amaryllis belladonna					X
Monocots	Amaryllidaceae	Narcissus tazetta					X
Monocots	Araceae	Lemna minor					X
Monocots	Araceae	Lemna minuta					X
Monocots	Araceae	Zantedeschia aethiopica					X
Monocots	Asphodelaceae	Kniphofia uvaria					X
Monocots	Cyperaceae	Bolboschoenus maritimus					X

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Monocots	Cyperaceae	Bolboschoenus robustus					X
Monocots	Cyperaceae	Carex bolanderi					X
Monocots	Cyperaceae	Carex brevicaulis					X
Monocots	Cyperaceae	Carex densa					X
Monocots	Cyperaceae	Carex divulsa					X
Monocots	Cyperaceae	Carex globosa					X
Monocots	Cyperaceae	Carex harfordii					X
Monocots	Cyperaceae	Carex leptopoda					X
Monocots	Cyperaceae	Carex obnupta					X
Monocots	Cyperaceae	Carex praegracilis					X
Monocots	Cyperaceae	Carex subfusca					X
Monocots	Cyperaceae	Carex tumulicola					X
Monocots	Cyperaceae	Cyperus eragrostis					X
Monocots	Cyperaceae	Eleocharis macrostachya					X
Monocots	Cyperaceae	Eleocharis pachycarpa					X
Monocots	Cyperaceae	Eleocharis quinqueflora					X
Monocots	Cyperaceae	Eleocharis rostellata					X
Monocots	Cyperaceae	Isolepis carinata					X
Monocots	Cyperaceae	Isolepis cernua					X
Monocots	Cyperaceae	Schoenoplectus acutus var. occidentalis					X
Monocots	Cyperaceae	Schoenoplectus americanus					X
Monocots	Cyperaceae	Schoenoplectus californicus					X
Monocots	Cyperaceae	Schoenoplectus pungens					X
Monocots	Cyperaceae	Scirpus microcarpus					X
Monocots	Hydrocharitaceae	Egeria densa					X
Monocots	Iridaceae	Chasmanthe floribunda					X
Monocots	Iridaceae	Crocosmia xcrocosmiflora					X
Monocots	Iridaceae	Iris douglasiana					X
Monocots	Iridaceae	Iris longipetala					X
Monocots	Iridaceae	Iris macrosiphon					X
Monocots	Iridaceae	Romulea rosea var. australis					X
Monocots	Iridaceae	Sisyrinchium bellum					X
Monocots	Iridaceae	Sisyrinchium californicum					X
Monocots	Iridaceae	Sparaxis tricolor					X
Monocots	Juncaceae	Juncus balticus ssp. ater					X
Monocots	Juncaceae	Juncus bolanderi					X
Monocots	Juncaceae	Juncus bufonius var. bufonius					X
Monocots	Juncaceae	Juncus bufonius var. congestus					X
Monocots	Juncaceae	Juncus capitatus					X
Monocots	Juncaceae	Juncus effusus					X
Monocots	Juncaceae	Juncus falcatus ssp. falcatus					X
Monocots	Juncaceae	Juncus hesperius					X
Monocots	Juncaceae	Juncus kelloggii					X
Monocots	Juncaceae	Juncus lescurii					X
Monocots	Juncaceae	Juncus mexicanus					X
Monocots	Juncaceae	Juncus occidentalis					X
Monocots	Juncaceae	Juncus patens					X
Monocots	Juncaceae	Juncus phaeocephalus var. paniculatus					X
Monocots	Juncaceae	Juncus phaeocephalus var. phaeocephalus					X
Monocots	Juncaceae	Luzula comosa					X

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Monocots	Juncaginaceae	Triglochin concinna					X
Monocots	Juncaginaceae	Triglochin maritima					X
Monocots	Juncaginaceae	Triglochin scilloides					X
Monocots	Juncaginaceae	Triglochin striata					X
Monocots	Liliaceae	Calochortus luteus					X
Monocots	Liliaceae	Calochortus tolmiei					X
Monocots	Liliaceae	Calochortus uniflorus					X
Monocots	Liliaceae	Clintonia andrewsiana					X
Monocots	Liliaceae	Fritillaria affinis					X
Monocots	Liliaceae	Fritillaria liliacea					X
Monocots	Liliaceae	Lilium maritimum					X
Monocots	Liliaceae	Lilium pardalinum ssp. pardalinum					X
Monocots	Liliaceae	Prosartes hookeri					X
Monocots	Liliaceae	Prosartes smithii					X
Monocots	Liliaceae	Scoliopus bigelovii					X
Monocots	Melanthiaceae	Toxicoscordion fremontii					X
Monocots	Melanthiaceae	Trillium chloropetalum					X
Monocots	Melanthiaceae	Trillium ovatum ssp. ovatum					X
Monocots	Melanthiaceae	Xerophyllum tenax					X
Monocots	Orchidaceae	Corallorhiza maculata var. maculata					X
Monocots	Orchidaceae	Epipactis gigantea					X
Monocots	Orchidaceae	Epipactis helleborine					X
Monocots	Orchidaceae	Goodyera oblongifolia					X
Monocots	Orchidaceae	Piperia elegans ssp. decurtata					X
Monocots	Orchidaceae	Piperia elegans ssp. elegans					X
Monocots	Orchidaceae	Piperia elongata					X
Monocots	Orchidaceae	Platanthera dilatata var. leucostachys					X
Monocots	Orchidaceae	Spiranthes romanzoffiana					X
Monocots	Poaceae	Agrostis avenacea					X
Monocots	Poaceae	Agrostis blasdalei					X
Monocots	Poaceae	Agrostis clivicola					X
Monocots	Poaceae	Agrostis densiflora					X
Monocots	Poaceae	Agrostis exarata					X
Monocots	Poaceae	Agrostis hallii					X
Monocots	Poaceae	Agrostis microphylla					X
Monocots	Poaceae	Agrostis pallens					X
Monocots	Poaceae	Agrostis stolonifera					X
Monocots	Poaceae	Aira caryophyllea					X
Monocots	Poaceae	Aira elegans					X
Monocots	Poaceae	Aira praecox					X
Monocots	Poaceae	Alopecurus aequalis var. sonomensis					X
Monocots	Poaceae	Alopecurus geniculatus					X
Monocots	Poaceae	Alopecurus pratensis					X
Monocots	Poaceae	Ammophila arenaria					X
Monocots	Poaceae	Anthoxanthum occidentale					X
Monocots	Poaceae	Arundo donax		X			
Monocots	Poaceae	Avena barbata					X
Monocots	Poaceae	Avena fatua					X
Monocots	Poaceae	Avena sativa					X
Monocots	Poaceae	Briza maxima					X

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Monocots	Poaceae	Briza minor					X
Monocots	Poaceae	Bromus carinatus var. carinatus					X
Monocots	Poaceae	Bromus catharticus var. elatus					X
Monocots	Poaceae	Bromus diandrus					X
Monocots	Poaceae	Bromus hordeaceus					X
Monocots	Poaceae	Bromus laevipes					X
Monocots	Poaceae	Bromus madritensis ssp. rubens					X
Monocots	Poaceae	Bromus maritimus					X
Monocots	Poaceae	Calamagrostis nutkaensis					X
Monocots	Poaceae	Calamagrostis stricta ssp. inexpansa					X
Monocots	Poaceae	Cortaderia jubata		X			
Monocots	Poaceae	Cynodon dactylon					X
Monocots	Poaceae	Cynosurus echinatus					X
Monocots	Poaceae	Dactylis glomerata					X
Monocots	Poaceae	Danthonia californica					X
Monocots	Poaceae	Deschampsia cespitosa ssp. cespitosa					X
Monocots	Poaceae	Deschampsia cespitosa ssp. holciformis					X
Monocots	Poaceae	Deschampsia danthonioides					X
Monocots	Poaceae	Deschampsia elongata					X
Monocots	Poaceae	Distichlis spicata					X
Monocots	Poaceae	Ehrharta erecta					X
Monocots	Poaceae	Elymus californicus					X
Monocots	Poaceae	Elymus glaucus					X
Monocots	Poaceae	Elymus mollis ssp. mollis					X
Monocots	Poaceae	Elymus pacificus					X
Monocots	Poaceae	Elymus triticoides					X
Monocots	Poaceae	Elymus x vancouverensis					X
Monocots	Poaceae	Festuca arundinacea					X
Monocots	Poaceae	Festuca bromoides					X
Monocots	Poaceae	Festuca californica					X
Monocots	Poaceae	Festuca idahoensis					X
Monocots	Poaceae	Festuca microstachys					X
Monocots	Poaceae	Festuca myuros					X
Monocots	Poaceae	Festuca occidentalis					X
Monocots	Poaceae	Festuca perennis					X
Monocots	Poaceae	Festuca rubra					X
Monocots	Poaceae	Festuca temulenta					X
Monocots	Poaceae	Glyceria x occidentalis					X
Monocots	Poaceae	Hainardia cylindrica					X
Monocots	Poaceae	Holcus lanatus					X
Monocots	Poaceae	Hordeum brachyantherum ssp. brachyantherum (H.b.)					X
Monocots	Poaceae	Hordeum brachyantherum ssp. Californicum					X
Monocots	Poaceae	Hordeum depressum					X
Monocots	Poaceae	Hordeum marinum ssp.gussoneanum					X
Monocots	Poaceae	Hordeum murinum ssp. glaucum					X
Monocots	Poaceae	Hordeum murinum ssp. Leporinum					X
Monocots	Poaceae	Koeleria macrantha					X
Monocots	Poaceae	Lagurus ovatus					X
Monocots	Poaceae	Lamarckia aurea					X

Clade	Family	Species	Tree	Shrub	SubShrub	Woody or Herbaceous Vine	Herbaceous
Monocots	Poaceae	Melica californica					X
Monocots	Poaceae	Melica geyeri					X
Monocots	Poaceae	Melica subulata					X
Monocots	Poaceae	Melica torreyana					X
Monocots	Poaceae	Panicum acuminatum					X
Monocots	Poaceae	Paspalum distichum					X
Monocots	Poaceae	Pennisetum clandestinum					X
Monocots	Poaceae	Phalaris aquatica					X
Monocots	Poaceae	Phalaris californica					X
Monocots	Poaceae	Phleum alpinum					X
Monocots	Poaceae	Pleuropogon refractus					X
Monocots	Poaceae	Poa annua					X
Monocots	Poaceae	Poa douglasii					X
Monocots	Poaceae	Poa howellii					X
Monocots	Poaceae	Poa pratensis ssp. pratensis					X
Monocots	Poaceae	Poa secunda ssp. secunda					X
Monocots	Poaceae	Poa trivialis					X
Monocots	Poaceae	Poa unilateralis					X
Monocots	Poaceae	Polypogon interruptus					X
Monocots	Poaceae	Polypogon monspeliensis					X
Monocots	Poaceae	Polypogon viridis					X
Monocots	Poaceae	Rytidosperma penicillatum					X
Monocots	Poaceae	Spartina foliosa					X
Monocots	Poaceae	Stipa lepida					X
Monocots	Poaceae	Stipa pulchra					X
Monocots	Poaceae	Torreyochloa pallida var. pauciflora					X
Monocots	Poaceae	Trisetum canescens					X
Monocots	Pontederiaceae	Eichhornia crassipes					X
Monocots	Potamogetonaceae	Potamogeton nodosus					X
Monocots	Ruppiaceae	Ruppia cirrhosa					X
Monocots	Ruppiaceae	Ruppia maritima					X
Monocots	Ruscaceae	Maianthemum dilatatum					X
Monocots	Ruscaceae	Maianthemum racemosum					X
Monocots	Ruscaceae	Maianthemum stellatum					X
Monocots	Themidaceae	Dichelostemma capitatum ssp. capitatum					X
Monocots	Themidaceae	Dichelostemma congestum					X
Monocots	Themidaceae	Muilla maritima					X
Monocots	Themidaceae	Triteleia hyacinthina					X
Monocots	Themidaceae	Triteleia laxa					X
Monocots	Themidaceae	Triteleia peduncularis					X
Monocots	Thermidaceae	Brodiaea elegans					X
Monocots	Thermidaceae	Brodiaea terrestris ssp. terrestris					X
Monocots	Tofieldiaceae	Triantha occidentalis ssp. occidentalis					X
Monocots	Typhaceae	Sparganium eurycarpum var. eurycarpum					X
Monocots	Typhaceae	Sparganium eurycarpum var. greenei					X
Monocots	Typhaceae	Typha domingensis					X
Monocots	Typhaceae	Typha latifolia					X
Monocots	Zosteraceae	Phyllospadix torreyi					X
Monocots	Zosteraceae	Zostera marina					X
Monocots	Zosteraceae	Zostera pacifica					X

SOP 22: Safety and Job Hazard Analysis

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

Managing risk appropriately and keeping employees safe is the highest priority for the National Park Service (NPS), along with accomplishing our congressionally-mandated mission. This SOP details mechanisms for assessing risk and minimizing hazards.

NPSafe

The San Francisco Bay Area Network (SFAN) complies with the NPSafe program and with local park safety programs. Crews will be trained on all safety aspects of this project prior to working in the field.

The vision of the NPSafe program is:

> *"The NPS is widely recognized for providing world-class resource stewardship and visitor experiences. Just as the NPS excels at protecting natural and cultural resources and serving park visitors, the NPS can excel in providing our employees with a safe work environment. All employees deserve the opportunity to do their jobs safely and effectively so they can go home healthy at the end of the day to fully enjoy their lives and families."*

The beliefs of the NPSafe program are:

- We believe that healthy, productive employees are our most important resource, and employee safety is our most important value.
- Injuries and occupational illnesses are unacceptable and all are preventable.
- At risk behaviors can be eliminated.
- Operating hazards and risks can be controlled.
- Safety is everyone's responsibility.
- Managing for safety excellence can enhance employee productivity, save millions of dollars in workers compensation costs, and improve overall management effectiveness.

The goals of the NPSafe program are:

1. The NPS becomes the safest place to work in Department of the Interior.
2. Safety is integrated into all NPS activities.
3. The NPS organizational culture values employee safety as much as it values protecting resources and serving visitors.
4. Employees, supervisors, and managers demonstrate unwavering commitment to continuous improvement in employee health and safety.

To meet these goals, SFAN has included several Job Hazard Analyses (JHAs) at the end of this SOP that will be followed while implementing this protocol:

- Driving vehicles in the course of one's job
- Remote field site access/ trail travel/ cross-country travel
- Environmental exposure
- Wildlife and Botanical Exposure
- Communication

The field crew will be working in some remote areas; it is therefore essential that everyone, to the extent possible, be prepared for emergency situations. All crew members will read this appendix before going into the field and will strictly adhere to it while working at the parks. The JHAs address known hazards (e.g., poison oak, rocky terrain, etc.), wildlife issues, communications, first aid, and an emergency response plan.

Operational Leadership

In order to minimize risk, this program will use the tools provided by the NPS Operational Leadership program. All staff will receive training in Operational Leadership principals, either through formal workshops or during seasonal orientation. This training will include:

- Expectations for conducting regular pre-work briefings (e.g., GAR analyses) and after action reviews
- Expectations that crew members will actively contribute to the continual evaluation and mitigation of hazards
- Expectations that crew members will speak-up promptly when observing something that could cause a near miss or injury
- Awareness of how stress, fatigue, and communication break-downs can contribute to near misses or injuries

Protocol Readiness Reviews

The Pacific West Region of the NPS has requested that all Inventory and Monitoring (I&M) monitoring programs in the region be subjected to an annual Protocol Readiness Review (PRR). This review will ensure that the monitoring protocol has sufficient resources and support to implement with full consideration for safety, field logistics, and supervisory oversight. The PRR process

requires that all I&M and park personnel have been informed of, understand, and concur with safety plans, procedures, and responsibilities, and will effectively communicate, supervise, and execute these measures through the I&M Program, SFAN, and park lines of authority. Through the annual review process, park staff and I&M personnel have jointly identified the key groups and individuals that will contribute and participate to ensure safe implementation of the protocol.

In the SFAN, PRR process consists of an assessment of:

- Operations planning and field logistics
- Training requirements
- Risk management
- Awareness of and consistency with park safety protocols and emergency procedures
- Identification of supervisory oversight
- Communication channels.

Each year relevant I&M and park staff will complete this assessment for each park in which this protocol will be implemented (Golden Gate National Recreation Area, Pinnacles National Park, Point Reyes National Seashore). This assessment will be documented and signed by the park superintendent, the SFAN Program Manager, and the SFAN vegetation ecologist. Copies of the certification are provided to the SFAN Board of Directors Chair and to the Regional I&M Program Manager. The signed original document is retained by the SFAN Program Manager.

Job Hazard Analysis

All personnel implementing this field protocol will be briefed as to the specific hazards of the job and provided with necessary tools to complete the work safety (including communication devices). This information can be found in the JHA below. This JHA will be reviewed and updated at the beginning of each field season by the SFAN vegetation ecologist and reviewed by each staff person and volunteer collecting data for this monitoring program.

JOB HAZARD ANALYSIS (JHA)		**Date: 1/29/2012**	
Park Unit: SFAN	Division: IMD	Branch: NRPC	Location: Sausalito, California
Task Title: **Driving vehicles in the course of one's job**		JHA Number: SFAN JHA 1	Page: 1 of 3
Job Performed By: ALL	Analysis By: Daniel Sarr for KLMN Modified By: Robert Steers for SFAN	Supervisor: Vacant	Approved By: Robert Steers
Required Standards and General Notes:	Employees driving as part of their duties must have a valid state issued driver's license.		
Required Training:	Standard drivers training. Also need to know how to change tires and jump start vehicle.		
Required Personal Protective Equipment:	Seatbelts must be used.		
Tools and Equipment:	Vehicle		

Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**
Starting vehicle, basic operation	• Lights not functioning, visibility impaired • Low tire pressure • Low fluid levels • Spare tire not in vehicle or deflated • Low gas	• Test headlights, turn signals, brake lights, breaks, tire pressure and all fluids • Check status of spare; insure that jack, properly sized lug wrench and all necessary tools are present in vehicle • Check gas
Using four wheel drive, if applicable.	• Not knowing how to engage, getting stuck in the field • Unsafe driving procedures due to perceived safety of four wheel drive	• Practice engaging four wheel drive • Engage four wheel drive prior to rough conditions • Use four wheel drive when increased traction is necessary; e.g., steep slopes, slick conditions, snow • Even in four wheel drive, do not assume safety is enhanced. Use cautious and defensive driving practices.
Driving in reverse	• Hitting objects, people, wildlife	• Check area behind vehicle prior to leaving site • Use a person outside the vehicle (other crew member) to direct traffic • Back into parking spots, so leaving sites after long field days are easier and less likely to result in fatigue or poor visibility related mishap

JOB HAZARD ANALYSIS (JHA)		JHA Number: SFAN JHA 1	Page: 2 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Transporting gear and heavy equipment	• Gear flying around, hitting driver and passenger in accident • Damage to gear during turns or stops	• Ensure that gear is adequately stowed. • If the gear comes with protective gear , then properly stow in container. • Do not put gear on top of vehicle; stow inside.	
Passenger/driver safety	• Distracted driving	• Wear seatbelts at all times while driving. • Practice safe and defensive driving habits. • Obey traffic laws. • Do not text, make calls, or answer calls while driving. Pull over and stop to use phone. • Keep windshields clean. • Drive with both hands on the wheel at 10 o'clock and 2 o'clock. • Do not pick up hitch hikers. • Use turn signals/indicators. • Plan route in advance. • Make sure seat and mirrors are properly adjusted for driver • Use headlights, even during day time driving.	
	• Driving on narrow, single lane roads with bumpy or "washboard" surfaces.	• Maintain a safe speed (this may be below the legal limit). • Stay to the right, especially on curves, and be aware for oncoming traffic. • If turning around, "face the danger," in other words, turn towards a steep slope, instead of backing into a steep slope cliff.	
	• Driving with limited visibility, as in heavy rain, fog, or dust.	• Slow down. • If possible, wait for conditions to improve. • Drive with lights on. In some conditions, low lights may penetrate better than brights.	

JOB HAZARD ANALYSIS (JHA)		JHA Number: SFAN JHA 1	Page: 3 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Passenger/driver safety	• Fatigued driving	• Be aware of signs of fatigue. Pull over and catnap if necessary, eat a snack, or have a partner drive. If in doubt, do not drive.	
	• Storm conditions (torrents, mud, wind)	• Keep informed of the weather. • If excess wind (tree top swaying, twigs falling) consider postponing trip. • Avoid wet clay roads as much as possible.	
	• Road obstacles	• Get out and move rocks in the road as necessary. If large amounts of rockfall or trees, report to the park staff. • If you hit rocks, stop and check tire and undercarriage conditions (splash pan, tire wear, sidewall, and inflation) for damage. • If obstacle is an animal, slow down! Be aware of high animal traffic areas and drive appropriately. It is better to “ride out” an impact than suddenly swerve. This is true for animals of all sizes, from squirrels to cattle.	
Working/Parking on or near a roadside	•Being hit by a car	• Stay off of the road. • Use pullouts or secondary road when parking. • Be aware of the traffic. • Walk on the side of the road facing traffic. • Always set out safety triangles or flares behind the vehicle before starting any maintenance. • Never go under the vehicle while it is up on a jack.	
Working/Parking on or near a roadside	•Running into objects, parking too far off the road, getting stuck, rolling vehicle	• Park on stable surface. • Don't park on a blind corner or a solid striped road area. • Set parking break.	
Description of Task When it is Done Safely			
Crew returns safe from the field day/season, with no injuries or damages.			

JOB HAZARD ANALYSIS (JHA)		Date: 1/29/2012	
Park Unit: SFAN	Division: IMD	Branch: NRPC	Location: Sausalito, CA
Task Title: **Remote field site access/ trail travel/ cross-country travel**		JHA Number: SFAN JHA 2	Page: 1 of 3
Job Performed By: ALL	Analysis By: Daniel Sarr for KLMN Modified By: Robert Steers for SFAN	Supervisor: Vacant	Approved By: Robert Steers
Required Standards and General Notes:	Crew members should be physically fit		
Required Training:	None required.		
Required Personal Protective Equipment:	Footwear appropriate to terrain (e.g., hiking boots); pants for brush and poison oak; Tecnu poison oak pre-exposure lotion, park radio with charged batteries, GPS units, eyewear, Tecnu post-exposure cleaning solution, first aid kit.		
Tools and Equipment:			

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Hiking on and off trails	• Getting lost	• Use and be trained in navigation techniques using both maps and GPS units. • Allow ample time to access site and return. • Bring safety gear (e.g., radio); extra clothes, water, food, etc. • Look at notes from crews that previously accessed this site.
	• Physical injury (e.g., twisted ankle, broken bones)	• Wear appropriate footwear, preferably boots with Vibram soles and tops above the ankle, broken in prior to field season. • Walk cautiously and don't run. • Take breather breaks as necessary. • Stay physically fit. • Know basic first aid. • Be trained in radio SOP. • Avoid talus or rocky, unstable slopes. On steep slopes, avoid walking directly below others. • Take care walking on wet or slippery ground, especially bridges.
	• Getting hit with tool, implement, or vegetation branch	• Maintain 6 foot spacing • Warn people behind of "snap-back" from vegetation branches; wear safety glasses (or other glasses).

JOB HAZARD ANALYSIS (JHA)		JHA Number: SFAN JHA 2	Page: 2 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Hiking on and off trails	• Blisters	• Wear broken in and proper fitting boots. Bring moleskin and use if blisters develop.	
	• Carrying heavy loads	• Use backpack appropriate to load; do not carry heavy items in arms or hands; make hands available to break a fall. • Properly fit backpack. • Use crew member to assist in putting pack on. • Be physically fit. • Report problems or issues to supervisor. • Stay hydrated.	
	• Loose footing; falls, broken bones, etc.	• Avoid steep slopes. • If unavoidable, walk at angle up slope; not straight up. • Wear good boots. • Do not go up hazardous slopes. • Watch for branches, wet, slick rocks, etc. Avoid as necessary. • Take your time, ascending and descending. • Plan your route so that hazardous terrain is minimized and the use of trails is maximized. • Do not travel alone (e.g., if one crew member is faster, only travel as fast as your slowest person).	
	• Branches and trees, other dangerous obstacles	• Examine for the safest way around. • Do not jump off trees. • Avoid going underneath large trees that could shift and crush a person.	
Wildfires	• Exposure to smoke and fire	• Don’t panic. Be alert. Keep calm. Think clearly & act decisively. Get out of the area immediately. • Maintain communication with other crew members and with dispatch. Follow local district policies regarding reporting fire. Wildfires	

JOB HAZARD ANALYSIS (JHA)		JHA Number: SFAN JHA 2	Page: 3 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Water Crossing	• Loose footing; falls, broken bones, etc.	• Choose stream crossing routes by scouting the area first • Avoid crossing when water levels are higher than knee height. Avoid crossing on logs whenever possible. • Use a stick or pole to secure footing. Place it upstream at a slight angle. Use pole to test for depth & walk to the pole. • Stay out of areas with swift current, especially after heavy rain. • Use footwear with non-slip soles while walking in streams. Do not wear sandals in streams. • When possible, step on streambed proper instead of the tops of boulders that may be slippery.	

Description of Task When it is Done Safely
Crew returns safe from the field day/season, with no injuries or damages.

JOB HAZARD ANALYSIS (JHA)		**Date: 1/29/2012**	
Park Unit: SFAN	Division: IMD	Branch: NRPC	Location: Sausalito, California
Task Title: **Environmental Exposure**		JHA Number: SFAN JHA 3	Page: 1 of 3
Job Performed By: ALL	Analysis By: Daniel Sarr for KLMN Modified By: Robert Steers for SFAN	Supervisor: Vacant	Approved By: Robert Steers
Required Standards and General Notes:	Field crew members in the field are expected to use common sense in dealing with exposure to elements or wildlife. Based on qualifications, all crew members should have experience in outdoor work prior to initiating the field season.		
Required Training:	None required.		
Required Personal Protective Equipment:	Appropriate clothing for conditions. Tecnu for post-exposure to poison oak (*Toxicodendron diversilobum*)		
Tools and Equipment:			

Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**
Being outdoors, far from facilities for long time periods	• Hypothermia	• Consult First Aid book for treatment. • Seek assistance. • Recognize the signs: Shivering; Numbness; Drowsiness; Muscle Weakness; Dizziness; Nausea; Unconsciousness; Low, weak pulse; Large pupils. • Practice prevention: stay dry; wear appropriate clothing; cotton kills; wear layers, shed layers as needed (don't overheat as sweat can cause hypothermia); watch or listen to the weather forecast, and plan accordingly; stay hydrated, cover head with warm clothing, stay active. • Be aware of the role that wind-chill can play in hypothermia; under certain conditions, hypothermia can occur without any rain or being wet.
	• Heat exhaustion; heat stroke	• Consult First Aid book for treatment but generally get the victim to cooler conditions. NOTE: HEAT STROKE IS A LIFE THREATENING CONDITION. • Recognize signs: above normal body temps; headaches, nausea, cramping, fainting, increased heart rate, pale and clammy skin, heavy sweating, etc. • Practice prevention: Stay hydrated: in the midst of the summer, it may be necessary to drink one liter of water per hour; wear a broad brimmed hat; take rest stops in shade. • Reschedule work day to do hot, heavy work in cooler hours of the day, or during cooler weather

JOB HAZARD ANALYSIS (JHA)		JHA Number: SFAN JHA 3	Page: 2 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Being outdoors, far from facilities for long time periods	• Electrical Storms – lightning	• Watch the sky for signs of thunderstorms and seek shelter before the weather deteriorates. • Stop work in streams. • If caught in electrical storms, seek shelter inside a vehicle or building; keep away from doors and windows, plugged in appliances, and metal. Avoid contact with metal objects in vehicles.	
	• Electrical Storms – lightning	• Do not use telephones. • If outside with no shelter, do not congregate. In case of lightning strike, someone must be able to begin revival techniques (e.g., CPR). • Do not use metal objects. • Avoid standing near isolated trees. • Seek lower elevations such as valleys or canyons; avoid being on peaks and trees. • If you feel your hair standing on end and your skin tingling, this is a sign that lightning might be about to strike – crouch immediately (feet together, hands on knees).	
	• Sunburn	• The risk of sunburn is year-round, even in overcast conditions. • Wear protective clothing and use sunscreen.	
	• High wind events	• Severe wind events can create “windthrows” where strong winds can blow down trees, causing hazardous conditions to field personnel. Crews should avoid sampling vegetation during high winds.	

JOB HAZARD ANALYSIS (JHA)		JHA Number: SFAN JHA 3	Page: 3 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
	• Giardia	• Treat, filter, or boil all drinking water. Do not drink untreated water from streams, lakes, or springs.	
Description of Task When it is Done Safely			
Crew returns safe from the field day/season, with no injuries or damages.			

JOB HAZARD ANALYSIS (JHA)		Date: 1/29/2012	
Park Unit: SFAN	Division: IMD	Branch: NRPC	Location: Sausalito, California
Task Title: **Wildlife and Botanical Exposure**		JHA Number: SFAN JHA 4	Page: 1 of 3
Job Performed By: ALL	Analysis By: Daniel Sarr for KLMN Modified By: Robert Steers for SFAN	Supervisor: Vacant	Approved By: Robert Steers
Required Standards and General Notes:	Field crew members in the field are expected to use common sense in dealing with exposure to elements or wildlife. Ideally, they have experience in outdoor work prior to initiating the field season.		
Required Training:	None required.		
Required Personal Protective Equipment:	Appropriate clothing for conditions.		
Tools and Equipment:			

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Driving to the site	• Animal in the road	• Slow down! Be aware of high animal traffic areas and drive appropriately. It is better to “ride out” an impact, rather than a sudden swerve. This is true for animals of all sizes, from squirrels to cattle.
Being in the field	• Rattlesnakes	• Be alert • Do not put your feet or hands where you cannot see • Do not pick up rattlesnakes • Give a wide berth • Avoid stepping over logs, when you cannot see the other side • If bitten, seek immediate professional medical attention if possible send someone for aid. • Lower bitten extremity below your heart, cover wound with sterile bandage while en route to medical attention.
	• Bears	• Be alert and stay calm. • If you encounter a bear, give it as much room as possible. • Try to leave the area but DO NOT RUN. Back away slowly, but if the bear follows, stop and hold your ground. • Wave your arms, make yourself look big, and talk in a normal voice • If the bear makes contact, surrender! Fall to the ground and play dead. Typically, a bear will break off its attack once it feels the threat has been eliminated. If the bear continues to bite after you assume a defensive posture, the attack is predatory and you should fight back vigorously.

JOB HAZARD ANALYSIS (JHA)		JHA Number: SFAN JHA 4	Page: 2 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Being in the field	• Mountain Lions	• Be alert, calm, and do not panic. • If you see a mountain lion, do not run; you may stimulate its predatory nature. Shout and wave arms to let it know that you are not prey. FIGHT BACK.	
	• Ticks	• Use DEET based repellants on exposed skin. • Check for ticks during and after field work. • Remove with tweezers within 24 hours, preferably immediately. • DO NOT leave the head imbedded. • DO NOT extract with matches, petroleum jelly, or other coatings (e.g., motor oil).	
	• Insect Sting	• Do not provoke insects by swatting at them. Remain calm and move away from the area. • Be alert for buzzing insects both on the ground and in the air. Walk around any nests you encounter. Inform others of nests. • Flag if necessary. Wear long sleeved shirt and pants. Tuck in shirt. Wear bright colors. Perfumes & metal objects may attract bees. • If stung, scrape stinger off skin. Cold can bring relief. Do not use tweezers. Tweezers can squeeze venom sac and worsen injury. • If you are allergic, carry an unexpired doctor prescribed bee sting kit (EpiPen) with you at all times. • Know the allergic reactions of co-workers as well as the location of the bee sting kit. If victim develops hives, asthmatic breathing, tissue swelling, or a drop in blood pressure, seek medical help immediately. Give victim antihistamine (Benadryl or cholamine tabs). Use EpiPen. • Prevent bug/mosquito bites by using repellent. Spray on clothing to avoid prolonged exposure to skin. Wear long sleeved shirts and pants. • Be aware of insect transmitted diseases (West Nile Virus, Lyme Disease, Plague).	
	• Rabies	• Be aware of animals acting strangely. If bitten by a wild or domestic animal get medical attention and report to local health authorities or animal control officer. Locate animal if possible. Follow accident procedures for animal bites.	

JOB HAZARD ANALYSIS (JHA)		JHA Number: SFAN JHA 4	Page: 3 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Encountering irrigation pipes, marijuana plantation, or grow operations.	• Unfriendly encounters with criminal elements	• Do not wear uniforms. • Carry radio in backpack, not visible. • Act like tourists (i.e., act unsuspicious). • Work in pairs or larger groups. • If working in areas likely to contain operations, check in with park staff when leaving vehicle and returning to vehicle. • Do not confront strangers. • Watch for suspicious vehicles and people and report to rangers. • Watch for black piping or other signs. • If finding a definite grow operation, LEAVE IMMEDIATELY, note location, and report to park ranger.	
Travel, movement or work in area with Poison Oak	• Allergic reaction to poison oak plants	• Recognize Poison Oak in all of its forms. • Avoid contact and wear long pants and long-sleeve shirts if travelling in dense areas. • If skin contact is made, flush with cold water as soon as possible. • DO NOT flush with warm water or use soap. This can open your pores and increase the reaction. • Use Tecnu or similar product to wash and rinse with cold water to remove oils (follow label instructions).	
Description of Task When it is Done Safely			
Crew returns safe from the field day/season, with no injuries or damages.			

JOB HAZARD ANALYSIS (JHA)		**Date: 1/29/2012**	
Park Unit: SFAN	Division: IMD	Branch: NRPC	Location: Sausalito, California
Task Title: **Communication**		JHA Number: SFAN JHA 5	Page: 1 of 2
Job Performed By: ALL	Analysis By: Daniel Sarr for KLMN Modified By: Robert Steers for SFAN	Supervisor: Vacant	Approved By: Robert Steers
Required Standards and General Notes:			
Required Training:	Radio / Spot use		
Required Personal Prospective Equipment:			
Tools and Equipment:	Professional Grade Radio, SPOT Monitoring System, (personal cell phone is a plus, but not required)		

Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**
Radio communication	• Communication not possible	• Make sure radio is working before you leave the office or field station. Make sure batteries are changed. Carry a second rechargeable battery as back up. • Check in mornings and evenings. If in a dead zone, try to check in from a better location throughout the day. Be prepared to relay messages in an emergency. If you are working alone, be sure to check in and out with dispatch. • Make sure that your supervisor knows your planned itinerary before you leave in case your radio fails. Follow crew-specific safety check in/checkout procedures. • Know which radio frequencies to use and which to monitor. Know who to call in case of an emergency. Know how to reach repeaters. • Carry a list of employee call numbers. Be prepared to relay messages in an emergency. • Keep messages short, less than 30 seconds per transmission. If a longer message is necessary, break every 30 seconds. • Conserve batteries. Carry a spare and don't leave scanner on. Turn radio off over night. Your life may depend on it.
Spot System	• Communication not possible	• Make sure system is working before you leave the office or field station. Make sure batteries are changed. Carry a second rechargeable battery as a backup. • Make sure that your supervisor knows your planned itinerary before you leave in case your system fails. Follow crew specific safety check in/checkout procedures. • Make certain system is setup properly and includes an accurate contact list.

JOB HAZARD ANALYSIS (JHA)		JHA Number: SFAN JHA 4	Page: 2 of 2
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Personal Cell Phone	• Communication not possible	• It is not required that field crew members have their own cell phones. However, such devices can be a useful tool for making contact in the event of an emergency. • Make sure your cell phone is working before you leave the office or field station. Make sure batteries are changed. • It is best to leave your cell phone off during work and to be able to turn it on only in the situation that your first two communication devices fail. Cell phone coverage is good in most of GOGA. Coverage is good to poor in PORE and MUWO. Coverage is poor in PINN. Cell phones should not be used as primary communication devices but only as a back-up, if available. • Carry a list of employee and Law Enforcement Dispatch phone numbers. • Conserve batteries.	
Description of Task When it is Done Safely			
Crew returns safe from the field day/season, with no injuries or damages.			

SOP 23: Plot Location Manuals

Version 1.00

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP describes the content of plot location manuals to be created for each of the sampling units utilized for plant community monitoring in the San Francisco Bay Area Network (SFAN). The plot location manuals will be used to navigate to selected vegetation stands and plot centers. An example plot location manual for Southern Coastal Scrub in the Pinnacles sampling unit is provided in Appendix SOP 23A. An electronic copy of each plot location manual shall be created and stored on the SFAN network drive, here: \\Inpgogamahe1\Divisions\Network I&M\Individual Vital Signs\Plant Communities\ Documents\ Plot_Location_Manuals.

Plot Location Manuals

For each vegetation type selected for monitoring per sampling unit, the plot location manuals shall contain the following information:

1) A description of the selected vegetation type, and membership rules used to validate vegetation stands in the field prior to plot establishment.
2) Table with the geographical coordinates of each sampling plot per selected stand.

For each stand that is selected for monitoring, the plot location manuals shall contain the following information:

3) Maps, photographs, and notes that illustrate the easiest and safest routes to reach each selected stand.
4) Map that shows the plot center, and boundary of the stand based on each sampling unit's park service vegetation map that was used in selecting vegetation types for monitoring.
5) Plot photographs of transects A, B and C from the most recent site visit.
6) Field for notes.

Usage

Prior to fieldwork, plot location manuals will be created for each vegetation type. Printed manuals are to be used to locate plots in the field, and any additional information on plot location or access should be noted during field visits to each site. Plot location information and maps are to be updated after each field season. Revised plot location information is to be printed out and included in the manuals the next time a vegetation type is visited.

Appendix SOP 23.A. Plot location manual: Southern Coastal Scrub, Pinnacles Sampling Unit.

Introduction

This Plot Location Manual provides information necessary for locating monitoring plots in the Southern Coastal Scrub plant community at Pinnacles National Park.

For Southern Coastal Scrub vegetation (Holland and Kiel 1995), the California Coastal Scrub Shrubland Macrogroup (Kittel et al. 2012) was selected for sampling. This level of classification is coarse but had to be selected since all other mapped coastal scrub vegetation types are not spatially abundant enough, are not dispersed as well throughout the park, or they are not indicative or representative of typical coastal scrub vegetation (e.g., alluvial scrub found in stream reaches).

Description and Membership Rules

California Coastal Scrub Shrubland Macrogroup

Dense to sparse stands of coastal sage scrub shrubs at high to sparse cover. *Artemisia californica*, *Eriogonum fasciculatum*, and/or *Salvia mellifera* may be present as dominant or co-dominant with each other. *Eriogonum fasciculatum* tends to favor the driest locations, *Salvia mellifera* not as dry, and *Artemisia californica* the least dry locations of the three. *Adenostoma fasciculatum* may be present at low to very low cover. *Quercus douglasii* and *Pinus sabiniana* may also be present at very low cover. This class also includes other low shrubs including *Lupinus albifrons, Lotus scoparius,* and *Eriodictyon tomentosum.* This mapping unit is found on gentle to moderately steep, lower to upper slopes. It is also found in alluvial washes and fans, and floodplain terraces, where *Eriogonum faciculatum* and *Lupinus albifrons* may occur. Throughout most of the park, coastal sage scrub tends to occur on southerly aspects. However, on the west side, mainly within the expanded study area, coastal sage scrub may be found on northerly as well as southerly aspects. This type is mapped within the park, buffer, and expanded study area.

Membership rules:

Shrubland stands dominated by *Artemisia californica, Eriogonum fasciculatum, Mimulus aurantiacus, Eriodictyon tomentosum, Lotus scoparius, Lupinus albifrons,* and/or *Salvia mellifera*. Woody plant cover is >8-10%, and Tree cover is <8%.

Plot Coordinates

Southern Coastal Scrub will be monitored at twelve plots (one sampling plot for each stand of vegetation in each sampling year Table 1). Coordinates for these locations is provided in Table SOP 23.A.1.

Table SOP 23.A.1. Geographic coordinates for Southern Coastal Scrub monitoring plots.

Stand	Plot_Name	X_Centroid	Y_Centroid
1	SCRB01	658575.7	4040988
2	SCRB02	659173.7	4038615
3	SCRB03	662754.1	4039441
4	SCRB04	665865.1	4040356
5	SCRB05	667591.5	4041564
6	SCRB06	667275.8	4042502
7	SCRB07	660239.1	4040876
8	SCRB08	661992.8	4041665
9	SCRB09	660440.5	4041496
10	SCRB10	658666.7	4040831
11	SCRB11	667363	4041702
12	SCRB12	660222.7	4040358

Figures

All maps display forty-foot interval contour lines. Trails are displayed with hatched black lines. Dirt roads are displayed with hatched brown lines. Paved roads are grey lines with black outlines. Access routes are indicated with bold red lines.

Plot SCRB01

This site is near the west entrance to the park, north of Highway 146. It is near the pig fence and western park boundary, so the easiest way to access it is by walking the pig fence north from Highway 146 and bypassing as much chamise bushwacking as possible (Figure SOP 23.A.1). Where Highway 146 makes a sharp 90 degree right turn, there is a gate that leads to two dirt roads. This is known by park staff as “Four Corners”. One dirt road goes west and the other northwest. Walk the northwest trending road about a quarter-mile to where it hits the pig fence. From there head north along the pig fence for just under a mile. You will come to a point where the fence is on the west side of a steep north-south trending valley with blue oaks. The stand will be in the hills to the east. There are two stands in the area, Stand 1 and Stand 10. Stand 1 is closer to the Pig Fence, Stand 10 is southwest of Stand 1.

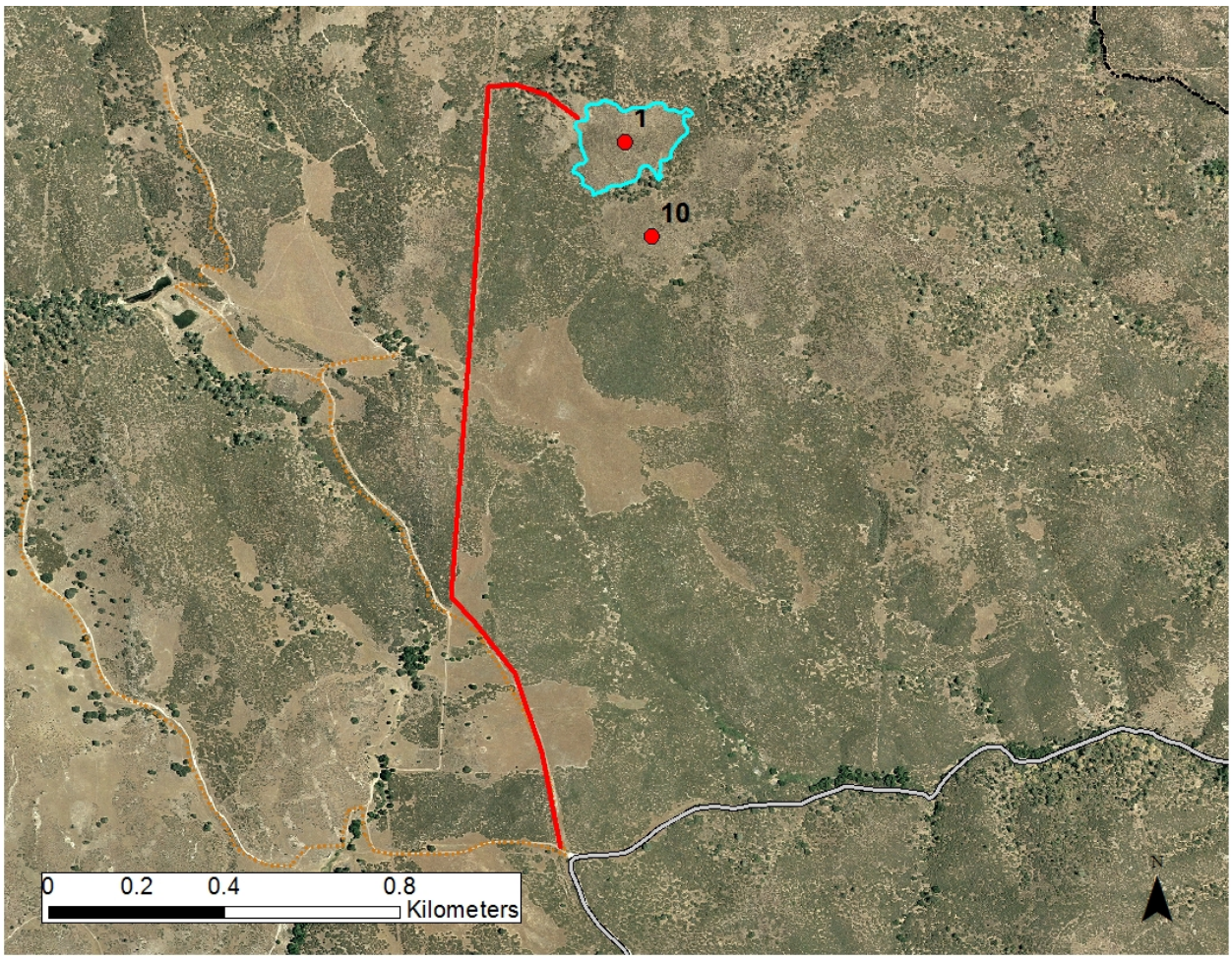


Figure SOP 23.A.1. Access to Stand 1 via the dirt road to the Pig Fence from Four Corners. Stand 1 is the more northern of the two stands.

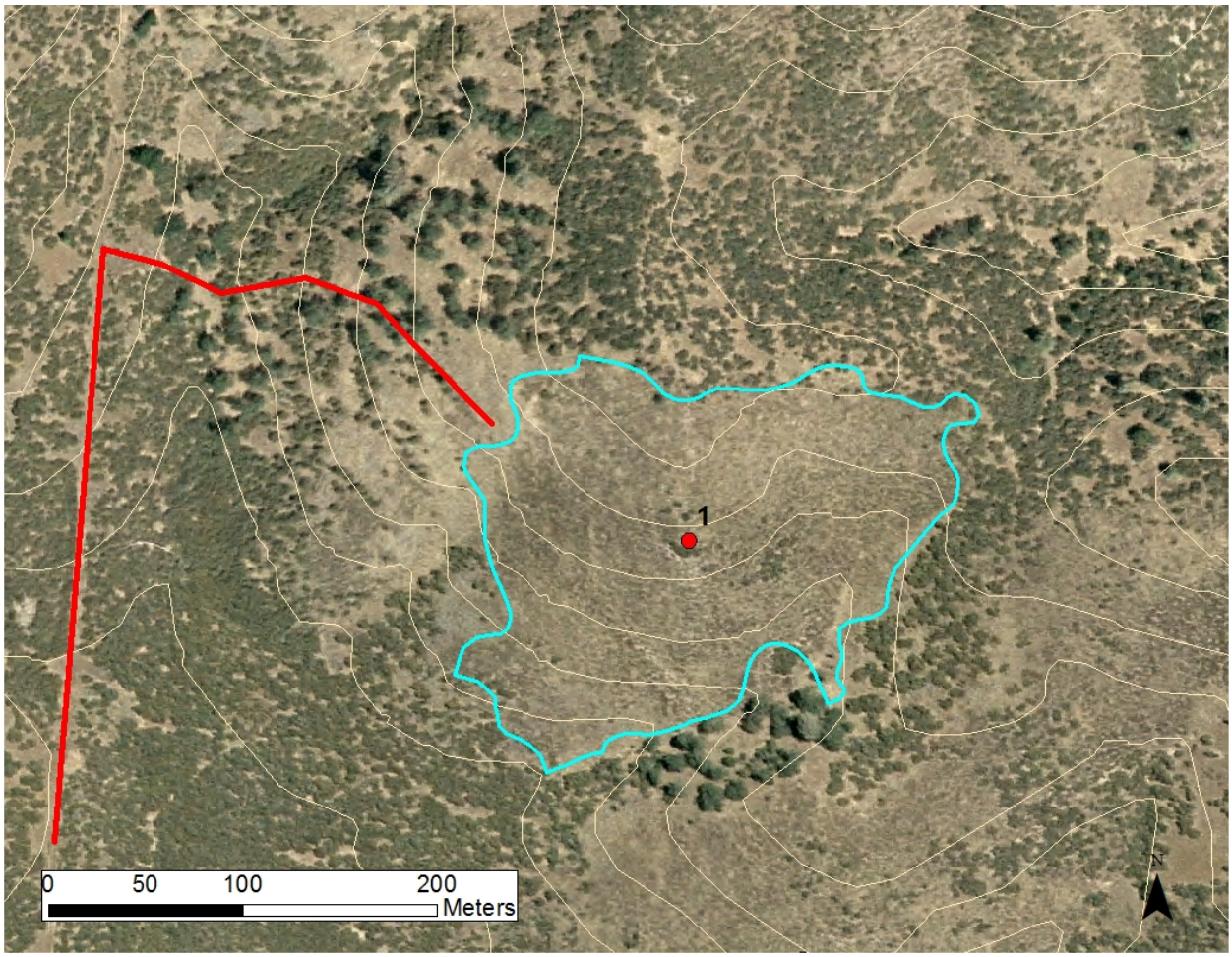


Figure SOP 23.A.2. Stand 1 plot center and access from the Pig Fence.



Figure SOP 23.A.3. PlotSCRB01, Transect A.



Figure SOP 23.A.4. PlotSCRB01, Transect B.

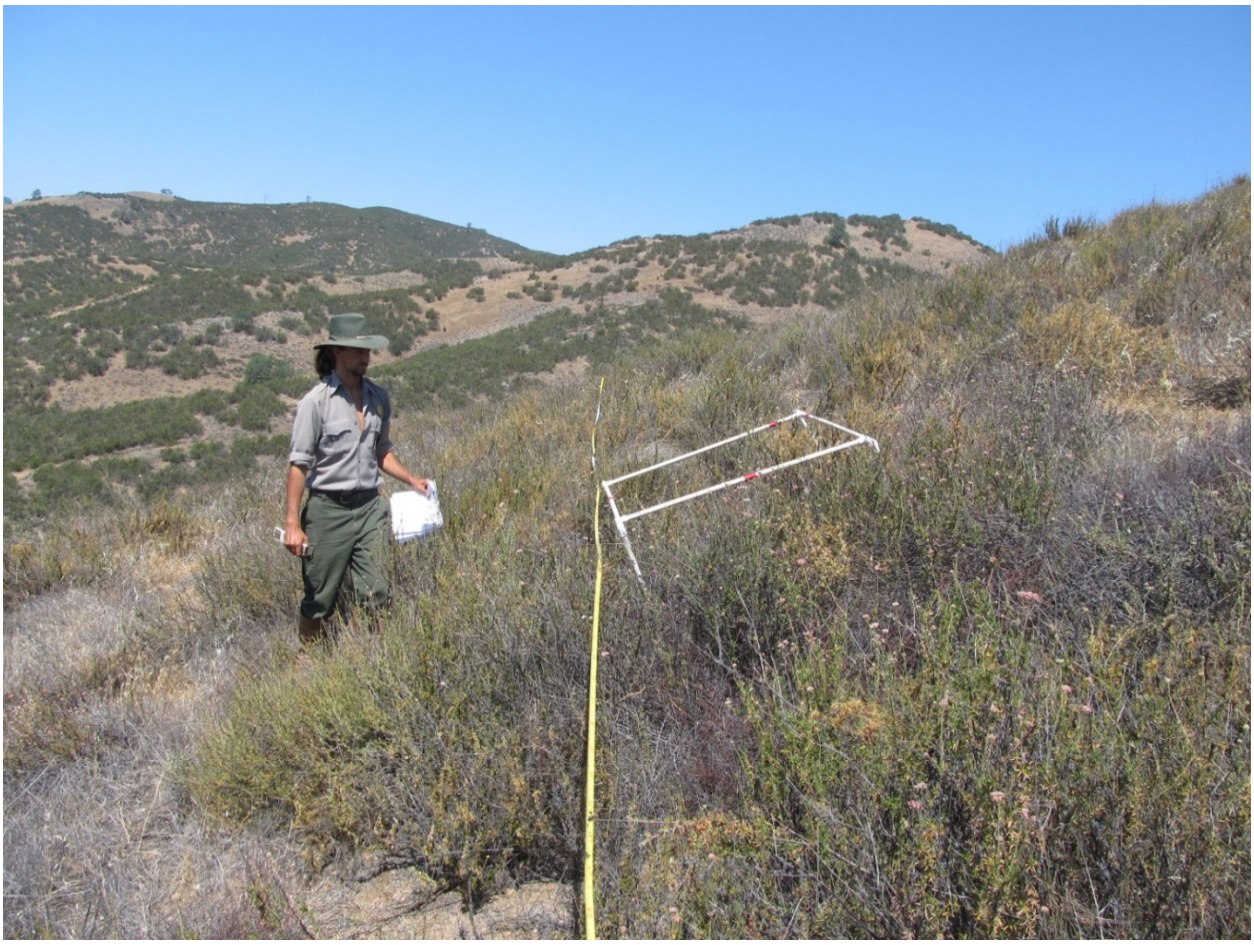


Figure SOP 23.A.5. PlotSCRB01, Transect C.

Plot SCRB02

This stand is just past the west entrance to the east of Highway 146. To access it park when you come to the grassy lowland past the entrance and head about 150m east through the grass. There is a small arroyo that runs through the grassland, and you should see the stand on the south-facing slope about 100m north of the arroyo.

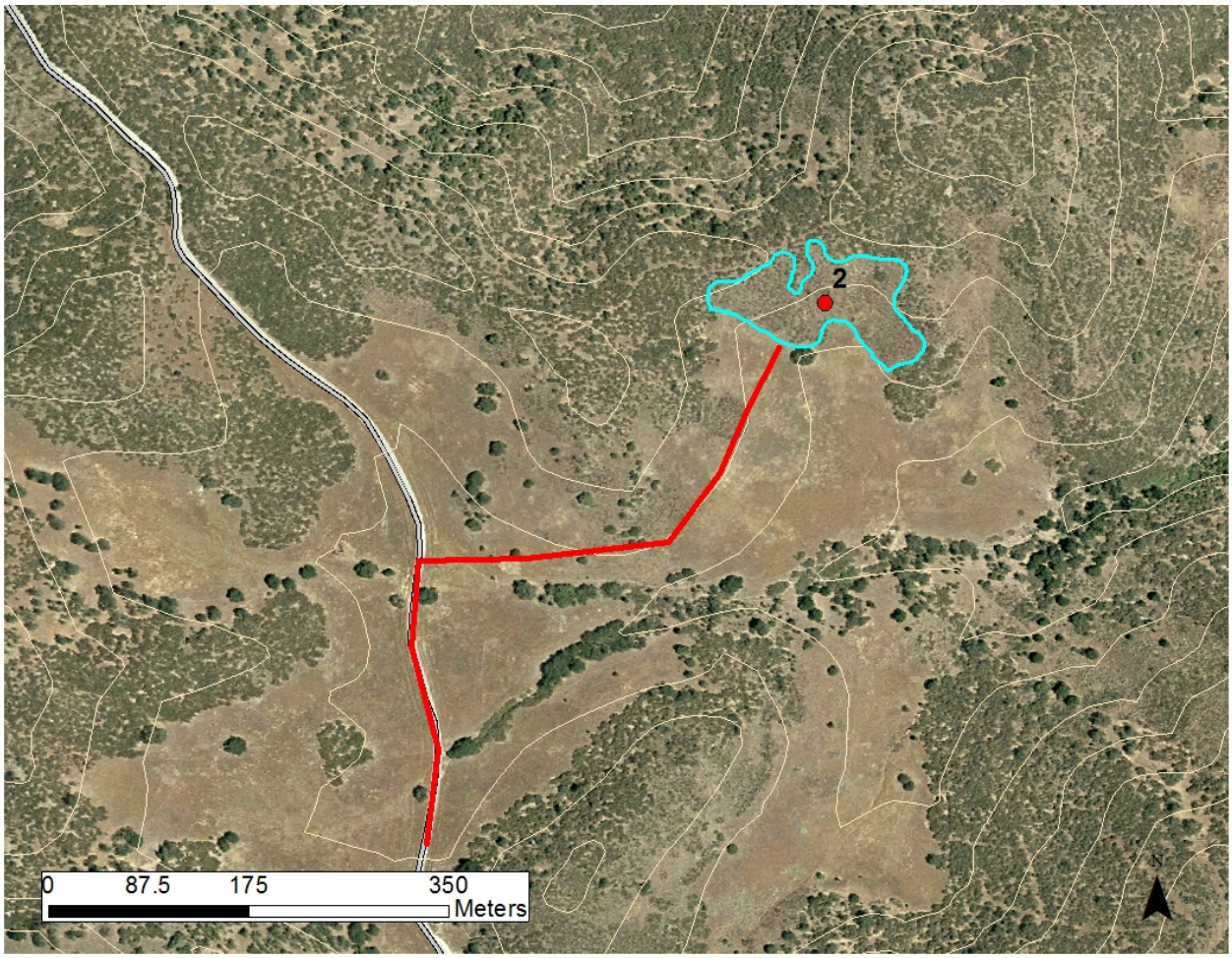


Figure SOP 23.A.6. Stand 2 location and access from Highway 146.

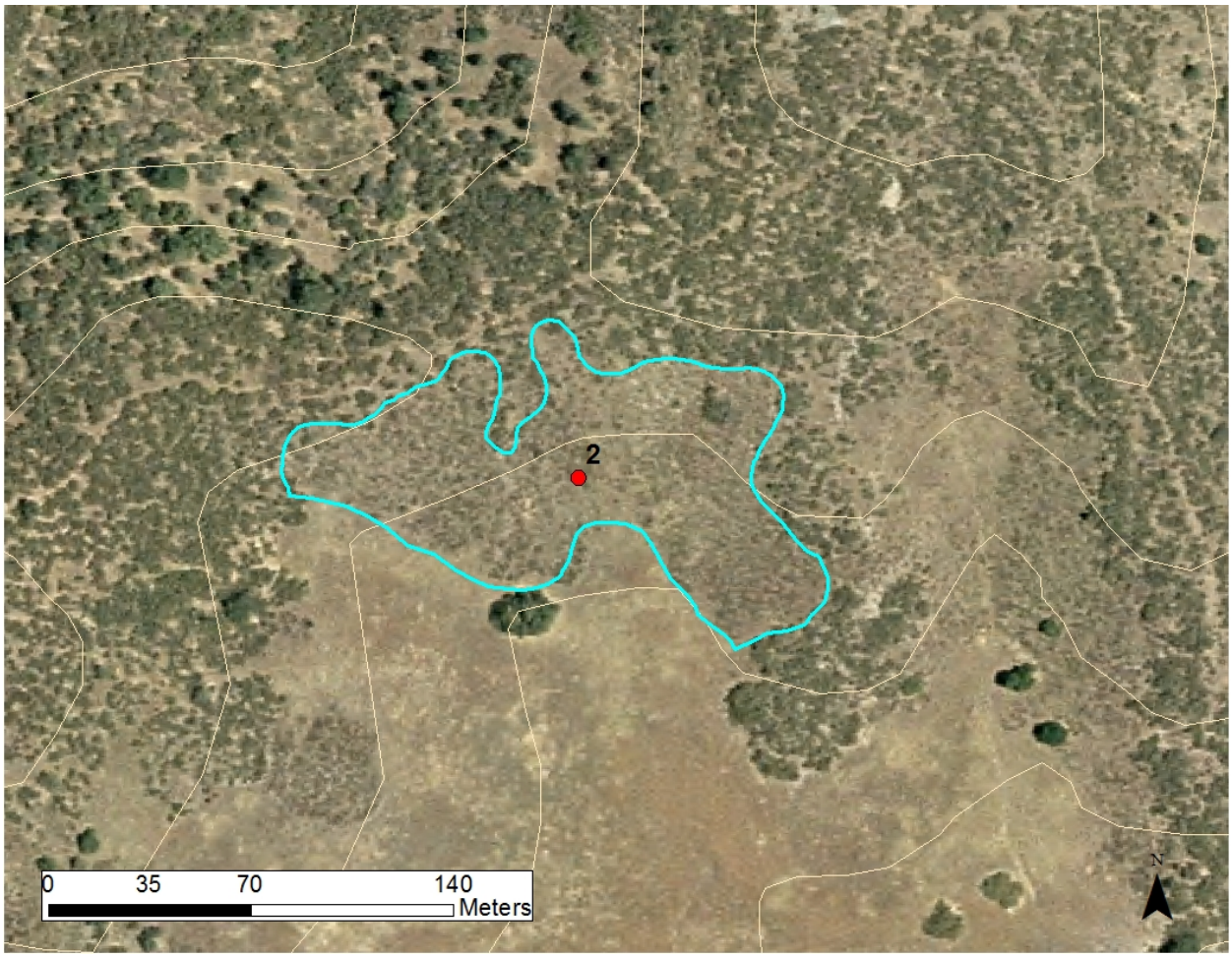


Figure SOP 23.A.7. Stand 2 plot center.



Figure SOP 23.A.8. SCRB02, Transect A.



Figure SOP 23.A.9. SCRB02, Transect B.



Figure SOP 23.A.10. SCRB02, Transect C.

Plot SCRB03

This stand is on the North side of Bear Gulch on the south-facing slope, directly across from park headquarters. To get here Hike a third of a mile up the Condor Gulch Trail, past the first large curve in the trail to the second large curve. Here there is a steep but grassy side canyon that you can follow directly up to the stand.

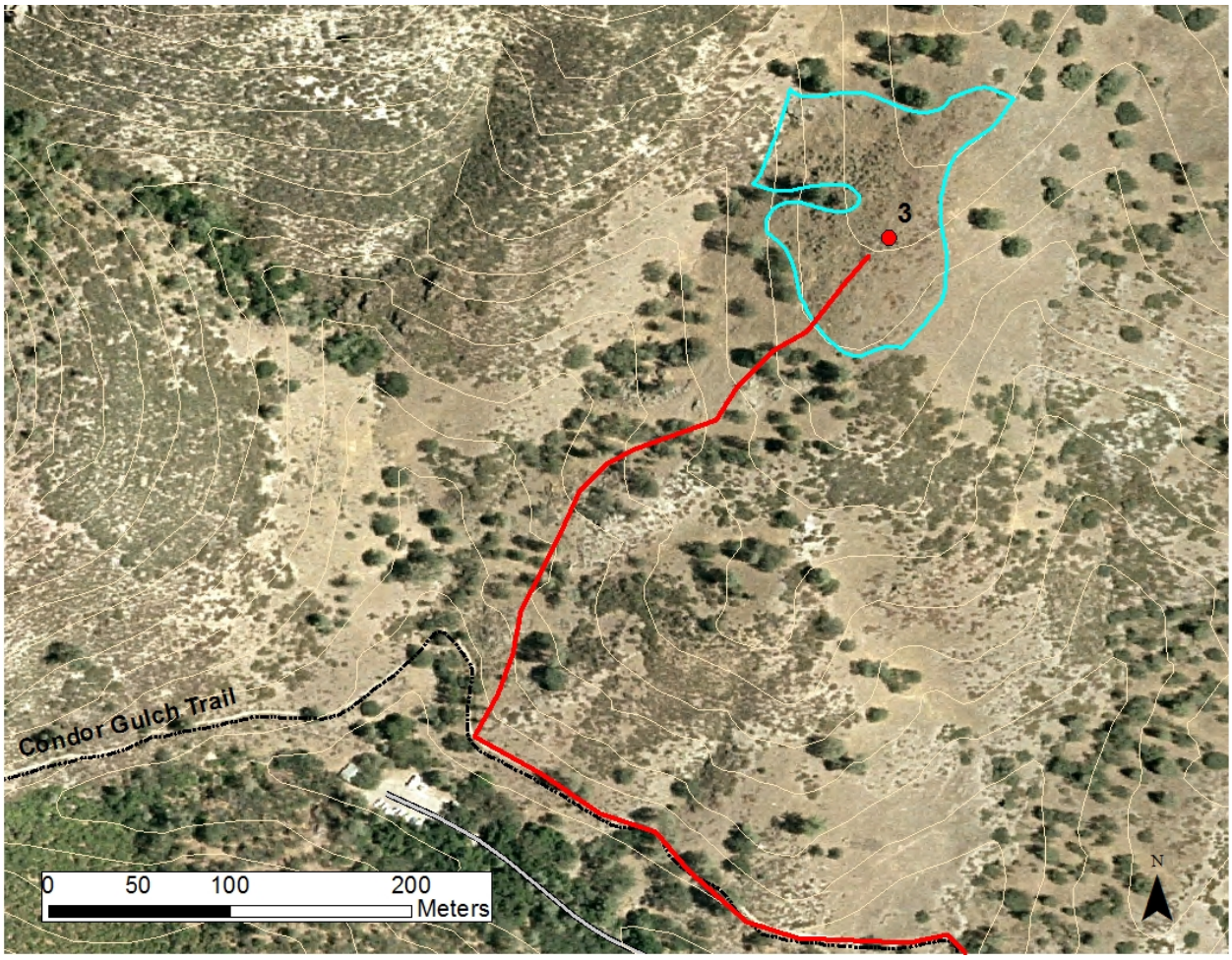


Figure SOP 23.A.11. Access to Stand 3 from the condor gulch trail via the second side canyon.

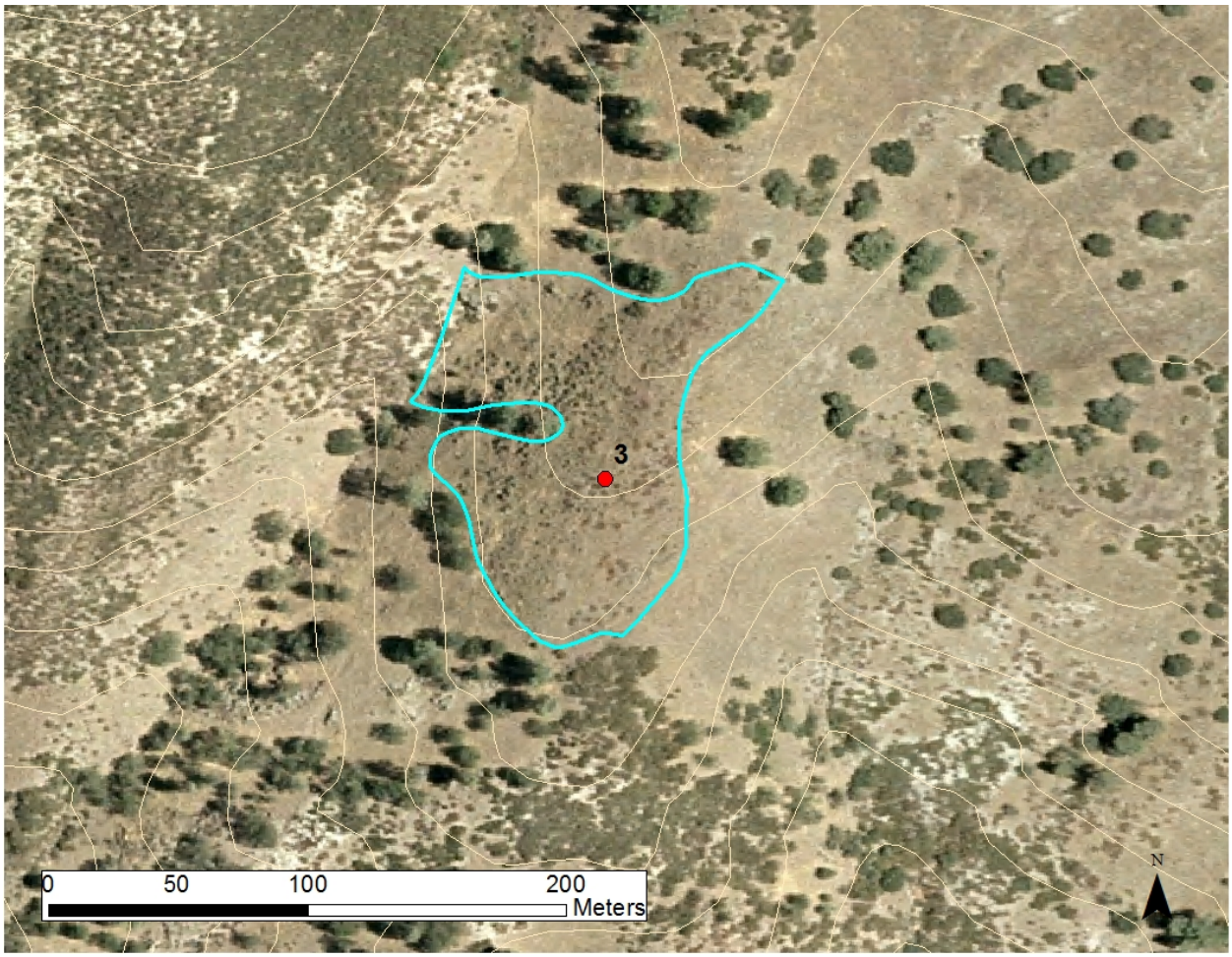


Figure SOP 23.A.12. Stand 3 plot center.



Figure SOP 23.A.13. PlotSCRB03, Transect A.

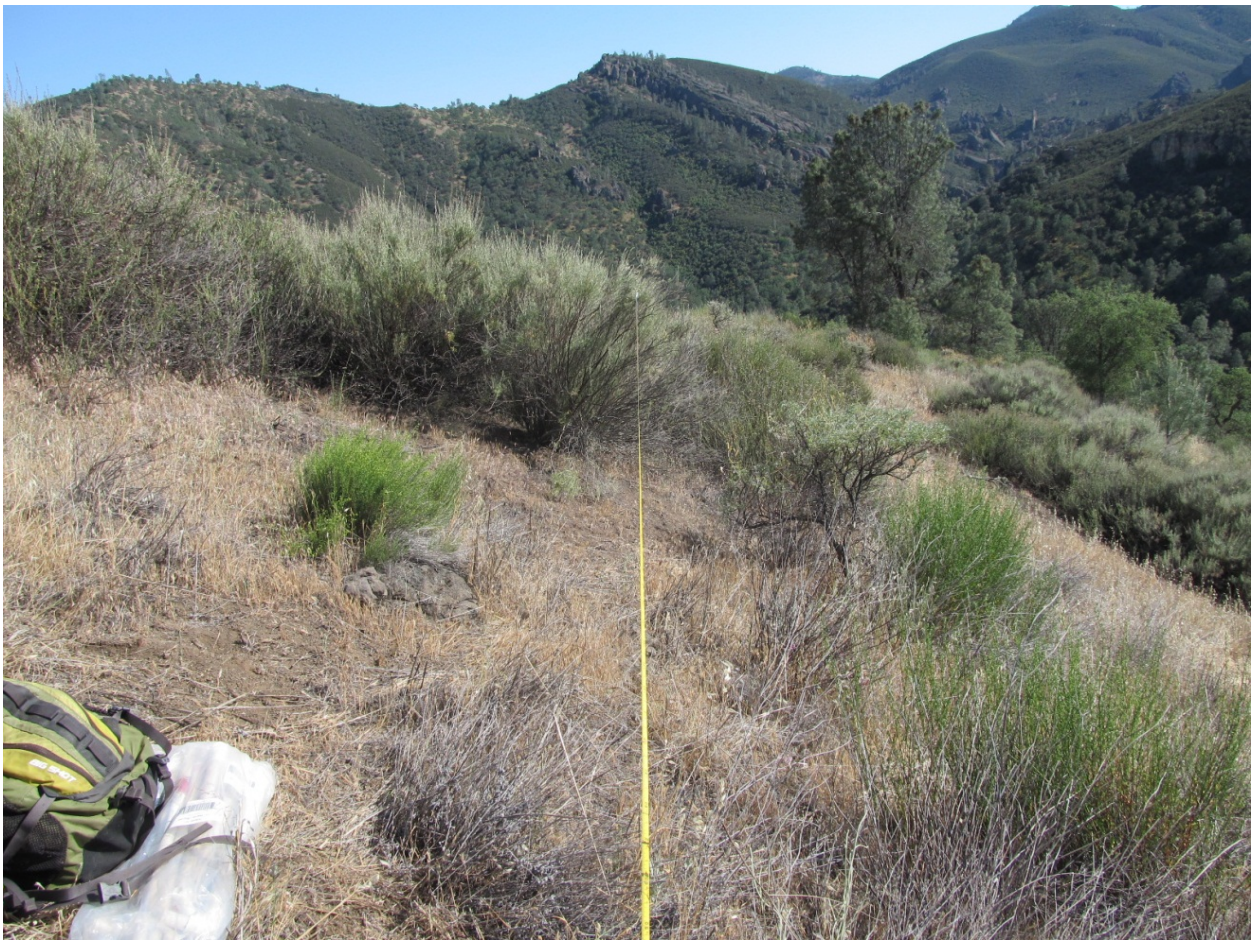


Figure SOP 23.A.14. PlotSCRB03, Transect B.



Figure SOP 23.A.15. PlotSCRB03, Transect C.

Plot SCRB04

This stand is just north of the bottom of McCabe Canyon directly across Highway 146 from the campground. To access it park at the visitor's center, head northwest across Highway 146, and climb the hill.

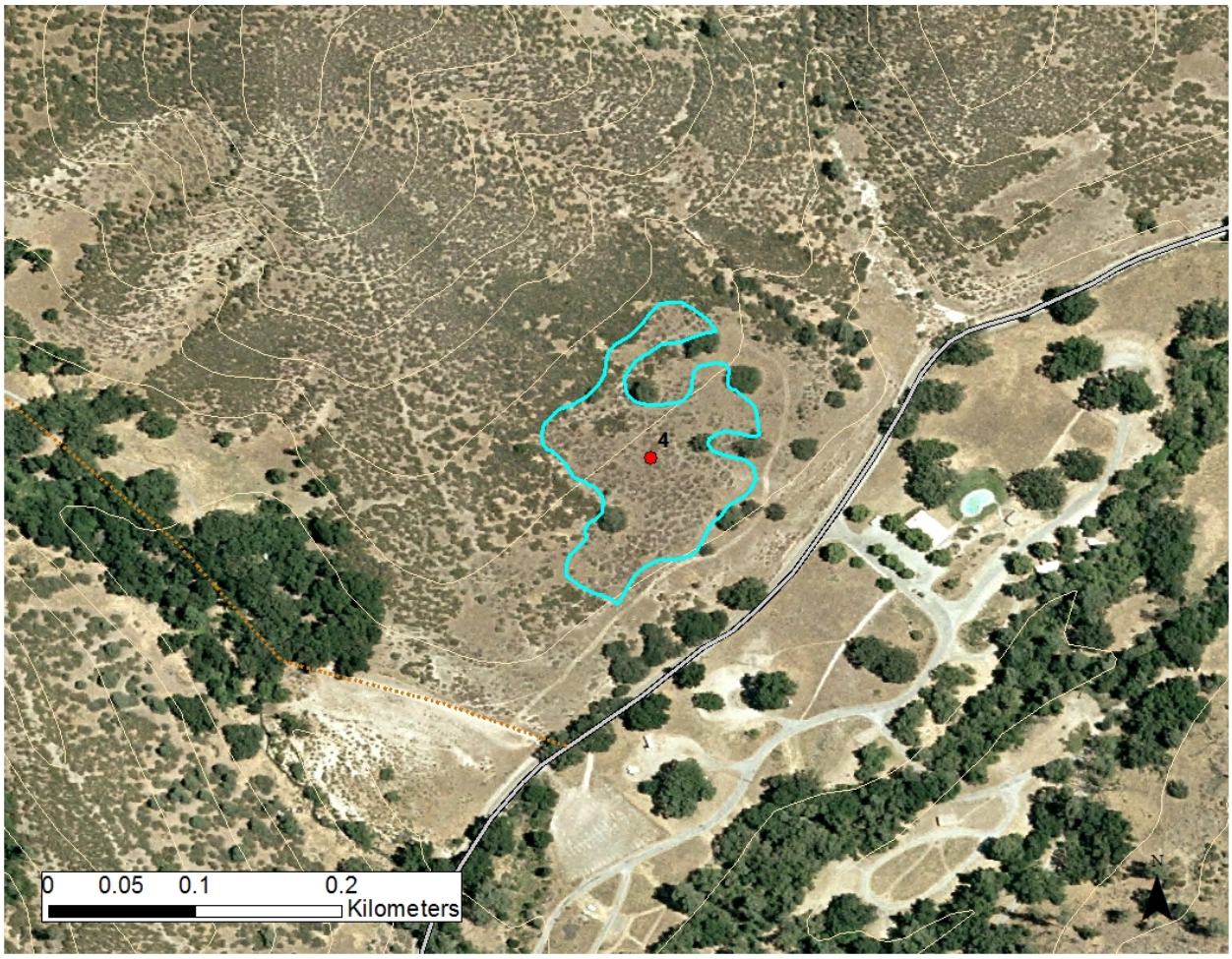


Figure SOP 23.A.16. An overview of Stand 4 showing the bottom of McCabe Canyon and the campground area.

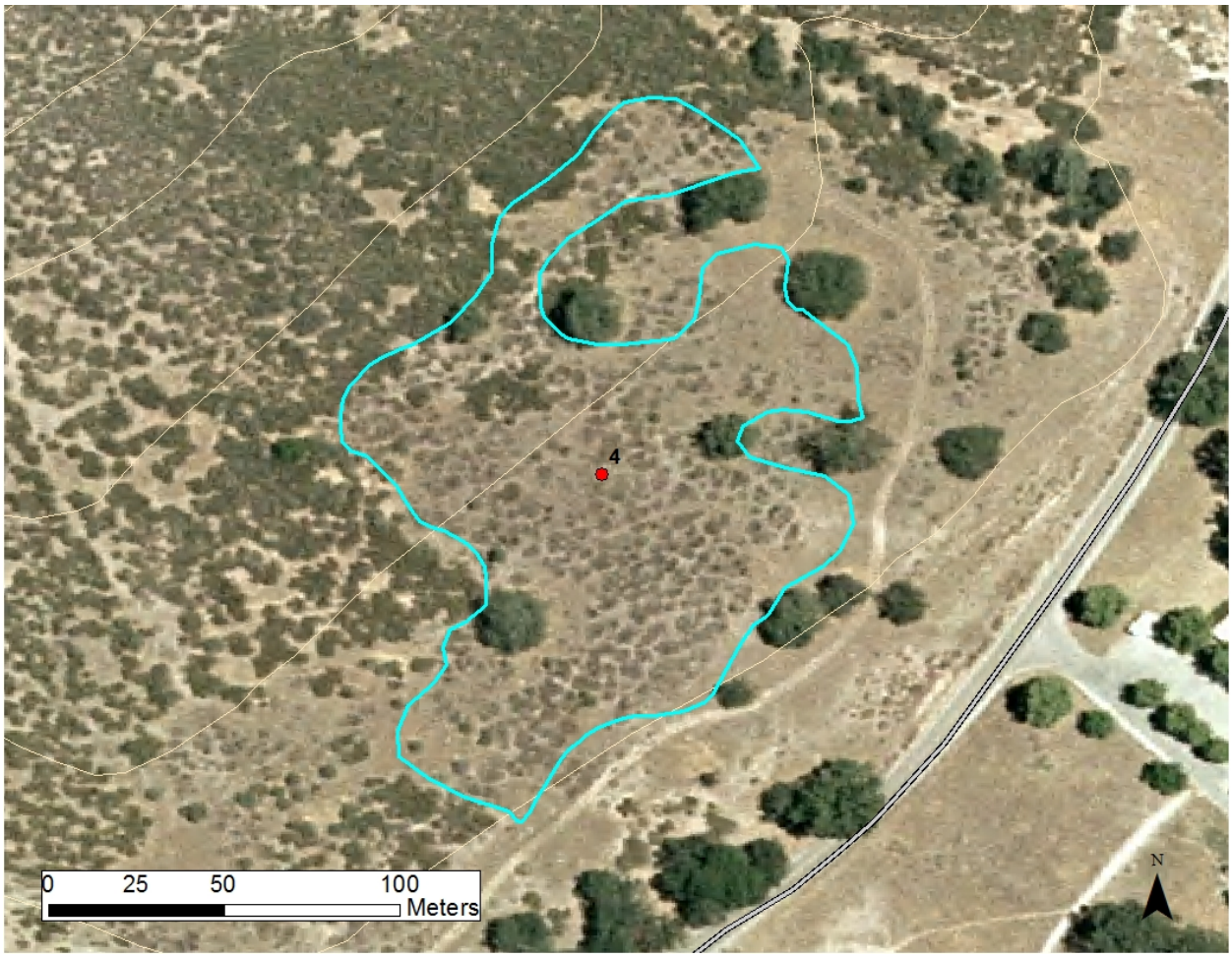


Figure SOP 23.A.17. Stand 4 plot center.



Figure SOP 23.A.18. PlotSCRB04, Transect A.



Figure SOP 23.A.19. PlotSCRB04, Transect B.



Figure SOP 23.A.20. PlotSCRB04, Transect C.

Plot SCRB05

This stand is on the hill between Rose and Needlegrass (aka Nassella) Canyons, which are just north of the Regan inholding, southeast of where Highway 25 and 146 meet. To access this area, drive out of the park and make a right onto highway 25, followed by an immediate right onto the Bottomlands Road, a dirt road heading back into the park on the opposite side of the valley. Park at the barn, and walk south past Needlegrass Canyon (the large one behind the barn) to the next little side canyon. Make your way up the south-facing slope and the stand will be at the top of the hill, just over the crest. You will pass through Stand 11 while en route.

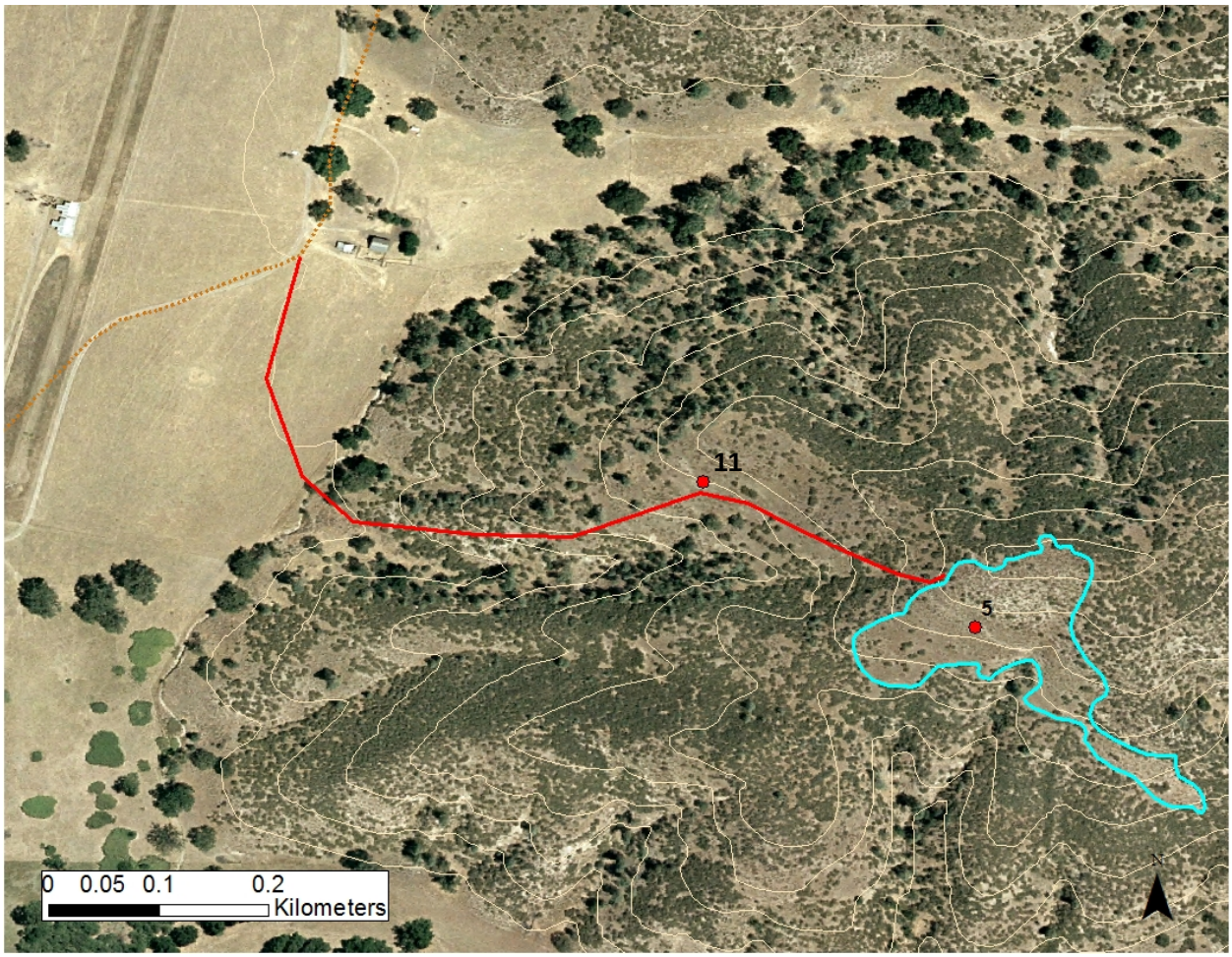


Figure SOP 23.A.21. Access to Stand 5 from the barn. Needlegrass Canyon is the large canyon north of the site, while Highway 146 is the red line in the top right of the image.

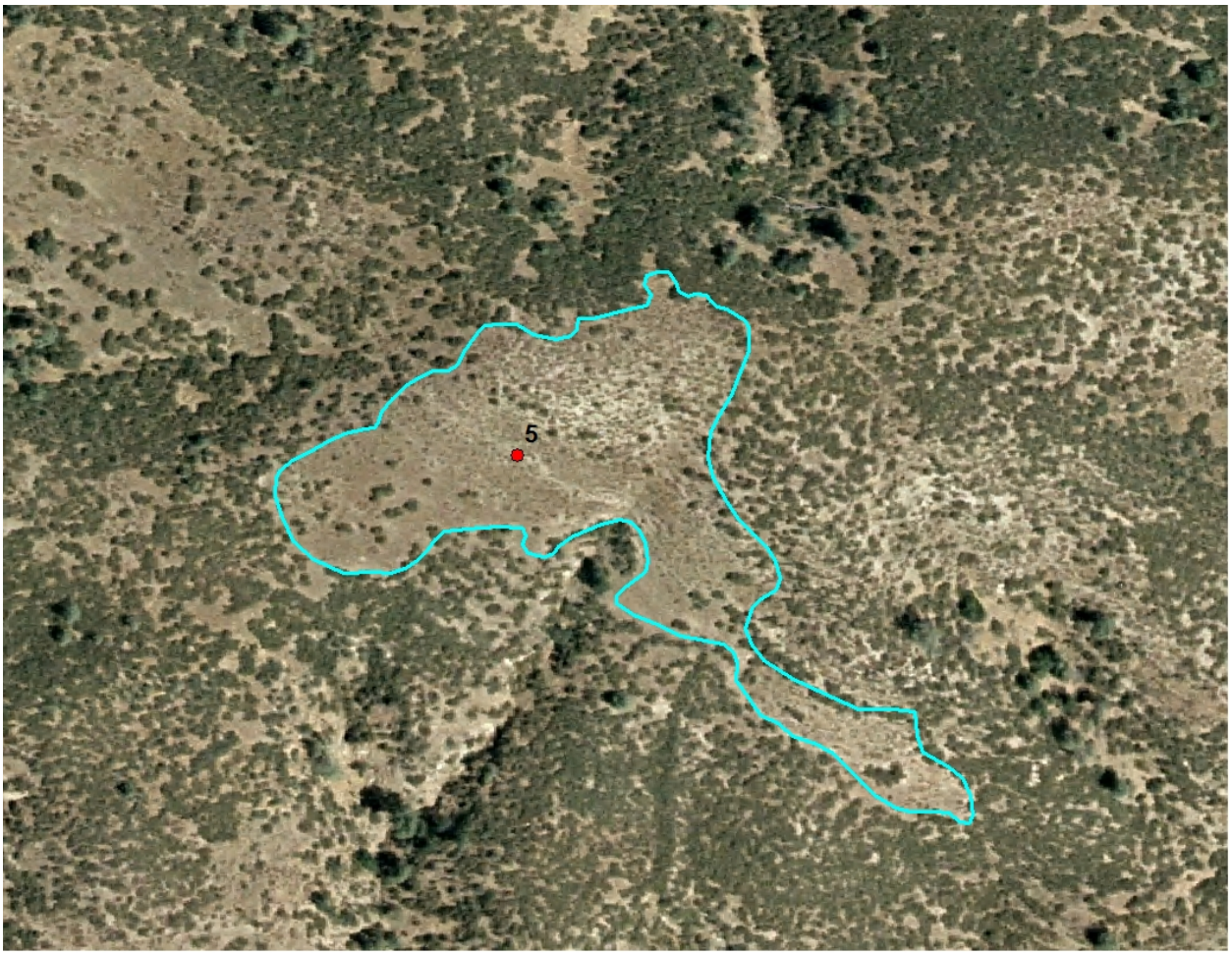


Figure SOP 23.A.22. Stand 5 plot center.



Figure SOP 23.A.23. A photo of Stand 5 taken from the south.



Figure SOP 23.A.24. PlotSCRB05, Transect A



Figure SOP 23.A.25. PlotSCRB05, Transect B.



Figure SOP 23.A.26. PlotSCRB05, Transect C.

Plot SCRB06

This stand is just south of Highway 25 off the Bottomlands Road running parallel to highway 146. About halfway to the barn in front of Needlegrass Canyon, the stand will be on the hill to your left, on the south facing slope of the side-canyon.

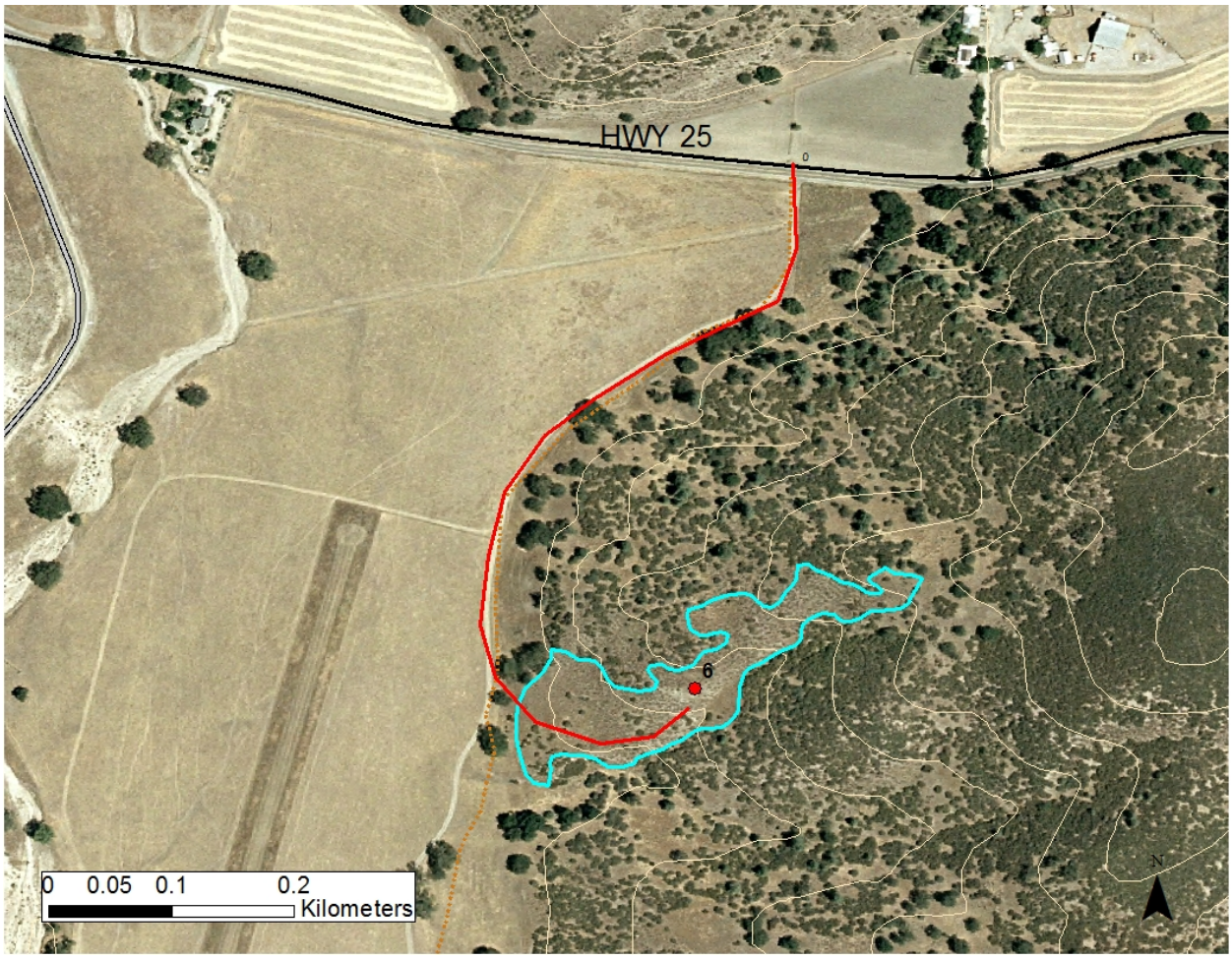


Figure SOP 23.A.27. Access to Stand 6 from the Bottomlands Road.

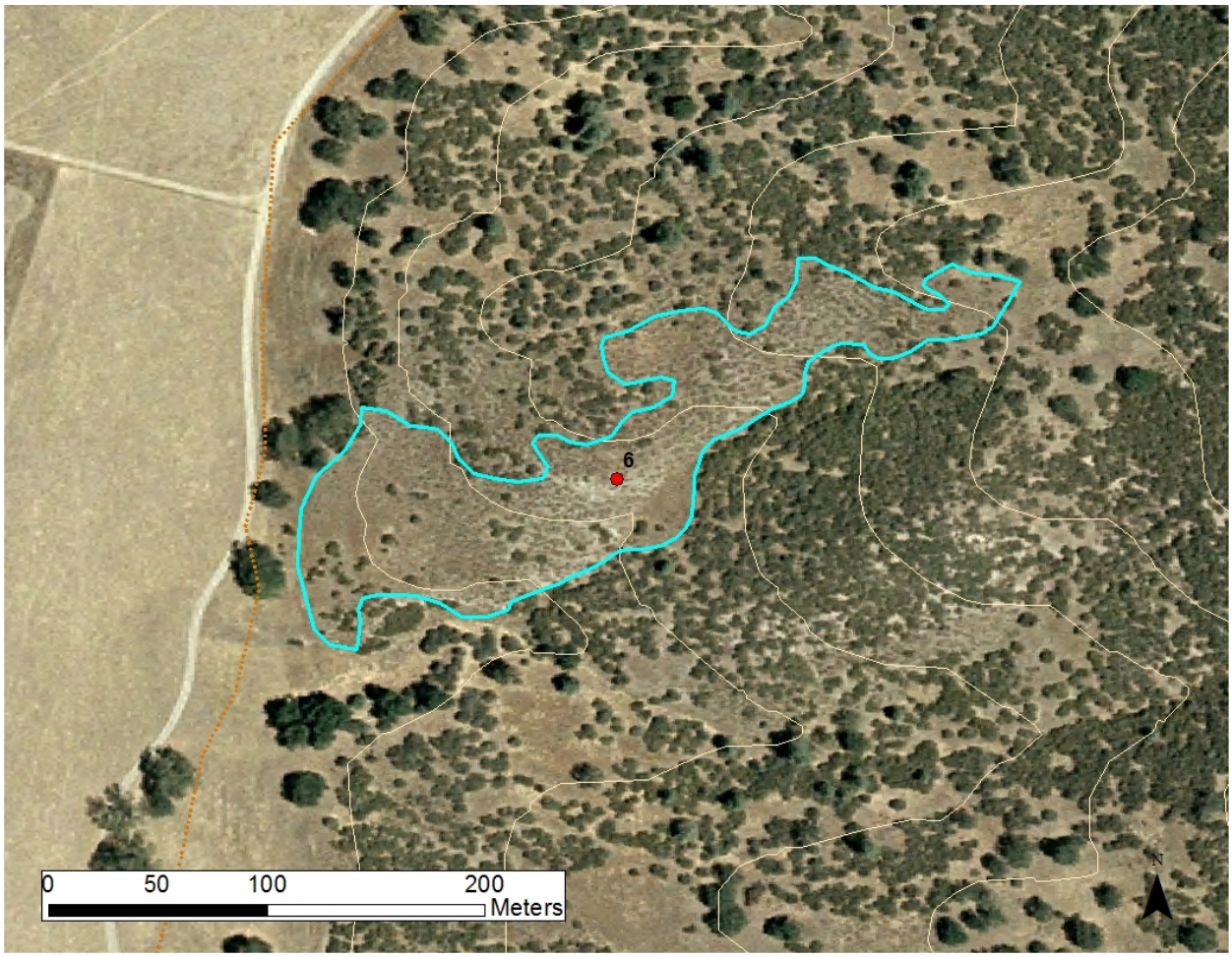


Figure SOP 23.A.28. Stand 6 plot center.



Figure SOP 23.A.29. A photo of Stand 6 from the bottom.



Figure SOP 23.A.30. A photo of Stand 6 from across the valley.

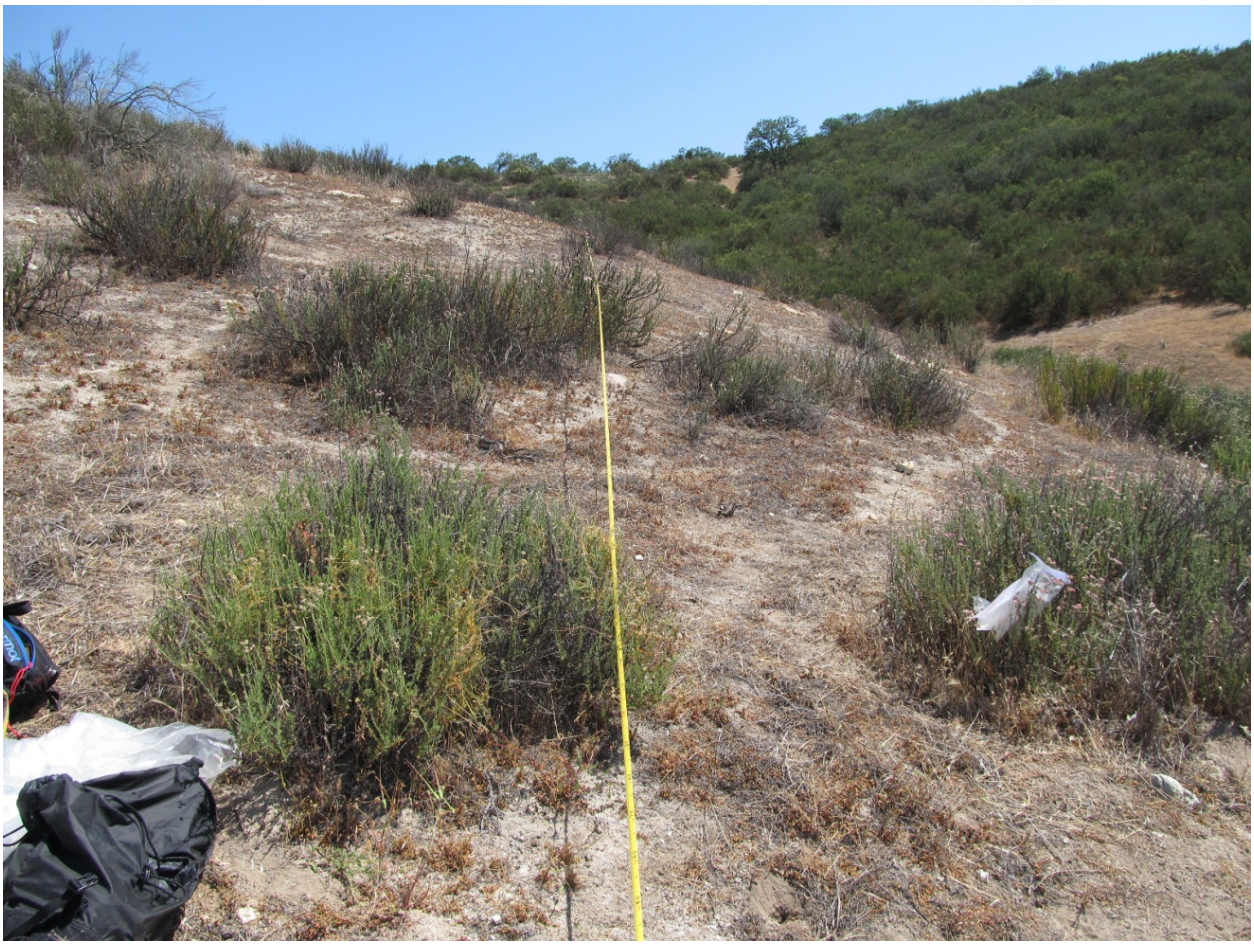


Figure SOP 23.A.31. PlotSCRB06, Transect A.



Figure SOP 23.A.32. PlotSCRB06, Transect B.



Figure SOP 23.A.33. PlotSCRB06, Transect C.

Plot SCRB07

This stand is on the west side of the park off of the North Wilderness Trail about a third of a mile up from the trailhead. From the parking lot, hike past the first small canyons, and the stand will be up the first major side canyon one the northeast side of the valley. There will be a blue oak woodland near the bottom that turns into a grassland which you can take all the way to the stand.

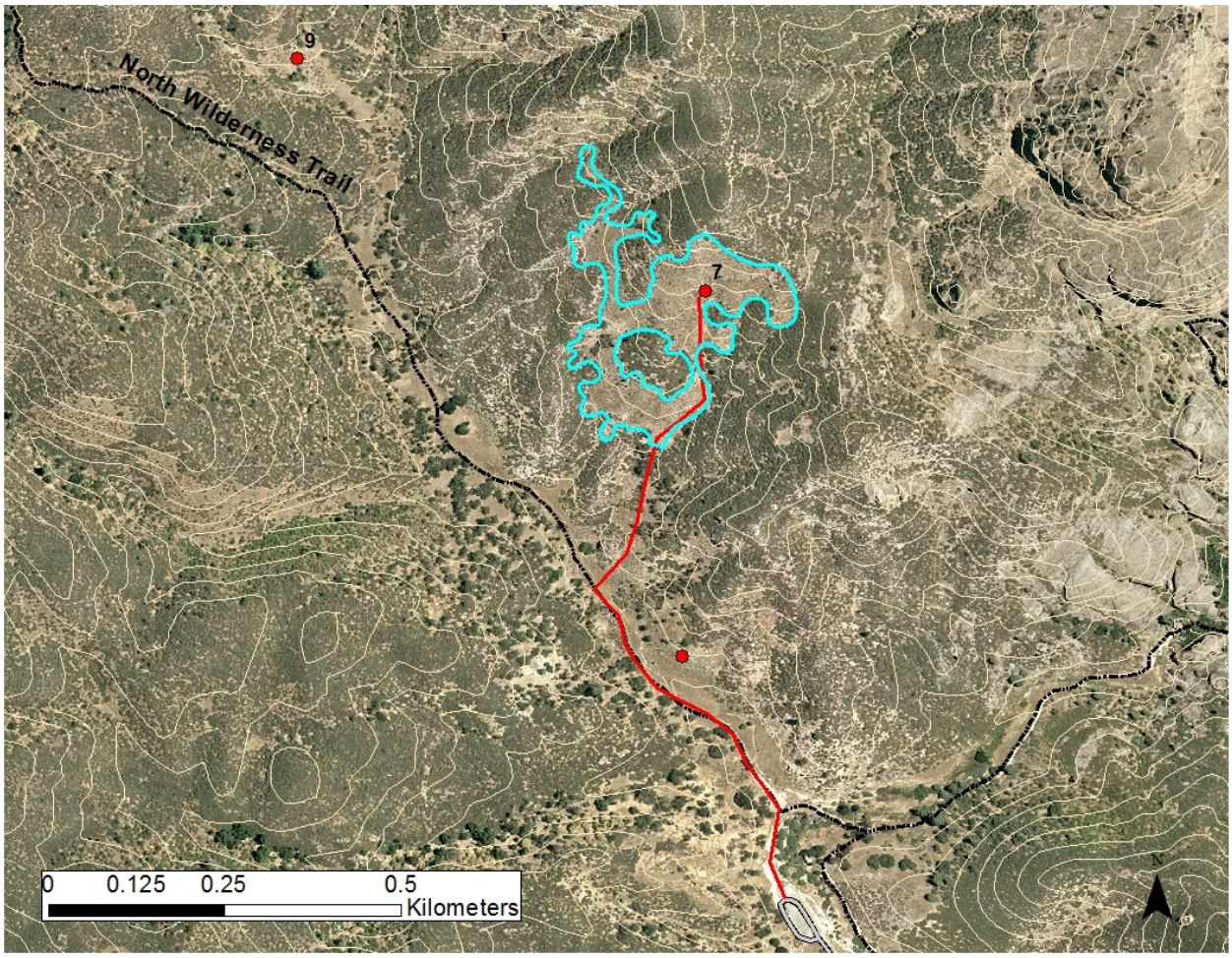


Figure SOP 23.A.34. Access to Stand 7.

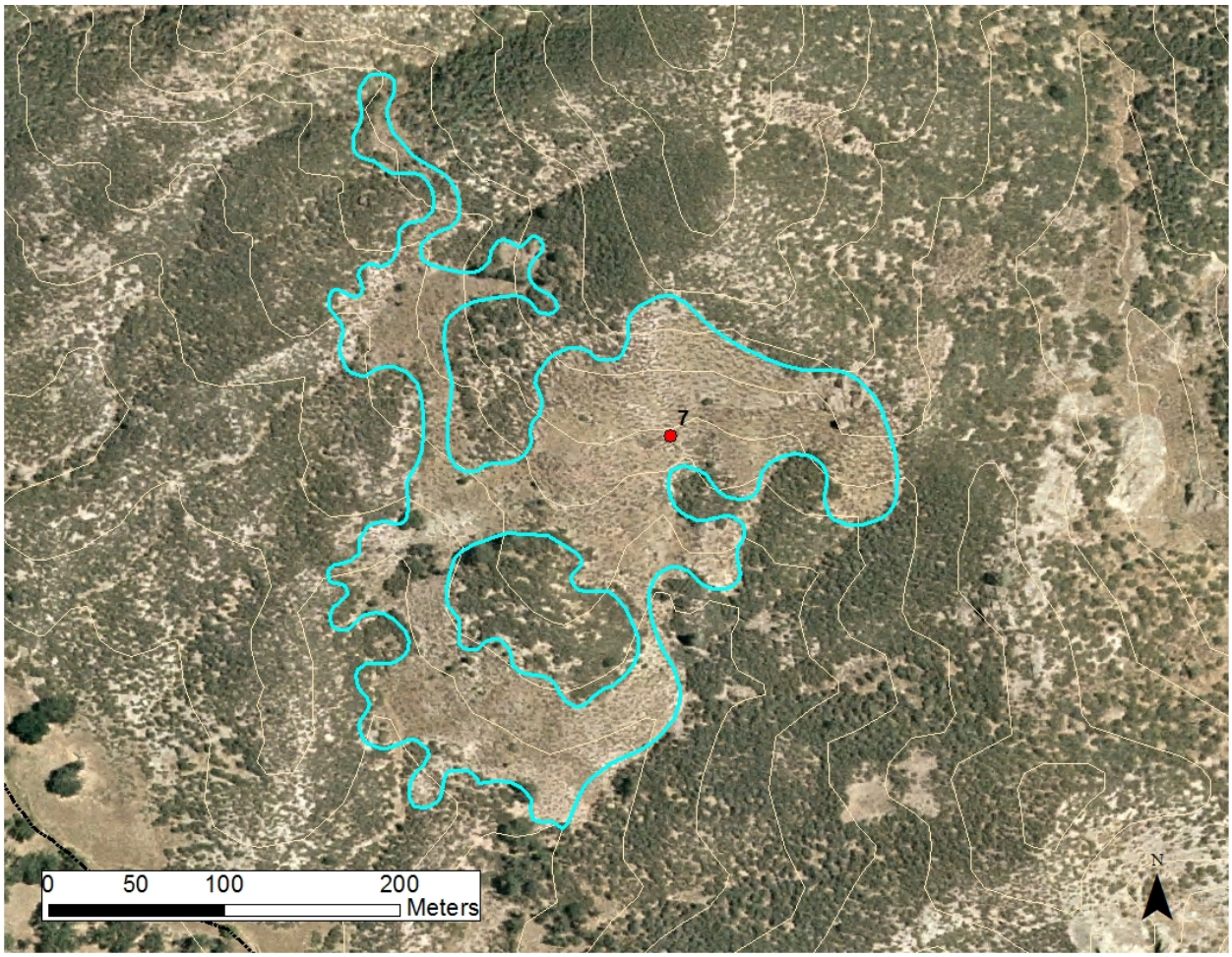


Figure SOP 23.A.35. Stand 7 plot center.



Figure SOP 23.A.36. PlotSCRB07, Transect A.

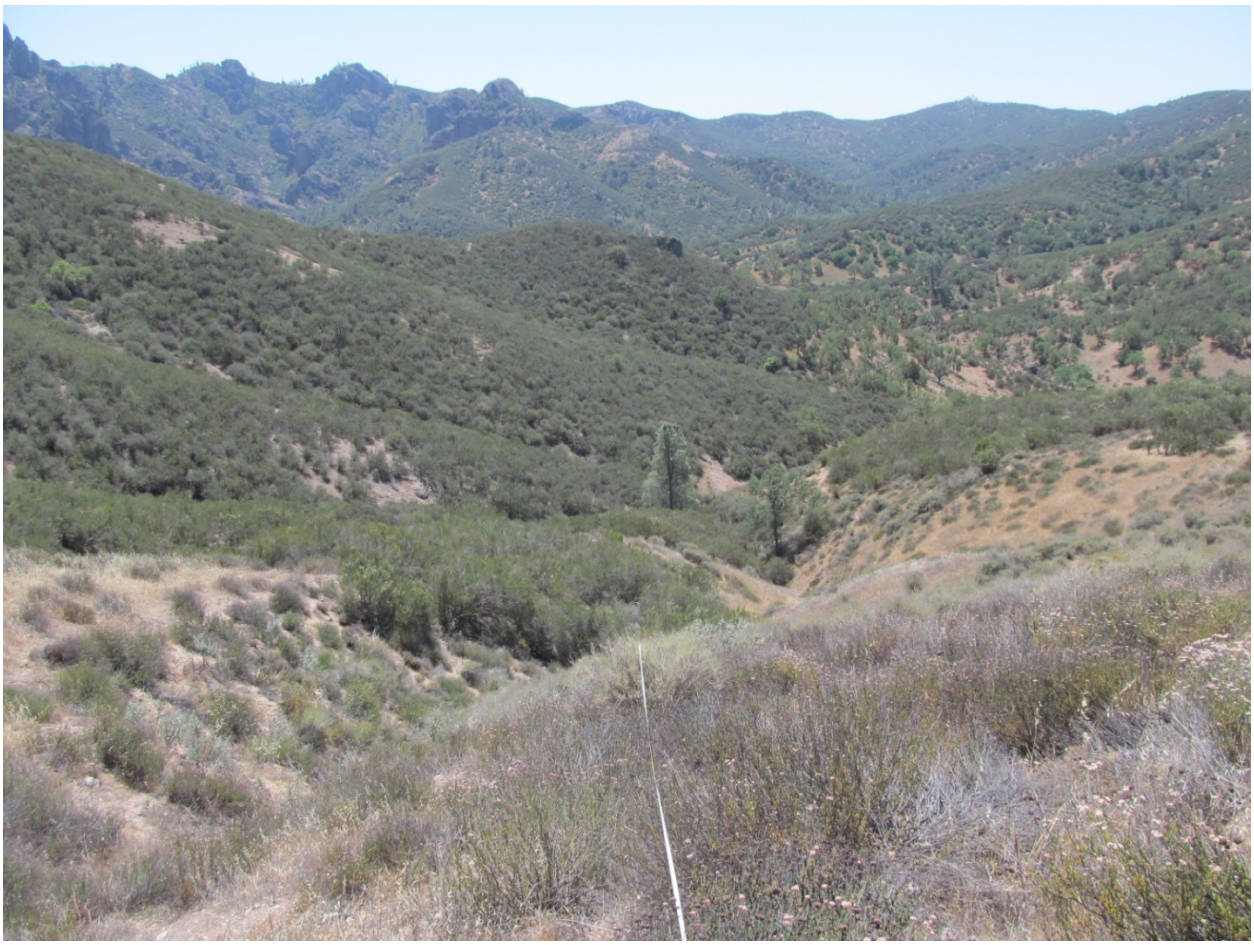


Figure SOP 23.A.37. PlotSCRB07, Transect B.



Figure SOP 23.A.38. PlotSCRB07, Transect C.

Plot SCRB08

This stand is just north of the Balconies trail about a half mile past where the North Wilderness trail splits from the Old Pinnacles Trail. You will be near the stream in a riparian area, and see some short rock cliffs in the hill to your right. The stand is just above these rocks on the south facing slope.

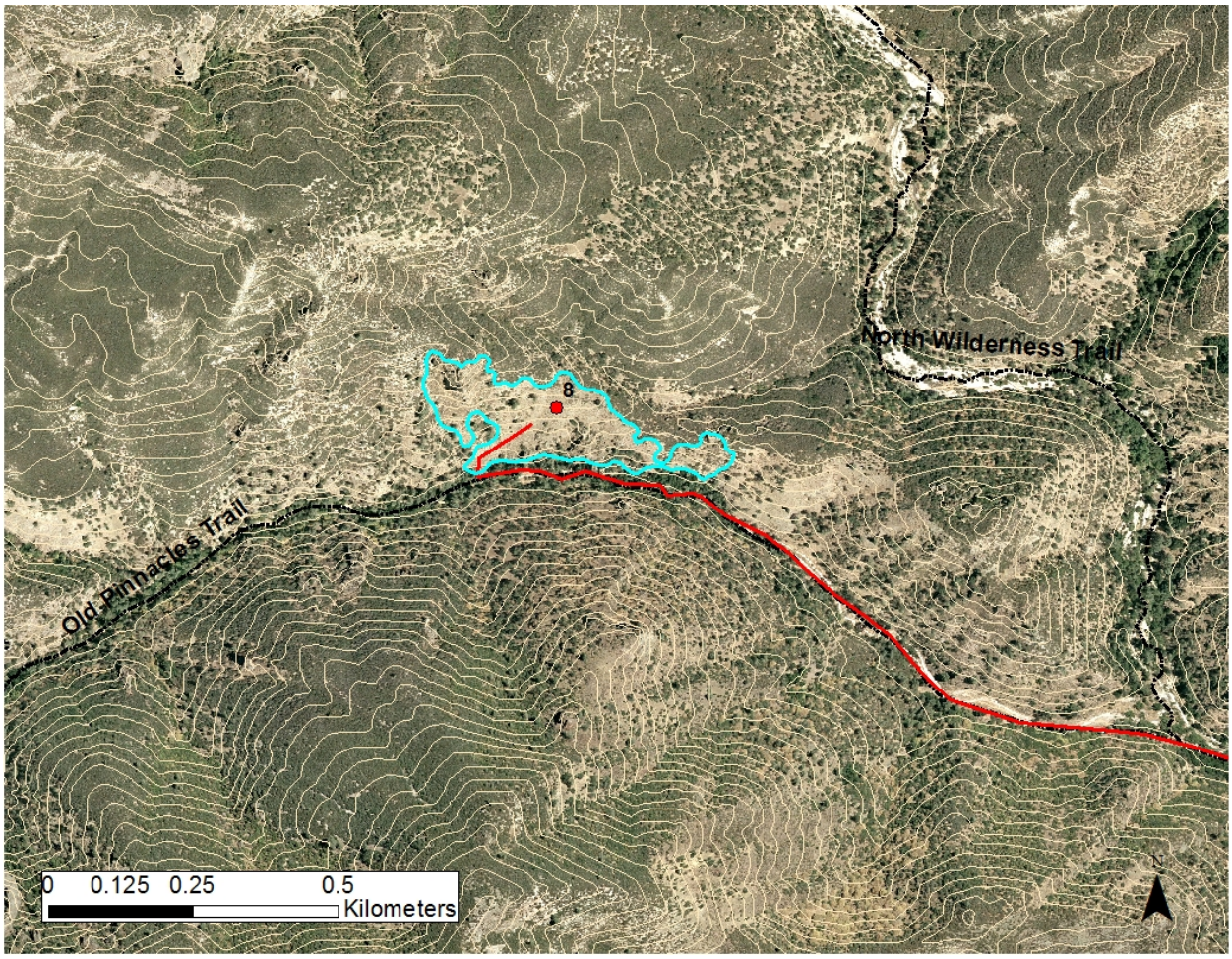


Figure SOP 23.A.39. Access to Stand 8 from the Balconies Trail.

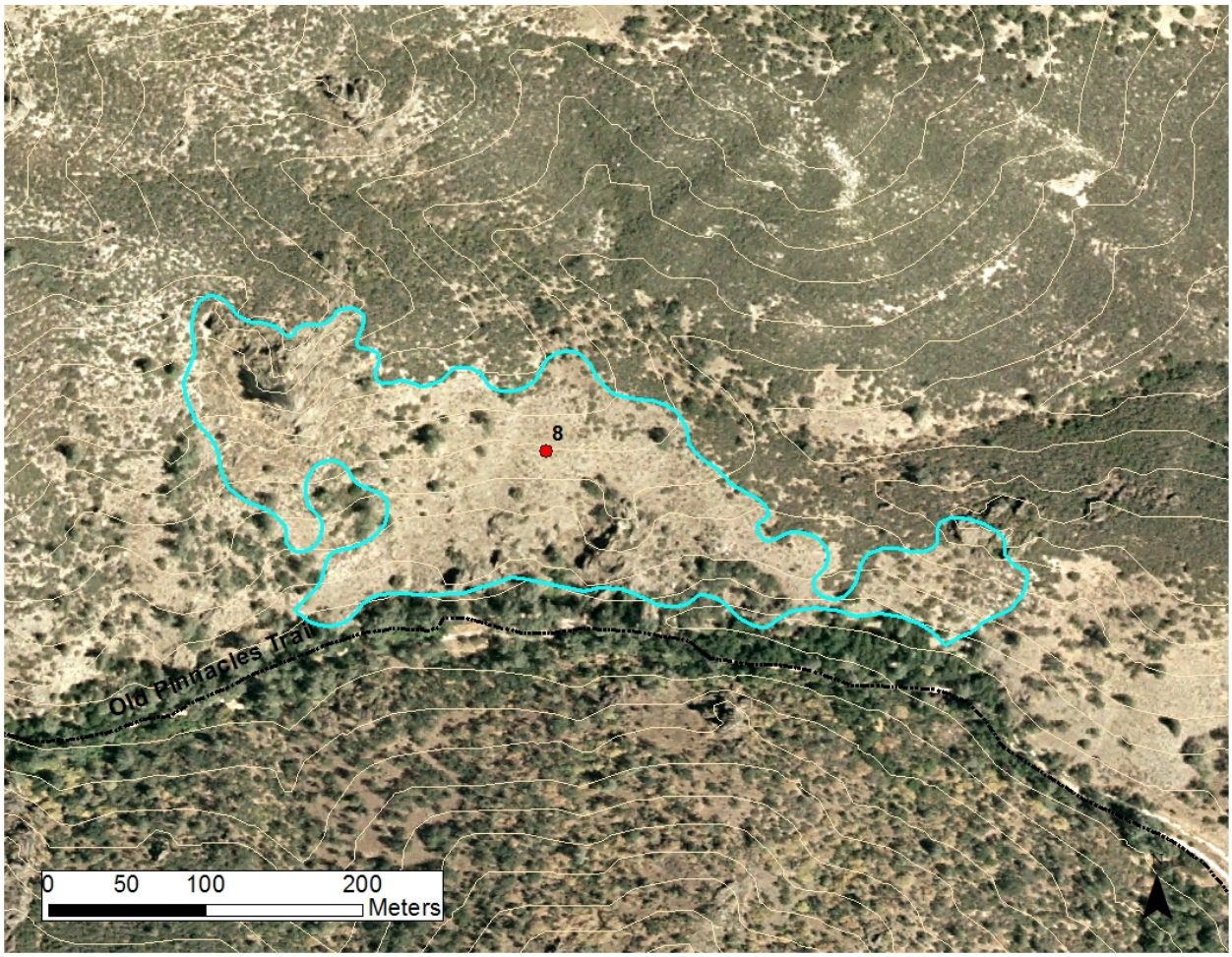


Figure SOP 23.A.40. Stand 8 plot center.



Figure SOP 23.A.41. The view east from Stand 8.



Figure SOP 23.A.42. The view to the north from Stand 8.



Figure SOP 23.A.43. A view of a portion of Stand 8.



Figure SOP 23.A.44. PlotSCRB08, Transect A.



Figure SOP 23.A.45. PlotSCRB08, Transect B.



Figure SOP 23.A.46. PlotSCRB08, Transect C.

Plot SCRB09

This stand is a small scrub stand northeast of the chaparral parking lot. To access it, follow the North Wilderness Trail half a mile up to the point where the trail leaves the canyon and goes up into the chaparral. Stay in the canyon and the stand will be 300 meters north of the trial on the left side of the canyon.

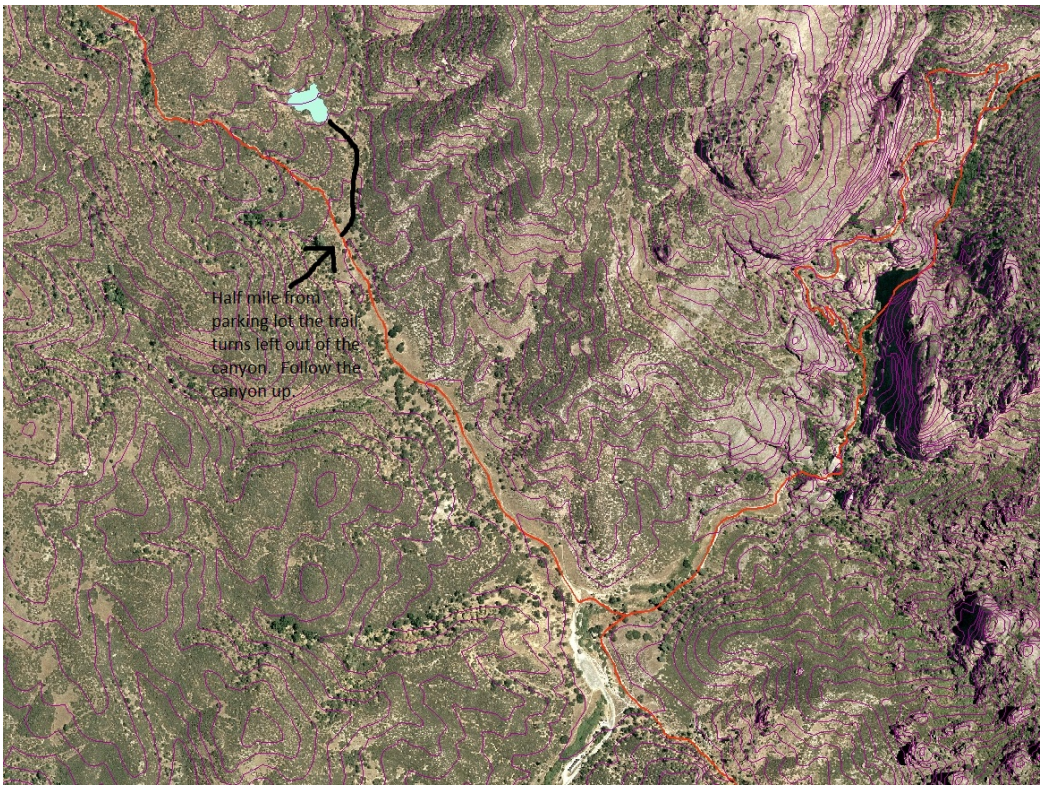


Figure SOP 23.A.47. Access to Stand 9 from North Wilderness Trail: veer north into the canyon when the trail leaves the grassy canyon and heads up into the chaparral.



Figure SOP 23.A.48. Stand 9.



Figure SOP 23.A.49. PlotSCRB09, Transect A.



Figure SOP 23.A.50. PlotSCRB09, Transect B.



Figure SOP 23.A.51. PlotSCRB09, Transect C.

Plot SCRB10

This site is near the west entrance to the park, north of Highway 146. It is near the pig fence and western park boundary, so the easiest way to access it is by walking the pig fence north from Highway 146 and bypassing as much chamise bush-wacking as possible. Where Highway 146 makes a sharp 90 degree right turn, there is a gate that leads to two old roads. One goes west and the other northwest. Walk the northwest trending road about a quarter-mile to where it hits the pig fence. From there head north along the pig fence for just under a mile. You will come to a point where the fence is on the west side of a steep north-south trending valley with blue oaks. The stand will be in the hills a quarter-mile to the southeast. There are two selected buckwheat stands in the area. This stand is the southeastern one.

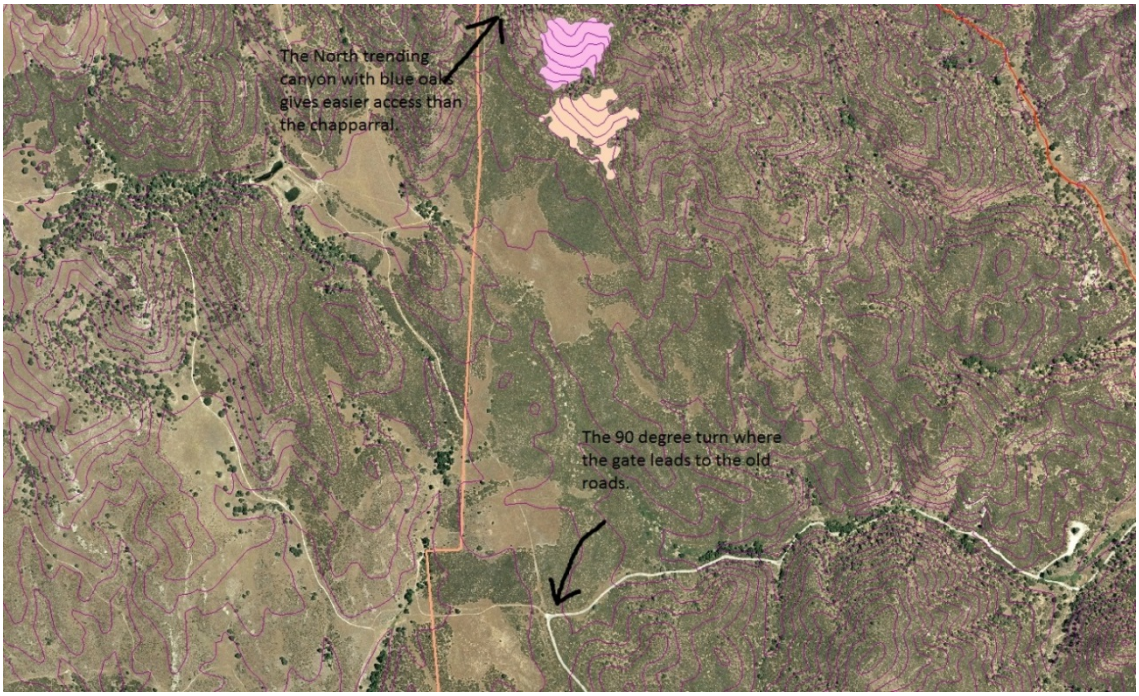


Figure SOP 23.A.52. Access to Stands 1 and 10, Stand 10 is southernmost.

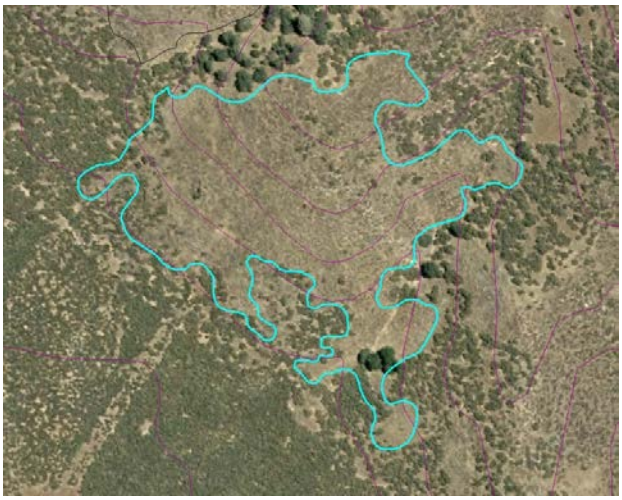


Figure SOP 23.A.53. Stand 10.

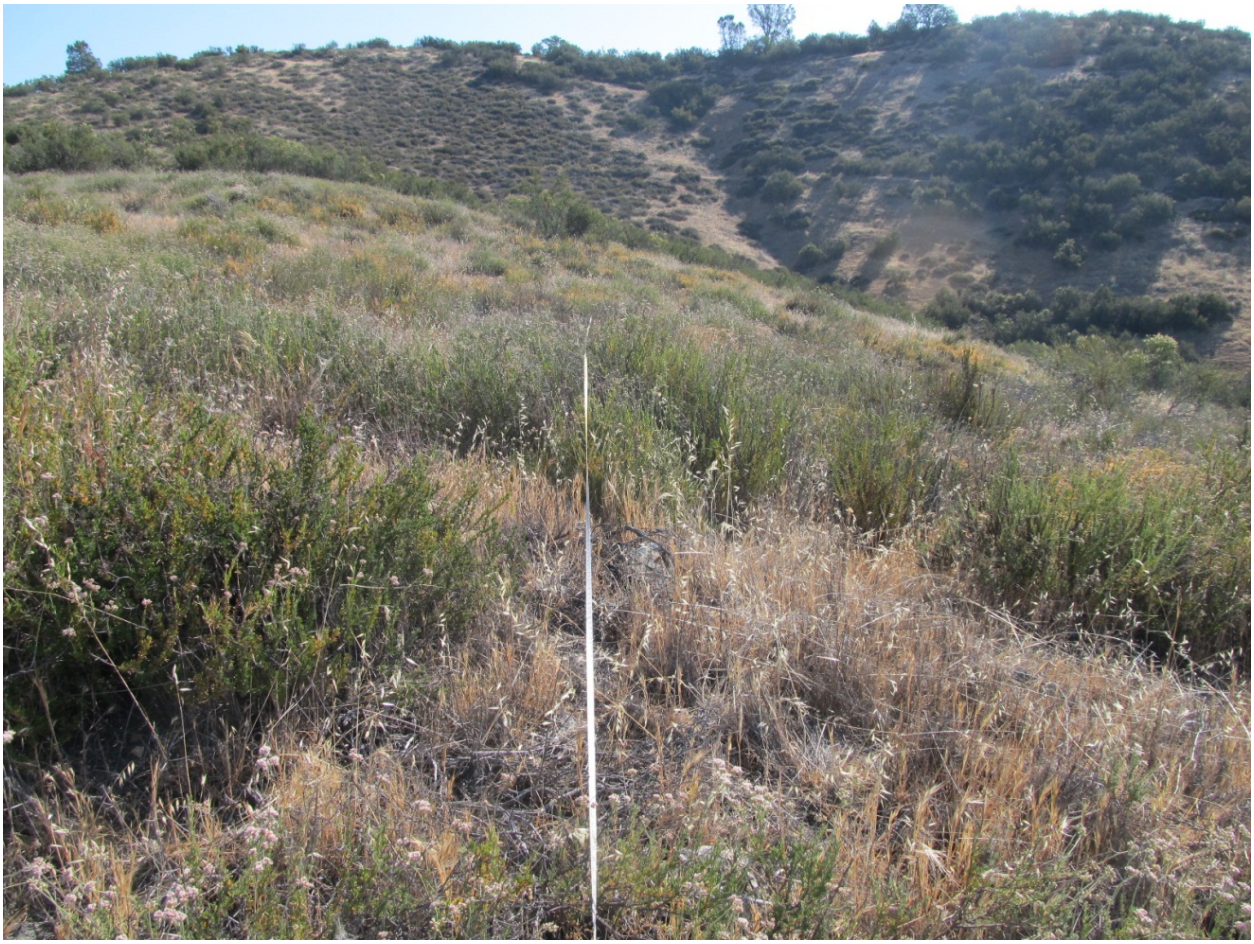


Figure SOP 23.A.54. PlotSCRB10, Transect A.



Figure SOP 23.A.55. PlotSCRB10, Transect B.



Figure SOP 23.A.56. PlotSCRB10, Transect C.

Plot SCRB11

The stand is on the West side of the park up the small canyon just south of Nasella Canyon. To get there, drive out onto the highway on the park road, make a right, and then make the first right back into the park on the dirt road. Park by the barn, and hike in.

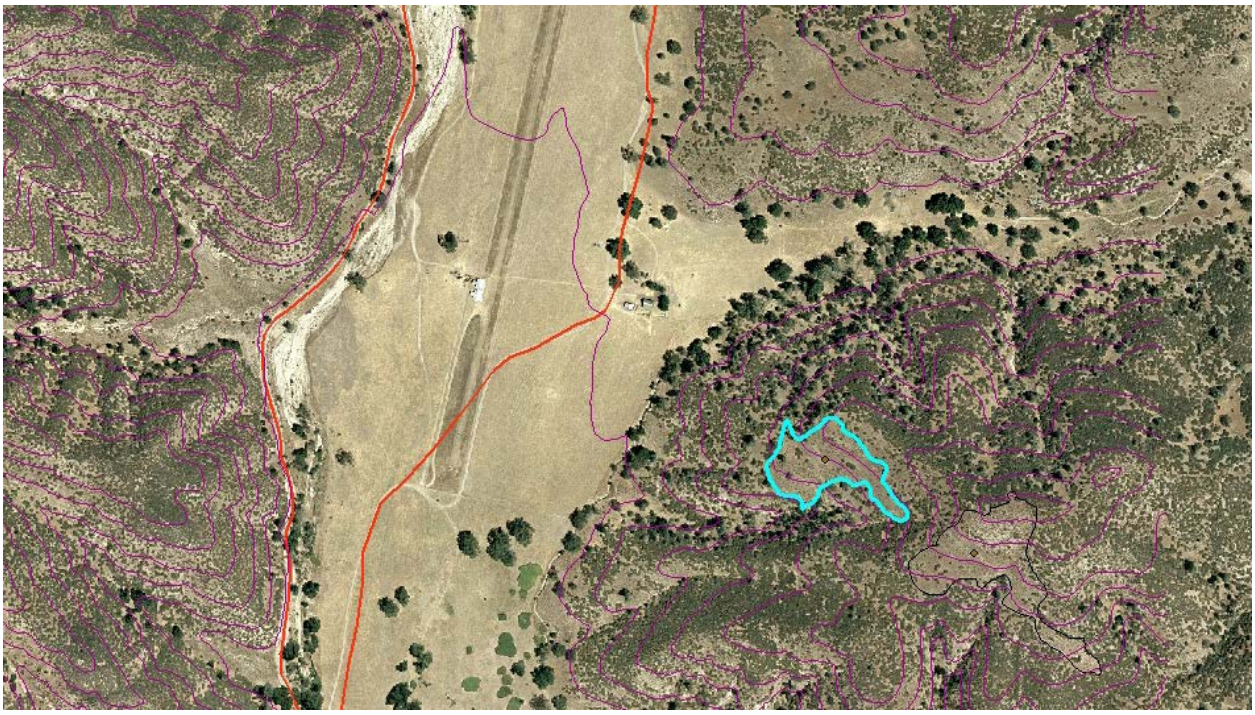


Figure SOP 23.A.57. An overview of Stand 11 showing the grassy bottomlands.



Figure SOP 23.A.58. Stand 11.

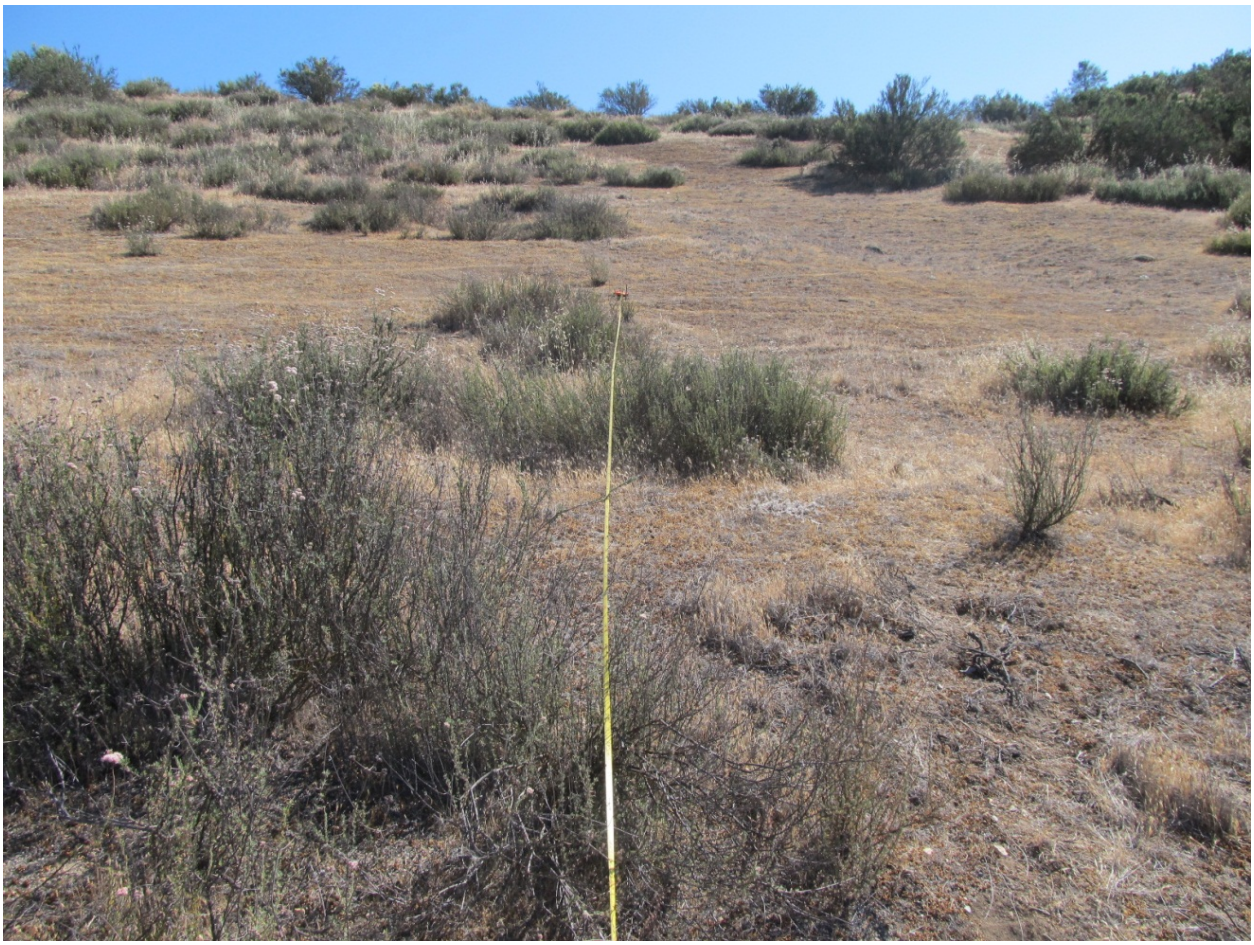


Figure SOP 23.A.59. PlotSCRB11, Transect A.



Figure SOP 23.A.60. PlotSCRB11, Transect B.



Figure SOP 23.A.61. PlotSCRB11, Transect C.

Plot SCRB12

This stand is on the West side of the park. It is directly off the North Wilderness Trail around 250m from the trailhead. It will be on your right between the grassy valley and the chaparral. It should be very easily accessible.



Figure SOP 23.A.62. An overview of Stand 12 showing the North Wilderness Trail and the West Side.



Figure SOP 23.A.63. Stand 12.



Figure SOP 23.A.64. PlotSCRB12, Transect A.



Figure SOP 23.A.65. PlotSCRB12, Transect B.



Figure SOP 23.A.66. PlotSCRB12, Transect C.

Literature Cited

Steers, R., M. Denn, E. Wrubel, B. Johnson, L. Parsons, and F. Villalba. 2016. Plant community monitoring protocol for the San Francisco Area Network of National Parks: Narrative Version 2.0. Natural Resource Report NPS/SFAN/NRR—2015/XXX. National Park Service, Fort Collins, Colorado.

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NPS XXXXXX, Month Year (The Fort Collins Support Office will fill out this line for you) **Rules/Guidance**

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U.S. Department of the Interior

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