Vegetation Monitoring Procedure for the Southern Plains Grassland Protocol

Standard Operating Procedure (SOP) #14: Circular Quadrat Sampling

Version 2.1 (May 2023)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.0 (Version 1.0 is internal only)	5/17/22	M. Owen	Changed "Rapid Assessment" procedure name to "Circular Quadrats." Reduced size of sampling area from 100m to 25 and updated plot diagram; removed cover classes; added canopy cover of woody species not rooted in quadrat; editing and reorganization.	New name to match updated procedure; prevent plot overlap; improve accuracy of cover estimates; collect data on all woody species; improve clarity and format.	2.0
2.0	5/20/23	M. Owen	Returned cover classes to methods; added new figures and further detail about electronic data collection.	Ocular cover estimates less accurate w/o cover classes.	2.1

This Standard Operating Procedure explains the methods necessary to sample vegetation in 10 circular quadrats randomly located within a 25m buffer of the 50m transect. The quadrats are circles with a 1m radius and a new set of ten is randomly generated for each sampling event. Field sampling of quadrats should not occur until the crew has set up and photographed the transect line. Procedures are done in this order to avoid trampling vegetation along the transect and to keep crew members out of plot photos.

Preparation for Data Collection

Creation of Random Sampling Points

1. The SOPN Data Manager will generate the quadrat center points for each transect before the field season begins. They maintain a geodatabase containing the sampling frames (25m buffer zones around each 50m transect) and randomly generated points for each year. The sampling frames are drawn so that they include, and only include, the vegetation communities intersected by the plot's transect line. Any overlap between neighboring plot perimeters is split evenly between the two.
2. The random quadrat locations are generated using the *Create Random Points* tool in ArcMap to generate 15-20 points for each transect in a park. Points are excluded from a 5m buffer placed around the inside edge of the sampling perimeter, and a 2m buffer placed around the transect line. This is done so that quadrats will not overlap the transect or fall outside the perimeter. Points must also be 2m apart so that they don't overlap. Points are reviewed individually and extras deleted randomly until 12 remain. Points are then numbered 1 through 12.

Prepare Paper Data Sheet(s) or the Field Laptop

1. Open the Plot Establishment Sheet on the field laptop or refer to a hard copy. This form shows all location information for the plot: transect origin and end point UTM's, directions to the plot, annual field notes and a list of all species codes recorded at the plot during vegetation sampling. Check for any notes referring to unknowns and/or voucher specimens that need to be collected.
2. If using paper data sheets, record relevant information in the header on both sides of the Field Data Form in preparation for data collection. Remember to print datasheets double sided, so that one side of the sheet can be used for the first 5 quadrats and the other side for the remaining 5 quadrats.
3. If using a field laptop, open the Grasslands Database. If this plot is the first of a park monitoring visit, be sure to connect to the new park's data storage file. Access the data for the appropriate plot and enter the relevant info into the tab header (Visit Date, Data Recorder/Observer for all procedures, etc.).

Select Equipment

The crew must choose how to delineate the 2m diameter circular plots while sampling. Favorable ways to do this are:

1. Tie two chaining pins together with p-cord, ensuring that the full length of the cord and chaining pins is 1m long. Secure one chaining pin in the ground to act as the center of the circular plot. The second chaining pin may be rotated around the first to act as the 1m radius. If the crew finds it helpful, a third chaining pin can be tied to the center pin as well, so that the full 2m diameter can be delineated on the ground. It can be helpful to flag the center pin so that you don't forget which one is which.
2. Utilize two plunking poles that have been labeled with cm measurements for the Line-Point Intercept protocol. Ensure that the poles are visibly marked at 1m. Place one pole in the ground to act as the center point and rotate the second pole around it to act as the 1m radius. If helpful, use three poles, so that the full 2m diameter can be delineated.

Data Collection

Navigating to Quadrats

1. Navigate to each quadrat using a GPS unit. Each plot will have 10 quadrats and two oversamples. The quadrats will be labeled in the GPS unit by plot and numbered 1 to 12. Numbers 11-12 are the oversamples: quadrats 1-10 are given priority for sampling and must be declared unsuitable before an oversample can be used.
2. On occasion, quadrats will be located in an area unsuitable for monitoring. If a quadrat is inaccessible or unsafe (this includes near rattlesnakes), or located in a body of water, thick brush, or on the transect line, disregard the point and substitute the first oversample instead (# 11). If a second quadrat is unsuitable, substitute oversample 12. Make a note on the datasheet or in the database stating the # quadrat discarded, the reason why and the # oversample used

to replace it. In the unlikely event that more than two oversamples are needed, field randomization should be used to generate a new quadrat location:

- From the center of the transect (25m), have the navigating technician shut their eyes and slowly turn in a circle, while a second technician observes and randomly tells them to stop.
- Randomly select a number between 1 and 20. Measure this distance in meters from the transect center, in the direction that the navigating technician is facing, to reach the new quadrat location. If the route is unsafe, repeat the process until a safe direction is determined.
- Record the coordinates for the new location (in WGS84 UTM's) on the datasheet or in the database. Remember to make a note stating the # quadrat discarded and the reason why.

Sampling Quadrats

1. Sampling is best conducted in pairs, with one technician acting as an observer and the other as a recorder. Once the observer is finished sampling each quadrat, have the recorder search for additional species -- studies have shown that more species are detected with two observers than with one.
2. Upon arrival at a quadrat location, mark the center point with either a changing pin or plunking pole. Get as close to the location as the GPS unit will allow – make sure the GPS unit is completely zoomed in. Delineate the 1m radius (2m diameter) circular quadrat using the equipment chosen during data collection prep.
3. The observing technician should then call out all plant species rooted 50% or more within the quadrat. Move the measuring tool in a circle and continue calling out all new species until confident that all plants have been found. Remember to check under taller vegetation as it can hide other species.
4. Record plant names using standardized six-letter codes: the first three letters of the genus and first three of the species. Codes will be followed by a number if duplicates exist: the most common example at our parks is ERIANN1 and ERIANN2. The database will show the full species name in the dropdown menu for any code entered. On paper datasheets, be sure to check the species list each time to determine if there are numbers at the end of a given code, as it can be difficult to ascertain the intended species name when numbers are missing. For species identified to the genus level only, use the first 5 letters of the genus name, taking care in matching the code to the proper genus in the database drop-down menu. On paper datasheets, crews should write out the entire genus followed by "sp.". For unknown species, follow the procedures outlined in SOP #10 – Unknown Plants.
5. Next, estimate foliar cover for each species using ocular estimation techniques. Cover should be estimated using the following cover classes: 1-10%, 11-20%, 21-30%, 31-60% and 61-100%. Each individual plant cannot exceed 100% cover, but when combined, cover values for a quadrat may be greater than 100% due to overlapping species.

6. After recording all species rooted 50% or more within the circle, estimate additional canopy cover of trees and shrubs (but not subshrubs) rooted outside the quadrat. This may include trees that are far overhead and difficult to estimate, but do the best that you are able. In the database, mark each of these species as "canopy" (Figure 1), and if using a paper data sheet make a note that the species cover is "canopy."

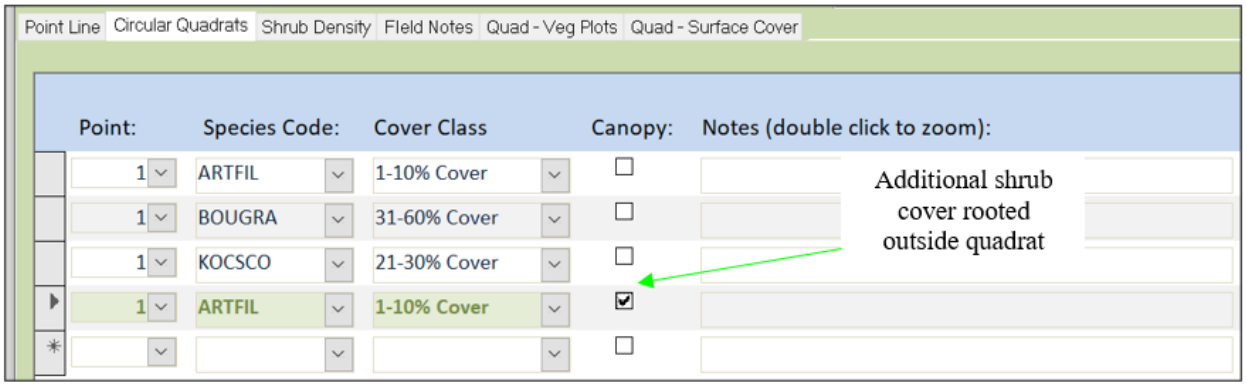

Figure 1. Circular Quadrats Tab in the Data Entry Form, showing the quadrat number (Point), the Species Codes and Cover Classes. When entering additional cover from woody species rooted outside the quadrat, be sure to check the "Canopy" box. The line will then highlight in green. NPS figure

Aid for Ocular Estimation

The validity of ocular estimation has come into question due to observer variability both within and across seasons. It is of critical importance that observers be well trained at the beginning of the season and recalibrate their estimations on a regular basis during the field season. Cover of plant species will be estimated using two different procedures: by ocular estimate in the quadrats and through the Line-Point Intercept protocol, which currently has greater validity within the scientific community. Comparisons of these two estimates will be made to determine the degree of observer error for future monitoring effort.

Here are some visual aids to calibrate observer estimation:

Figure 21 on Page 84 in: Adams, B.W., G. Ehlert, C. Stone, M. Alexander, D. Lawrence, M. Willoughby, D. Moisey, C. Hincz, A. Burkinshaw, J. Richman, K. France, C. DeMaere, T. Kupsch, T. France, T. Broadbent, L. Blonski, and A.J. Miller. 2016. Rangeland health assessment for grassland, forest and tame pasture. AEP, Rangeland Resource Stewardship Section. Field Workbook.

Figure 4.2 on Page 135 in: Walmsley, M., G. Utzig, T. Vold, D. Moon, and J. van Barneveld (eds.). 1980. Describing ecosystems in the field. RAB Technical Paper 2, Land Management Report No. 7. Province of British Columbia, Ministry of Environment and Ministry of Forestry.

QA/QC and Database Backup

Once data collection is finished, the crew lead (or lead technician) is responsible for ensuring that all QA/QC checks are completed, and, if using the database, that a pdf of the field data is printed and a backup of the database is made before leaving the plot.

1. Confirm that 10 quadrats were sampled. There is a query for this in the database.
2. To verify that species were recorded correctly, read through the listed species codes and check for misspellings or species that are not on the park species list. In the database, a list of species recorded may be queried. Any plants that are not on the park species list must be labeled as unknowns (see SOP #10).
3. Confirm that all unknown plants have been collected or photographed and entered into the Unknown Plant Tracking Log (see SOP #10).
4. If using the database, print a pdf of the plot data, exit the database and save a backup.