

SOP 11: Data Quality Assurance and Quality Control

Version 2.0 (January 2022)

Overview

Careful, accurate data collection and stewardship are critical to the success of the vegetation monitoring program. This SOP describes data quality assurance and quality control (QA/QC) procedures for the vegetation monitoring process. Ensuring data quality must be a priority during training, and throughout the data collection, entry, verification, and validation process.

Field teams will typically consist of a field crew leader, who is the lead botanist or protocol lead, and one or two additional crew members. Ideally all members of the field team will have read all protocol SOPs and attended annual training at the beginning of each field season. However, CUPN invites and encourages park personnel to participate in field data collection as much or as little as their schedule allows. This assistance and interaction in the field is always appreciated! With that said however, it is important to assign tasks based on a team members previous training and experience with this protocol. It has been a common practice in the past to assign minimally trained and inexperienced crew members the task of data recorder or scribe. However, in an effort to evaluate and potentially reduce data recording errors, this is discouraged beginning with the 2020 field season. Instead various tasks have been highlighted in the field SOPs for this protocol that can be assigned to “temporary” assistants with limited training and/or experience. Examples include verifying tag tree information and laying out 10 m² quadrats ahead of the botanist.

The lead botanist will:

1. collect data according to established methods
2. possess adequate plant id skills for completing assigned tasks
3. understand how to correctly complete data forms in the field
4. collect and process unidentified plants and/or plants new to the park

Crew members will:

1. correctly and legibly record all data values on the data sheets
2. complete all assigned tasks
3. adhere to any additional instruction provided by more experienced crew in the field
4. when in doubt, about plant id or methods, ask questions

Data Collection

Field data are collected by entering data onto a series of paper datasheets. Field data may in the future be collected using handheld devices or field laptops.

Regardless of the data collection method, all data values shall be called out by the “measurer” and repeated by the recorder when one crew member is measuring and one crew member is recording. The measurer shall clearly call out the value to be recorded. The recorder shall clearly

repeat the value aloud as it is recorded, to ensure that the value was heard and recorded accurately. If the measurer does not hear a response from the recorder, the measurer shall repeat calling out the measurement until a response is obtained. If the measurer hears a different value from the value measured, the measurer must immediately correct the value.

Datasheets

Carry datasheets within an enclosed clipboard to keep them clean, dry and secure in one location. **Print legibly** all information on datasheets using pencil.

Once data collection is complete and before leaving the plot, crew members must review all sections of the paper datasheets to ensure all fields are complete and no obvious errors exist. Each data sheet should be reviewed by someone other than the person who originally recorded the data on that sheet. Once it has been determined that the data sheet is complete, the reviewer will sign his or her initials in the “Reviewed by” box in the header for each SOP on the field data sheets. Common data omissions to keep an eye out for include:

1. Decay Class for standing snags on the Tree sheet
2. Incomplete plot diagram
3. Any data associated with the last few trees or herbaceous plants in the plot
4. Failure to map all trees >10 cm DBH
5. Coarse woody debris data for both transects
6. Lack of marks indicating which species were collected
7. USNVC classification information
8. Incomplete plot establishment information including detailed directions to plot and total time on plot
9. Failure to record a presence value in the herb (SOP 7) list after having recorded it in tree or seedling data

Field data forms will be maintained by CUPN and the lead botanist on the team will be able to request digital scans of datasheets if needed to aid in plant specimen review. Once all specimens have been reviewed, the lead botanist communicates with CUPN to update the original datasheets, while photocopies/digital scans may remain with the botanist (e.g., NatureServe offices).

Datasheet Review and Midseason Training

Upon return to the office and prior to scanning, datasheets are reviewed again by experienced staff for data collection errors and/or omissions. Substantive or consistent issues are to be communicated back to the field crew members as soon as practicable. Additionally, an interim field season training or check-in will be scheduled to discuss among other topics, an overview of field data collection issues. This session, which will most likely be conducted via teleconference, should at minimum include the protocol lead, data entry staff and those involved in data collection.

Data Entry

The goal of data entry is to transcribe field observations into a computer database with 100% accuracy. Recognizing however, that errors are unavoidable verification steps are incorporated. As a general rule, the following guidelines are used for data entry for all CUPN projects:

1. To the extent possible and practicable, data entry will be automated
2. Data will be entered as soon as reasonably possible following collection
3. Data entry will be completed by someone familiar with data collection
4. Data will be entered into pre-designed database forms that resemble field sheets and maximize error control

When the person entering data is uncertain about writing, she/he will highlight that information and follow-up with the field crew to get clarification on what they intended.

Currently data are entered into the Vegetation Monitoring Database from the paper field forms. Before interacting with the data, users must log into the database. This allows the database to track primary tasks (with time stamp) including Entry Started, Entry Complete and Verified (i.e., verification complete) (Figure 11.1). **An “in-house” user manual is utilized for the database and will be reviewed before attempting data entry. In addition, the data manager and or protocol lead will be contacted prior to initiating data entry to ensure database versions, plant lists, etc. are up to date and to determine what level of data entry training is needed.**

The database incorporates many functions and utilities to help reduce data entry errors such as look-up fields and appropriate upper and lower bounds for fields. However, care must be taken to avoid any potential entry errors. If there are any uncertainties about an entry (e.g., data are illegible or inconsistent with the database), do not guess. Instead, mark the data sheet with a Post-it Note. Describe the illegible or inconsistent entry on the Post-it Note with an arrow pointing to the questionable item. In addition, utilize the data entry notes fields in the database, as these will be reviewed during the data verification and validation processes.

At the conclusion of data entry for a plot, the data entry person will press [Entered] on the database form (Figure 11.1). This opens a new database form providing tallies of various fields such as number of crew members, number of plot diagrams (should be 1), number of tree, herb, seedling/sapling, coarse woody debris records, as well as number of “non-standard” plant names and missing fields (with hyperlinks to the records). Before continuing to mark the plot data entry as being complete, the database asks if the tallies are an accurate reflection of what is actually on the datasheets, prompting the data entry person to double-check. If the data entry person is in agreement, they trigger another button in the database that tags the record as “data entry complete” with user id and time stamp. Once entered, database users do not have the ability to directly modify these fields.

Completed Tasks	Date
Entered CB	10/22/2019 3:54:41 PM
Notes:	
Updated: CB	12/17/2019 10:08:52 AM
Notes:	
Verified CB	12/17/2019 10:11:23 AM
Notes:	
Valid. start	
Valid. done	
Notes:	
Certified	
Notes:	

Figure 11.1. CUPN Forest Veg Monitoring database, plot data completed – completed data lifecycle or processing steps (plot level).

After each plot is entered, the person entering the data will print their initials and date in the lower right corner of the field data sheets, page 1 (See SOP 3: Site Selection and Plot Establishment).

Data Verification

Following data entry, network staff implement additional procedures to ensure data are accurately and completely entered into the database. As already noted, the protocol database (Microsoft Access) incorporates many functions to reduce data entry errors including lookup

Data Verification - Quality Assurance tools or processes where data are checked for accuracy and inconsistencies as they migrate through the data management lifecycle. Data Verification helps to ensure that data are complete, properly formatted so that they can be processed, and accurately translated when transferred from one source to another.

fields, restrictions on data types and upper/lower bounds on fields. Data entry forms are also configured to match the field forms as much as possible to aid the data entry process.

During the data entry process the database checks for a number of errors and prompts the user when the focus is moved from a field or row. Examples of warnings include:

- Species is not known to occur in park
- Distance to primary geocoordinates is large
- Tree diameter is generally not so large
- Tree species should also be listed in herb data
- Duration of sampling is out of usual range
- Directions to plot is blank but is generally filled in

Examples of errors include:

- At least one presence value is required for each species
- Spherical densiometer tally should be between 0 and 96
- Species is duplicated in this module-corner
- UTM Zone does not match park UTM Zone
- Code is invalid (multiple fields including species codes)
- Image file is not found in the server folder

In excess of 200 such warnings and errors can be found in the protocol database in tbl_valid_cert_type. These are automated checks that are summarized for the user in various locales in the database (Figure 11.2). It should be noted that many of the warnings/errors are actually validation checks (e.g., species not known to occur in a park) and will be addressed in the validation process outlined below. The goal of data entry and subsequent verification is not singularly on correcting all warnings and errors but rather to ensure that the entered data match the data (errors and all) found on the paper field forms. The purpose of the warnings/errors is to draw the user's attention at this phase to make sure that an error did not occur during entry. The messages provide an opportunity to double-check these values against the paper filed forms. Once the value has been double-checked, and it is determined to be an error on the field data form than a note is made in the database (record level data entry notes) indicating that the value was indeed recorded in the field in error. These errors will be addressed later during the

validation process, but this approach allows for the documentation and subsequent correction of errors originating in the field. Additionally, data are entered by someone who is experienced in field data collection for this protocol. During the data entry process if they see a value that does not return an error or warning message but still seems suspect, they have the ability to flag the record for additional follow up by the protocol lead and/or field crew leader.

Following data entry and double-checking all warnings and errors, two individuals will conduct a 100% review of all entered data. This is a tedious process but is important to ensuring data quality. During this process, one individual will read entries (row by row) in the database, while a second individual looks at the paper field form to make sure the value being read matches what is on the datasheet with any discrepancies being addressed before moving on in the review process.

After each plot is verified, the person doing the verification will add their initials and date in the lower right corner of the field data sheets, page 1(See SOP 3: Site Selection and Plot Establishment). This individual will also press [Verified] on the database form (Figure 11.1). This indicates to the protocol lead (and others) that the plot data are now ready for validation.

Unit Code	Subunit Code	Event	Start Date	Event Type	Permanent Plot	Event status	Flags	Errors	recheck
MACA	MACA	MACA040	9/8/2014	plot establishment	yes	Validation Complete	0	0	
MACA	MACA	MACA039	9/8/2014	plot establishment	yes	Validation Complete	0	0	
MACA	MACA	MACA031	9/8/2014	plot establishment	yes	Validation Complete	0	0	
MACA	MACA	MACA036	9/8/2014	plot establishment	yes	Validation Complete	0	0	
MACA	MACA	MACA041	9/9/2014	plot establishment	yes	Validation Complete	0	0	
MACA	MACA	MACA034	9/9/2014	plot establishment	yes	Validation Complete	0	0	
MACA	MACA	MACA037	9/9/2014	plot establishment	yes	Validation Complete	0	0	
MACA	MACA	MACA033	9/9/2014	plot establishment	yes	Validation Complete	0	0	
MACA	MACA	MACA036Q	9/10/2014	QA/QC	yes	Validation Complete	0	0	
MACA	MACA	MACA031Q	9/10/2014	QA/QC	yes	Validation Complete	0	0	
MACA	MACA	MACA038	9/10/2014	plot establishment	yes	Validation Complete	0	0	
MACA	MACA	MACA035	9/10/2014	plot establishment	yes	Validation Complete	0	0	
MACA	MACA	MACA042	9/11/2014	plot establishment	no	Validation Complete	0	0	
MACA	MACA	MACA037Q	9/11/2014	QA/QC	yes	Validation Complete	0	0	
MACA	MACA	MACA043	9/11/2014	plot establishment	yes	Validation Complete	0	0	
MACA	MACA	MACA032	9/12/2014	plot establishment	yes	Validation Complete	0	0	
MACA	MACA	MACA039	9/9/2019	plot revisit	yes	Verification Complete	4	4	
MACA	MACA	MACA040	9/9/2019	plot revisit	yes	Verification Complete	5	5	
MACA	MACA	MACA031	9/9/2019	plot revisit	yes	Verification Complete	0	0	
MACA	MACA	MACA036	9/9/2019	plot revisit	yes	Verification Complete	5	2	
MACA	MACA	MACA033	9/10/2019	plot revisit	yes	Verification Complete	1	1	
MACA	MACA	MACA037	9/10/2019	plot revisit	yes	Verification Complete	4	4	
MACA	MACA	MACA034	9/10/2019	plot revisit	yes	Verification Complete	1	3	
MACA	MACA	MACA041	9/10/2019	plot revisit	yes	Verification Complete	1	0	
MACA	MACA	MACA032	9/11/2019	plot revisit	yes	Verification Complete	9	10	
MACA	MACA	MACA043	9/11/2019	plot revisit	yes	Verification Complete	0	0	
MACA	MACA	MACA037Q	9/11/2019	QA/QC	yes	Verification Complete	1	1	
MACA	MACA	MACA035	9/11/2019	plot revisit	yes	Verification Complete	0	1	
MACA	MACA	MACA036Q	9/12/2019	QA/QC	yes	Verification Complete	8	4	
MACA	MACA	MACA038	9/12/2019	plot revisit	yes	Verification Complete	2	0	

Figure 11.2. CUPN Forest Veg Monitoring database Overview of Events form summarizing the event status, data entry flags and errors for each plot in the filtered list.

Data Validation

At this point steps have been taken to ensure data in the database are an accurate reflection of what was on the datasheets. This step (i.e., validation) involves making sure entries make sense and issues such as ‘new species’ and ‘invalid codes’ are addressed.

Ultimately at the end of validation, all images should be on the server with correct names and locations and all flags and/or errors have been addressed (i.e., resolved or in some cases suppressed). Data validation is performed by the protocol lead. The protocol lead maintains a draft “user manual” of validation processes and steps to perform to aid in consistency and completeness across years. Validation processes include:

- Ensure all images are on server. This check will also verify that file naming convention has been adhered to because database will look for files with the specific naming convention.
- Double-check each plot to make sure primary geocoordinates are reasonable (i.e., within 10m of target)
- Resolve all remaining errors. Ideally the only remaining errors will be taxonomic related (i.e., new to parks or invalid species codes). In regard to invalid species codes the data entry person was instructed to not change but rather enter what was on the field datasheet and make a note of what they believed the code should be, as appropriate.
- Add/update taxa on park list in `tbl_Plant_Concepts`. This includes a cross-check of Weakley (2020) to evaluate species presence and abundance for the state x physiographic province of the park. Is it common, uncommon, rare? Would it be a range extension? What was the ID confidence of the botanist?
- Remove blank herb record rows (i.e., Species detected during previous sampling event but not detected during current record event)
- Review DBH differences between events (`qry_checkDBHDiffBetweenYears_flag`) and other comparisons across events/years (`qry_currRepScope_rep_plot_summary`).

Data Validation - Quality Control tools or processes designed to evaluate legitimacy of data as they proceed through the data management lifecycle. Typically data that do not pass validation procedures are either corrected using prescribed methods or flagged/graded to inform data users as to their appropriate use.

While the above steps reference activities that take place once datasheets are brought back to the office, data verification and validation also occur in the field. In the field, crew members review one another’s work to ensure values are legible, accurate and complete. Additionally, preseason field training of crews is also important to data quality, impacting the results (in a positive manner hopefully!), by reducing the number of warnings and errors discovered within formalized verification and validation steps highlighted above.

Observer Bias

To determine whether the plots are being measured consistently by field crews, randomly selected plots will be re-sampled during each field season. Refer to SOP1: Field Season Preparation for details regarding selection of the QA/QC plots and crew. Prior to the completion of plot sampling, field crews will not know if a given plot has been selected for QA/QC sampling, and logistics will be worked out such that a different field crew (from the one that did the original plot sampling) will be selected for the resample. Except for potential safety concerns, no data sharing or generalized knowledge of the plot will be shared between the two crews.

Data from the QA/QC event will be analyzed and compared with the data collected by the primary data collection team to make sure that measurement techniques and crews yield consistent results. Performance standards, also referred to as measurement quality objectives, are presented in Appendix A to this SOP.

Training and review of methods is conducted each season to ensure field personnel are capable of collecting data that meet the standards. If standards are not being achieved, a re-evaluation of sampling techniques and training will be undertaken and adjustments will be made in future years in an attempt to address the discrepancy or collection methods will need to be modified.

Data Updates

Data sets are rarely static. They often change through additions, corrections, and improvements made following the archival of a data set. There are three main caveats to this process:

- Only make changes that improve or update the data while maintaining data integrity.
- Be prepared to recover from mistakes made during editing.
- Document changes.

Any editing of archived data is accomplished jointly by the protocol lead and data manager. Every change must be documented and accompanied by an explanation that includes pre- and post-edit data descriptions.

Naming Convention and Version Control

Version control allows project staff to manage changes made to data sets or documents and provides an auditable trail of individual versions. As a general rule, to safeguard against loss or damage to data, each day's editing session (including entry, verification and validation) should begin by making a backup copy of the current version. This is easily accomplished within CUPN's Forest Vegetation Monitoring Database via an automated backup utility found in the Administrative Tasks menu. The word "backup" and current date are added to the file name, which is copied to the same folder as the frontend application.

As noted earlier, this project utilizes a front-end/back-end Microsoft Access application to manage data. The frontend contains the forms, queries, reports, etc. for interacting with the data which are stored in the backend application or file. The working version of these files are stored in the following folder: Vegetation\Data\Working_Data\Database

The naming convention for database files are as follows:

Table 11.1. Naming Conventions and Folder Locations using ABLI Site 0001.

Data File Type	File Naming Convention ¹
Database Frontend	<i>CUPN_plots_db_1.68</i>
Working Database Backend	<i>CUPN_Forest_Veg_be_20201229.mdb</i>
Working Database Backend - backup	<i>Backup_2020-12-29_CUPN_Forest_Veg_be_20201229.mdb</i>
Master Database Backend	<i>CUPN_Forest_Veg_Archive_20201208.mdb</i>
¹ Naming conventions for plot level data products (e.g., photos) can be found in SOP12: Data management: Procedures upon return from field	

Taking a quick look at the file naming examples in Table 11.1, interested users can discern the most recent version of the database frontend or user interface is 1.68. Data were last edited/updated in the backend file on 12/29/2020. A backup copy was also made that same day. The master backend datafile containing fully QA/QC'd data was last archived up or updated on 12/08/2020. In addition to this naming convention, the data manager also maintains a simple edit log (*.txt) tracking the primary data processing steps and archived datasets versions. The edit log is updated and archived along with the master backend database files.

Appendix A. Performance standards (a.k.a. measurement quality objectives) for the CUPN Forest Vegetation Monitoring protocol. Standards are based on comparisons between two independent sampling events (regularly scheduled and QA/QC) conducted within a two-week span.

	Activity	Measure	Performance Standard	Reference(s)
	Plot Establishment	Record UTM X and Y coordinates of plot center	<5 m error for recorded location on geographic positioning system unit	Using the Global Positioning System, Site Selection and Plot Establishment SOPs
	Stand Data Collection	Disturbance Presence	100% agreement between observers, multiple categories (Yes/No)	Site Selection and Plot Establishment SOP
	Stand Data Collection	Tree height	±3 m averaged for plot	Canopy Closure and Stand Height Measurements SOP
	Stand Data Collection	Crown closure	± 10% averaged for plot	Canopy Closure and Stand Height Measurements SOP
	Stand Data Collection	Taxonomic Accuracy	pseudoturnover ≤ 20% for plot taxa. Some allowances, such as generalizing to genera, can be made for problematic taxa (e.g., <i>Carex</i>)	Herbaceous Plant and Seedling/Sapling Measurements, Recording Species Nomenclature SOPs
	Stand Data Collection	Taxonomic Resolution	90% of observations are identified to species	Herbaceous Plant and Seedling/Sapling Measurements, Recording Species Nomenclature SOPs
	Stand Data Collection	Cover	90% of matched species within one cover class (choose from 10 classes)	Herbaceous Plant and Seedling/Sapling Measurements SOP
	Tree Data Collection	Taxonomic Accuracy	99% of species IDs are in agreement between observers. Allowances are made within hybridizing groups (e.g., red oaks)	Tree Measurements, Recording Species Nomenclature SOPs
	Tree Data Collection	Taxonomic Resolution	95% of observations are identified to at least species level	Tree Measurements, Recording Species Nomenclature SOPs
	Tree Data Collection	Tree Mapping	Module grid coordinates (x,y) ± 1 m	Tree Measurements SOP
	Tree Data Collection	Tree diameter-at-breast-height (DBH)	±1 cm	Tree Measurements SOP
	Tree Data Collection	Tree status	100% agreement between observers (choose from 5 categories)	Tree Measurements SOP
	Tree Data Collection	Crown position	Within one crown class between observers (choose from 5 classes)	Tree Measurements SOP
	Tree Data Collection	Vigor	Within one vigor category between observers (choose from 5 categories)	Tree Measurements SOP
	Tree Data Collection	Dieback	Within one dieback category between observers (choose from 5 categories)	Tree Measurements SOP
	Tree Data Collection	Snag decay	Within one decay class (choose from 5 classes)	Tree Measurements SOP
	Tree Data Collection	Tree Conditions	100% Agreement in recording pest/pathogen evidence on plot	Tree Measurements SOP

	Tree Data Collection	Foliage Conditions	Within one class for individual conditions (choose from 5 classes)	Tree Measurements SOP
	Tree Seedling Data Collection	Taxonomic Resolution	95% of observations are identified to at least species level	Herbaceous Plant and Seedling/Sapling Measurements SOP
	Tree Seedling Data Collection	Taxonomic accuracy	95% of species IDs are in agreement. Allowances are made within hybridizing groups (e.g., red oaks).	Herbaceous Plant and Seedling/Sapling Measurements SOP
	Tree Seedling Data Collection	Seedling counts	Average ± 2 individuals/ corner sampled in 5-15 cm size class; ± 1 individual/ corner sampled in all other size classes	Herbaceous Plant and Seedling/Sapling Measurements SOP
	Tree Sapling Data Collection	Taxonomic resolution	95% of observations are identified to at least species level	Herbaceous Plant and Seedling/Sapling Measurements SOP
	Tree Sapling Data Collection	Taxonomic accuracy	95% of species IDs are in agreement. Allowances are made within hybridizing groups (e.g., red oaks)	Herbaceous Plant and Seedling/Sapling Measurements SOP
	Tree Sapling Data Collection	Tree sapling counts	Average ± 1 individual/ corner sampled in all size classes	Herbaceous Plant and Seedling/Sapling Measurements SOP
	Coarse Woody Debris Data Collection	Decay class	Within one decay class between observers (choose from 5 classes)	Coarse Woody Debris SOP
	Coarse Woody Debris Data Collection	Total CWD Volume	Within 20% between observers	Coarse Woody Debris SOP
	Community Classification Data Collection	Community Classification (USNVC)	90% agreement for plots that are keyed with high confidence or fit by either crew	U. S. National Vegetation Classification Measure SOP
	Photopoint Data Collection	Image	Individual photopoint scenes capture 90% of the same area between observers	Plot Photopoints SOP

References

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Revision History

Version numbers are incremented by decimals where minor grammatical changes or textual clarifications are incremented by hundredths (e.g., 1.01, 1.02, 1.03, ..., etc.) and moderate changes, such as equipment updates or changes in methodology that do not impact analysis are incremented by tenths (e.g., 1.1, 1.2, 1.3, ..., etc.). Whole number increments (e.g., 1.0, 2.0, 3.0, ..., etc.) are reserved for major revisions. Of course, differentiating between what is moderate vs. major may not always be clear, but it is anticipated that with a little “common sense” and discussion protocol leads can adequately document and track revisions through time to the benefit of future data users. It should be noted that prior to 2020 all revisions were incremented by tenths.

Revision History Log

Version #	Date	Revised by	Changes
1.1	01/15/12	B. Moore and R. White	- Additional details about field team make up and roles were added, as well as encouragement to involve park staff in sampling - Made reference to protocol's Appendix D in this SOP and added copy of field datasheet and field datasheet descriptions to Appendix D. Previously Appendix D was a placeholder - Updated list of common data omissions - Updated directions that datasheets should remain with individual identifying any collected specimens (plot botanist) until this identification is complete. Originals are returned to CUPN headquarters. Ideally this is done within 3 weeks of plot work

			- Changed references to protocol database from future tense to present. Protocol database was not complete when written protocol initially approved - Made reference to the use of "Data Entry Notes" field in the protocol database. Data entry personnel can leave notes for future data processing steps (e.g., verification, validation...) - Removed "review 10% of all entered data" from verification section (all entries should be reviewed) - Other minor editorial changes
1.2	9/27/12	B. Moore and R. White	- Updated list of common data omissions - Instructed data entry personnel to follow-up with field crew regarding any illegible handwriting
1.21	3/25/2020	B. Moore	- Added text discouraging use of minimally trained or experienced crew members as data recorders - Added plan to have a midseason training or recalibration where data collection errors will be discussed with field crew members - Moved Revision History to end of SOP and added more detailed list of changes made to date
1.24	3/2/2021	B. Moore	- Address grammatical changes and clarifying comments made by IMD regional program manager (May 2020) - Changed wording indicating a plot would not be sampled "more than three times in four years" to "two times in a five year rotation" - Added more details to Data Entry Section - Added more details to Data Verification Section - Added more details to Data Validation Section - Clarified/updated Observer Bias section to more closely align with updated text in SOP1, V1.4 - Added subsection on database file(s) naming convention
2.0	1/26/2022	B. Moore	- Updated Observer Bias Section (QA/QC) including the addition of Performance Standards (Appendix A). These were based largely on standards from ERMN Quality Assurance Plan (Perles et al. 2018). - Attempted to avoid using field crew leader and lead botanist interchangeably, because NatureServe is longer regularly participating on crews in the lead botanist role.