Terrestrial Assessment, Inventory, and Monitoring Program Calibration Protocol

Why Calibrate?

- "Calibration of data gatherers is an integral component of the quality assurance process. Calibration ensures that a data gatherer collects data accurately each time and that data are collected consistently with other data gatherers…" *Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems: Volume 1 2nd Edition* (Herrick *et. al.*, 2017), page 4.
- Calibration ensures the defensibility and integrity of data by providing evidence that the data are consistent and trustworthy.

Before Getting Started

- Calibration can be time consuming, please allow for adequate time in your work plan for this.

What Methods to Calibrate on

- Line-point intercept (LPI) (required)
- Canopy gap intercept (required)
- Vegetation height (required)
- Species inventory (required)
- Soil texturing (recommended)

When to Calibrate

- A significant change in vegetative community*
- A new data collector joins the team
- If a month has passed since the last calibration
- Optional: soil texturing calibration to be completed once per month

*Vegetative communities can be significantly different in stratum, it is up to the discretion of the Project Lead or Crew lead to decide whether that difference in vegetative community is great enough to call for a calibration. For example, a crew may have only encountered grass-dominated sites. If within same stratum new site is shrub-dominated a calibration is in order.

How to Calibrate

Materials:

- ❏ Transect tape (Remember to take care to not trample the sample area along the transect or to move the tape)
- ❏ Chaining pins (or other anchoring tools for the transect)
- ❏ Paper data sheets or electronic data capture device (Survey123, DIMA)
- ❏ Pins for LPI (flag pins or similar)
- ❏ Multi-tool or other means of measuring vegetation height and canopy gap, height pole
- ❏ *Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems: Volume 1 2nd Edition*
- ❏ Optional: Soil samples (5 minimum) that have been lab tested and/or verified by a soils expert that represent a range of textures (e.g., sand, sandy loam, loam, clay, silt).
- ❏ Optional: Soil texture worksheet
- ❏ Optional: Spray bottle and water (deionized, reverse osmosis, or distilled) for texturing

Steps to Calibrate on Methods:

1. Establish a standard length transect for your project (e.g., 25 m) in a location representative of the ecosystem where AIM data will be collected.
2. Have *each* data collector complete LPI, vegetation height, and canopy gap intercept along the transect.
    a. Take care to protect the left side of the transect, as multiple runs through a line may change the observed environment.
    b. If there is a large number of observers to calibrate, set up a separate transect for each method.
3. For species inventory, establish a second standard length transect 120 degrees from the transect the transect used for LPI.
    a. This will create a wedge, simulating one of the wedges that a standard AIM plot with three transects would create.
    b. Walk the wedge following species inventory protocol outlined in the *Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems: Volume 1 2nd Edition* (Herrick *et. al.*, 2017), recording the number of species found in 5 minutes.
4. Calculate the calibration indicators for each observer. You may do this manually with a calculator or using an indicator report on your electronic data capture device.

5. Compare results between observers. Verify the ranges between observers against the calibration criteria (Tables 1-3).
6. If any range between observers (see Tables 1-3) is greater than the acceptable range, attempt to identify why calibration was not achieved.
7. All indicators for a method must meet the defined criteria for that method to be considered calibrated. The data collectors must repeat the whole method, for all indicators, if they demonstrated that they were not calibrated for one or more indicators. However, if the data collectors calibrate on one method's criteria but not another method's criteria, then they only repeat the calibration for the method that did not meet the criteria. See example on page 4.
8. Repeat the calibration exercise on a new transect until each method is completely calibrated. If the crew values were highly variable, you may increase the sample size by doubling the transect length or including a second transect on subsequent calibration attempts.

Steps to Calibrate on Soil Texture:

1. Select a minimum of 5 samples that have been lab tested and/or verified by a soils expert that represent a range of textures (e.g., sand, sandy loam, loam, clay, silt).
2. Each crew member will texture and record their classification for each sample on a soil texture worksheet (see pages 14 & 15 of this document).
3. To meet calibration criteria, each crew member must exactly match the official soil classification for 2 or more samples (40% of the sample population) and match the official classification or an adjacent classification (using the soil texture triangle) for 4 or more samples (80% of the sample population).

Example:

Jane records a tested soil sample as being a sandy loam. The lab testing had determined that the soil was actually a loam. Jane cannot count this as one of her two exact matches, but the loam and sandy loam polygons are adjacent on the soil texture triangle and so she can count it towards her four for the lower precision criterion.

What If the Calibration Criteria is Not Met?

- ➔ Identify the methods and indicators that exceeded the acceptable range of variation
- ➔ Discuss possible reasons with one another and compare technique and definitions
- ➔ Remember that an outlier value may be the most correct one
- ➔ Consider equipment used (*e.g.* Did all of the collectors use the same pin?)

Examples:

If Jack collects a litter cover of 10%, Pablo collects a litter cover of 22%, and Jane collects a litter cover of 12% then the range of values is 12% (22 - 10 = 12) which is greater than the maximum permitted range of 10% and the crew must repeat the LPI calibration for all indicators.

If Pablo, Jane, and Jack do not meet the criteria for all canopy gap intercept indicators but do calibrate on LPI, each collector will repeat only the canopy gap intercept method until collectors meet the acceptable range of variation for all canopy gap intercept indicators.

Other Resources Discussing Calibration:

➔ Please see pages 10 through 13 of this document.

> **10 2 2**
>
> Considering all data collectors, Gap intercept and LPI indicators must have a range of less than or equal to **10%**, each height category must have a range of **2** or fewer records, and Species Inventory species counts must have a range of **2** or fewer.

Table 1. Canopy gap calibration criteria

Canopy gap size class	Calibration Criteria
25 cm to 50 cm	Absolute difference ≤10%
51 cm to 100 cm	Absolute difference ≤ 10%
101 cm to 200 cm	Absolute difference ≤ 10%

Table 2. Species inventory calibration criteria

Species inventory indicator	Calibration Criteria
Total Species Recorded Along Transect	Absolute difference ≤ 2 species records in number of species recorded

Table 3. Vegetation height calibration criteria

Vegetation height class	Calibration Criteria
Count of Woody Plants: 0 to 50 cm	Absolute difference ≤ 2 height records
Count of Woody Plants: 51 cm to 1 m	Absolute difference ≤ 2 height records
Count of Woody Plants: 1.01 m to 2 m	Absolute difference ≤ 2 height records
Count of Woody Plants: >2m	Absolute difference ≤ 2 height records
Count of Herbaceous Plants: 0 to 10 cm	Absolute difference ≤ 2 height records
Count of Herbaceous Plants: 11 cm to 30 cm	Absolute difference ≤ 2 height records
Count of Herbaceous Plants: 31 cm to 50 cm	Absolute difference ≤ 2 height records
Count of Herbaceous Plants: > 50 cm	Absolute difference ≤ 2 height records

Table 4. Line-point intercept calibration criteria

Line point intercept cover indicator	Calibration Criteria
Foliar Cover	Absolute difference ≤ 10%
Basal Cover	Absolute difference ≤ 10%
Rock Fragments	Absolute difference ≤ 10%
Litter Cover	Absolute difference ≤ 10%
Standing Dead	Absolute difference ≤ 10%
Bare Ground	Absolute difference ≤ 10%

Table 5. Soil texture calibration criteria

Soil texture criteria	Calibration criteria
Soils exactly matching official classification	Sample proportion ≥ 40%
Soils matching official classification or adjacent classification	Sample proportion ≥ 80%

Calculating Indicators

Calculating Indicators on Paper

At a Glance:

- ➔ Indicators from the above tables can be calculated on paper or via electronic report.
- ➔ LPI data sheets contain information for LPI indicators, Vegetation height, and Species inventory.
- ➔ Canopy gap intercept data sheets record information for canopy gap and basal gap observations.

Materials:

- ❏ Pen or pencil
- ❏ Calculator (or calculator app; optional depending on math confidence)
- ❏ Calibration data sheet
- ❏ LPI data sheets
- ❏ Gap data sheets

> Tips & Examples
>
> ➔ Examples of calculating LPI indicators and indicator variation are found in the *Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems: Volume 1 2nd Edition* (Herrick *et. al.*, 2017), on pages 13 and 35.

How to Calculate LPI Indicators on the Standard LPI Data Sheet

For each of the following, divide by the total number of points recorded and multiply by 100. For a 25 point transect, the math is 100 / 25, the same as multiplying by 4.

- % foliar cover = # of points with a species recorded in the Top Layer column
- % basal cover = # of points with a species code at the soil surface
- % rock fragments = # of points with a rock code (“R”, “CB”, *etc.*) at the soil surface
- % litter = # of points with a litter code (“L”, “WL”, etc.) recorded in a Lower Layer column

- % standing dead = # of points with one or more species codes circled
- % bare ground = # of points with no species recorded and "S" at the surface

Calculating Gap Intercept Indicators using the Gap Intercept Data Sheet

1. Find the length of each gap (End - Start = Length) and record it under the appropriate size class.
2. Find the sum of all of the gap lengths in each listed size class.
3. Divide each sum by the length of the transect and multiply by 100 to find % of line in each gap class.

Examples:

- ➔ A gap starting at 120 cm and ending at 162 cm would be 162 - 120 = 42 cm long and would be recorded in 25 to 50 cm class. A gap of 125 cm would belong to the 101 to 200 cm class.
- ➔ If you only had a 25 cm gap, a 42 cm gap, and a 33 cm gap, the sum in the 25 to 50 cm class would be 27 + 40 + 33 = 100 cm.
- ➔ A total of 100 cm in gaps 25 to 50 cm on a 25 m transect would make up 100 cm / 2500 cm * 100 = 4% of the transect.
- ➔ See the *Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems: Volume 1 2nd Edition* (Herrick *et. al.*, 2017), pages 45 and 13 for examples of calibrating on gap intercept.

Calculating Vegetation Height Indicators using the LPI Data Sheet

1. Record the heights of woody and herbaceous plants according to the protocol.
2. Tally the number of plants recorded by height category and growth habit.
3. Compare the tallies by category to confirm that the ranges in counts are ≤ 2.

Examples:

- ➔ A grass recorded at 8 cm would count as one record for herbaceous plants 0 to 10 cm.
- ➔ If for woody plants 11 to 30 cm tall, one observer had 11 records and another had 14 the range would be |11 - 14| = 3 and because 3 is not ≤ 2 they therefore would not be calibrated.
- ➔ See the *Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems: Volume 1 2nd Edition* (Herrick *et. al.*, 2017), page 38 and 39.

Calculating Indicators for Species inventory

1. Refer to the Species inventory data sheet.
2. Tally the number of unique species codes, including unknown codes, recorded in the wedge by each data collector.
3. The number of species recorded by each observer should not differ by more than 2.

Note: For calibration, do not consider whether the codes match between observers, only how many unique codes were used.

Calculating Indicators in DIMA

Please refer to the Calibration Report Generation Handout found on the AIM Landscape Tool Box website.

Calculating Indicators in Survey 123

To follow.

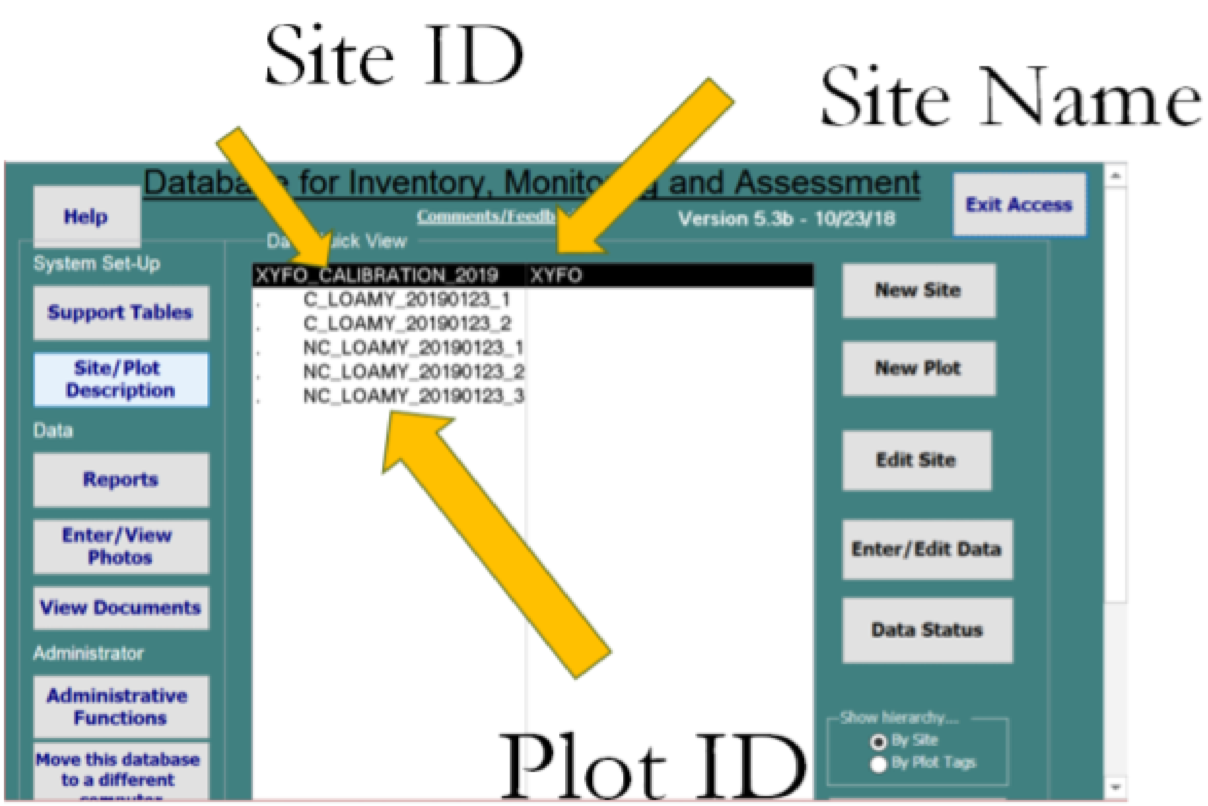


Figure 1. Example of storing data in the DIMA from the Calibration Report Generation Handout.

Managing Calibration Data

- ➔ Calibration data must be organized using a uniform naming method for analysis.

Storing Data

Note: All naming schemes are in all capital letters and all dates are YYYYMMDD (*e.g.* 20190420)

- ➔ Crews will create a separate filename following the pattern of [STATE CODE]_[PROJECT NAME]_CALIBRATION_DIMA[DIMA version number]_[Current year], *e.g.* UT_BURLEYFO_CALIBRATION_DIMA5_3b_2019.
- ➔ Within that file, there must be a site with an ID following the pattern of [PROJECT NAME]_CALIBRATION_[Current year], *e.g.* BURLEYFO_CALIBRATION_2019. **The site name must be the project name**, *e.g.* BURLEYFO.
- ➔ Projects with multiple crews will assign each crew a letter as a way to distinguish separate crews in the site name e.g. BURLEYFO_A_CALIBRATION_2019, BURLEYFO_CALIBRATION_B_2019. Instead of using a unique letter for every grouping of data collectors, it is suggested that each crew lead be assigned a letter. They will then continue to use their letter as an identifier for their site name **even if their crew composition changes**. See Figure 2.
- ➔ Individual calibration events will each be a separate plot and named with the sample design strata names for the ecosystem (or whatever method for strata your FO sample design uses) that the data collectors are calibrating in following the format C_[STRATUM NAME]_[Current date]_[Number of calibration attempt], *e,g.* C_LOAMY_20190604_1 or C_FOREST_20180814_1.
- ➔ If a crew does not calibrate on any methods along the transect, the plot name prefix must be changed from C_ to NC_ and each subsequent calibration attempt will increment the [Number of calibration attempt] by 1, *e.g.* label the plot C_LOAMY_20190123_1 becomes NC_LOAMY_20190123_1 and the next calibration attempt at that location is C_LOAMY_20190123_2, *etc*. This can be accomplished by using the Edit Plot button in DIMA. If you only calibrate on one method, save the This naming scheme may result in the crews having multiple calibrated plots (C) and not calibrated plots (NC). For an example, see Figure 1. C_LOAMY_20190123_1 contains the calibrated LPI indicator data. C_LOAMY_20190123_2 contains the data for Gap intercept, Species inventory, and Vegetation height indicators. The NC_LOAMY_20190123_x are the plots where the crew did not calibrate on indicators for any methods, hence the "NC_" prefix (not calibrated).
- ➔ Although only one transect is being sampled, create a transect for each crew member in the **SAME** calibration plot. Crews of five must have five total lines, crews of three must have three lines total. All plots are under the same XYFO_CALIBRATION_YEAR site ID. There is only one site per calibration DIMA per crew. DIMAs may have more than one site if they contain information for multiple projects or field offices.
- ➔ Crews will complete the methods described in the *Monitoring Manual for Grassland,*

Shrubland, and Savanna Ecosystems: Volume 1 2nd Edition (Herrick *et al.*, 2017). To verify accuracy within 10%, 2 species, and 2 height categories, crews will generate reports with DIMA. Explicit directions and screen shots are available in the Calibration_Report_Generation_AIM_2019 powerpoint presentation and handout (Appendix VII).

➔ If it takes a crew multiple days to calibrate in an area, the date of the day the calibration was *started* is used instead of the current date. This way all of the plots for that calibration are using the **SAME** date. For example, if a crew started calibrating on 20190401 but did not finish until 20190403, their DIMA plot names would all use the date 20190401.

Above From The BLM's Terrestrial Assessment, Inventory, and Monitoring (AIM) 2019 Field Season Data Management Protocol VERSION 4.0, page 12.

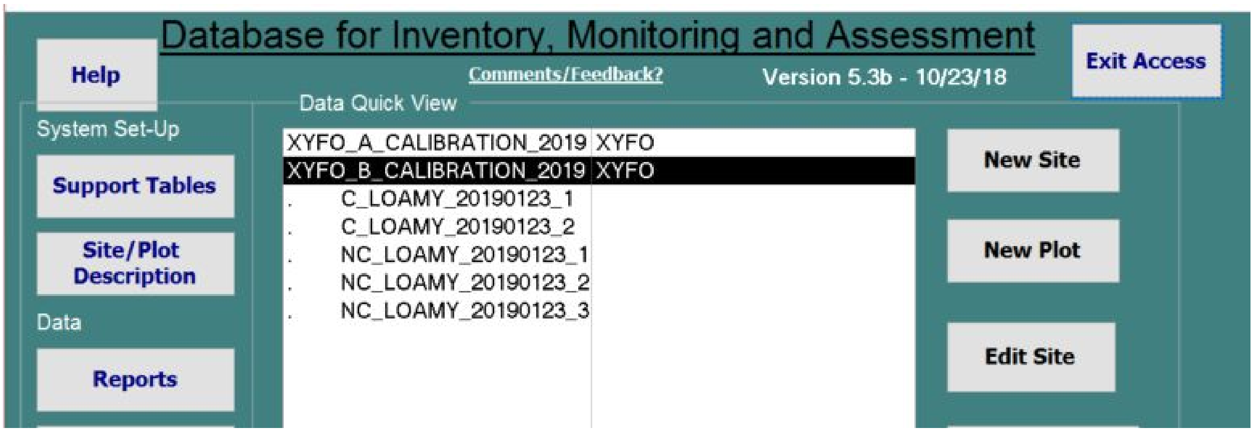


Figure 2. Example of a DIMA containing data for a project with two crews for the 2019 field season.

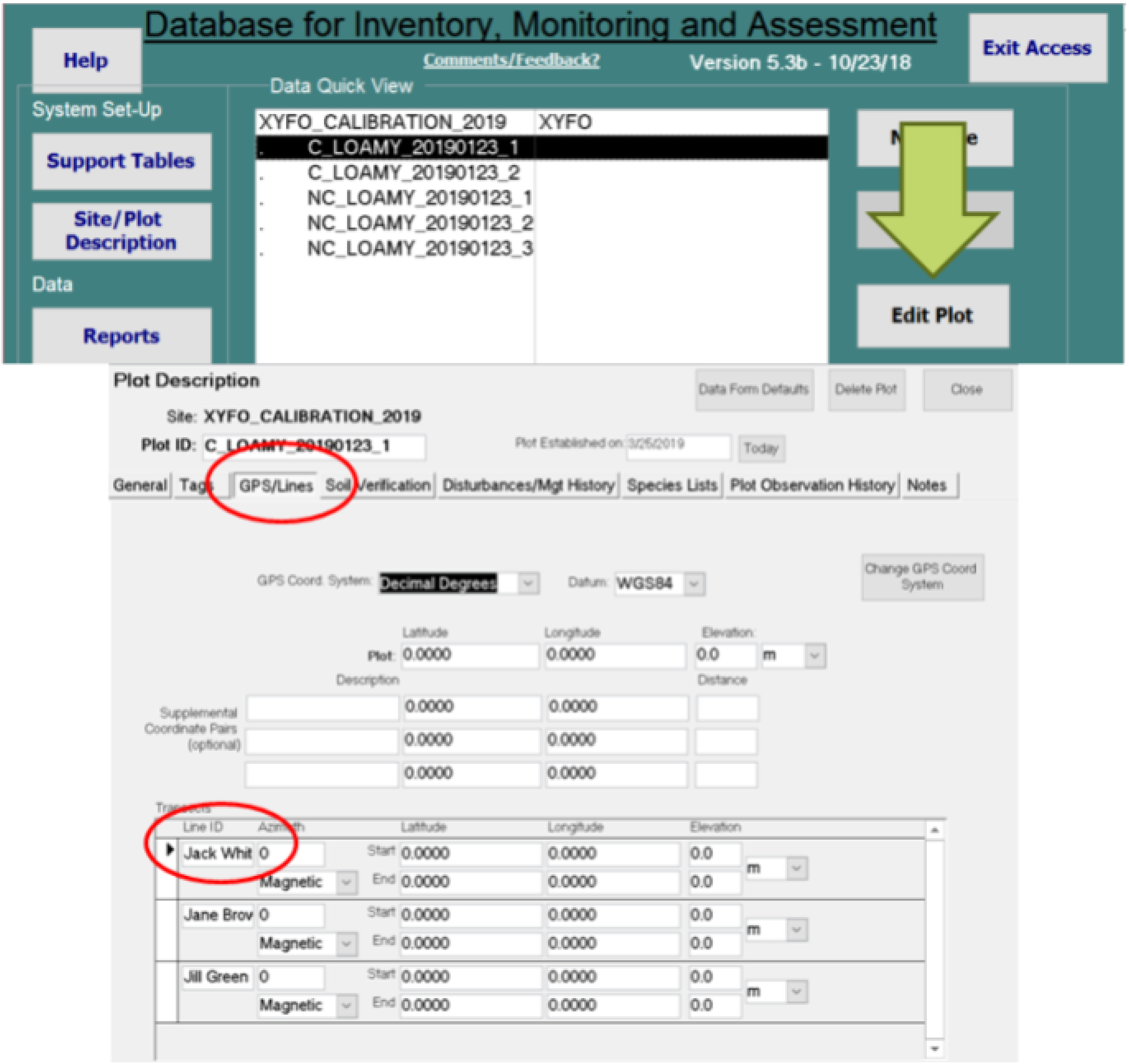


Figure 3. Example of naming transects after data collectors.

Resources on Calibration:

Calibration Resources:

- Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems
    - Page 4 and 9 mention that calibration is a necessary part of QA/QC and designing a monitoring plan
    - Page 11-13 - Instruction for calibrating, recalibrating, required calibration criteria (how close crew members must be), examples of LPI, Gap and Height calibration forms
    - Page 29 - "During calibration, there may be slight differences at points along the vegetation measurement line as pin hits will not be repeated exactly (especially in windy conditions or if plants have small or single-stemmed bases), but in aggregate over a plot each indicator is detected consistently between data gatherers."
    - Page 60 - Examples of plot data summaries and how to calculate each for calibration
- landscapetoolbox.org
    - Core Method Data Forms - Calibration form available
- aim.landscapetoolbox.org
    -
    - Terrestrial Quality Control - this page discusses why calibration data is required during data submission and how it should be submitted.
    -
    - Training - this page discusses the importance of calibration during training and throughout the field season.
    - Supplemental Monitoring, Sample Sizes and Frequency - this page provides a reminder about the importance of quality assurance and quality control (such as calibration) in supplemental methods.
    -
- Data Management Protocol Version 4 -
    - Page 6 - one of the required data components to be submitted at the end of the season (in a separate DIMA)
    - Page 7-8 - 2.2 PROJECT LEAD QUALITY ASSURANCE (QA): DURING DATA COLLECTION

        - "Ensure that regular calibrations (monthly, when ecotype changes, or when new crew member joins) are completed by checking your field crew's DIMA periodically."
    - Page 8 - 2.3 PROJECT LEAD QUALITY CONTROL (QC): AFTER DATA COLLECTION
        - "Check field crew calibration results, once after their first hitch and periodically throughout the field season."
        - "Confirm that the Calibration data is stored in a separate DIMA and that it is part of the data package."
    - Page 11 - Under Field Crew Data Management; Field Crew QA; Monthly and Change in Ecosystem Type QA Steps
        - " you should calibrate data gatherers (see section 3.1.2) for each method in the protocol (please see the next section, 3.1.2 Field Crew Calibration and the 2nd Edition of the Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems: Volume I for detailed instructions)"
        - 3.1.2 FIELD CREW CALIBRATION - I won't paste all of it here but there is a lot of information on calibration in this section
    - Page 14 - 3.2 FIELD CREW QUALITY CONTROL: AFTER DATA COLLECTION
        - "Create one DIMA for the project data (and separate DIMA for calibration data) and confirm that the BLM-approved version of DIMA was used (please see Quality Control section of the aim.landscapetoolbox.org for the correct version to use).
    - Page 16 - Field Crew DIMA QC
        - "Maintain calibration data in separate DIMA to ensure that calibration data and project data are not combined (See section above 3.1.2 Field Crew Calibration for naming convention)."
    - Page 17 - State AIM Monitoring Coordinator QA/QC
        - "Ensure that regular calibrations are completed by checking their DIMA periodically."
        - "Keep each project's calibration DIMA separate, but include them all in the final data transfer. Make sure that naming conventions have been adhered to - see Field Crew Calibration in section 3.2.1"
    - Page 18 - NOC QA/QC
        - "Ensure that regular calibrations are completed by checking in with projects periodically."
    - Appendices - calibration included in the checklists

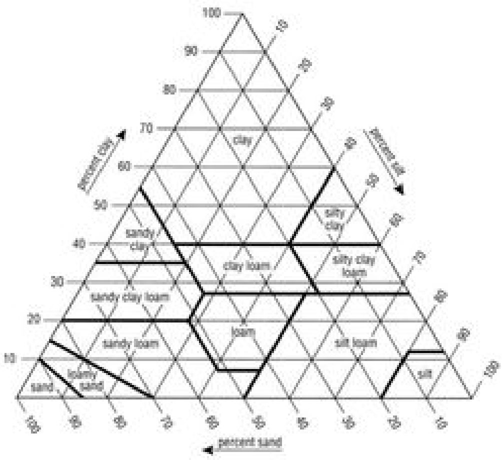
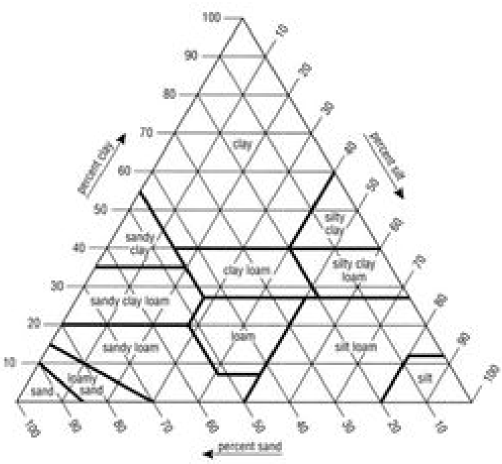
Online Resources:

- ➔ https://aim.landscapetoolbox.org/quality-assurance-quality-control/quality-assurance/
- ➔ https://aim.landscapetoolbox.org/quality-assurance-quality-control/quality-control/terrestrial-quality-control/
- ➔ https://aim.landscapetoolbox.org/wp-content/uploads/2019/02/AIM_DataManagmentProtocol_V4.0.pdf
- ➔ https://aim.landscapetoolbox.org/wp-content/uploads/2019/03/calibration_report_generation_handout_2019-1.pdf

Name_______________________________ **Page** ____ **of** ____

Soil Texture Calibration Form

For each soil sample, use the soil texture key to determine the texture by feel. Record the texture class, estimated % clay, and the position on the texture triangle for each texture.

	Texture Class	**Percent Clay**
	Estimate: Actual:	Estimate Actual
	Estimate: Actual:	Estimate Actual

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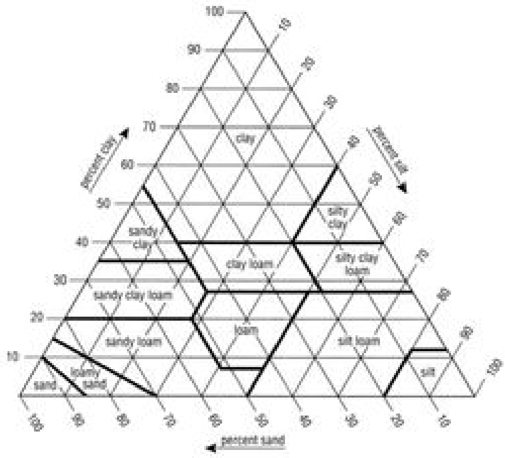
<td>
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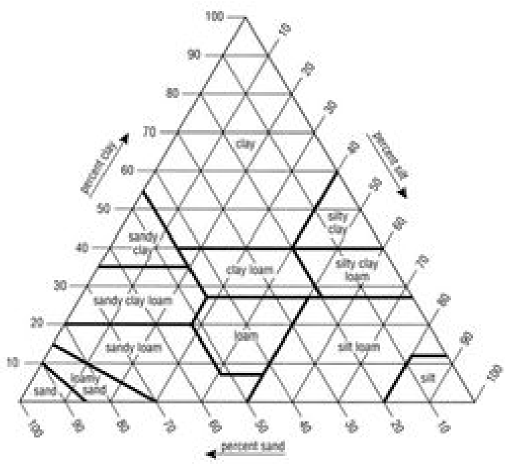
<td>
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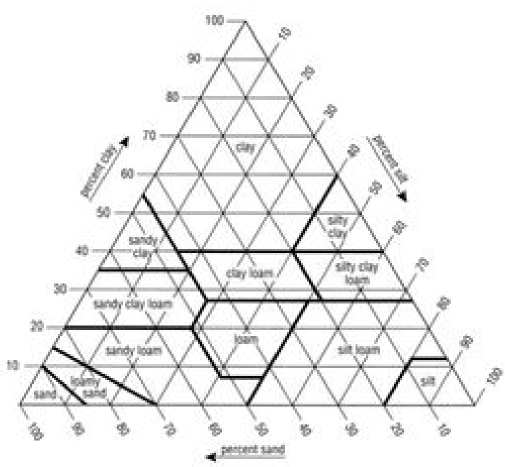
<td>
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