National Park Service
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Natural Resource Program Center

# Camas Lily Monitoring Protocol Standard Operating Procedures

## *Upper Columbia Basin Network*

*Version 1.0, October 2007*

Natural Resource Report NPS/UCBN/NRR—2007/011

**ON THE COVER**
*Camassia quamash* (Pursh) Greene
NPS Photograph from Big Hole National Battlefield, courtesy of Dr. Penny Latham.

# Camas Lily Monitoring Protocol Standard Operating Procedures

*Version 1.0, October 2007*

Natural Resource Report NPS/UCBN/NRR—2007/011

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**Camas Lily Long-Term Monitoring Protocol**

# Standard Operating Procedure (SOP) 1: Preparations and Equipment Set-up Prior to the Field Season

**Version 1.0, October 2007**

## Change History

| Original Version # | Date of Revision | Revised By | Changes | Justification | New Version # |
|---|---|---|---|---|---|
| 1.0 Draft | October 2007 | UCBN | Revision following peer review | | 1.0 |
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**Note:** This SOP describes the step-by-step procedures for preparing for field work and for constructing, preparing, and organizing field equipment prior to the initiation of personnel training and entry into the field. Field time is expensive, both in time as well as in money. Adequate field and equipment preparation is crucial to a successful monitoring program.

## Suggested Reading

Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Appendix 12 *in* Measuring and Monitoring Plant Populations. US Department of Interior, Bureau of Land Management, Denver, CO.

## Annual Review

Key network and park staff should conduct an annual review of the protocol and SOPs prior to spring preparations. This is a central element to season close-out procedures. Review should include training and field procedures, recruitment and participation of citizen scientists as participating field technicians, data management, analysis, and reporting, as well as fundamental design issues. Most importantly, careful consideration should be made of the resulting analyses and the overall confidence in results. The adequacy of sampling effort must be evaluated. Any necessary changes should be made to the protocol and SOPs with enough time to circulate updated material to key staff. Finally, a new set of randomly generated sampling locations must be created for each sampling population, following procedures outlined below.

## Procedures

### *Generating Sample Locations in ArcGIS 9.1*

**Important Note:** A random sampling extension for ArcGIS 9.1 must be installed prior to drawing samples. Hawth's Tools, available at the following url: http://www.spatialecology.com/index.php or the NPS AlaskaPak extension both offer flexible sampling tools http://www.nps.gov/akso/gis/.

Generating simple random sample points for each management zone (e.g. A through E at Weippe Prairie) using Hawth's Tools or AlaskaPak should be completed in the following sequence:

1) Load the appropriate ArcMap project file (extension .mxd).

2) Select a target zone polygon (e.g. polygon A, Weippe Prairie).

3) Open the random sampling tool extension and select to draw a sample for the selected feature only. Enter the number of desired samples. Do not enforce a minimum distance between points, as this turns a simple equal probability sample into an unnecessarily complicated conditional probability (unequal probability) sample, which requires different design-based parameter estimators.

4) Name the output shapefile according to standard UCBN naming conventions (e.g. UCBN_2008_WEPRzoneA_NAD83_20070906.shp)

5) Update the projection file for this output, and add UTM X and Y coordinates to each sample point.

6) Note that NPS and UCBN standards require that spatial data be projected in the North American Datum 1983 (NAD 83). However, the native datum for GPS satellites is the World Geodetic Survey 1984 (WGS 84), and coordinates output for uploading into GPS units should be in this datum. This requires that the shapefile be reprojected and X and Y coordinates added again (a second step), or that the data frame environment for the .mxd is in WGS 84 to begin with. Note that the example output shapefile name in step 4 above specifies the datum. Careful attention should be paid to this issue to avoid confusion.

Fortunately there is very little difference between the two projections. Spatial data and maps produced for archiving, analysis, and reporting should be projected in NAD 83.

7) Export the output table (extension .dbf) and update the camas lily monitoring project Access database.

8) Once samples have been drawn for each population, output maps with labels and color codes for each field team can be prepared and printed. Organize proximal clusters of sites into discrete lists for individual field teams. See Figure 3 for an example from 2007. A good rule of thumb if exact number of teams is not known ahead of time is to group clusters of 20 points together. These groups can than be assigned *ad hoc* to teams in the field.

9) Finally, import the master sampling location list, as a text file (extension .txt), to GPS waypoints following procedures outlined in SOP # 3, Finding GPS Waypoints.

### *Scheduling and Organizing Field Work*

The UCBN and its constituent parks are unable to maintain a large field staff for financial and logistical reasons. This combined with the remote and widely dispersed nature of the network, as well as the demands from other vital signs monitoring efforts requires that the field portion of the camas lily monitoring program be sustained by citizen scientists. This fact mandates that field work should be scheduled well in advance of the May-June sampling window, and scheduling efforts should begin no later than the previous January. The network ecologist or alternate project lead will coordinate this planning with the NEPE and BIHO park resource and interpretive staff. Network and park staff will work together to maintain an active outreach effort with educational institutions in order to build and maintain active involvement from students and teachers. While NEPE and BIHO staff will assume primary responsibility for recruiting local volunteer groups, the network will provide additional support in this area, and will be responsible to supplement field crew support if citizen science involvement falls short in any given year. A minimum of four people, organized into two teams, must be available in order to complete sampling in a reasonable amount of time.

Once the number of participants is known, available teams can be determined, and sampling points can be organized into team “clusters”, according to proximity and travel efficiency. Each team’s clusters can be mapped with a unique color, and hard copies of coded maps should be prepared for each team to refer to during field operations (Figure 3). Travel considerations at Weippe Prairie are important to consider to avoid splitting team clusters with Jim Ford Creek or the deep drainage ditches located on the western portion of the site.

### *Equipment Construction and Preparation*

Equipment List: The following equipment should be assembled each spring, and sufficient time allowed to construct or order replacement equipment. Camas field equipment will be checked out/in of the UCBN office by the person in charge of supply inventories. The number of individual items required is not included here, as they change according to the number of field participants and teams available. Each team should be completely outfitted, as it is not practical for teams to share equipment in the field. The miscellaneous equipment category provides a list of items found useful when incorporating citizen science in the camas monitoring.

*Measuring Equipment (see Figure 1):*

- 4 m long wire rope, pre-marked for thatch depth measurements, loops at both ends (3/16" coated wire braid) secured with aluminum ferrules.
- Steel chaining pins (14" red and white painted)
- 15 cm PVC measuring pipe (1/2" schedule 40 white PVC)
- Orienteering compass, with moveable housing and adjustable declination
- 30 cm stiff wire pin or rod with cm measurements marked
- Plant identification material for targeted invasive weeds
- Hard copies of relevant SOPs for field reference

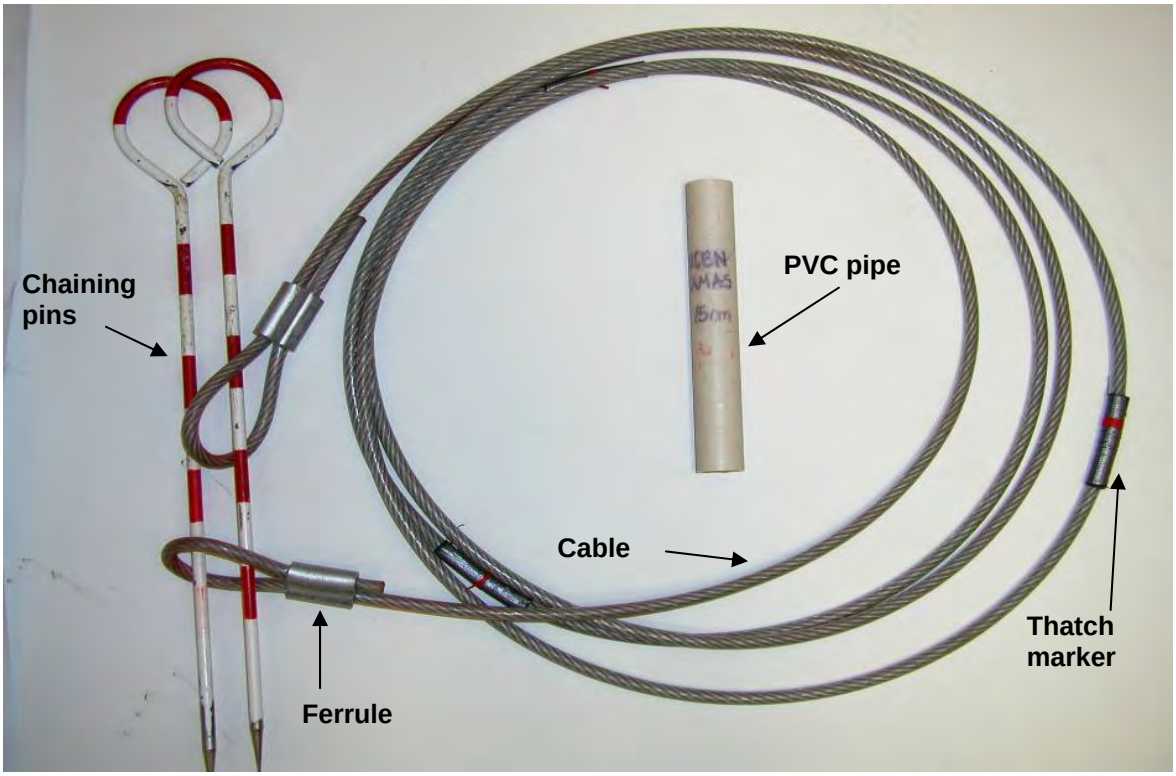


Figure 1. "Cable set" required for measuring camas density.

*Navigation and Recording Equipment:*

- GPS unit with pre-loaded sampling location waypoints (UCBN supplied, or comparable unit)
- Weatherized field data entry forms and maps (e.g. Rite-in-the-Rain paper), prepared with UTM coordinates, team numbers, and random azimuths
- Backup copies of data entry forms
- Mechanical pencils and clip boards
- Extra batteries

*Miscellaneous Field Equipment/Equipment for Citizen Science Involvement:*

- Two-way handheld radios
- Large display map of area and easel
- First aid kits
- Collapsible table
- Sun shade canopy (for large group use)
- Water jug
- Portable latrine (for Weippe Prairie) (usually ordered by the NEPE resource manager)

Construction and Preparation:

1) Although a variety of materials could be used for the quadrat "hard edge", 3/16" plastic coated braided wire rope available from hardware stores such as Home Depot, Lowe's, and Ace works very well. At 3/16" thickness, wire rope is adequately flexible and light, but maintains a straight line along uneven ground or dense herbaceous vegetation. A strong pair of wire or bolt cutters is necessary to cut and trim the wire rope.

Figure 2. Cable assembly of wire loop with aluminum ferrule.

Use ¼" aluminum ferrules, also available at most hardware stores, to secure a loop at each end of the rope. Make one loop by threading the wire rope through the ferrule, allowing for about a 2" diameter inside the loop (see Figure 2). Use a hammer to compress and secure the ferrule. Use a chaining pin to secure the looped end, and stretch out the rope to 4 m, with another 8-12" extra tail for ease in forming the second loop. Use a metric reel tape to measure the rope length accurately. For the second loop thread the rope through the ferrule, and iteratively tighten the rope and measuring tape and adjust the loop diameter so that the inside end of the loop, when pulled tight against a second chaining pin, will be exactly 4 m from the inside edge of the loop on the opposite end. Trim the extra wire rope after securing the ferrule. Using the metric reel tape as a guide, mark the three thatch measurement points on each wire rope with brightly colored plastic "electrical" tape. Use a black permanent marker or very thin piece of colored tape (since the black marker tends to rub off) to mark the exact midway point on the tape to indicate where the edge of the ruler should be placed during field thatch measurement.

2) PVC measuring bars are easily constructed with a pair of PVC cutters or hacksaw. PVC is most often purchased in 10' lengths. Measure and mark 15 cm sections and cut carefully to ensure each bar used in the field will be the same length.

3) 30 cm stiff wire pins should be used to measure the distance between the dirt and top of thatch directly. Wire pin flags work well, as do the thin rods available from hardware stores used for welding. The wire pin should have marks indicating each centimeter so that measurements can be made to the closest centimeter.

4) Each compass must be adjusted to account for magnetic declination, or magnetic variation, by adding approximately $18^{o}$ to the direction of "true" or grid north. Orienteering-grade compass housings can be adjusted, usually by turning a small set screw, so that the fixed north arrow, usually inscribed on the bottom of the plastic housing points to $18^{o}$ rather than $0^{o}$. This will ensure that when this fixed north arrow is aligned with the red end of the magnetic arrow, the compass directional arrow will actually point in the correct direction according to "true" or grid north.

5) Although identification of camas is relatively straightforward, target invasive weeds may not be. The two current target species, orange hawkweed (*Hieracium auranticum*) and sulphur cinquefoil (*Potentilla recta*) could be easily misidentified without crew access to adequate identification material and field training. Field identification and key material should be organized ahead of time and enough copies made for each field team to carry. Laminated or "Rite-in-the-Rain" type paper is recommended. High quality photographs may be helpful, but dichotomous key characteristics should be included in text form. Be sure to include information on similar species (e.g. *Potentilla gracilis*). These materials must be updated when target species change.

6) Hard copies of all field-relevant SOPs and sampling point location maps should be prepared and made available to each field team for the duration of the survey period. Hard copies of sampling point maps should show the clusters of points organized into efficient routes for each team. This is typically done by color coding points according to team membership.

Preparation of Navigation and Field Data Management Equipment:

1) Development of a new set of randomly generated sampling points must be conducted following the procedures described at the beginning of this SOP, and a digital text file (.txt) created with the Quadrat ID and UTM coordinates. This list will then be uploaded to each GPS unit following procedures outlined in SOP # 3. GPS preplanning also includes review of satellite availability for the duration of the scheduled sampling window, and is described in SOP # 3. Both park sites are flat, open, and typically have excellent satellite coverage, but this should be double-checked. Make necessary schedule changes if an unusually poor arrangement of satellites is scheduled during the sampling window. Data entry forms should be revised and printed, with extra copies available for each team. Back-up GPS units should also be available and have all necessary files pre-

loaded. Be sure to include random azimuths in the data entry form. Random azimuths should be restricted to the whole number set {0, 359} to avoid quadrat overlap.

2) Be sure to completely charge all GPS units, as well as backup batteries, prior to departure for the field.

3) Paper data sheets should be prepared and printed to Rite-in-the-Rain paper for each field team. Pre-selected lists of quadrats organized for each team should be listed in rows, with random azimuths, as shown in Figure 4.

   **Note for using citizen scientists:** When using citizen science to collect data, variables such as weather, student absences, travel, and even lack of motivation/interest should be considered. The UCBN field or project lead should be responsible for preparing each day's data sheets. This person will have to get an estimate of the number of citizen scientists expected each day and the time they are available (this information should be obtained from the NEPE crew coordinating the citizen scientists). Sample points should be organized into spatially contiguous groups appropriate for the time and group size. For example, zone A has 60 points and with 4 groups of 3 team members (2 citizen scientists and the team leader) and 2 hours to conduct measurements, each group can measure 15 plots. Fifteen plots will fit onto a single data sheet, and these can be prepared ahead of time, with accompanying color coded reference maps. In the absence of pre-determined teams, groups of 20 points (20 per data sheet) are a good rule of thumb. The field lead should be prepared, however, for some groups in low density areas to finish 20 points before others, and extra sheets of points in other areas of the site should be available. The field lead must carefully coordinate this and tally completed and remaining plots before subsequent field sessions.

Miscellaneous Preparatory Notes:

1) Analysis and reporting of previous year's data is necessary before starting a new field effort. This is covered in SOP # 6, data management, and SOP # 7, data summary and analysis. It is particularly important that adequacy of zone boundaries and sampling effort has been considered, and any changes to sampling design have been made before new points are generated.

2) Prepare a realistic schedule of events in advance of group arrival, and circulate to team leaders and group organizers ahead of time to manage expectations and ensure timely arrival. **In 2006 at Weippe Prairie, seven teams measured 220 quadrats over the course of 2 days, and the first ½ day was dedicated for training. At BIHO, three non-student teams, with a central data recorder (via two-way radio) measured 100 quadrats in ½ day.**

3) Weippe Prairie is currently an undeveloped park site, and has no bathroom facilities. Arrangements should be made for delivery of a portable latrine well in advance of group arrival on site.

4) Safety is an important, but easily overlooked consideration. The safety plan (SOP # 9) should be reviewed before the group splits into teams and heads into the park. With multiple teams operating simultaneously, communication can be difficult, especially at Weippe Prairie, where groups can easily be out of eyesight and shouting distance. Provide two-way radios to the group(s) heading to the farthest portions of the site. Direct a team surveying near the vehicles to maintain regular radio contact with these teams. Make sure all team leaders know where vehicle keys are to be stored during field operations, the location of the nearest pay phone and/or cellular phone coverage opportunity, and emergency contact and operation procedures for NEPE and BIHO staff.

5) After the field season be sure to clean and organize all non-electronic equipment and store in well labeled plastic bins in the UCBN or NEPE headquarters. Some of this equipment will be used by other UCBN monitoring projects so a well organized and well stored collection of equipment is essential. Remove batteries from GPS units requiring long-term winter storage. PDAs need to remain charged to prevent loss of programs such as ArcPad, so these are typically stored by the UCBN under the direction of the data manager in the central office. All equipment should be checked in with the UCBN staff person responsible for equipment inventories.

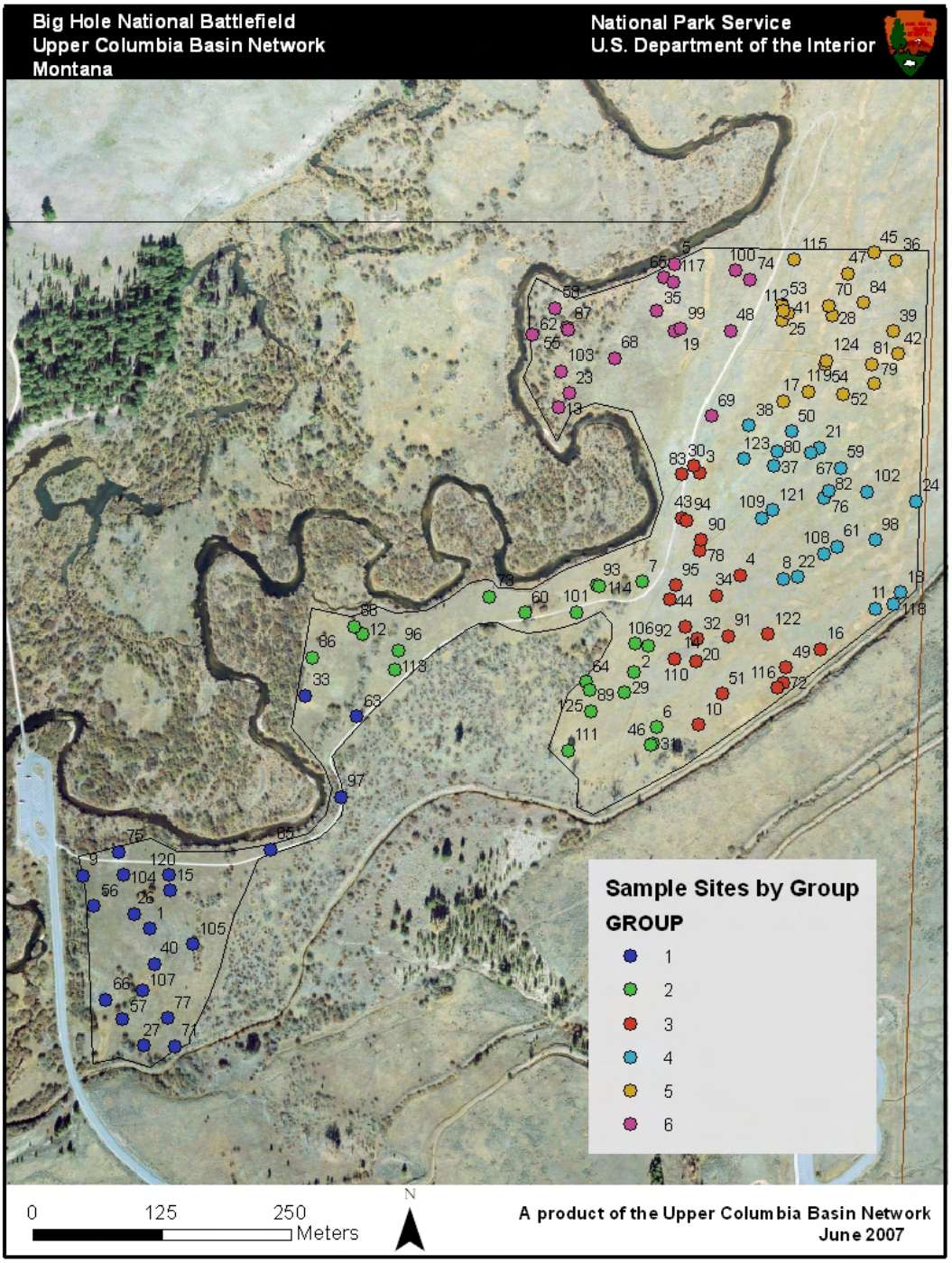


Figure 3. Color coded and labeled quadrat locations for 2007 sampling at Big Hole Battlefield. Each field team was assigned a group of points (approximately 20 points per group) from the same color set and provided a detailed map of the respective set, along with a data sheet with a list of quadrats from that same set.

**NPS Camas Monitoring Survey**
**Weippe Prairie 2007**
**Group 1 – Orange**

Survey Date:
Team Lead:
GPS Unit:

| G | Pop | QuadID # | Azim | Camas # | 2nd Camas sample # | Flower # | Cinq Y/N | Hawk Y/N | Thatch 1 (mm) | Thatch 2 (mm) | Thatch 3 (mm) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | D | 297 | 79 | | | | | | | | | |
| 1 | D | 305 | 229 | | | | | | | | | |
| 1 | D | 286 | 260 | | | | | | | | | |
| 1 | D | 306 | 160 | | | | | | | | | |
| 1 | D | 294 | 284 | | | | | | | | | |
| 1 | D | 309 | 168 | | | | | | | | | |
| 1 | D | 308 | 23 | | | | | | | | | |
| 1 | D | 302 | 106 | | | | | | | | | |
| 1 | D | 279 | 166 | | | | | | | | | |
| 1 | D | 298 | 269 | | | | | | | | | |
| 1 | D | 288 | 173 | | | | | | | | | |
| 1 | D | 303 | 89 | | | | | | | | | |
| 1 | D | 307 | 240 | | | | | | | | | |
| 1 | D | 304 | 323 | | | | | | | | | |
| 1 | D | 280 | 128 | | | | | | | | | |

Figure 4. Sample paper data entry field form. Each team will receive a set of these sheets printed on Rite-in-the-Rain photocopy paper. In this example, group 1 has been assigned to 15 adjacent plots in Weippe Prairie zone D. Azimuths (Azim) have been randomly pre-assigned. Bold squares indicate which plots must be counted twice for relative percent difference (RPD) calculations. Other plots can be evaluated for repeatability and precision as necessary.

**Camas Lily Long-Term Monitoring Protocol**

# Standard Operating Procedure (SOP) 2: Training Observers

**Version 1.0, October 2007**

## Change History

| Original Version # | Date of Revision | Revised By | Changes | Justification | New Version # |
|---|---|---|---|---|---|
| 1.0 Draft | October 2007 | UCBN | Revision following peer review | | 1.0 |
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**Note:** This SOP describes the step-by-step procedures for organizing and training field personnel. Note that none of these SOPs are meant to be stand-alone training manuals replacing the thorough documentation available for GPS and PDA hardware and software. Training personnel should refer to these SOPs as a guide, and seek out additional information in the suggested references and through hands-on training courses provided by NPS and outside vendors.

## Suggested Reading


Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Chapter 8 *in* Measuring and Monitoring Plant Populations. US Department of Interior, Bureau of Land Management, Denver, Colo.

Garmin. 2005. GPSMAP 76CSx Owner's Manuel. Garmin International, Olathe, KS. Available online at http://www.garmin.com/products/manual.jsp?product=010-00469-00

## Procedures

### *Team Organization*

Once the number of participants is known, teams can be organized. Two persons per team is a minimum, three is ideal, and four is acceptable. Larger team sizes are inefficient. Provide each team with a complete set of measuring equipment. Also provide each team with a hard copy of each of the relevant field SOPs for reference during training and field operations. Each team should also be provided with a hard copy map of the entire park site as well as with a larger scale map indicating the team's cluster of individual sampling points and their point ID labels. These hard copy maps are crucial for field efficiency and to minimize errors associated with misidentified points. Once the composition of teams is established, it should be maintained throughout the duration of training and sampling in order to maintain consistency. Experience during pilot work indicated that teams quickly made idiosyncratic adjustments (within the outlined SOP constraints) that utilized the strengths and interests of individual team members and enhanced overall team efficiency. For monitoring involving citizen science, there should be one team lead that has an excellent understanding of the monitoring plan and measurement methods. This person will also be in charge of quality control for the data and making sure the counts fall within the acceptable relative percent difference (5%).

Each team should be provided with:

- A complete set of measuring equipment
- Data sheets
- Invasive ID cards
- Map of the entire area for orientation
- Focused large scale maps indicating the team's cluster of sampling points with IDs
- Radio
- First Aid Kit

### *Equipment Operation*

1) Operation of GPS units is outlined in SOP # 3.

2) Compass use is best taught in a group setting outside and away from magnetic interference. Compasses should be held flat, on an open palm, in front of and close to the user's body. To move the compass around for alignment of arrows and determination of a bearing, or azimuth, the user should move with the whole body rather than just the arm or hand. A simple mnemonic for using orienteering compasses is to "put red in the shed", where "red" is the magnetic arrow that always points to magnetic north, and the "shed" is the fixed north arrow

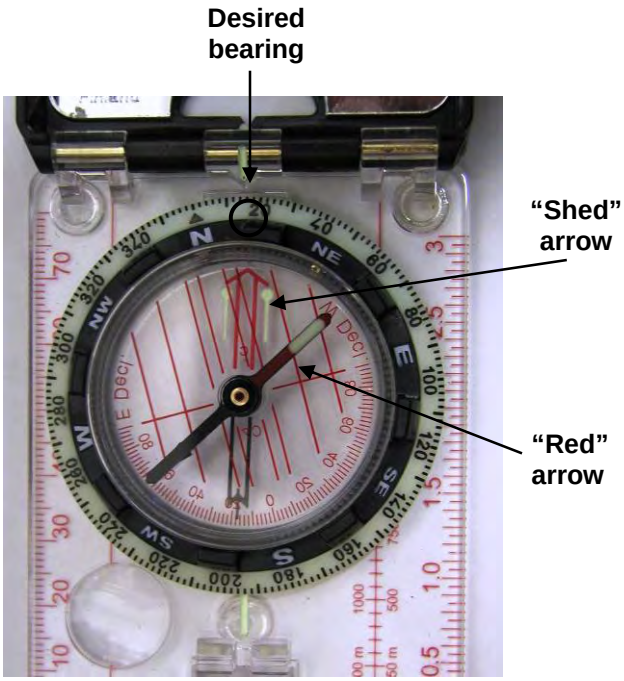


Figure 5. Compass displaying components used to find a bearing.

inscribed on the bottom of the moveable housing (See Figure 5). Once the “shed” is set to accommodate the magnetic declination and the “red” is in the “shed,” the compass directional arrow that is inscribed on the outside of the compass housing along the end of the base plate will always point to a true bearing or azimuth. Quadrats should be oriented along the pre-assigned azimuth by turning the compass housing to the desired number, and then turning the body until “red is in the shed”.

### *Field Operations*

1) Designate a lead trainer. This will typically be the project lead, if present, or the designated field lead. This person should not be assigned to a team and should be available to float between teams throughout training and field work in order to troubleshoot and reassign new quadrats as teams finish assignments.

2) Definitions for key field terms are presented in Table 1 and should be reviewed during training.

Table 1. Important field definitions for monitoring camas in the UCBN.

| Term | Definition |
|---|---|
| Established camas plant | Recognized by 2 or more leaves that emerge from the ground at a central point (from the same bulb); recognizing small camas plants can require poking around at the soil surface |
| Camas seedling | Recognized by only one small leaf emerging from the soil surface. |
| “In” (for camas and invasive plants) | The plant originates from the ground (is rooted) within the inside edge of the quadrat edge; a plant is either in or out, never halfway. |
| Flowering stem (for camas) | A camas plant is reproductive if it has a leafless stem (scape) of any kind, regardless if the stem is bearing fruit, flowers, or buds, and regardless if it has been grazed down to a short stub (Note: all stems in camas are reproductive and should be counted as a “flowering stem). |
| Thatch | A tightly bound layer of dead grass, including leaves, stems, and roots, that builds up on the soil surface at the base of the living grass of a lawn or meadow. |
| Azimuth | Azimuth is the horizontal component of a compass direction or bearing. It is usually expressed in degrees. |

3) As with compass training, field measurement operations are best taught outside, at the park site or another camas prairie. Initial training can also take place on a lawn or in some other flat area dominated by herbaceous vegetation. Be sure not to conduct training in or near sampling locations in order to avoid trampling vegetation. Start by organizing personnel into teams. Two person teams are a minimum, three is optimal, and four is adequate. Larger teams are inefficient. Personnel should already have basic GPS navigation and data entry skills, but additional training on those topics can be provided in the field as well. Practice sample points can be included in the waypoint list in an anticipated training area, enabling participants to practice GPS navigation.

4) Experience during pilot work demonstrated that some preliminary exposure to objectives, ecological and cultural background, and introductory field methods was very helpful. We strongly recommend that park and/or network staff schedule a 2-3 hour session with the citizen scientists in advance of actual on-site training and field work.

5) On-site training can be accomplished in one ½ day, typically in the morning. The entire group should be assembled at the beginning for a review of concepts and techniques. Basic plant identification should be reviewed here, and plant specimens should be assembled and presented to the group at this time. A set of identification cards for distinguishing *Potentilla recta* and the native slender cinquefoil *Potentilla gracilis* is included as Figure 6. The stiff perpendicular hairs along the stem and leaves (*hirsute* tending toward *hispid*) of *Potentilla recta* is the most reliable diagnostic characteristic, especially early in the growing season before flowering. This should be emphasized against the short flattened (appressed and *tomentose* tending toward *tomentulose* or even *glabrous*) pubescence of *Potentilla gracilis*. Cards for orange hawkweed and camas lily are included in Figure 7. A good source of information on orange hawkweed can be found at the following location: http://www.weeds.crc.org.au/documents/wmg_orange_hawkweed.pdf. There are no confusing look-alike species for orange hawkweed at Weippe Prairie or BIHO. The group should also walk to nearby target plants *in-situ* in order to develop a search image. The definition of an established camas plant should be reviewed at this time and the group should all get down on hands and knees and carefully inspect an established camas plant and a seedling.

6) Following group introductory material, teams should be assembled and practice calibration should begin. Have teams work in the same vicinity. Be careful not to allow teams to travel too far into the sampling frame in order to avoid trampling quadrats. Team members should practice locating and establishing quadrats with GPS, compass, and chaining pin. Teams should practice taking measurements and performing data entry. To facilitate this, extra field data entry sheets should be made available. **Emphasize clear communication practices between team members during data entry.** Once teams are comfortable with basic operations, have teams switch quadrats to remeasure. Make sure that both team results are available for comparison. If disparity is high, have groups repeat counting and observe closely how this is done. Try and identify sources of disparity. Have teams establish new quadrats nearby and repeat calibration exercises. Aim for successive measurements to be within 5%. This is an achievable level of

precision. Once this portion of training is complete, reassemble into the full group and review questions and concerns. Present the precision and reproducibility requirements at this time (RPD measurements), which will resemble the training exercises within teams. Make sure that each team leader is comfortable and confident in the methods.

7) **Go for it!**

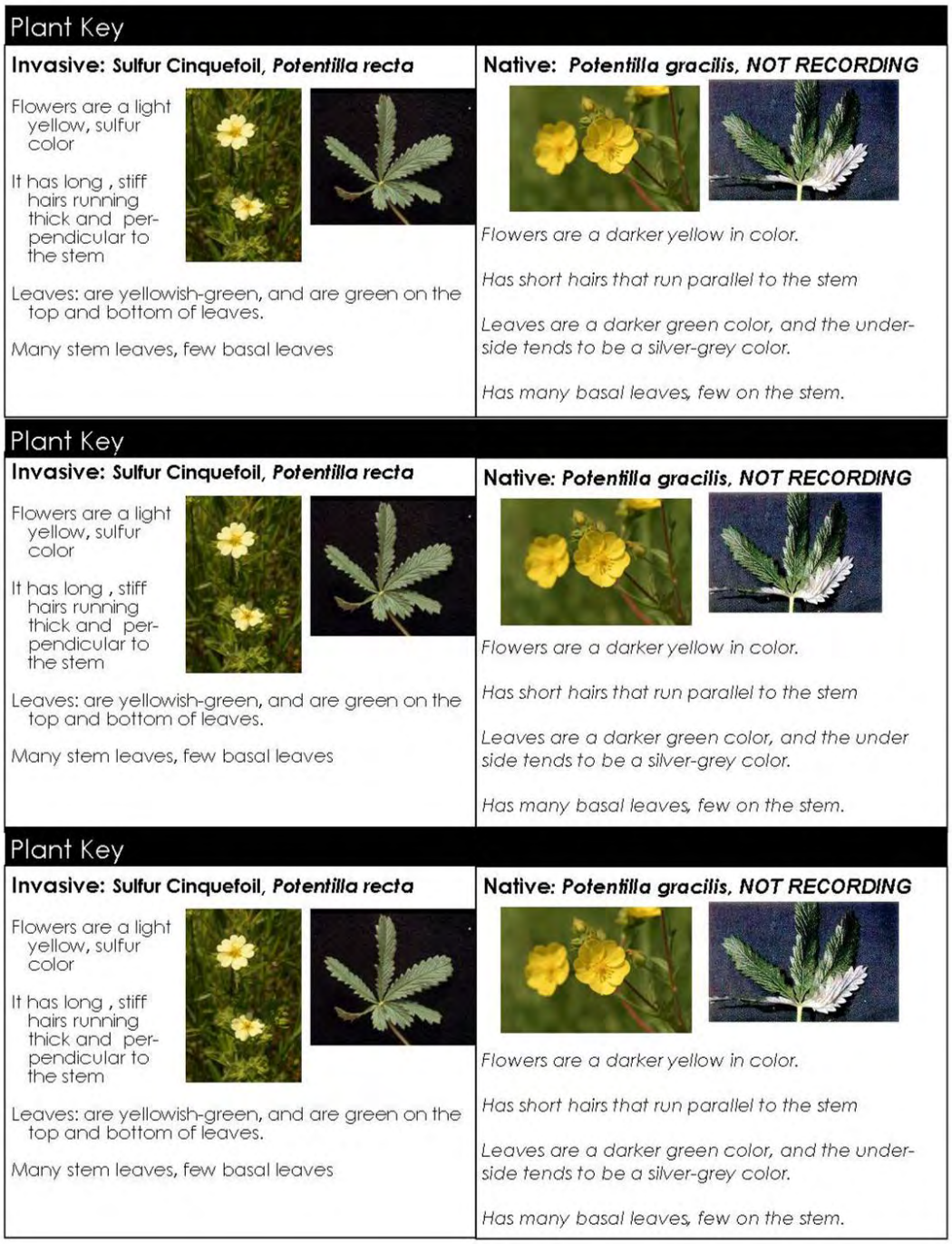


Figure 6. Identification cards produced for NEPE interpretive staff for distinguishing the target invasive plant sulphur cinquefoil from the native congener slender cinquefoil. Both species are common at Weippe Prairie.

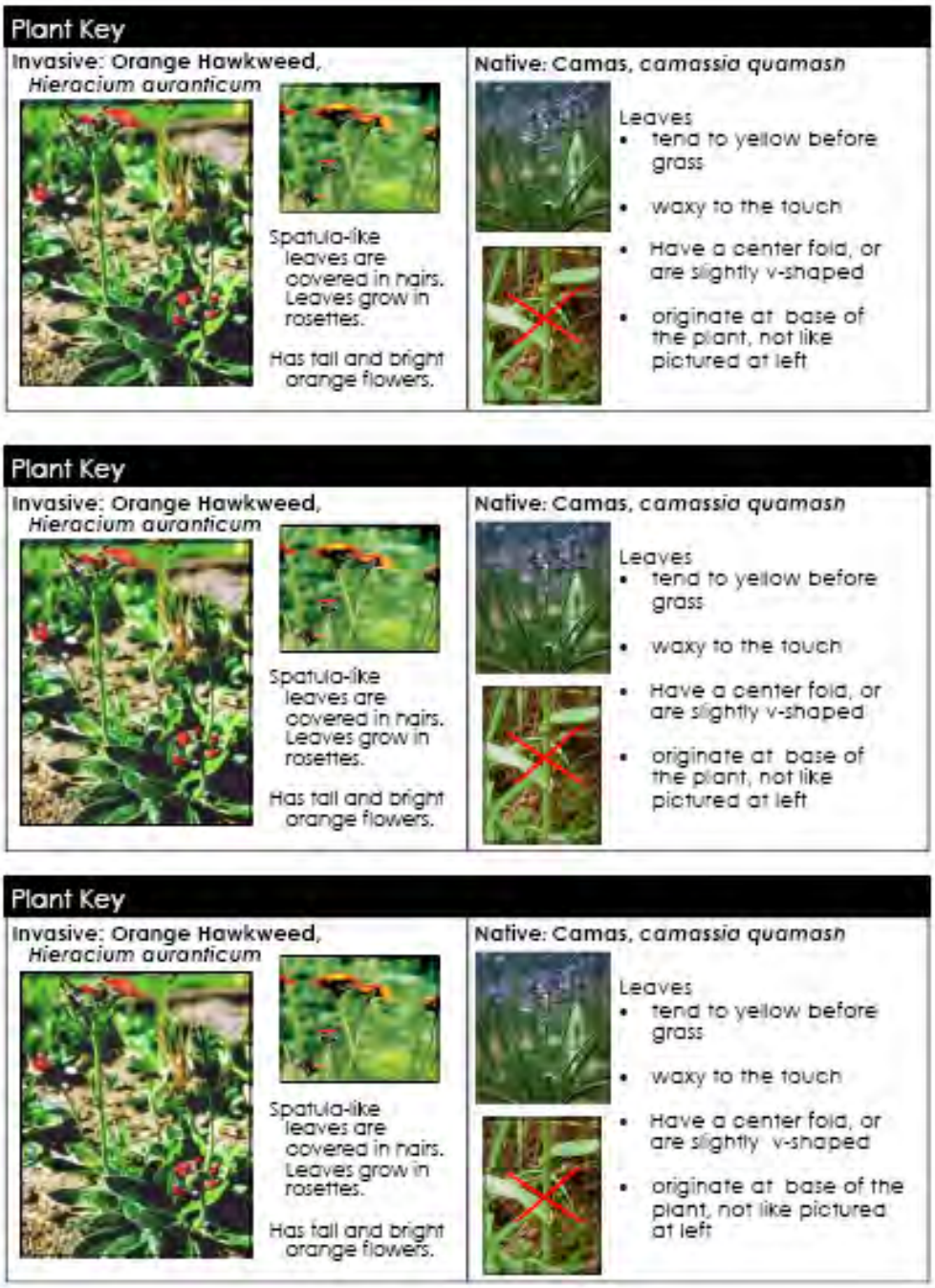


Figure 7. Identification cards produced for NEPE interpretive staff for distinguishing the target invasive plant orange hawkweed (*Hieracium aurantiacum*) and camas lily (*Camassia quamash*). Tips for distinguishing camas leaves from grass leaves are a particularly helpful addition.

**Camas Lily Long-Term Monitoring Protocol**

# Standard Operating Procedure (SOP) 3: Finding GPS Waypoints

**Version 1.0, October 2007**

## Change History

| Original Version # | Date of Revision | Revised By | Changes | Justification | New Version # |
|---|---|---|---|---|---|
| 1.0 Draft | October 2007 | UCBN | Revision following peer review | | 1.0 |
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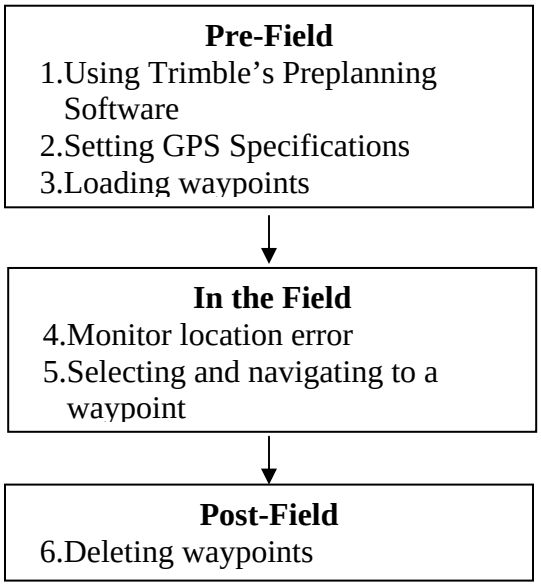
## Suggested Reading

Garmin. 2005. GPSMAP 76CSx Owner's Manuel. Garmin International, Olathe, KS. Available online at http://www.garmin.com/products/manual.jsp?product=010-00469-00

## Introduction

The purpose of this SOP is to describe the procedures necessary to navigate to waypoints using GPS units, particularly Garmin Map 76CSx. Information on GPS specifications and settings are also included. This is not intended as a substitute users guide for GPS units. Please consult the appropriate users guide for more detailed information on unit functionality.

The following flowchart provides a general overview of steps addressed in this SOP:




## Before the Field

Preparation is key to successful field work, particularly when that field work relies on GPS data collection or navigation. The baseline GPS constellation consists of 24 satellites that orbit the earth approximately every 12 hours. The position and time signals transmitted by these satellites are used by GPS receivers to triangulate a location on Earth. While this process is subject to various sources of error, pre-planning can minimize the impacts.

### *Using Trimble's Preplanning Software*

Trimble offers a free stand-alone program that determines visibility for GPS, GLONASS, and WAAS satellites. The software can be downloaded from http://www.trimble.com/planningsoftware.html. Make sure to also download the Ephemeris file (current.ssf).

1) Use the Station Editor to select the location, date, and time of data collection (See Figure 8).

2) Import current .ssf file and check the satellite information. Select those satellites of interest. Default is all.

3) Create graphs.

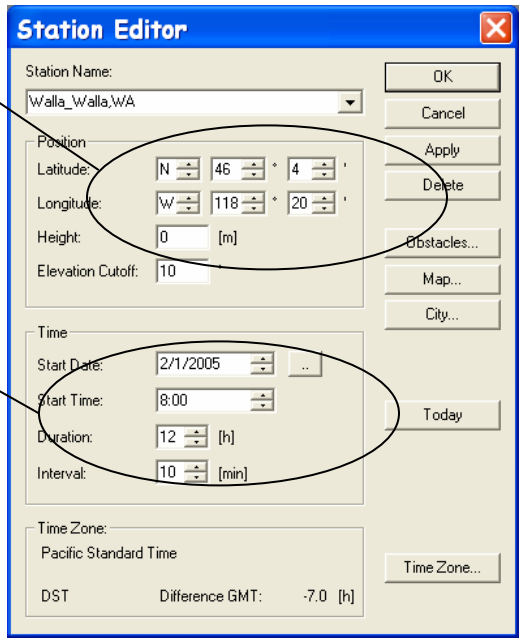



Figure 8. Station Editor in Trimble's preplanning software highlighting position and time.

Look for the time of day when the most satellites are available and the PDOP (Position Dilution of Precision) is lowest. PDOP is the measurement of error introduced by satellite orientation or geometry and can be easily minimized through the timing of field data collection.

### *Setting GPS Specifications*

Verify Time: Time synchronization of the GPS receiver and GPS satellites is critical for the most accurate data collection and navigation. With Garmin MAP76CSx, use the Time Setup Menu to set the time format, zone, and to conform to Daylight Savings Time.

Verify Projection and Datum: All GPS positioning information is referenced to the World Geodetic System 1984 (WGS84) datum. While the difference between WGS84 and NAD83 is minimal (< 1m), best practice is to navigate and collect data in WGS 84. In the case of UCBN camas sampling, select UTM Zone 11 WGS 84 for Weippe Prairie and UTM Zone 12 for Big Hole. With Garmin MAP76CSx, use the Units Setup Menu to select the position format and map datum.

Enable WAAS:  Enabling WAAS (Wide Area Augmentation System) allows for real-time correction of GPS coordinates as long as the WAAS satellites are in view.  Due to the fixed position of these satellites over the equator, signal reception is best in open areas with a clear view of the southern sky. With Garmin MAP76CSx, use the System Setup Menu to enable WAAS.

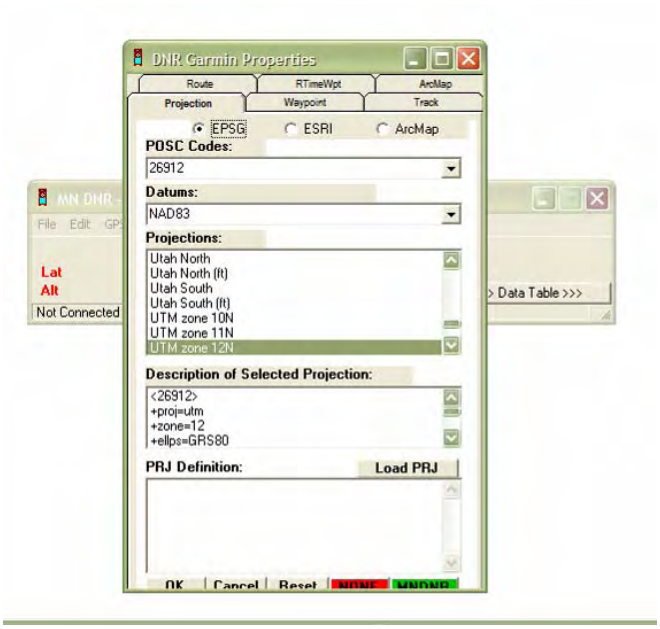
Calibrate the Compass: The internal compass in the Garmin MAP76CSx should be calibrated prior to each use for increased accuracy in navigation. Use the Calibration Setup Menu to calibrate the compass. Follow the directions on screen.

Batteries: Lastly, fully charge the batteries and remember to take spares! The Garmin Map76 units tend to fail on battery power quickly and without warning.

Loading Waypoints: Following the camas monitoring protocol, random sample points are generated using ArcGIS 9.1 and exported to a shape or dBase file. Uploading these locations to the Garmin Map76CSx as waypoints is simplified by using DNRGarmin, a freeware program developed and maintained by the Minnesota Department of Natural Resources. The program can be downloaded from http://www.dnr.state.mn.us/mis/gis/tools/arcview/extensions/DNRGarmin/DNRGarmin.html. The site has information on the application including installation guidelines and documentation.

To upload waypoints to the Garmin Map76CSx, connect the GPS unit to the PC and open DNRGarmin. DNRGarmin should display your GPS unit and say connect. If it does not, go to GPS and open port.

Use the File Menu to set the correct projection (i.e. Zone 11 for WEPE points and Zone 12 for BIHO points both with the datum as WGS84) (Figure 9). Next go to load data in the File Menu and select your shapefile or dBase file of interest. You can delete and or edit points, add comments, etc. if necessary (Figure 10). Use the GPS Menu to open the port to the GPS unit. Then, use the Waypoint Menu to upload the points to the GPS unit.



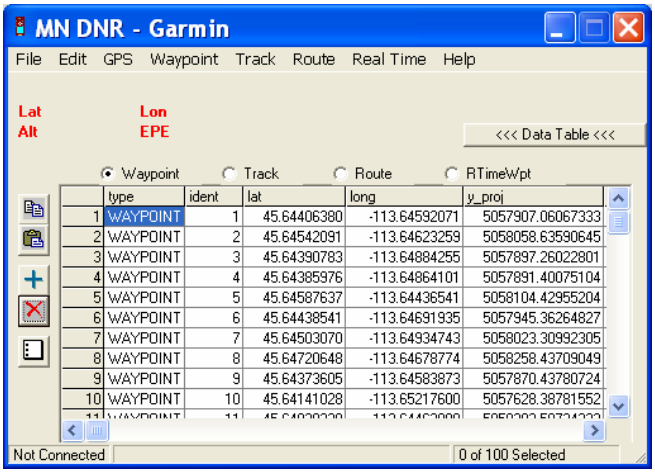




Figure 9 (left). Screenshot from DNRGarmin used to set the correct map projection.
Figure 10 (right). Screenshot from DNRGarmin used to view and upload selected waypoints.

## In the Field

### *Monitor Location Error*

Ideally, you would be able to set thresholds for the maximum PDOP allowed as well as the minimum number of satellites. While you cannot set these values in the Garmin MAP76CSx, you can monitor the satellite strength and relative location error by using the Satellite Main Page.

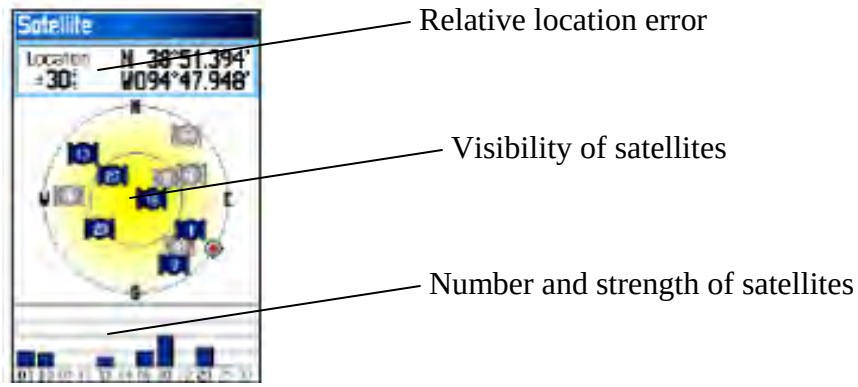



Figure 11. Screenshot from GPS unit for satellite information.

These values should all be monitored frequently during data collection and navigation (see Figure 11). The maximum relative location error allowed should be set prior to beginning field work. For the camas monitoring protocol, the maximum location error allowed is 30 ft (10m). If a GPS unit is used that allows for user-defined PDOP thresholds, the maximum should be set at 6.

### *Selecting and Navigating to Waypoints*

With Garmin Map76CSx, use the Find Menu to search for a waypoint of interest. Select 'Find by Name' and scroll to the point ID of interest. Conversely, you can select the waypoints icon and scroll to the Point ID of interest. Note that often the menu is set to 'Find by Nearest' and if no point are near, no points will be displayed. To change this setting, go to the waypoint menu, push the menu button, and select 'Find by Name.'

Once selected, the items information page for the waypoint opens, allowing you to show the item on the map (by selecting Map) or create a route to the point (select GoTo). Select GoTo to navigate to the point. You can use the 'Page' button to switch through various pages, select the Compass page (Figure 12) and, holding the GPS level, walk in the direction indicated by the compass until the 'Dist to Dest' window reads zero.

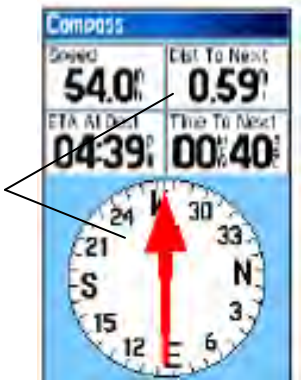



Figure 12. Screenshot from GPS unit compass page for navigation to a waypoint.

## After the Field

### *Delete Waypoint*

After completion of fieldwork, with permission of the Project Leader, delete any waypoints on the GPS units. Go to the Find Waypoints page, select Menu – Delete – All waypoints. Remove batteries from units before any long-term winter storage to prevent corrosion and leakage.

**Camas Lily Long-Term Monitoring Protocol**

# Standard Operating Procedure (SOP) 4: Locating and Establishing Sampling Quadrats

**Version 1.0, October 2007**

## Change History

| Original Version # | Date of Revision | Revised By | Changes | Justification | New Version # |
|---|---|---|---|---|---|
| 1.0 Draft | October 2007 | UCBN | Revision following peer review | | 1.0 |
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**Note:** This SOP describes the step-by-step procedures for locating and establishing non-permanent quadrats for purposes of long-term monitoring of camas lily and selected non-native invasive weeds.

## Suggested Reading

Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Chapter 8 *in* Measuring and Monitoring Plant Populations. US Department of Interior, Bureau of Land Management, Denver, CO.

## Driving Directions

### *Weippe Prairie*

From the Nez Perce National Historical Park headquarters at Spalding Mission, cross the Clearwater River and travel east on U.S. Highway 12 for approximately 40 miles. At Greer, Idaho, turn north on to state Highway 11, which travels through very steep switchbacks up out of the Clearwater River canyon. Once out of the canyon, travel another 10 miles to the town of Weippe, Idaho. Travel straight through the main intersection of town, on Pierce St. which turns into Musselshell Rd., and take a quick right turn on to Cemetery Rd. which is also named E. 4$^{th}$ St. Travel south on Cemetery Rd. for several miles and turn east on to Larson Rd., where the state sign describing the Lewis and Clark encounter with the Nez Perce is located. There is a pullout here for parking vehicles. However, field operations should be staged in zone B on the north side of Larsen Rd. Travel farther along Larsen Rd., after taking a 90$^{o}$ turn to the north the road crosses Jim Ford Creek and makes another 90$^{o}$ turn to the east. There is a gate in the fence on the north side of the road at this point, where teams should enter the property into zone B. This is where the portable latrine should be placed and where the sun-shade canopy should be erected. Vehicles should be parked along the north edge of the road at this location. Driving time between NEPE headquarters and Weippe Prairie is approximately 1 hour 15 minutes.

From Moscow, travel on east on Hwy 8 out of Moscow towards Troy. Turn right (south) on Driscoll Ridge Rd, follow the curve to the left on Lamb Rd east to Hwy 99. Turn right on Hwy 99 south and travel down to the Potlatch River. Turn right (southwest) on Hwy 3 towards Juliaetta. Turn left (south) on McGary Creek Rd (Hwy 220) and then right on to Hubbard Gulch Rd (Hwy 219) down to the Clearwater River. Turn right (west) and then a quick left across the Cherry Lane Bridge across the River to Hwy 12. Turn left (east) on to Hwy 12 to Greer. From here follow the directions described above up Hwy 11 to Weippe. Driving time between Moscow and Weippe Prairie is approximately 1 hour 30 minutes.

Campsites: Several campsites are available close to the Weippe Prairie for volunteers and visiting staff. Travel east on Larson Rd, turn north on Wilson Creek Rd. which will ‘T’ at Musselshell Rd. Turn right on Musselshell Rd. and travel east on to USFS Rd. 100, which turns south, passes the USFS work station at Musselshell Meadow, and continues several more miles along Lolo Creek. Lolo Creek CG has several group sites, toilets, water, and a good swimming hole. Reservations for groups must be made in advance with the Clearwater National Forest. Coordinate this through NEPE staff.

### *Big Hole*

Big Hole National Battlefield is located on U.S. Highway 43 midway between the town of Wisdom, Montana, to the east, and the junction of U.S. Highway 93 and Highway 43 at Lost Trail Pass, to the west, along the border between Idaho and Montana. The camas meadow is located along the North Fork Big Hole River below the visitor center. A short park access road is used to access this lower portion of the park. An interpretive trail for the Nez Perce campsite can be used to access the sampling area. Field crews will always check in with park staff at the visitor center before proceeding down to the sampling area. Allow for a full day of travel between NEPE and BIHO on U.S. Hwy 12 over Lolo Pass.

## Procedures

1) Prior to entry into the field, pre-determined sampling points should be organized into routes for each field team. For example, if seven 2-person teams are available for sampling, points should be organized into seven efficient groups. Follow SOP # 3 "Finding GPS Waypoints" for instructions on pre-loading sampling point coordinates for field navigation.

2) To locate a new sampling point, go through the steps outlined in SOP # 3 "Finding GPS Waypoints" to initiate navigation to a waypoint. Ensure that you are navigating to the correct point, according to the Quadrat ID #. Once the GPS unit registers "zero" distance to the waypoint or otherwise indicates the point has been reached exactly, stop immediately and establish the quadrat origin. It is crucial that navigators ignore the vegetation and rely on the GPS unit in order to eliminate selection bias.

3) To establish a quadrat origin, place a steel chaining pin into the soil between the feet of the navigator while standing exactly on the point location as indicated by the GPS unit (see Figure 13).

4) To establish the "hard edge" of the quadrat, first determine a random azimuth from a random numbers list, typically included as a column in the data entry spreadsheet. Random numbers will be restricted to a range from 0 to 359$^{o}$ in order to ensure that sampling is without replacement and that quadrats have no chance of overlapping one another. Place one looped end of the 4 m long wire rope around the chaining pin.

Figure 13. Illustration of establishing a quadrat origin with a chaining pin.

5) Using two team members, one person sights along the azimuth using a navigational grade compass (see step 5 below) and directs the other person to thread the wire rope in a straight line along the azimuth through the vegetation. The rope should be placed as close to the ground as possible. Great care should be taken to avoid trampling the vegetation on the right hand ("inside") side of the rope. Be sure to stretch the rope tight and hold it in place with a second chaining pin at the end of the rope, as illustrated in Figure 14.

6) Proper training of field personnel prior to the field season should involve compass use. Only compasses that have adjustable housings should be used. Ensure that all compasses are set at the same magnetic declination. Currently, the declination for Weippe Prairie and BIHO is approximately 18$^{o}$.

7) In the event that a particular random azimuth leads a quadrat through a boundary fence, impassable drainage ditch, inaccessible willow thicket, or other impediment to

measurement, the 180$^{o}$ back-azimuth should be used. Because of the 10 m buffering in the sample frame and the flat open topography of both park sites, this should be rare, and every attempt should be made to try and complete measurement using the original azimuth in the difficult situations, such as willow thickets. Encourage teams to thread wire rope through willows thickets at BIHO and make "best possible" measurements.

8) It is very helpful to approach a sampling point with an idea of the approximate orientation of the quadrat, and to avoid trampling vegetation on that side of the point during final navigation and set up. After completion at one point, identify the subsequent quadrat's ID# and azimuth. General familiarity with the cardinal directions and the orientation of the park boundary and distant landmarks will enable teams to avoid trampling during their approach to new sites.

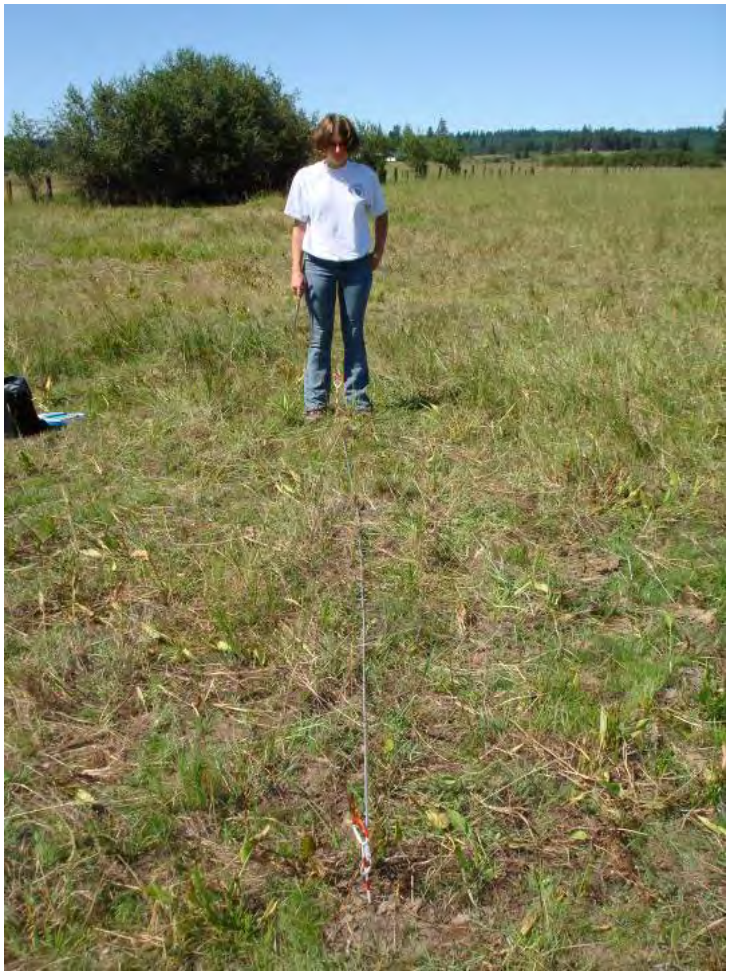

Figure 14. Placement of the quadrat's "hard edge" using a 4 m long wire rope. The rope should be threaded through the vegetation from the origin along a random azimuth, kept as straight and taut as possible, and secured with a second chaining pin.

**Camas Lily Long-Term Monitoring Protocol**

# Standard Operating Procedure (SOP) 5: Measuring Vegetation in Quadrats

**Version 1.0, October 2007**

## Change History

| Original Version # | Date of Revision | Revised By | Changes | Justification | New Version # |
|---|---|---|---|---|---|
| 1.0 Draft | October 2007 | UCBN | Revision following peer review | | 1.0 |
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**Note:** This SOP describes the step-by-step procedures for taking measurements from non-permanent quadrats for purposes of long-term monitoring of camas lily and selected non-native invasive weeds.

## Suggested Reading

Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Chapter 8 *in* Measuring and Monitoring Plant Populations. US Department of Interior, Bureau of Land Management, Denver, CO.

## Procedures

1) Once the quadrat is established following SOP # 4, team members can reposition themselves for efficiency, comfort, and personal preference for counting camas plants and entering data.

2) Using the wire rope as one edge of the quadrat and a 15 cm ½" PVC pipe to define the remaining edges of the 4m × 15 cm quadrat, begin measuring vegetation *on the right hand side of the wire rope* (see Figure 14). The order of operations is important although not rigid. Measuring thatch depth first will minimize the effect of trampling and displacement on measurements. It also provides the team an opportunity to identify weeds and visually assess the overall camas density and requisite counting strategy to be taken. Proceeding with camas counting, begin by slowly moving from one end of the quadrat to the other, counting each *established* camas plant with 2 or more basal leaves rooted within the quadrat boundary. It is highly recommended that camas be counted by a pair of team members in order to reduce measurement error and increase efficiency, although team size and configuration is flexible. Pair counting involves two team members working on opposite sides of the quadrat. Typically, one person will use the 15 cm PVC pipe while the other will part dense vegetation and assist in separating individual camas plants. One person should be primarily responsible for keeping track of the count and voicing the running tally of camas plants out loud. The other should watch for missed plants and help track the count. Pair counting will reduce measurement error.

3) The number of flowering camas stems should be tallied simultaneously. The recommended way to do this is for the counter to tally and announce both numbers sequentially, such as "1 and 5, 1 and 6, 2 and 7, 3 and 8, 3 and 9, 3 and 10…", with the first and smaller number being the number of flowering plants and second number the established plant count. Alternatively, the assistant counter can track the flowering plants separately. It is unnecessary and inefficient to complete the total count first and then return to the quadrat origin and count flowering plants.

4) Utilize the PVC pipe to determine "in" and "out" plants. Plants that are obviously "in" the quadrat can be quickly counted without needing to use the PVC pipe, in order to expedite the counting process. See Figure 15 for an illustration of the quadrat, PVC pipe usage, thatch depth measuring points, and "in" and "out" plants. "In" plants originate and are rooted within the interior boundaries of the wire rope and PVC pipe, even if leaves and inflorescences reach beyond this boundary.

5) Camas count data should be entered into the field form during or immediately after completion of the count, and before proceeding to other measurement activities. As is outlined in the training SOP # 2, clear communication between the data recorder and other team members is essential. It is recommended that results are announced out loud to the recorder, and that the recorder repeats the announced result, confirming successful transmission of information. Other team members can then assist the data recorder by verifying announced results.

6) Once the total camas and flowering camas counts are complete and entered into the field form, note the presence or absence of targeted invasive weeds. These are subject to change over the course of the monitoring program. **In 2008, two weed species, *Hieracium auranticum* and *Potentilla recta* will be targeted at Weippe Prairie. No weeds will be measured in BIHO.** Care must be taken to ensure that target species are correctly identified. Subsequent revisions of the protocol will include updated lists as management priorities change. All team members should be trained to recognize target species, and training personnel should be adept at identifying all target species**,** as well as potentially confusing non-target species.

7) Record thatch depth to the nearest centimeter, along the "hard edge" of the quadrat at 67 cm, 200 cm, and 333 cm from the quadrat origin. These three points will be pre-marked with colored electrical tape following the procedure outlined in SOP # 1. Place a calibrated 30 cm (approximately) stiff wire pin or rod with centimeter units clearly marked, down through all live and dead vegetation immediately adjacent to marked recording point. The wire pin will easily pass through vegetation without depressing thatch. Ensure that the pin is touching the soil surface, and then mark the height of the thatch with thumb and forefinger. Remove the pin from the vegetation while maintaining the marked height and record the thatch depth to the nearest centimeter. If thatch is absent, record a "0". Thatch depth measuring locations will be pre-marked prior to field entry following the procedure outlined in SOP # 1.

8) Clerical and operational errors are costly and potentially disastrous. **Be sure to establish clear and consistent communication between team members measuring and entering data.** As noted in step 3 above, data entry for thatch depth should occur either simultaneous to measurement or immediately following completion depending on team size and arrangement. Loud, clear announcements of measurement results and confirmation of receipt by data recorders will ensure success.

9) Double-check data entry at the conclusion of each quadrat, and before moving on to the next plot. Double-check Quadrat ID numbers are correct before moving on the next plot.

10) Quantifying the precision and repeatability of quadrat measurements is important for long-term assessment of data quality. Duplicate counts of camas and flowering camas will be made periodically during sampling in order to provide estimates of precision, reproducibility, and measurement error. Specifically, each field team will independently assess relative percent difference (RPD) on 10% of its quadrats, which involves 1 duplicate measurement taken per quadrat by an alternate team member. Quadrats chosen for RPD estimation will include some from the early, middle, and late periods of the sampling period (i.e. at the beginning of the first day, end of the first day, and end of the second day). A minimum number of quadrats requiring 2$^{nd}$ counts will be noted on the data form by a bold border around the entry cell (see Figure 4 in SOP # 1). Team leaders should determine if additional quadrats should also be counted twice, according to the density (e.g. high density quadrats can lead to counting errors) and focus and professionalism of the team. Some student groups can lose interest and focus, and the team leader needs to be aware of the group dynamic. Students are volunteers and cannot

be forced to count camas. Team leaders facing morale problems can reassign students to other tasks, such as data entry and compass use, and reserve counting for themselves. This will help ensure high quality data collection.

11) The RPD value should be computed quickly in the field following the following equation

$$\text{RPD} = \frac{y_i - x_i}{\left(\frac{y_i + x_i}{2}\right)} * 100$$

12) where $y_i$ and $x_i$ are the two counts, and the difference is divided by their average and multiplied by 100. RPD values exceeding 10% should trigger a 3rd count in order to determine the exact number of camas in the plot. The RPD calculation can be computed by hand in the margins or notes section of the data form. This can be a good opportunity for students to exercise basic math skills as well. Once the most accurate count is determined (typically the last count), it should be circled on the data form so that it can be used as the "real" value for subsequent analysis.

13) Example RPD counts are shown in Table 2.

Table 2. Example of relative percent difference (RPD) counts.

| Camas (1st count) | Camas (2nd count) | Difference | Average | RPD | 3rd count REQUIRED |
|---|---|---|---|---|---|
| 22 | 20 | 2 | 21.0 | 9.5 | No |
| 25 | 20 | 5 | 22.5 | 22 | Yes |
| 44 | 40 | 4 | 42.0 | 9.5 | No |
| 46 | 40 | 6 | 43.0 | 13.9 | Yes |
| 95 | 100 | 5 | 97.5 | 5.12 | No |
| 95 | 105 | 10 | 100.0 | 10 | No |
| 95 | 106 | 11 | 100.5 | 10.9 | Yes |

Figure 15. Measuring vegetation on the “right-hand” side of the quadrat, when viewed from the quadrat origin. In this figure, the origin is not shown at the top of the photograph. A 15 cm PVC pipe section is used to determine “in” and “out” plants.

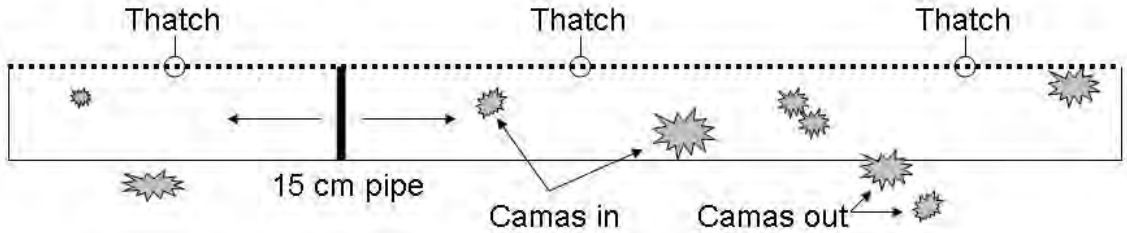


Figure 16. Diagram of the 4 m X 15 cm quadrat, with points noted for measuring thatch depth, and “in” and “out” plants. In this diagram, the origin is on the left side of the figure. The “hard edge” wire rope is indicated with a dotted line. Thatch depth recording points are noted. In this illustration, 6 plants are clearly “in” the quadrat, 2 are clearly “out”, and one is marginal and requiring use of the PVC pipe.

**Camas Lily Long-Term Monitoring Protocol**

# Standard Operating Procedure (SOP) 6: Data Management

**Version 1.0, October 2007**

## Change History

| Original Version # | Date of Revision | Revised By | Changes | Justification | New Version # |
|---|---|---|---|---|---|
| 1.0 Draft | October 2007 | UCBN | Revision following peer review | | 1.0 |
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**Note:** This SOP provides documentation for the camas lily monitoring project database UCBN_Camas.mdb and provides instructions for the development, maintenance, archiving, and distribution of the database or datasets.

## Suggested Reading


Dicus, G. H. and L. K. Garrett. 2007. Upper Columbia Basin Network Data Management Plan. National Park Service Upper Columbia Basin Network Inventory and Monitoring Program. Moscow, ID

Garrett, L. K., T. J. Rodhouse, G. H. Dicus, C. C. Caudill, and M. R. Shardlow. 2007. Upper Columbia Basin Network vital signs monitoring plan. Natural Resource Report NPS/ UCBN/NRR—2007/002. National Park Service, Fort Collins, CO.

National Park Service. 2006. Natural Resource Database Template Version 3.1 documentation. Natural Resource Program Center, Office of Inventory, Monitoring, and Evaluation, Fort Collins, CO.

## Database Model

The camas monitoring project database, UCBN_Camas.mdb, has been developed within Microsoft Access. The database structure described here applies to both the "working copy" of the database (used to enter the current season's data, then conduct error-checking and validation) and the "master version" of the database (used to store all data, to facilitate multi-year analyses, and to provide specific data report and export formats). Figure 17 presents a logical model of this database structure -- a collection of linked tables, lookup tables, and cross reference tables, organized according to recommendations in the Natural Resource Database Template (NRDT) version 3.1. The following tables are included in the database:

TABLE NAMES
tbl_Sites
tbl_Locations
tbl_Events
tbl_CamasLily_Data
tbl_CamasRPD_Data
xref_RPD_Counts
xref_Event_Weeds
tlu_Event_Group
tlu_Protocol_Ver
tlu_Schools
tlu_GPS_Models
tbl_DB_Revisions
tbl_DB_Meta

Core tables include tbl_Locations and tbl_Events, and the two central protocol-specific tables, tbl_CamasLily_Data and tbl_CamasRPD_Data. Each of these is supported by lookup tables that are linked by user-defined natural primary keys and/or globally unique artificial identifiers (GUIDs). The locations table stores the unique physical location information for each event. Events are defined as a single sampling occasion at a single quadrat. Each sampling period (e.g. 5 days per year) therefore is characterized by a collection of events corresponding exactly to the total sample size (the number of quadrats visited). Given that the project is designed for non-permanent quadrats, it follows that each event has a unique location. Events and locations are somewhat redundant in this situation. However, this does provide a flexible data model that can accommodate the eventual inclusion of a panel of permanent sampling units, and it allows the data model to reflect more closely the core structure recommended by the NRDT version 3.1. The events table is linked to the camas lily data table, which stores the camas density, thatch depth, and weed frequency information.

Protocol-specific lookup tables include tlu_Schools, tlu_Event_Group, tlu_PopArea, and tlu_Protocol. These lookup tables reside in the UCBN_Camas.mdb file, and allow sampling events to be linked to the local school involved, a defined sampling period, a management zone, and the protocol/vital sign name, respectively. The event group table will store information about a collection of events, which in this case, will be defined as an annual group for each management zone (e.g. 2007 Weippe Prairie zone A). The protocol lookup table is used to attach

protocol versions and quadrat dimensions to each event, which will facilitate data summaries. For example, if quadrat dimensions are changed, the multiplicative factor required to scale up estimated means per quadrat to mean per $m^2$ will change (currently this is 4 m*15 cm = 0.6 $m^2$, or a factor of 1.66 to scale to 1 $m^2$), and the protocol lookup table can be used to populate summary queries. The table tbl_Sites will serve, if necessary, to attach park subunit information that is not well handled in the units table. Finally, the database also contains two metadata tables, tbl_Db_Meta and tbl_Db_Revisions, that will document project database metadata and database revisions, following recommendations in the NRDT.

Generic lookup tables include _tlu_Parks_UCBN, _tlu_UCBN_Contacts, _tlu_LocalSppList_UCBN, and tlu_GPS_Models. Each of these can be used in all of the UCBN monitoring databases, as they store basic information about UCBN parks and contacts, UCBN species lists, and the different GPS units used by UCBN and park staff. These generic lookup tables will be managed in one or more separate MS Access files that will be linked to protocol-specific databases, such as this Camas.mdb file.

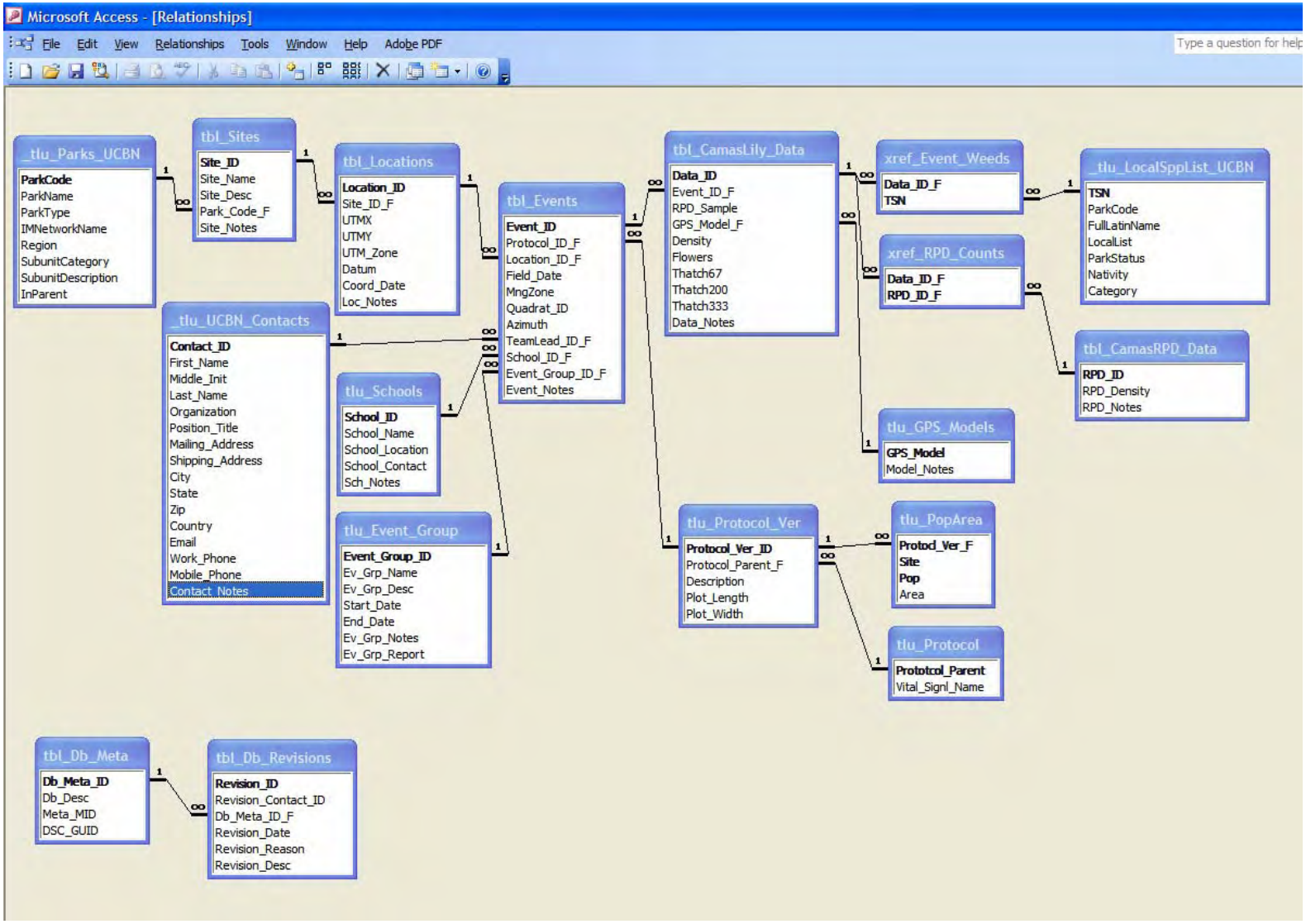


Figure 17. UCBN camas lily monitoring protocol database model.

### Data Entry

Entry of data from paper field sheets to the database will be accomplished each season shortly after completion of field work. Figure 4 in SOP # 1 illustrates a paper data entry form. The Access data entry form is patterned after the structure of the basic field form, and has built-in quality assurance components, including pick lists and validation rules to test for missing data or illogical combinations. Data entry should be viewed as an important step in the overall QA/QC process, and care should be taken to review both the input from the paper forms and the resulting entries in the database.

### Quality Review

After the data have been entered and processed, they need to be reviewed by the Project Lead for quality, completeness, and logical consistency. The working database application will facilitate this process by showing the results of pre-built queries that check for data integrity, data outliers and missing values, and illogical values. The user may then fix these problems and document the fixes. If errors and/or inconsistencies cannot be corrected, the resulting errors or inconsistencies are then documented and included in the metadata and certification report.

### Metadata Procedures

Data documentation is a critical step toward ensuring that data sets are useable for their intended purposes well into the future. This involves the development of metadata, which can be defined as structured information about the content, quality, and condition of data. Additionally, metadata provide the means to catalog data sets within intranet and internet systems, making data available to a broad range of potential users. Metadata for all UCBN monitoring data will conform to Federal Geographic Data Committee (FGDC) and NPS guidelines and will contain all components of supporting information such that the data may be confidently manipulated, analyzed, and synthesized. For long-term projects such as this one, metadata creation is most time consuming the first time it is developed – after which most information remains static from one year to the next. Metadata records in subsequent years will need to be updated to reflect current publications, references, taxonomic conventions, contact information, data disposition and quality, and to describe any changes in collection methods, analysis approaches or quality assurance for the project.

Specific procedures for metadata development and posting are outlined in the UCBN Data Management Plan. In general, the Project Lead and the Data Manager (or Data Technician) will work together to create and update an FGDC- and NPS-compliant metadata record in XML format. The Project Lead should update the metadata content as changes to the protocol are made, and each year as additional data are accumulated. Edits within the document should be tracked so that any changes are obvious to those who will use it to update the XML metadata file. At the conclusion of the field season, the Project Lead will be responsible for providing a completed, up-to-date metadata interview form to the Data Manager. The Data Manager will facilitate metadata development by creating and parsing metadata records, and by posting such records to national clearinghouses as described below.

### Sensitive Information

Part of metadata development includes determining whether or not the data include any sensitive information, which includes specific locations of rare, threatened, or endangered species. Prior to

completing metadata, the Project Lead and Park Resource Manager should work together to identify any sensitive information in the data. Their findings should be documented and communicated to the Data Manager. We do not anticipate that sensitive information will be present in the camas lily monitoring program at this time.

## Data Certification and Delivery

Data certification is a benchmark in the project data management process that indicates that 1) the data are complete for the period of record; 2) they have undergone and passed the quality assurance checks; and 3) that they are appropriately documented and in a condition for archiving, posting, and distribution. Certification is not intended to imply that the data are completely free of errors or inconsistencies which may not have been detected during quality assurance reviews.

To ensure that only data of the highest possible quality are included in reports and other project deliverables, the data certification step is an annual requirement for all tabular and spatial data. The Project Lead is primarily responsible for completing certification. The completed form, certified data, and updated metadata should be delivered to the Data Manager as outlined in the following steps and in Table 3.

### *Data certification steps*

To package the certification materials for delivery, the Project Lead should follow these steps:

1) After the quality review has been completed, open the back-end working database file and compact it (in Microsoft Access, Tools > Database Utilities > Compact and Repair Database). This will make the file size much smaller.

2) Create a compressed file (using WinZip® or similar software) and add the back-end database file to that file. Note: The front-end application does not contain project data and as such should not be included in the delivery file.

3) Add the completed metadata to the compressed file.

4) Add the completed certification report to the compressed file.

5) Add any geospatial data files that aren't already in the possession of the Data Manager.

6) All file names – except for image files and geospatial data files – should include the assigned UCBN project code, in addition to the year or span of years for the data being certified. For example: CAMAS_2007_certified.mdb, CAMAS_2007_cert_report.doc.

7) The compressed file may then be uploaded to the new submissions folder of the UCBN Digital Library. The Data Manager should be notified of this submission by email.

Upon receiving the certification materials, the Data Manager will check them in, store them in the UCBN Digital Library, upload the certified data to the master project database, and update the project GIS data sets with any geospatial data that are submitted. Upon notification that the

year's data have been uploaded and processed successfully, the Project Lead may then proceed with data summarization, analysis and reporting.

## Data Archiving

Paper data sheets will be archived for three years, which allow ample time to complete QA/QC and certification steps for digital data. Long-term archiving will only be used for digital data. Upon certification, data and reports will be archived on the UCBN Network Attached Storage (NAS) unit, posted to the UCBN website, and posted to the national web-accessible secure databases hosted by the NPS Washington Areas Support Office (WASO) or National I&M program. These include:

- *NatureBib* – the master database for natural resource bibliographic references
- *NPSpecies* – the master database for biodiversity information including species occurrences and physical or written evidence for the occurrence (i.e., references, vouchers, and observations)
- *NPS Data Store* – a centralized data repository with a graphical search interface.

A review of archive and expendable data products will be undertaken by the Project Lead and Data Manager during season close-out each year. An example of an expendable data product is an intermediate draft of an annual report that was saved during report preparation.

### *Directory Structure*

The following directory structure will be used to store and archive all information related to the camas lily monitoring project on the UCBN Network Attached Storage (NAS) drive. This is a generic structure that should provide a foundation and a minimum standard of organization and consistency. The goal is to organize all project materials in an efficient hierarchical structure that reflects the life cycle and workflow of the project. Toward this goal, all subfolders are organized into four primary project folders that reflect life cycle stages (initiate, plan, implement, and close). Additional subfolders may be added as needed, but a strong emphasis must be placed on keeping the structure as simple and logical as possible. The four primary project folders and their standard subfolders are presented below.

**\Initiate –** Store information about the initiation of the project here, including proposals, contract agreements, relevant e-mails, etc.

**\Agreements_Contracts**
**\Meetings_Correspondence**
**\Proposals**

**\Plan –** Store information about the planning phase of the project here, including monitoring objectives, protocol development summaries, conceptual models, protocol and SOP drafts, study plans, and research permits.

**\Conceptual_Models**
**\Data_Mng_Models**
**\Equipment**
**\Meetings_Correspondence**
**\Monitoring_Objectives**
**\Protocol_Develop_Summary**
**\Protocol_SOP_Drafts**

**\Research_Permits**
**\Study_Plans**

**\Implement –** Store information about the implementation phase of the project here, including data management documents and draft products, data analysis documents and draft products, project photos, and relevant correspondence.

**\Data_Analysis**
**\Data_Management**
- **\Data_Dictionary**
  - **\PDA_Forms**
- **\Database_Working**
- **\Download_Files**
  - **\GPS_Files**
  - **\Datalogger_Files**
- **\GIS_Data_Working**
  - **\Map_Products**
  - **\Templates**
  - **\Features**
  - **\Geodatabases**

**\Meetings_Coorespondence**
**\Photos**
- **\Final**
- **\Originals**
- **\Working**

**\Close –** Store finalized documents and products from the close-out phase of the project (on either an annual basis or a final project close-out basis) here, including final reports, certified data and GIS products, and presentations.

**\Certified_Data_GIS_Metadata**
**\Final_Reports**
- **\Annual_Reports**
- **\Investigator_Annual_Reports**
- **\Protocol_SOP_Final**

**\Other_Final_Deliverables**
**\Presentations**

## Schedule of Data Management Tasks

Table 3. Yearly camas monitoring data management task list. This table identifies tasks by project stage, indicates who is responsible for the task, and establishes the timing for its execution.

| Project Stage | Task Description | Responsibility | Timing |
|---|---|---|---|
| Preparation | Notify Data Manager of needs (field maps, GPS support, training) | Project Lead | ASAP, before Feb 1 |
| | Ensure that project workspace is ready for use and GPS download software is loaded | Data Manager | by May 1 |
| | Prepare and print field maps and data sheets | Data Manager | by May 1 |
| | Update and load data dictionary, background maps, and target coordinates into GPS units | Data Manager | by May 1 |
| | Provide database/GPS training as needed | Data Manager/Project Lead/Field Lead | May |
| | Train field crew in plant identification and field sampling protocols | Project Lead and/or Field Lead | May |
| | Examination and certification of field observer qualifications | Project Lead and/or Field Lead | May |
| Data acquisition | Collect field observations and position data during field trips | Technicians/ Volunteers | May-Jun |
| | Review data sheets after each day | Field Lead | daily |
| Data entry & processing | Enter data into working copy of the database | Technicians | After each tour |
| | Verification of accurate transcription as data are entered | Technicians | After each tour |
| | Periodic review of database entries for completeness and accuracy | Field Lead | As needed |
| | Upload processed and verified data to archive master database copy | Data Manager and/or Technician | August |
| Interim product delivery | Report weed location data to Parks | Project Lead | ASAP After each tour |
| Quality review | Quality review and data validation using database tools | Project Lead/Data Manager | Jul-Aug |
| | Prepare coordinate summaries and/or GIS layers and data sets as needed for spatial data review and reports | Project Lead/Data Manager | by Sep 15 |
| Metadata | Identify any sensitive information contained in the data set | Project Lead and Park Resource Manager | Aug |
| | Update project metadata records | Project Lead | Aug-Oct |
| Data certification | Certify the season's data | Project Lead | Aug-Sep |

Table 3. Yearly camas monitoring data management task list (continued). This table identifies tasks by project stage, indicates who is responsible for the task, and establishes the timing for its execution.

| Project Stage | Task Description | Responsibility | Timing |
|---|---|---|---|
| Data delivery | Deliver certified data and updated metadata to Data Manager | Project Lead | by Sep 15 |
| | Upload certified data into master project database, store data files in UCBN Digital Library [1] | Data Manager | Sep |
| | Notify Project Lead of uploaded data ready for analysis and reporting | Data Manager | Sep |
| | Update project GIS data sets, layers and associated metadata records | Data Manager | Sep-Nov |
| | Finalize and parse metadata records, store in UCBN Digital Library [1] | Data Manager | by Nov 1 |
| Data analysis | Power analyses and sample site selection for upcoming season | Project Lead/Data Analyst | Sep |
| | Status and Trend Analyses | Project Lead/Data Analyst | Sep-Oct |
| Product development | Export automated summary queries and reports from database | Data Analyst | Sep |
| | Produce park-wide and zone-specific map output for archives | Data Manager / Data Analyst | Sep |
| | Generate report-quality map output for reports | Data Manager / Data Analyst | Sep |
| | Acquire the proper report template from the NPS website, create annual report | Data Analyst and Project Lead | Sep-Nov |
| | Screen all reports and data products for sensitive information | Project Lead and Park Resource Manager | Sep |
| Product delivery | Submit draft report to Network Coordinator for review | Project Lead | by Nov 15 |
| | Review report for formatting and completeness, notify Project Lead of approval or need for changes | Network Coordinator | by Dec 1 |
| | Upload completed report to UCBN Digital Library [1] submissions folder, notify Data Manager | Project Lead | by Dec 15 |
| | Deliver other products according to the delivery schedule and instructions | Project Lead | upon completion |
| | Product check-in | Data Manager | upon receipt |

Table 3. Yearly camas monitoring data management task list (continued). This table identifies tasks by project stage, indicates who is responsible for the task, and establishes the timing for its execution.

| Project Stage | Task Description | Responsibility | Timing |
|---|---|---|---|
| Posting & distribution (Section 4k) | Submit metadata to NR-GIS Data Store [2] | Data Manager | by Dec 15 |
| | Create NatureBib [3] record, post reports to NPS clearinghouse | Data Manager | upon receipt |
| | Update NPSpecies [4] records according to data observations | Data Manager | Dec |
| | Submit certified data and GIS data sets to NR-GIS Data Store [2] | Data Manager | Dec |
| Archival & records management | Store finished products in UCBN Digital Library [1] | Data Manager | upon receipt |
| | Review, clean up and store and/or dispose of project files according to NPS Director's Order #19 [5] | Project Lead | Dec |
| Season close-out | Meet to discuss the recent field season, and document any needed changes to field sampling protocols or the working database | Project Lead, Park Resource Manager and Data Manager | July-Aug |
| | Discuss and document needed changes to analysis and reporting procedures | Project Lead, Park Resource Manager and Data Manager | Oct |

[1] The UCBN Digital Library is a hierarchical digital filing system stored on the UCBN file server. Network users have read-only access to these files, except where information sensitivity may preclude general access.
[2] NR-GIS Metadata and Data Store is a clearinghouse for natural resource data and metadata (http://science.nature.nps.gov/nrdata). Only non-sensitive information is posted to NR-GIS Metadata and Data Store. Refer to the protocol section on sensitive information for details.
[3] NatureBib is the NPS bibliographic database (http://www.nature.nps.gov/nrbib/index.htm). This application has the capability of storing and providing public access to image data (e.g., PDF files) associated with each record.
[4] NPSpecies is the NPS database and application for maintaining park-specific species lists and observation data (http://science.nature.nps.gov/im/apps/npspp/index.htm).
[5] NPS Director's Order 19 provides a schedule indicating the amount of time that the various kinds of records should be retained. Available at: http://www.nps.gov/refdesk/DOrders/DOrder19.html

**Camas Lily Long-Term Monitoring Protocol**

# Standard Operating Procedure (SOP) 7: Data Analysis and Reporting

**Version 1.0, October 2007**

## Change History

| Original Version # | Date of Revision | Revised By | Changes | Justification | New Version # |
|---|---|---|---|---|---|
| 1.0 Draft | October 2007 | UCBN | Revision following peer review | | 1.0 |
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**Note:** This SOP describes details of the recommended analytical approaches and reporting guidelines for the UCBN camas lily monitoring program. Code written for the R statistical software and language environment is included.

## Suggested Reading


Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Chapter 11 *in* Measuring and Monitoring Plant Populations. US Department of Interior, Bureau of Land Management, Denver, CO.

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Sokal, R.K., and F.J. Rohlf. 1981. Biometry: the principle and practice of statistics in biological research. W.H. Freeman, San Francisco, CA.

Thompson, S. K. 2002. Sampling. 2nd Edition. John Wiley and Sons, New York, NY.

White, G. C., and R. E. Bennetts. 1996. Analysis of frequency count data using the negative binomial distribution. Ecology **77**:2549-2557.

## Analytical Procedures

The statistical methods outlined below are described for implementation in the statistical freeware R, an open source version of S-Plus. R is a powerful system for statistical computations and graphics, which runs on Windows, Unix, and Mac computers. R is a combination of a statistics package and a programming language. It can be downloaded for free from http://www.r-project.org/ . The R Wiki provides an online forum http://wiki.rproject.org/rwiki/doku.php and documentation. R is the analytical environment of choice for the Upper Columbia Basin Network.

### *Power Analysis*

The following description outlines the power analysis approach developed for the UCBN camas monitoring program. We reassigned membership of the 2006 Weippe Prairie quadrats to the new populations A, B, C, D, and E for current sample size estimates but this should be unnecessary in the future. To begin, let n be a sample size for which we wish to estimate power to detect a 25% change between two samples from a given population. Let $X_1,\ldots,X_n$ represent a random sample of camas density observations in time $t_0$ and $Y_1,\ldots,Y_n$ those observations collected within the same population at time t in the future, and assume that the underlying distributions of those observations, *F*, differ in location only ($\delta$). With only a single season of complete pilot data (2005 samples were not taken from the whole property), the simulated sample of $X_i$'s and declined $Y_i$'s is obtained by taking a bootstrapped sample, with replacement, of 2n, from the 220 observed samples in 2006. Set the first n observations as $X_1,\ldots,X_n$ for time $t_0$, and add $\delta$ to $X_{n+1},\ldots,X_{2n}$ to simulate the set $Y_1,\ldots,Y_n$ for time t. Let $\delta=0.25*\hat{\mu}$, where $\hat{\mu}$ is the estimated mean of *F*, obtained from the sample mean, $\bar{x}$, of the 2006 pilot data for a given population. Log transform each $X_i$ and $Y_i$ by $\log(X_i+1)$ and $\log(Y_i+1)$. Perform a permutation *t*-test of no difference between the means $\hat{\mu}_x$ and $\hat{\mu}_y$ (sensitive only to $\pm$25% of $\hat{\mu}_x$), without replacement, on these two bootstrap samples. The observed *t*-statistic (*t**) is calculated first, followed by the calculation of 500 permutations of *t*-statistic outcomes from the combined pool of $X_i$'s and $Y_i$'s. Determine the p-value, the probability of obtaining a *t*-statistic as or more extreme than the observed, under the null hypothesis of no difference. However, given that the alternative hypothesis is in fact true, a "success" is recorded only if 2*p-value is $\leq$ 0.10 (for a 2-sided test with $\alpha$=0.10). This is appropriate since the permutation distribution of *t*-statistics is symmetric. To calculate power, the ability of a test to correctly reject the null hypothesis, for a given n, these steps are repeated 500 times, and the proportion of "successes" out of 500 is power. This is performed iteratively for a sequence of n's (e.g. 50, 100, 200) for each population, which results

in a power curve as illustrated in Figure 9 of the protocol narrative. A complete power analysis script written for the R statistical software language and environment (http://www.r-project.org/) is provided in the following section and can be brought in to R by copying this script into a text file (extension .txt) and using the "source R code" function.

Power Analysis Code for R: The power analysis code for R is available on the CD that accompanies this manual or by request from the UCBN. The power analysis code for R is stored on the UCBN Network Attached Storage (NAS) drive under Camas Lily/DataAnalysis/RCode.

### *Status Analysis*

Estimating mean density, population total, ratio of flowering to total plants, and weed frequency: The population means of established camas density and flowering stem density are the central parameters of interest for this protocol. Recall that the sampling objectives for the protocol require detection with 90% confidence of a change in the mean for camas total stem and flowering stem density ≥25%, which requires that an estimate of the mean and a 90% confidence interval be calculated. The unbiased estimator of the population mean, $\bar{y}$, is $\frac{1}{n}\sum_{i=1}^{n} y_i$, where $y_i$ is the observed density count of interest. The R function `mean()`, with the appropriate camas density data called in between ( ), will quickly compute this value for any set of camas population sample data. Alternatively, the function `sapply` can efficiently do this for all groups defined by a factor (e.g. Year or Zone). To calculate the mean density per $m^2$ rather than per 0.6 $m^2$ quadrat, simply multiply `mean() * 1.66`.

The unbiased estimator for the sample variance, $s^2$, is $\frac{1}{n-1}\sum_{i=1}^{n} (y_i - \bar{y})^2$ and calculated in R by `var()`.

The population total, τ, is also of interest since an estimate of the total number of plants (or flowering plants) corresponds directly to the number of bulbs in the target population. Total is estimated by $\frac{N}{n}\sum_{i=1}^{n} y_i$, or more simply, $N\bar{y}$, and where N is the total area, in $m^2$, of the population. In R, this would be computed as `N*mean()`. The variance of the estimated population total is N(N-n) $\frac{s^2}{n}$, or `N^2*(var()/n)`. The total area N, in $m^2$, for each zone is shown in Table 4.

Table 4. The total area for each management zone.

| Zone | Area ($m^2$) |
|---|---|
| WEPR A | 105102 |
| WEPR B | 152287 |
| WEPR C | 495728 |
| WEPR D | 152263 |
| WEPR E | 101514 |
| BIHO | 190268 |

The ratio of flowering to total plants can be computed by simply dividing the number of flowering stems by the total plant count for each quadrat, and then computing means and variances as described above. In R, for example, one approach using sapply would be as follows: `sapply(split((Flowers)/(Density),Year),mean,na.rm=TRUE).`

Frequency (*p*) is defined as the number of times a species is present divided by the total number of plots sampled. This random variable follows a binomial distribution and is simply estimated as $\hat{p}$=x/n, where x is the number of quadrats with a target species (e.g. *Potentilla recta*), and n is the total number of quadrats sampled. The variance $s^2$ is calculated as ($\hat{p} * \hat{q}$)/n-1, where $\hat{q}$ is 1-$\hat{p}$, or the proportion of quadrats without the target species (Thompson 2002).

The estimated standard error (SE) of $\bar{y}$(or $\bar{x}$) and for simple random sampling of a finite population, used to compute confidence intervals, is simply the square root of the variance divided by the square root of the sample size n as follows,
$\sqrt{\frac{N-n}{N}\frac{s^2}{n}}$, where the first term under the radical sign, $\frac{N-n}{N}$, is the finite population correction factor. This term is effectively 1 for any foreseeable level of camas sampling effort at Weippe Prairie or Big Hole Battlefield, and is included only for thoroughness and to avoid confusion with texts, such as Thompson (2002). For the population total, τ, the finite population correction factor N(N-n) is used instead. For frequency, SE($\hat{p}$)=√ ($\hat{p} * \hat{q}$)/n-1.

Confidence Intervals: An approximate 100(1-α)% confidence interval for the population mean $\mu$, is $\bar{y} \pm t^* \sqrt{\frac{N-n}{N}\frac{s^2}{n}}$
Where *t* is the appropriate multiplier from a student's *t*-distribution for α and the degrees of freedom n-1. For example, for a 90% confidence interval with 80 quadrats, the appropriate *t*-multipler is 1.66. For the population total τ the interval is $\tau \pm t * \sqrt{N(N-n) * \frac{s^2}{n}}$. In R, the standard error can be written as a simple function `SE<-sd()/sqrt(length())`, and SE could then be called in the following statement for the upper 90% confidence limit: `mean()+((qt(.95,79))*SE)`. For weed frequency, a large sample normal approximation can be used that takes the form $\hat{p} \pm t$√ ($\hat{p} * \hat{q}$)/n-1, using an appropriate *t*-distribution multiplier (Thompson 2002).

Bootstrap Confidence Interval Code for R: To calculate a 90% confidence interval for mean density using the simple percentile bootstrap method, where 10,000 bootstrap samples of size n are taken with replacement, use the short R script available on the CD that accompanies this manual or by request from the UCBN. The bootstrap confidence interval code for R is stored on the UCBN Network Attached Storage (NAS) drive under Camas Lily/DataAnalysis/RCode.

### *Trend Analysis*

Step Trend: Trend will be addressed in two ways, as described in the protocol narrative. The first will be to evaluate the presence of a "step trend" using a two-sample permutation *t*-test

following the basic procedures of the power analysis described earlier. The hypothesis for this test is $H_0$: $\mu_1$-$\mu_0$ = 0 and $H_a$: $\mu_1$-$\mu_0 \neq 0$. The p-value is determined through permutation and is interpreted as the number of permuted *t*-statistics $\geq$ the observed *t*-statistic, providing a measure of how unusual the observed test statistic is under the null hypothesis (Manly 2001). R code from Maindonald and Braun (2007) for computing a permutation *t*-test can be found on the accompanying CD and provides an example of how this should be done.

Randomization Confidence Intervals for Difference in Means Code for R: A 90% confidence interval for the difference between two means using a randomization approach described by Manly (2001) can be computed following the script included on the accompanying CD and stored on the UCBN NAS storage drive.

Continuous Trend: The second approach will involve the use of linear models to estimate the slope of the regression of a response (camas density) against time (year). The following code provides an example for determining the significance of a linear effect of year on density (density~year). Tests for equal variance (homoscedasticity), an important assumption, are also included. Following recommendations by Manly (2001), the approach fits a linear model using ordinary least squares and determines the significance of the coefficient with a randomization test. A routine for establishing the magnitude of the effect and a 90% confidence interval for that effect is also included, following recommendations in Manly (2001). Note, however, that this procedure is sensitive to user input and should be thoroughly understood before computation and reporting. Simulation results described in Manly (2001) suggest that the standard parametric approach to obtaining model coefficient confidence intervals (e.g. using a *t* distribution multiplier) is adequate under most circumstances and may be appropriate for this project as well.

Randomization Regression Code for R: The randomization regression code for R is available on the CD that accompanies this manual or by request from the UCBN. The randomization regression code for for R is stored on the UCBN Network Attached Storage (NAS) drive under Camas Lily/DataAnalysis/RCode.

Weed Frequency Trend: Weed frequency trend can be tested in two ways. For the difference between two years, a simple chi-square test or Fisher's exact test can be conducted on a 2 x 2 contingency table (Sokal and Rohlf 1981, Elzinga et al. 1998). Sokal and Rohlf provide an excellent discussion on contingency table tests of independence, and suggest that the log-likelihood G-test with the Williams' correction is the most appropriate test in circumstances where only the total sample size is fixed and table marginal totals are free to vary. However, all of these tests will provide similar results if expected frequencies are not too small. The accompanying code illustrates all three tests. Note that the hypotheses tested with contingency tables is that weed presence is independent of year. Once multiple years of weed frequency data become available, logistic regression can be used to test for the effect of year (trend). In R, this can be accomplished as follows:

```
summary(glm(weeds~year,family=binomial(link="logit")))
```

### *Precipitation*

The effects of precipitation and thatch depth on density, as well as other covariates, can also be tested using the linear model framework. For this protocol version, analysis of precipitation is

considered only in a preliminary manner. Any precipitation effect on density will take several more years to be detectable. More in depth treatment will be provided in a future SOP. Currently, it is hypothesized that total precipitation during the winter months (dormant period) preceding spring growth is the most significant seasonal precipitation driver.

Precipitation data will be retrieved from the Western Regional Climate Center at [http://www.wrcc.dri.edu/Climsum.html](http://www.wrcc.dri.edu/Climsum.html) (Figure 18). Click on the link to N.Idaho/Montana stations and then navigate to the Pierce, Idaho station (Station 107046) or the Wisdom, Montana station (Station 249067) and click on the "monthly totals" hyperlink under precipitation. Right click on the data and save as a text file (.txt) to the appropriate directory and folder.

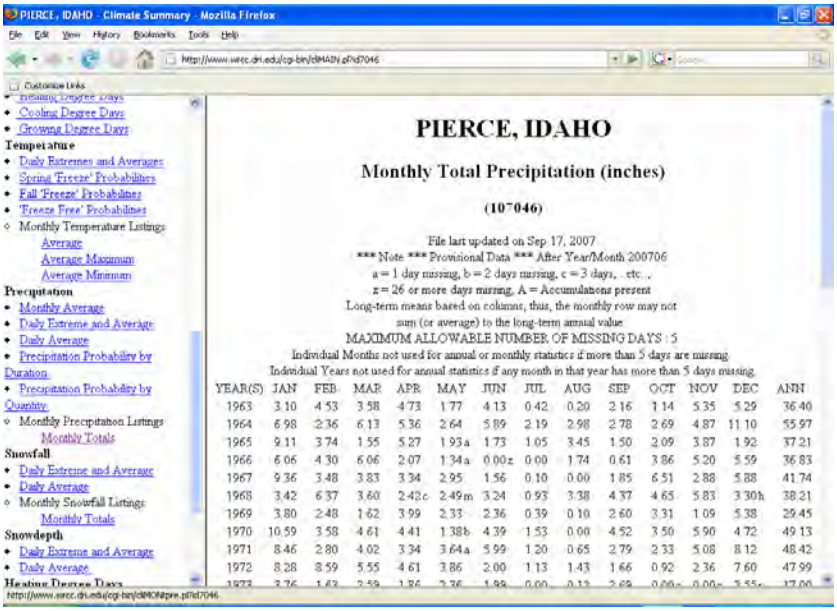



Figure 18. Screenshot of precipitation data for Pierce, Idaho, retrieved for the Western Regional Climate Center website.

This file can be imported into Microsoft Excel and prepared for analysis. Monthly totals with more than 4 days missing (coded as e or greater) should be treated as missing values and coded as NA in Excel. Summations of precipitation during the camas dormant period (Oct-Mar), peak precipitation period (Nov-May), and annual total preceding the current growing season (June-May) can all be considered for analysis.

### *Goodness-of-fit for the Negative Binomial Distribution*

As with many ecological phenomena, camas lily populations grow in aggregated or "contagious" patches, leading to density count data that are highly positively skewed. This leads to the phenomena of "overdispersion", in which observed variances are higher than expected based on theoretical distributions such as the normal or Poisson. The large values of skewness and kurtosis encountered in the pilot data, even for standard data transformations, indicate the degree to which a normal approximation would inadequately fit these data. The utility of the Poisson distribution is also quickly dismissed, since it requires that the variance, $\sigma$, equal the mean, $\mu$. Overdispersion can be addressed somewhat with a quasi-poisson adjustment to the assumed variance structure. The negative binomial distribution has added flexibility in this regard and can serve biological count data well. However, goodness-of-fit tests for the Weippe Prairie 2006 pilot data indicate that total stem density is still not well described by the negative binomial distribution ($\chi 2 = 25.6$, 9 df; $p=0.002$). Flowering stem density is described adequately ($\chi 2 = 6.8$, 6 df; $p=0.34$), and generalized linear models using a negative binomial error structure may be useful for modeling some of the data in the future. In R, with the MASS package loaded, the function `glm.nb()` can be used for this purpose.

The negative binomial relies on two parameters, the mean $\mu$, and the dispersion parameter k (referred to as theta in R). Small values of k (<1) indicate clumping or non-random aggregation, whereas large values of k (>5) indicate random dispersion of the sample values. An estimate of k can be obtained from $\frac{\mu^2}{s^2 - \mu}$. Crawley (2005) provides simple instructions on how to test for goodness-of-fit for negative binomial distribution using R. The small frequencies in the tail will need to be pooled into one "bin" in order for this procedure to work properly. The rule of thumb is for all bins to have values $\geq 4$. Figure 19 illustrates expected frequencies of flowering stem density using estimates of $\mu$ and k from 2006 pilot data (left) and observed frequencies (right). In this case, the fit is quite good, suggesting that future analyses may be able to make use of this parametric distribution for the response of flowering stem density. Future reports should evaluate goodness-of-fit.

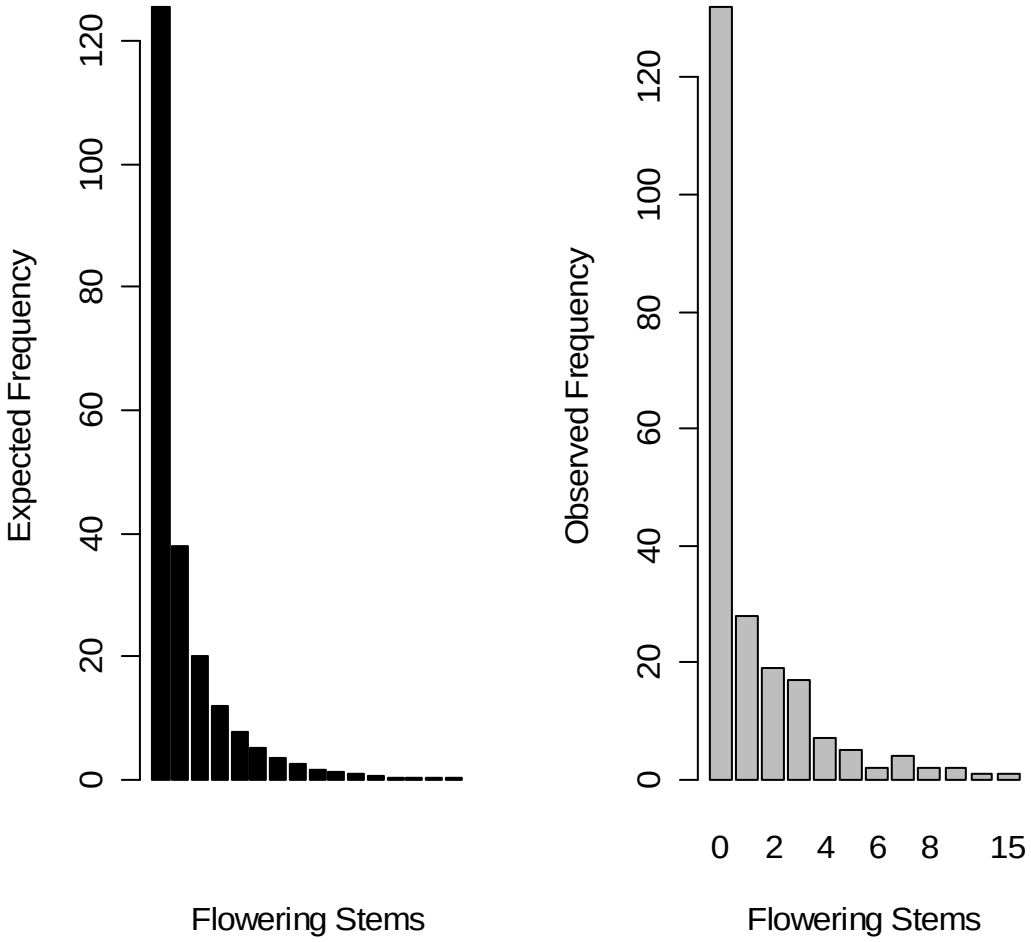


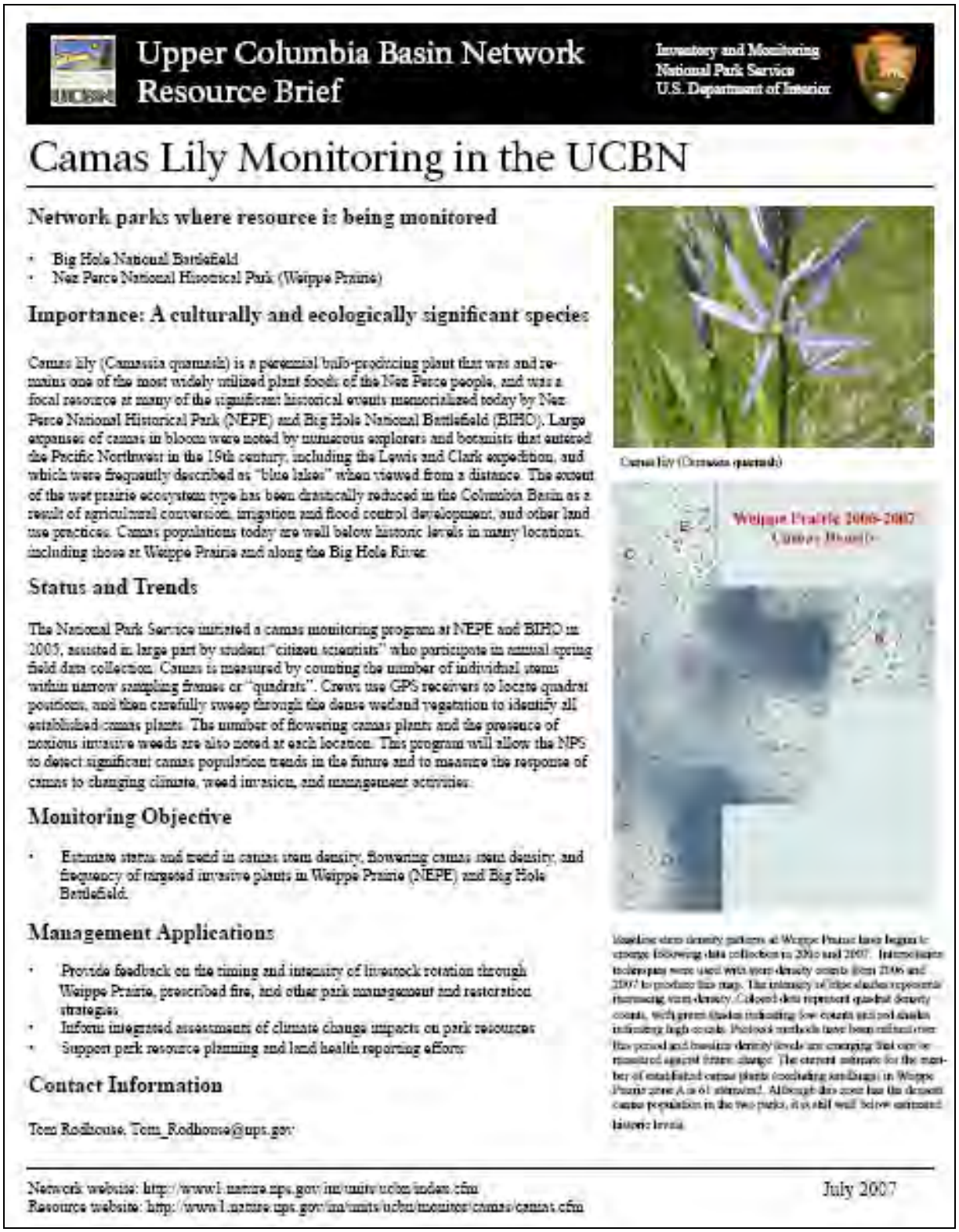

Figure 19. Expected frequencies, as determined from a negative binomial distribution, and observed frequencies of camas flowering stem density from 2006 pilot data at Weippe Prairie.

## Reporting

A summary will be produced annually, with a more detailed status and trend report produced every five years. The annual summary will:

- List project personnel and their roles.
- List sample quadrats measured during the current year.
- Provide a summary history of the number of quadrats completed during each year of the study (broken down by population and park).
- Provide status and trend (after 2010) estimates for each population and park.
- Estimate the ratio flowering stem density:total established camas density.
- Provide a summary of additional measurements, including weed frequency, thatch depth, and annual and monthly precipitation from nearby weather stations.
- Provide maps of quadrats symbolizing camas density, weed presence, and other measured attributes
- Evaluate data quality and identify any data quality concerns and/or deviations from protocols that affect data quality and interpretability.
- Evaluate and identify suggested or required changes to the protocol.

In order to reduce the reporting burden of the I&M program on UCBN staff, the annual summary will be developed for internal Network distribution only. However, a 1-2 page resource brief should be prepared for public consumption, and that can be provided to park interpretive staff for distribution to interested visitors. Figure 20 illustrates the resource brief template currently in use by the UCBN. An NPS template for producing maps with ESRI ArcGIS or ArcView software is available at http://imgis.nps.gov/templates.html.



Upper Columbia Basin Network
Resource Brief

Inventory and Monitoring
National Park Service
U.S. Department of Interior

# Camas Lily Monitoring in the UCBN

## Network parks where resource is being monitored

- Big Hole National Battlefield
- Nez Perce National Historical Park (Weippe Prairie)

## Importance: A culturally and ecologically significant species

Camas lily (Camassia quamash) is a perennial bulb-producing plant that was and remains one of the most widely utilized plant foods of the Nez Perce people, and was a focal resource at many of the significant historical events memorialized today by Nez Perce National Historical Park (NEPE) and Big Hole National Battlefield (BIHO). Large expanses of camas in bloom were noted by numerous explorers and botanists that entered the Pacific Northwest in the 19th century, including the Lewis and Clark expedition, and which were frequently described as "blue lakes" when viewed from a distance. The extent of the wet prairie ecosystem type has been drastically reduced in the Columbia Basin as a result of agricultural conversion, irrigation and flood control development, and other land use practices. Camas populations today are well below historic levels in many locations, including those at Weippe Prairie and along the Big Hole River.

## Status and Trends

The National Park Service initiated a camas monitoring program at NEPE and BIHO in 2005, assisted in large part by student "citizen scientists" who participate in annual spring field data collection. Camas is measured by counting the number of individual stems within narrow sampling frames or "quadrats". Crews use GPS receivers to locate quadrat positions, and then carefully sweep through the dense wetland vegetation to identify all established camas plants. The number of flowering camas plants and the presence of noxious invasive weeds are also noted at each location. This program will allow the NPS to detect significant camas population trends in the future and to measure the response of camas to changing climate, weed invasion, and management activities.

## Monitoring Objective

- Estimate status and trend in camas stem density, flowering camas stem density, and frequency of targeted invasive plants in Weippe Prairie (NEPE) and Big Hole Battlefield.

## Management Applications

- Provide feedback on the timing and intensity of livestock rotation through Weippe Prairie, prescribed fire, and other park management and restoration strategies
- Inform integrated assessments of climate change impacts on park resources
- Support park resource planning and land health reporting efforts

## Contact Information

Tom Rodhouse, Tom_Rodhouse@nps.gov

Camas lily (Camassia quamash)

Weippe Prairie 2006-2007
Camas Density

Baseline stem density patterns at Weippe Prairie have begun to emerge following data collection in 2006 and 2007. Interpolation techniques were used with stem density counts from 2006 and 2007 to produce this map. The intensity of blue shades represents increasing stem density. Colored dots represent quadrat density counts, with green shades indicating low counts and red shades indicating high counts. Protocol methods have been refined over this period and baseline density levels are emerging that can be monitored against future change. The current estimate for the number of established camas plants (excluding seedlings) in Weippe Prairie area A is 61 stems/m2. Although this area has the densest camas population in the two parks, it is still well below estimated historic levels.

Network website: http://www1.nature.nps.gov/im/units/ucbn/index.cfm
Resource website: http://www1.nature.nps.gov/im/units/ucbn/monitor/camas/camas.cfm

July 2007

Figure 20. Resource brief template for annual vital signs reporting to park staff and the public.

Invasive weed locations will be reported to the NEPE and BIHO resource managers immediately following completion of field activities in May (Weippe Prairie) and June (BIHO). Reported information must include GPS locations and maps of quadrats with weeds present both within quadrats and within the approximate 5 m reporting radius surrounding quadrats. Any additional weed information noted during travel between quadrats will also be included. Exact format of the reported information required by NEPE managers should be determined each year but will likely either include an ESRI shapefile (.shp) or dBase file (.dbf).

A more in-depth analysis and report will be produced approximately every five years, or as the importance of emerging information warrants. This report will provide greater analytical and interpretive detail, and will evaluate the relevance of findings to long-term management and restoration goals. The report should also evaluate operational aspects of the monitoring program, such as whether population boundaries need to be changed or the sampling period remains appropriate (the optimal sampling season could conceivably change over time in response to climate change).

The 5-year status and trend report should use the NPS Natural Resource Publications Natural Resource Technical Report (NRTR) template, a pre-formatted Microsoft Word template document based on current NPS formatting standards. This template, guidelines for its use and documentation of the NPS publication standards are available at the following address: http://www.nature.nps.gov/publications/NRPM/index.cfm. This camas protocol is also an excellent example of the NPS Natural Resource Report formatting standard, which is very similar to the NRTR template.

### *Schedule for Camas Monitoring Project Deliverables*

Table 5. Schedule for camas monitoring project deliverables.

| Deliverable Product | Primary Responsibility | Target Date | Destination(s) |
|---|---|---|---|
| Weed location data | Project Lead | Immediately and no later than June15 (Weippe) | NEPE, BIHO, UCBN Digital Library [1] |
| Raw data files | Field Lead | July 15 of the same year | UCBN Digital Library [1] |
| Photographs (select, quality images for long-term storage) | Project Lead | October 1 | UCBN Digital Library [1] |
| Certified working database and geospatial data with draft metadata | Project Lead with Data Manager assistance | September 15 | Master project database and GIS data sets, copy to UCBN Digital Library [1], and NR-GIS Metadata and Data Store [2] |
| Full metadata (parsed XML) | Data Manager | December 15 | NR-GIS Metadata and Data Store [2], UCBN Digital Library [1] |
| Resource Brief | Project Lead | October 1 | NEPE, BIHO, UCBN website |
| Annual report (for internal purposes) | Project Lead | December 15 | NatureBib [3], UCBN Digital Library [1], printout to local park collections |
| 5-year analysis report | Project Lead | Every 5 years by December 15 | NatureBib [3], UCBN Digital Library [1], printout to local park collections |
| Other publications | NPS Lead, Project Lead, Data Manager | As completed | NatureBib [3], UCBN Digital Library [1], printout to local park collections |
| Other records | NPS Lead and Project Lead | Review for retention every December | Retain according to NPS Director's Order #19 [4] |

[1] The UCBN Digital Library is a hierarchical digital filing system stored on the UCBN file server. Network users have read-only access to these files, except where information sensitivity may preclude general access.
[2] NR-GIS Metadata and Data Store is a clearinghouse for natural resource data and metadata (http://science.nature.nps.gov/nrdata). Only non-sensitive information is posted to NR-GIS Metadata and Data Store. Refer to the protocol section on sensitive information for details.
[3] NatureBib is the NPS bibliographic database (http://www.nature.nps.gov/nrbib/index.htm). This application has the capability of storing and providing public access to image data (e.g., PDF files) associated with each record.
[4] NPS Director's Order 19 provides a schedule indicating the amount of time that the various kinds of records should be retained. Available at: http://www.nps.gov/refdesk/DOrders/DOrder19.html

**Camas Lily Long-Term Monitoring Protocol**

# Standard Operating Procedure (SOP) 8: Protocol Revision

**Version 1.0, October 2007**

## Change History

| Original Version # | Date of Revision | Revised By | Changes | Justification | New Version # |
|---|---|---|---|---|---|
| 1.0 Draft | October 2007 | UCBN | Revision following peer review | | 1.0 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Note:** This SOP describes the recommended protocol revision practices and provides a history and documentation of the protocol development and revision process.

## Procedures

This monitoring protocol is an actively evaluated and updated document that reflects the latest procedures of the monitoring program. Revisions are expected, and can involve only minor changes with little overall impact or occasional major revisions and course corrections. Evaluation and revision of the protocol is directed by the project leader on an annual basis in association with season close-out. The narrative as well as each SOP has a revision history log whereby changes can be recorded. Older versions of the narrative and SOPs should be archived to ensure proper legacy of past work is maintained. Each revision will require the updating of the version number. Minor changes are recorded as decimal numbers (e.g. 1.0, 1.1, 1.2, etc…). Major changes are recorded as a change in the primary number of the protocol version (e.g. 1.0, 2.0, 3.0, etc…). In some cases, major revisions to the protocol may prompt the need for additional peer-review. The project lead and Network Coordinator will coordinate this with the Regional I&M Program Coordinator.

## Development and Revision History Log

Table 6. Protocol development and revision history log. This table summarizes the major events leading to the development and revision of the UCBN camas lily monitoring protocol (version 1.0).

| Date | Development Step | Documentation |
|---|---|---|
| June 2005 | Initial pilot sampling at Weippe Prairie, in conjunction with OMSI Salmon Camp Program | Summary of findings report available from UCBN |
| November 2005 | First draft Protocol Development Summary | PDS available from UCBN |
| December 2005 | Protocol Development Agreement signed between Dr. Mark Wilson, OSU Botany and Plant Pathology, and UCBN (Agreement Completed) | Agreement available from UCBN |
| May 2006 | Field reconnaissance to Weippe Prairie and Big Hole Battlefield with University of Idaho statistician Dr. Jon Horne, Dr. Mark Wilson, Tom Rodhouse, Lisa Garrett, Jason Lyon, Kira Crawford, and Dr. Penny Latham (Big Hole only) | |
| June 2006 | Draft protocol narrative and SOPs 4 and 5 (locating and measuring quadrats) complete and used in field testing | Draft narrative available from UCBN |
| June 2006 | Pilot sampling at Weippe Prairie and Big Hole Battlefield in conjunction with OMSI Salmon Camp Program | |

Table 6. Protocol development and revision history log (continued). This table summarizes the major events leading to the development and revision of the UCBN camas lily monitoring protocol (version 1.0).

| Date | Development Step | Documentation |
|---|---|---|
| September 2006 | Complete draft protocol version 0.0, including SOPs 1-5, prepared and provided to Dr. Jeff Yeo, The Nature Conservancy, for formal "pre-review". | Draft protocol available from UCBN |
| September 2006 | Peer-review comments from Dr. Jeff Yeo provided to UCBN | Comments available from UCBN |
| October 2006 | Dr. Kirk Steinhorst, University of Idaho Statistics, begins implementing task agreement between University of Idaho and UCBN for statistical consultation on monitoring design | |
| October 2006 | Dr. Kirk Steinhorst, Kathi Irvine, and Leigh Ann Harrod begin consulting with UCBN, Kirk and Kathi join camas protocol development team | |
| October 2006 | Meeting at Oregon State University with Kathi Irvine, Mark Wilson, Leigh Ann Harrod, and Tom Rodhouse | |
| December 2006 | Allen Kitchel, University of Idaho Business and Marketing, begins developing the camas lily monitoring project database, under a cooperative task agreement with the UCBN, and in consultation with Tom Rodhouse and Lisa Garrett | Draft copy of .mdb in development and available from UCBN |
| December 2006 | Meeting at Oregon State University with Kathi Irvine, Mark Wilson, Leigh Ann Harrod, and Tom Rodhouse; Meeting with Dr. Susan Kephart, Willamette University Biology Department, on same day | |
| December 2006 | UCBN submits final Phase III monitoring plan for peer review; updated Protocol Development Summary complete | PDS attached |
| February 2007 | Final draft of camas protocol version 1.0 complete, submitted for peer review | Draft protocol version 1.0 available from UCBN |
| May 2007 | Academic peer review complete, accepted with minor revision; comments compiled by editor Dr. Jim Agee, University of Washington, and presented to UCBN for revision | Review comments available from UCBN upon request |

Table 6. Protocol development and revision history log (continued). This table summarizes the major events leading to the development and revision of the UCBN camas lily monitoring protocol (version 1.0).

| Date | Development Step | Documentation |
|---|---|---|
| August 2007 | NPS I&M regional administrative review complete, protocol accepted for publication, implementation, with minor revision | Review comments available from UCBN upon request |
| October 2007 | Revised protocol version 1.0 complete | Complete protocol available on-line from UCBN, national I&M, and NBII websites |

## UCBN Protocol Development Summary

**Protocol:** Camas Lily

**Parks Where Protocol will be Implemented:** NEPE and BIHO

**Justification/Issues being addressed:**
Camas lily was historically one of the most widely utilized plant foods of the Nez Perce people, and remains so for many tribal members today (Harbinger 1964; Hunn 1981; Turner and Kuhnlein 1983, Mastrogiuseppe 2000). Camas was also a focal resource at many of the significant historical events memorialized today by NEPE and BIHO. It was during the camas harvest at Weippe Prairie, a subunit of NEPE, that the Lewis and Clark Corps of Discovery first encountered the Nez Perce, and the battle at Big Hole occurred at a traditional Nez Perce camas lily harvesting campsite. It is also noteworthy that the botanical "type" specimen for the Camas genus as well as for camas lily itself was collected by the Lewis and Clark Expedition returning through the Weippe Prairie during the spring of 1806 (Gould 1942). Camas lily is therefore a central, important element of the cultural landscapes NEPE and BIHO seek to interpret for the public. The focal cultural resource status of camas is one of two driving rationales for establishing a camas lily monitoring program in the UCBN.

Camas lily, a facultative wetland species (Reed 1988), is also ecologically significant. It is strongly associated with seasonal wet prairie ecosystems of the interior Columbia Plateau, which are represented at Weippe Prairie and along the North Fork of the Big Hole River. The extent of the wet prairie ecosystem type has been drastically reduced in the Columbia Basin as a result of agricultural conversion, irrigation, and flood control development, and other land use practices, a pattern seen elsewhere (Dahl 1990; Taft and Haig 2003). Remaining wet prairies in the region are often structurally altered and compromised by non-native and woody native invasive species. The NPS-owned portions of Weippe Prairie and the Big Hole valley are no exception. Both sites have historic irrigation developments that have altered site hydrology, are infested by invasive weeds, and Weippe Prairie has also been used for intensive haying and grazing. Orange hawkweed, listed as a noxious plant in Idaho, and sulfur cinquefoil, an invasive species of concern to NEPE, are both present at Weippe Prairie and part of the focus of current park weed management. Despite the impacts of these anthropogenic stressors, such highly productive ecosystems exhibit a good potential for restoration (Taft and Haig 2003), and both sites continue to support a vigorous camas lily population.

Establishing a program to monitor the long-term trends in camas lily populations at Weippe Prairie and BIHO will provide important information to the parks for their adaptive management decisions and land health performance goals. Camas lily monitoring will be particularly important at Weippe Prairie because the site remains actively sprayed, mowed, and grazed; the impacts of which remain unknown. At BIHO, where the wetland ecosystem supporting camas lily is more intact and in a higher functioning condition, site management is less intense and camas lily monitoring will provide an invaluable indication of overall status and trend of wetland condition over time. It will also provide information on the impacts of weed control efforts periodically made by BIHO staff in that wetland community.

**Monitoring Questions and Objectives to be Addressed by the Protocol:**
Monitoring questions addressed by this protocol include:

- What is the range of variation in camas lily abundance and flowering rate estimates at Weippe Prairie and along the Big Hole River at BIHO?
- What magnitude of change in parameter estimates is necessary for separating real change from inherent inter-annual variation?
- Are the camas lily populations at NEPE and BIHO stable, declining, or increasing?
- Is the frequency of targeted invasive plant populations increasing in camas-supporting wetlands of NEPE and BIHO?

Monitoring objectives addressed by this protocol include:

1) Estimate the abundance (status) of the camas lily population in Weippe Prairie and within the targeted portion of the BIHO. ***Justification.*** *Camas lily population status estimates will inform near-term site management and will contribute to long-term trend detection. Camas lily abundance will be measured as total number of plants and number of flowering plants. The number of plants, hence the number of camas lily bulbs, relates directly to the cultural importance of camas lily.*

2) Determine trends (net trend, as reviewed by MacDonald 2003) in the abundance of camas lily in Weippe Prairie and BIHO. ***Justification:*** *Net trend measures the total response or mean change and is an appropriate parameter for our objectives and for camas lily, a plant subject to high interannual variation in abundance. Long-term trend detection in camas lily, particularly the detection of downward trends, is of critical importance to park management of this fundamental park resource.*

3) Determine trends in the proportion of flowering to non-flowering camas lily plants, as a measure of population vigor, in Weippe Prairie and BIHO. ***Justification:*** *Flowering is a measure of population vigor, and, although camas lily reproduces asexually through bulb budding, it also invests a tremendous amount of energy into flowering and seed production. A number of issues justify monitoring of flowering rate trends, and include potential changes in phenology resulting from changing precipitation and soil moisture over time to competition from invasive plants and heavy graminoid thatch.*

4) Determine trends in frequency of occurrence of targeted invasive plant species. ***Justification:*** *Invasive plants pose the greatest threat to camas lily populations in NEPE and BIHO and include non-native exotic forbs as well as graminoids and secondary graminoid thatch depth. Monitoring these species will provide critical information to park resource managers and will contribute to the UCBN integrated invasive plant vital sign monitoring program.*

5) Establish whether graminoid thatch depth and cinquefoil, hawkweed, or other future targeted invasive species presence are associated with lower camas lily density and/or lower flowering rate. ***Justification:*** *Several important potential stressors related to camas lily population abundance and hypothetical declines have been identified, including competition from invasive forbs and graminoids, and elimination of fire from seasonally wet prairies, leading to an*

*increase in thatch depth. Our protocol will permit model-based relationships between camas lily abundance and these measurable stressors to be tested. Ultimately, these kinds of relationships, if present, will be directly relevant to management decisions, such as reintroduction of prescribed fire.*

**Basic Approach:**
No existing camas lily monitoring protocol is currently available for adoption from NPS or other relevant organizations. The UCBN camas lily monitoring protocol will be developed following NPS I&M standards as outlined by Oakley et al (2003). A probabilistic sampling design will be developed that balances the need for maximum scope of inference and statistical power with logistical and financial efficiency. In particular, the design will emphasize rapid data collection that produces simple and straightforward results directly applicable to trend detection and site management. In addition, the UCBN is incorporating camas lily monitoring into its "*citizen science*" program in which high school students and other volunteers directly participate in, and perhaps even sustain, field data collection. To that end, sampling methods that are effective toward meeting stated objectives but are as simple as possible and require minimal training will be selected. Required sample size for desired precision and power levels will be estimated *a priori* with data available from 2005 and 2006 field data collected at Weippe Prairie and BIHO and other relevant data sets available from Universities, TNC, and other organizations. In accordance with management and monitoring objectives, minimizing the missed-change (type II) error will be emphasized and a higher false-change (type I) error rate tolerated if necessary. Our current sampling objective is to achieve at least 80% power to detect a 30% decline in estimates of camas lily abundance through the life of this monitoring program. Thorough SOPs will be developed for all aspects of the monitoring program following recommendations in Oakley et al. (2003) and as demonstrated by other available peer-reviewed NPS I&M program protocols in order for the UCBN to implement and sustain long-term camas lily monitoring.

**Principal Investigators and NPS Lead:**
Principal Investigator: Dr. Mark Wilson, Ecological Consulting, Philomath, OR, 541-929-5281.
NPS Lead: Tom Rodhouse, UCBN Ecologist, 541-312-8101.

**Development Schedule, Budget, and Expected Interim Products:**
The PI and NPS lead produced a draft monitoring protocol for field testing on June 12, 2006, which was revised following analysis of 2006 field data. A "pre-review" of the draft protocol was completed by Dr. Jeff Yeo, Idaho TNC, in September, 2006. The complete draft protocol will be ready for external peer review by January 31, 2007. Field testing of the revised protocol (following reviewer's comments) will occur in June 2007. We will consider the June 2007 field work as "implementation". We have budgeted $10,000 for FY 2007 for protocol completion. Field testing has been accomplished through the UCBN citizen science VIP program in collaboration with the OMSI Salmon Camp program in June 2005 and 2006.

**Literature Cited:**

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**Camas Lily Long-Term Monitoring Protocol**

# Standard Operating Procedure (SOP) 9: Field Safety

**Version 1.0, October 2007**

## Change History

| Original Version # | Date of Revision | Revised By | Changes | Justification | New Version # |
|---|---|---|---|---|---|
| 1.0 Draft | October 2007 | UCBN | Revision following peer review | | 1.0 |
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**Note:** This SOP describes recommended safety practices and emergency contact information.

## Procedures

### *Weather and Field Gear*

Field work in northern Idaho and western Montana can bring with it challenging weather extremes. During pilot sampling at Weippe Prairie in 2005, the team spent three days in cold rainy weather. In 2006, at the same time of year, the team spent three very hot, still days – an 180$^{o}$ switch in weather. It is essential to the success of the program that all volunteers and staff are well prepared for weather extremes. Good rain gear, warm clothes, sunhats, sunscreen, and mosquito repellant are essential. In 2006, Idaho emerged as a "hot spot" for West Nile Virus, and numerous cases of human infection and illness caused by this mosquito-borne virus were reported. The U.S. Center for Disease Control website for this disease contains up-to-date information on location of outbreaks and prevention tips. The web address is as follows: http://www.cdc.gov/ncidod/dvbid/westnile/ Mosquito nuisance can be extreme at Big Hole Battlefield in the late spring/early summer. Lightweight long-sleeve clothing can be helpful, and mosquito repellant is a must!

### *Safety Precautions*

The terrain of Weippe Prairie and Big Hole Battlefield (camas meadow) is flat and easy to travel through. At Weippe Prairie, several deep and narrow drainage ditches, and the Jim Ford Creek that bisects the site, can be difficult to cross. It can be tempting to jump across rather than walk to a bridge or easier crossing. This can lead to injury or wet and cold field technicians. Weippe Prairie is also a rather remote location and travel time to transport injured or sick personnel is considerable. Conservative decision making is imperative. An injury, even a minor one, could cause a substantial interruption in field schedules and overall monitoring program progress. The camas sampling area at Big Hole is located within sight of the park headquarters and visitor center, but if field work is conducted after visitor center hours, the situation changes abruptly to a remote situation also requiring substantial travel time to help and a phone. Cell phone coverage at both park sites is intermittent and should not be relied upon in case of an emergency. **Use of two-way radios is strongly encouraged!** Radios are particularly helpful when multiple sampling teams are spread out across Weippe Prairie. Teams can quickly traverse out of eye and ear contact. **First aid kits should be available in vehicles parked at the park site during field work!**

### *Emergency Contact Information*

Park headquarters at Spalding is located within Nez Perce County and the Nez Perce Indian Reservation. The park is served by the Nez Perce County Sheriff, Nez Perce Tribal Police and Clearwater Fire Service. There are two fully staffed medical centers within 12 miles of the park with emergency medical facilities. All structural fire and life-threatening emergencies are to be reported by calling 911. Weippe Prairie is approximately 1.25 hours drive away from the Spalding headquarters. The nearest emergency facility is in Orofino, along the Clearwater River in between Weippe Prairie and the park headquarters. Emergency Medical Technicians are available to respond to an emergency in the town of Pierce, approximately 20 minutes drive from Weippe. The contact phone number for Timberline EMT in Pierce is (208) 464-2174. The Weippe police telephone is (208) 435-4211. The Weippe rural fire department telephone is (208) 435-9015.

Big Hole National Battlefield, located near Wisdom, Montana, is served by Beaverhead County sheriff's office and the Dillon Interagency Dispatch Center. Nearest emergency medical facilities are in Dillon, about 85 miles away, and all emergencies are reported by calling 911. The nearest town, Wisdom, is located 10 miles to the east of the park, and an ambulance is kept at Wisdom, dispatched through the 911 system. Park hours after Memorial Day are 9 am to 6 pm. Park staff live on site, and can be contacted to help in an emergency **AFTER** a 911 call has been made or attempted. Park staff should not be bothered after hours for minor problems and inconveniences. The park superintendent telephone is (406) 689-3384 and the park ranger is x3560.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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