

# Southeast Coast Network

National Park Service  
Inventory and Monitoring Division

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## Standard Operating Procedure 2.4.05

### *Data Management, Quality Assurance and Quality Control—Version 1.2*

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## Summary

This standard operating procedure (SOP) provides instructions to ensure the vegetation monitoring data collected by the Southeast Coast Network are assembled and managed with care and accuracy. This SOP also describes the procedures for field-based data collection, transcription, and stewardship; quality assurance/quality control (QA/QC); and assessment of data quality.

## Revision Log

| Revision Date | Author     | Changes Made                                                                                                                                                                                   | Reason for Change                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | New Version # |
|---------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| March 2020    | M.F. Boyle | <p>Re-ordered the stages within the Data Management Overview section.</p> <p>Added a brief description of the FEAT/FIREMON Integrated (FFI) data system which houses SECN fuel elements.</p>   | <p>Moved the Accepted Datasheets stage to occur following the Database Validation stage, as the latter stage requires a signature/date on the raw datasheets.</p> <p>The CUPN forest monitoring database is only set up for housing CWD elements; because the SECN also collects FWD and duff/litter elements, our network needed to either build these elements into the new vegetation database or use an existing database to house all fuels data (e.g., FFI). We chose the latter, for efficiencies and cost savings.</p> | 1.1           |
| January 2021  | M.F. Boyle | <p>Replaced image in Figure 1 with screen capture of SECN Vegetation Plots Database.</p> <p>Changed language in Appendix B to describe how to use the 2020 SECN Vegetation Plots Database.</p> | Prior to 2020, the SECN did not have a database.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1.2 (?)       |
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## Overview

Careful, accurate collection of data as directed in this SOP is critical to the success of vital signs monitoring. This SOP describes procedures for accurate data collection, transcription, and stewardship; quality assurance/quality control (QA/QC); and assessment of data quality. The Southeast Coast Network (SECN) will use eight standardized paper datasheets for field data collection. Datasheets are reviewed in the field for completeness (datasheet verification) and reviewed after leaving the field by the protocol lead or field crew lead for correct spelling of Latin names, up-to-date taxonomy, and reasonable values for all data fields (datasheet validation). Once validated, datasheets are then scanned and stored as final, accepted data at the datasheet level. Next, data are entered into a modified version of the Cumberland Piedmont Network (CUPN) vegetation monitoring database in Microsoft Access. As data are entered, they are checked and verified for proper transcription of hand-written data. A first 100% check is completed by the data entry person and a subsequent 10% check is performed later, by another lead, and then followed by a validation step by the protocol lead to check for realistic and logical values. A *protected data handling* step is performed where an accepted data set is processed to apply any record-level removal or obscuring to sensitive data, as required by park-specific data handling agreements. A flat file (.csv) of the protections-applied data set is produced for the period of record. Metadata are then prepared for all validated data for the master Access database and the “protections-applied” file(s). Accepted data sets and accepted data sets after data protections have been applied may be posted and appropriately distributed, as well as used in data analysis and product development.

## SOP Source and How It Was Modified

This SOP is an adaptation of SOP VEG09 *Data Management and Quality Assurance/Quality Control—Version 1.0* (Carlson et al. 2018a) of the *Monitoring Vegetation in Gulf Coast Network Parks: Protocol Implementation Plan* (Carlson et al. 2018b); and SOP 11 *Data Quality Assurance and Quality Control—Version 1.2* and SOP 12 *Data Management Procedures Upon Return from the Field—Version 1.3* of the *Cumberland Piedmont Network Vegetation Monitoring Protocol* (White et al. 2011). For a general explanation of how the Southeast Coast Network modified the Cumberland Piedmont Network (CUPN) protocol and its SOPs, see the SECN Terrestrial Vegetation Monitoring Protocol Implementation Plan (Boyle et al. 2019a). The Southeast Coast Network made three specific modifications to the GULN and CUPN data management SOPs: (1) combining the two CUPN SOPs into one and using the format of the GULN SOP, (2) including as an appendix, a documentation/work flow section of the CUPN vegetation database, and (3) including a step for protected data handling. The detailed list of modifications to corresponding CUPN SOPs 11 and 12 is in Appendix A of this SOP.

## Definitions

**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 data are complete so they can be processed and accurately transferred from one source to another.

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

**Quality Assurance (QA):** The prevention of defects by ensuring scientific and data collection approaches, techniques, methods and processes are designed and implemented correctly. Quality assurance tends to monitor and verify that the processes to create data have been followed and function well. It is the proactive portion QA/QC that is “preventative” in nature and recognizes flaws in “process.”

**Quality Control (QC):** The identification of defects in results. Quality control verifies that outputs are correct. So, a re-sample is essentially performed to test for differences and uncover any irregularities or defects that can point to problems. The problems themselves may have happened due to a failure in quality assurance or some other issue, but an action that tests for this is usually in the QC category. Quality control is “detecting” in nature and recognizes or uncovers defects themselves.

**Raw Data:** Data in their state of original collection, either in the form of paper or electronic field forms, electronic sensor files, or digital media (photo, video, or audio). These data generally have been collected following some QA procedures, but have not undergone any QC procedures.

**Provisional Data:** Provisional data are data that have undergone incomplete QA/QC procedures and are not suitable for general use. Provisional data may still be useable in some cases, however, depending on the amount of QA/QC completed and the intended use.

**Accepted Data:** Data that have undergone all QA and QC procedures as defined in a published protocol and associated SOPs. Used in cases where a quality assurance plan has not been developed and approved.

**Certified Data:** Certified data (a) have been through all QA/QC procedures as outlined in the quality assurance plan, (b) meet expected quality standards, or are appropriately identified and annotated at the record level in cases where they do not meet those standards, (c) have documented procedures for data collection, processing, and transformation in appropriate metadata formats, and (d) are suitable for use.

# SECN Data Management Overview

Project information management is an ongoing or cyclic process. The stages of this cycle are summarized in the following list. Additional details and full citations for associated SOPs are provided in subsequent sections of this SOP.

1. **Preparation**—The field crew is trained on scientific methods and on data collection and processing procedures, park logistics are planned, field supplies are assembled following equipment lists, and paper datasheets are printed (eight different field data forms per plot, plus spare copies of each; SOP 1.4.07 *Field Season Preparation—Version 1.1* [Boyle 2020a]).
2. **Maps and GPS**—Park maps (both with topographic and color/infrared aerial backgrounds) are printed; map images include plot locations, plot identification, UTM grids, park boundaries, and any other helpful field navigation features (e.g., roads, trails); X- and Y-coordinates of each plot are exported from ArcGIS into handheld GPS units (SOP 1.4.07: *Field Season Preparation—Version 1.1* [Boyle 2020a], and SOP 1.4.10 *Site Selection, Plot Establishment and Return Visits—Version 1.1* [Boyle 2020b]).
3. **Data Acquisition**—Collecting data in the field to obtain high-quality data, in accordance with all SOP instructions. Data are recorded on paper datasheets for each plot. This step also includes procedures for within-season plot revisits for quality control purposes (SOP 1.4.10 *Site Selection, Plot Establishment and Return Visits—Version 1.1* [Boyle 2020b]; SOP 1.1.05 *Plot Photo Points—Version 2.0* [Boyle 2019a]; SOP 1.4.11 *Tree Measurements—Version 1.0* [Boyle 2019b]; SOP 1.4.14 *Species Diversity and Seedling/Sapling Measurements—Version 1.0* [Boyle 2019c]; SOP 1.4.12 *Fuel Load Measurements—Version 1.0* [Boyle et al. 2019b]; SOP 1.4.15 *U.S. National Vegetation Classification Identification—Version 1.0* [Boyle 2019d]; SOP 1.4.16 *Soil Measurements—Version 1.0* [Boyle 2020c]; and this SOP).
4. **Datasheet QA/QC Workflow: Review and Validation**—Reviewing and initialing the datasheet for completeness prior to departing the field site produces a verified datasheet. Checking each datasheet for realistic entries, correct spelling, and current taxonomic names produces validated paper datasheets (this SOP).

5. **Photo, Soil and Unknown or Vouchered Plant Samples**—Digital images of the plot are collected by a member of the field crew and checked by a second field crew member for validation. Images are loaded onto a field computer at the end of the field day. Soil bags are labeled by a member of the field crew and checked by a second field crew member to ensure they have the correct plot identifier, enough soil has been collected, and that bags are sealed tightly after sample collection. At the end of the field day, soil samples are stored in a secure location and opened to begin drying. Unknown plant samples or images should be keyed out to the highest level of taxonomic accuracy possible within 24 hours of collection, with identifications added to the original data sheet. If this cannot happen, unknown plants and any vouchered plant specimens are placed in a plant press until processing can occur (SOP 1.1.05 *Plot Photo Points—Version 1.0* [Boyle 2019a]; SOP 1.4.16 *Soil Measurements—Version 1.1* [Boyle 2020c]; SOP 1.4.14 *Species Diversity and Seedling/Sapling Measurements* [Boyle 2019c]; and this SOP).
6. **Data Entry, Processing, and Backup**—Validated datasheets are entered into the SECN Terrestrial Vegetation Monitoring database as soon as possible after data collection. The Southeast Coast Network uses a modified version of the CUPN database. This is completed upon return to the SECN office or, less frequently, while on travel. The person entering data should be someone who participated in the data collection at the plot (this SOP).
7. **Database Verification and Quality Review**—As data are entered from paper datasheets into the database, multiple verification checks are performed. Soil data imported or entered by hand from laboratory results are also verified. The final products at this stage are verified and considered quality-checked in the database (this SOP).
8. **Database Validation**—Once data are verified as entered correctly, additional validation tests are completed by the protocol lead to ensure that data in the database are logically consistent and realistic. At the end of this stage, the products are validated data in the database; if data have been verified and validated, the database is considered accepted (this SOP).
9. **Accepted Datasheets**—Validated datasheets are initialed and dated once Database Verification and Validation have occurred. Once these have been noted, datasheets are scanned and stored on the SECN shared drive as a single file per sample event (i.e., plot sample/single sample year) in .pdf format (this SOP).
10. **Accepted and Certified Database**—After both verification and validation steps are complete, the data are classified as accepted, or are instead classified as certified if an approved quality assurance plan is in place.
11. **Protected Data Agreement**—An accepted data set is processed to apply any record-level removal or obscuring to sensitive data, as required by park-specific data handling agreements. The output of this step is a .csv flat file. This is the version of the data made available publicly.

12. **Metadata Documentation and Data Delivery**—All data accepted or certified are accompanied by metadata that describe the data set and document the results of the quality review (this SOP).
13. **Data Analysis and Product Development**—Data are summarized, analyzed, and prepared for reports and presentations (SOP 2.4.06 *Data Analysis and Reporting* [Boyle 2019e]).
14. **Product Posting and Distribution**—Finalized products are distributed to parks and other stakeholders and posted to NPS clearinghouses (this SOP).
15. **Protocol Operational Review**—The annual operational review for the protocol addresses a variety of implementation topics, including how well the data management and QA/QC processes are working.

## **Preparation**

Instructions for preparing for field data collection are detailed in SOP 1.4.07 *Field Season Preparation—Version 1.1* (Boyle 2020a).

## **Maps and GPS**

Instructions for preparing field navigation maps and GPS units are detailed in SOP 1.4.07 *Field Season Preparation—Version 1.1* (Boyle 2020a) and SOP 1.4.10 *Site Selection, Plot Establishment and Return Visits—Version 1.1* (Boyle 2020b).

## **Data Acquisition**

### ***Field Procedures for Data Collection***

Network staff will exactly adhere to instructions for field data collection, as outlined in the following SOPs: SOP 1.4.10 *Site Selection, Plot Establishment and Return Visits—Version 1.1* (Boyle 2020b), SOP 1.1.05 *Plot Photo Points—Version 2.0* (Boyle 2019a), SOP 1.4.11 *Tree Measurements—Version 1.0* (Boyle 2019b), SOP 1.4.14 *Species Diversity and Seedling/Sapling Measurements—Version 1.0* (Boyle 2019c), SOP 1.4.12 *Fuel Load Measurements* (Boyle et al. 2019b), SOP 1.4.15 *U.S. National Vegetation Classification Identification—Version 1.0* (Boyle 2019d), and SOP 1.4.16 *Soil Measurements—Version 1.1* (Boyle 2020c). This will prevent bias in measurements across years and increase the network's ability to detect long-term trends. The crew must fully understand the layout of the field datasheets prior to recording any data and use the datasheets the same way at every site. The crew should never deviate from established protocols or alter the datasheet without first consulting with the protocol lead, who will approve any potential changes and record deviations in the project's metadata (see below). The crew adheres to these specific procedures for recording data in the field:

- Crew members ensure they are in close enough physical proximity to clearly hear one another. Regardless of the data collection method, all data values shall be called out by the field crew member actively collecting the data measure (the measurer) and repeated by the crew member recording the data measure on the datasheet (the recorder). The measurer clearly calls out the value, and the recorder clearly repeats the value aloud as it is recorded, to

ensure the value was heard and recorded accurately. If the measurer does not hear a response from the recorder, the measurer repeats calling out the measurement until a response is obtained. If the measurer hears a different value from the value measured, the measurer immediately corrects the value. Data sheets should be reviewed after sampling each corner and at the completion of each module.

- The crew records all data onto paper datasheets printed on Rite-in-the-Rain paper. Datasheets contain as much preprinted project information as possible with designated labels for specific data elements, including general data such as date and collectors' names. The header of each datasheet provides some instructions for its use, and other instructions and examples are included as laminated cards, where needed, as handy references to ensure the proper data are recorded. In a field pack, each crew member carries a small Rite-in-the-Rain notebook for recording details of unsampleable plots as well as personal notes on plant ID or other anecdotal observations. Datasheet forms for this protocol are in the appendices of the applicable SOP.

#### ***Checklist for Accurate and Secure Field Data Collection onto Paper Datasheets***

- Datasheets are protected within an enclosed clipboard.
- All information added to a datasheet must be printed legibly using pencil.
- While manually recording data, the crew member entering the data verbally double checks all field values for accuracy and completeness with the crew member collecting and announcing the data. All discrepancies are corrected prior to moving to the next data field.
- Information is never erased from a datasheet, and incorrect information discovered after the field event is never overwritten.
- Any revisions during data recording are accomplished by crossing through the erroneous data with a single line, such that the original value is still legible but clearly marked in this way as erroneous.
- After collecting all data at each site but prior to departure, original datasheets are reviewed and checked for legibility and completeness (see below). This is the field-based review and verification step for the datasheet, which is followed by a validation step by the protocol lead (see further below). After the datasheet is verified, the document is scanned as a high-quality (at least 300 × 300 dpi) color digital image.

Check for these common data omissions:

- Height and Decay Class for standing snags on the Tree Measurements datasheet
- Incomplete plot diagram
- Any data associated with the last few trees or herbaceous plants in the plot

- Map locations of all trees greater than 10 centimeters (3.9 inches [in]) diameter at breast height (DBH)
- Fuel load measures for both transects
- Marks indicating collected specimens
- U.S. National Vegetation Classification information
- Detailed directions to plot and total sample time on plot
- Missing species on the species diversity datasheet for species measured as a tree or seedling/sapling
- Missing cover values

### ***Field Procedures for QA/QC plots***

Each year of field work, the network samples six of the plots on two separate occasions (approximately 5% of the year's plots) to determine reliability of field data collection. Field quality control occurs as close as possible to (but not before) the original sample date of the plot to reduce seasonal variability. Although logistical and budgetary constraints may necessitate using most of the same crew for the original and quality control revisits to sampling points, the network must use different staff members for field work tasks and post-field identifications. If the same team members are used for both an initial sampling visit and a quality control revisit, the tasks they perform must be switched (e.g., data recorder becomes the person who measures), and at least four other plots should be sampled between a plot's original sampling visit and its QC revisit. To minimize trampling impacts, QC revisits should not occur at plots which are particularly sensitive, and no plot should be sampled more than five times in twelve years. The quality control team should sample the plot as it was left from the previous sampling, using the same plot markers, and perceived locations of tree DBH measurements. All data are collected without viewing the data collection event from earlier in the season, except for the tree map which is used to ensure that trees receive the same ID number during both plot visits. If the quality control team detects a potential issue with the data, it is always recorded in the notes. The protocol lead later compares the original data and data from the QA/QC revisit.

If consistent observer biases are seen, there are a few solutions to consider. These include:

- Mid-season training if the problem is caught early
- Renewed focus on training in future years for the measures that were off
- Disqualification of some data if it is inconsistent between observers

## **Datasheet QA/QC Workflow: Review and Validation**

### ***Datasheet Review***

Before leaving a plot, one of the crew members reviews all data forms to ensure they have been filled out legibly and in their entirety. If possible, this person is not the data recorder, because they are less likely to notice their own illegible writing or other mistakes. Once all sheets are checked, the reviewer signs their initials on the “Reviewed by” line on the top line of each datasheet. After returning to the field office, complete additional research on species IDs (online, with taxonomic keys or with field guides) to identify species unknown while in the field.

### ***Datasheet Validation***

As soon as possible after returning to the field office and prior to data entry, each datasheet is subjected to a validation step. This step must be completed by a participant with a solid botanical background, such as the SECN terrestrial vegetation monitoring protocol lead. This person reviews all datasheets for correct spelling of Latin names, the use of current taxonomic names for species, and reasonable entries for all data fields. This review is finalized by initialing and dating the datasheet in the “Validated by” line on the Vegetation Plot Establishment datasheet. All network staff members (including the crew) who make post-field modifications to the datasheet indicate their identity (initials), date of modifications, and purpose of their review in the allocated space on the back of the datasheet.

If validation does not occur immediately following the datasheet review stage, then a backup copy photograph or scan is taken of the reviewed datasheets. The final scan will occur after validation (see Accepted Datasheets below).

## **Plot Photographs, Soil Samples, and Plant Vouchers**

Instructions for preparing plot photo points are detailed in SOP 1.1.05 *Plot Photo Points—Version 2.0* (Boyle 2019a), soil samples are detailed in SOP 1.4.16 *Soil Measurements—Version 1.1* (Boyle 2020c), and plant vouchers are detailed in SOP 1.4.14 *Species Diversity and Seedling/Sapling Measurements* (Boyle 2019c).

## **Data Entry, Processing, and Backup**

The Southeast Coast Network uses a modified version of the Microsoft Access (front end and back end) CUPN vegetation monitoring database to manage data elements collected from the following SOPs: 1.1.05 *Plot Photo Points—Version 2.0* (Boyle 2019a), 1.4.10 *Site Selection, Plot Establishment and Return Visits—Version 1.1* (Boyle 2020b), 1.4.11 *Tree Measurements—Version 1.0* (Boyle 2019b), 1.4.14 *Species Diversity and Seedling/Sapling Measurements—Version 1.0* (Boyle 2019c), and 1.4.15 *U.S. National Vegetation Classification Identification—Version 1.0* (Boyle 2019d). This database also manages Coarse Woody Debris data collected from SOP 1.4.12 *Fuel Load Measurements—Version 1.0* (Boyle et al. 2019b). The SECN Vegetation Plots Database main menu is shown in Figure 1. Other fuel load measurements (e.g., Fine Woody Debris and Duff/Litter) are stored within the FEAT and FIREMON Integrated (FFI) data system (Lutes et al. 2009). Soil nutrient data that are returned from analytical labs are currently stored in Microsoft Excel spreadsheets, but will eventually be incorporated into the vegetation monitoring database.

The goal of data entry is to transcribe field observations into a digital database with 100% accuracy. Whenever a transcription step occurs, errors are possible so use the following guidelines in the data entry portion of this protocol:

- When possible, data entry will be augmented by pick lists or drop downs (e.g., use of pre-populated species lists).
- Data will be entered as soon as reasonably possible following field collection.
- Data entry will be completed by someone who participated in the collecting at the sampling plot.
- Data will be entered into pre-designed database forms that resemble field datasheets.
- When the person doing data entry is uncertain about handwriting, they will highlight that information on the datasheet and follow-up with the data recorder to get clarification on what data were intended.

Data are entered into the SECN vegetation monitoring and FFI databases from the paper field forms. Review the user manual for the CUPN vegetation database in Appendix B and the FFI User Guide (December 2018, available at:

[https://www.frames.gov/sites/default/files/FFI/FFI\\_UG\\_December\\_2018.pdf](https://www.frames.gov/sites/default/files/FFI/FFI_UG_December_2018.pdf)) before attempting data entry. These databases incorporate 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 should 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, confirm the correct value with the person who recorded the data. If the entry cannot be deciphered prior to data entry, utilize the data entry notes fields and flags in the database, as these will be reviewed during the data validation process.

Main Menu

SECN Plots Database Main Menu [Maxwell Boyle logged in](#)

Version: 1.70, 2020-Apr-09

Backend:  
Connected to SECN\_VegetationPlots\_backend\_x64\_v1.1\_COR.accdb

Connect to (different) backend database    Check connection    Set event scope (parks to work with)

Data entry    Add new plots    Data queries and reports

Overview of parks    Overview of events    Administrative tasks

Options  
☒ Display all images automatically  
☒ Print photos (large photos can cause other images to fail)  
☒ Check for errors after each row entered

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**Figure 1.** Main menu of the Southeast Coast Network Vegetation Monitoring Database.

After each plot is entered, the person entering the data prints their initials and date in the lower right corner of the *SECN Veg Form 1—Vegetation Plot Establishment* (see Appendix A in SOP 1.4.10 *Site Selection Plot Establishment and Return Visits—Version 1.1*; Boyle 2020b).

At the beginning of the field season, a copy of the front-end database is provided to each field crew. These databases are stored locally on a travel computer. When internet connection speeds are ideal at field locations, data can be entered into the front-end database that is linked to the back-end database stored on the SECN server. If connection speeds are slow, it may be more efficient to postpone data entry until field crews are back at an office with faster speed.

### Database Verification and Quality Review

Southeast Coast Network staff implement procedures to ensure that data are accurately and completely entered into the SECN vegetation monitoring database. First, after entering each

datasheet into the database, the data entry person compares each value in the database to each value on the paper datasheet to ensure all typed numbers match what was written. Second, a different crew member reviews all datasheets entered that day to again ensure that all typed data match the datasheet. This is the 100% check. Third, the protocol lead reviews 10% of all datasheets, again for proper entry from the datasheet. This is the 10% check and functions as quality review. To account for scenarios which require flexibility due to staffing, if the protocol lead is the crew member who performs the 100% check, then the data manager or other data management staff performs the 10% check instead of the protocol lead. The final products at this stage are verified and considered quality-checked in the database.

After the data are verified in the database, the verifier prints their initials and date in the lower right corner of the *SECN Veg Form 1—Vegetation Plot Establishment* (see Appendix A in SOP 1.4.10 *Site Selection Plot Establishment and Return Visits—Version 1.1*; Boyle 2020b).

### **Database Validation**

Once data are verified as entered correctly, additional validation tests are completed by the protocol lead to ensure data in the database are logically consistent and realistic. Although data may be correctly transcribed from the original field forms, their values may not always be accurate or logical. The logic and accuracy of a verified database is tested through database validation. For example, some plant species found in maritime parks do not occur in inland parks. If a maritime plant is identified erroneously to be present in an inland park, this would represent a logic error. As often as possible, components of the data validation process are built into the database (e.g., value range restrictions, default entries, separate species pick lists for trees and shrubs, and separate favorites species lists for each park). Although many validation problems can be addressed by a well-designed database, the protocol lead must also review and validate the data after verification is complete. The protocol lead is the authority on the methodologies and species involved. Validation steps can include:

- Running summary queries and tallies on the data
- Identifying out-of-range values, including new species and checking that tree/sapling/seedling data are also present in the species diversity list
- Evaluating outliers
- Comparing plot location coordinates in the database with coordinates in GIS files from the GPS unit

These steps include plotting data points, calculating summary statistics, and reviewing species lists. Any problems uncovered by this process prompt the protocol lead to go back to the database records and apply appropriate quality flagging or documentation where applicable. At the end of this stage, the products are validated data in the database. After the data are validated in the database, the validator prints their initials and date in the lower right corner of the *SECN Veg Form 1—Vegetation Plot Establishment* (see Appendix A in SOP 1.4.10 *Site Selection Plot Establishment and Return*

*Visits—Version 1.1*; Boyle 2020b). If data have been verified and validated, the database for the season is considered accepted.

### **Accepted Datasheets**

Once datasheets have been validated, and their content has been entered, verified, and validated in the database, they are ready to be scanned and stored on the SECN share drive. Each set of datasheets per plot are scanned, bound together as a single .pdf, and the resulting file is named in the following convention:

- Plot ID (park acronym + plot number) Sample Date (YYYYMMDD).pdf; for example (CAHA001\_20190701).
- This file can be saved in the “Accepted Field Datasheets” folder on the SECN share drive.

### **Accepted and Certified Database**

After the database for a given field season passes these various validation tests, it is considered validated and thereby accepted. The accepted database is accompanied by appropriate documentation (see Metadata below). If there is a quality assurance plan, then finishing this step produces certified data.

### **Protected Data Handling**

Once a complete data set is processed and accepted, the protocol lead performs a step of creating a second version of the accepted dataset with appropriate data protections applied. Each park in the Southeast Coast Network has documented their requirements for the handling of potentially sensitive categories of data in a signed agreement between the network and the park. These agreements specify customized protected data handling guidelines. The protocol lead applies the specified protections to the identified data categories. This database must be accompanied by its own documentation (see Metadata Documentation and Data Delivery below).

### **Metadata Documentation and Data Delivery**

All data that are accepted or certified are accompanied by metadata that describe the data set and document the results of the quality review. The products here are accepted data and the associated metadata, are then uploaded to the master project database in the [Integrated Resources Management Applications \(IRMA\) Data Store](#). This is the NPS clearinghouse for natural resource data and metadata and the authoritative source of the data (for the full record) and the version designated for public access (for the version with data protections applied). These products are completed within three months of the final sampling event for a given field season.

### **Data Analysis and Product Development**

Data are summarized, analyzed, and prepared for reports and presentations. Vegetation Monitoring Event and Status Reports are created each year at the end of the field season. After the first three surveys per site are completed and summarized, more in-depth reports on Status and Trends in Vegetation are prepared, including results of statistical analyses of cross-year trends.

## Product Posting and Distribution

Once digital products are delivered and processed, the protocol lead or data manager takes the following steps to make them available:

1. On an annual basis, all data products are posted to the Integrated Resource Management Applications Data Store. The Terrestrial Vegetation Monitoring project (<https://irma.nps.gov/DataStore/Reference/Profile/2258943>) within the IRMA Data Store application houses all SECN vegetation monitoring data products beginning in 2018. Refer to the IRMA website for upload and product linking instructions.
2. A reference for reports and other publications is created in the Integrated Resource Management Applications Data Store. The digital reports are uploaded as a holding to the reference and made available for discovery. Appropriate access restrictions must be applied to each holding. Refer to the IRMA website for reference creation and upload instructions.
3. A separate reference for the full Microsoft Access database, accompanying metadata, and digital scans of field sheets for the individual parks, is created in the Integrated Resource Management Applications Data Store. Appropriate access restrictions are applied to this reference. Another separate reference for the database version with protections applied and accompanying metadata is also created.
4. Finalized products (including reports) and links to IRMA records are distributed to parks and other stakeholders. All products posted will have the appropriate access applied.

## Protocol Operational Review

An annual operational review is conducted for the protocol according to the guidance in Mitchell et al. (2018). The operational review covers all aspects of protocol implementation, including field methods, data management procedures, and quality assurance/quality control processes.

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## **Appendix A. Modifications to CUPN SOP 11 and SOP 12 and GULN SOP VEG09 for SECN SOP 2.4.05**

### **Combination of CUPN SOP11 and SOP12 with GULN SOP VEG09**

The Southeast Coast Network utilized a similar structure developed by the 2018 data management SOP for the GULN vegetation monitoring protocol to adhere to updated national policies concerning data management and quality control/quality assurance (DeVivo 2015). Quality control and quality assurance sections of the CUPN SOPs were coupled with the data management SOP due to the stepwise linkages between these efforts.

### **Addition of Appendix B**

A workflow document developed by the Cumberland Piedmont Network to assist with use of the CUPN vegetation plots database system was added to this SOP, because of the Southeast Coast Network's plan to utilize this same database structure for the management of its vegetation monitoring data.

### **Appendix A Literature Cited**

DeVivo, J. 2015. DRAFT: Quality management plan for the National Park Service Inventory & Monitoring Program: guidance for vital signs monitoring protocols. Natural Resource Report NPS/XXXX/NRR—2015/XXX. National Park Service, Fort Collins, Colorado.

## **Appendix B. Documentation of the Southeast Coast Network Vegetation Plots Database System**

The Southeast Coast Network (SECN) Vegetation Plots Database System is a front-end/back-end Microsoft Access Database that has the primary function of data entry, error checking, data certification, and reporting for the vegetation monitoring plots established by the network. This database is modified from the Vegetation Plots Database System used by the Cumberland-Piedmont Network (CUPN).

For details on how the SECN vegetation plots are sampled, please see Boyle et al. (2019). This database was developed by Michael Lee (NatureServe; University of North Carolina, Chapel Hill; mikelee.unc@gmail.com) through a Professional Services Agreement with the National Park Service.

## Installing the database system

The database system has two database files:

- The **front-end (or shell)** database that contains all the **functionality** (such as forms, queries, reports, error checking routines) of the database, and
- The **back-end** database that contains the **data**.

This two-file setup allows functionality to be updated without changing the underlying data. For example, if new reports are created or something is edited in forms, you can use a new front-end database acquired from the developer without importing your data again; it resides separately in the back-end database.

To start using the database, you will need to download the files either from SECN staff. Once you have downloaded both files, **unzip** them into a folder on your computer or network. If multiple people want access to the database, it may be best to install the back-end database on the network. The front-end database is designed for only a single user at a time. Copies of the front-end database can be made so each user has their own copy, which can be connected to the same back-end database.

To start using the SECN Vegetation Plots Database, double-click on the front-end database file (the one that does not have “backend” in the name), and that will open the file if you have Microsoft Access installed on your computer.

Once you have opened the front-end database in a compatible version of Access, you may see a screen that warns you that certain content or macros have been disabled (Figure B-1):

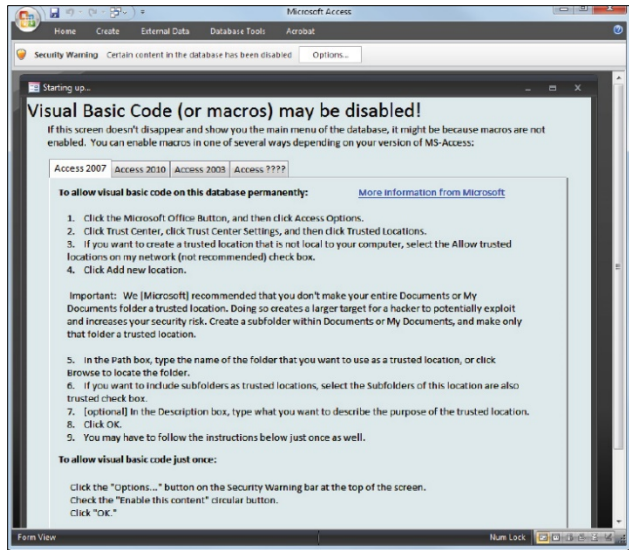


**Figure B-1.** Screenshot of warning screen for macros being disabled.

Please note that if you open the back-end database, you will see a message (Figure B-2) that tells you that you have opened the wrong database file:

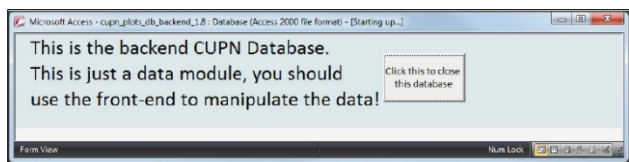


**Figure B-2.** Message showing the wrong database file was opened.

Macros (including Visual Basic Code) can perform powerful tasks on your computer, including creating, deleting, or executing files. You should not enable macros for databases from sources you do not trust.

To enable macros, follow the instructions on the screen for your version of Microsoft Access. If you are going to be using this database frequently, you may want to add the SECN database folder to the list of “trusted folders” that automatically allow macros on your computer. You only want to copy Access database files that you trust into this folder.

### **Connecting to the back-end database**

If your back-end database is in the same folder as the front-end, or in a separate “backend” folder, it should connect automatically. If not, you will need to specify where the back-end database is located. You may see a warning message (Figure B-3) that the front-end database cannot find the back-end database:

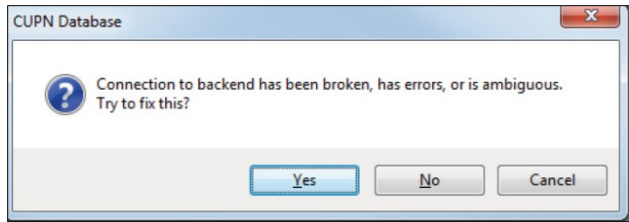


**Figure B-3.** Warning showing the front-end database cannot find the back-end database.

If it asks you whether you want to try to fix the connection, it will search for a back-end in the same folder, or a “backend” folder. If it finds only one back-end database, it will connect to it, otherwise it will ask you to specify the location. A successful connection message (Figure B-4):

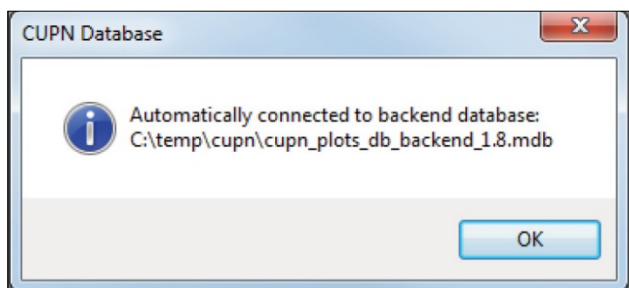


**Figure B-4.** A successful connection message.

Otherwise, press “Click here to connect to backend database...” (Figure B-5) on the startup screen to select a location, then browse for the correct backend file:

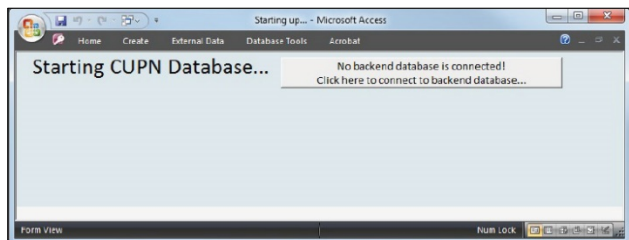


**Figure B-5.** Startup screen with button “to connect to backend database.”

From the Main Menu (Figure B-6) click “Connect to (different) backend database” and browse for the path to the *backend* database.

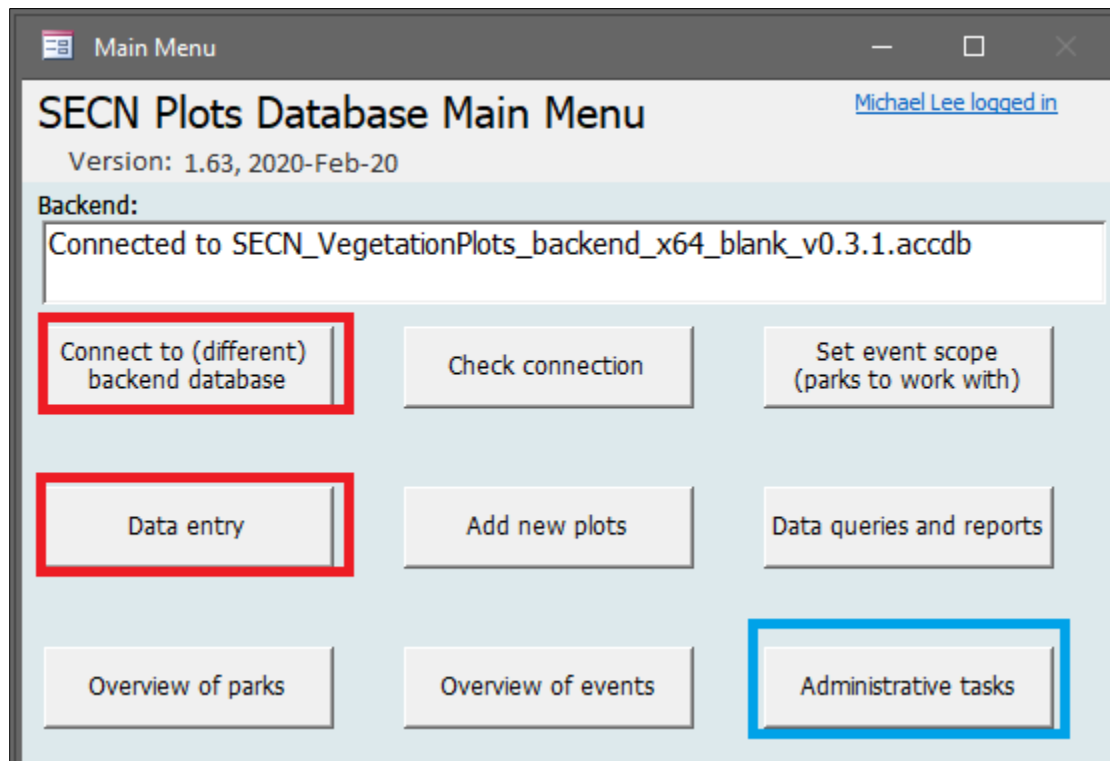


**Figure B-6.** SECN Vegetation Plots Front-end Database Main Menu, highlighting how to connect to the Back-end Database.

### Logging in

Once you have connected to a back-end database, you will need to login. This allows the SECN database to record who has performed certain tasks, like entering plots, updating taxonomy, or checking for errors. A list of people may be displayed who already exist in the back-end database (Figure B-7). By default, the box at the bottom of this screen is checked, meaning you will automatically be logged in from this Windows account. If you share an account with others, uncheck this box. If your name is listed, select it and press “Log in.”

Log in

Please select your name from the list: My name is not listed

☐ Always log me in on this computer/domain and account

Log in

refresh list

Casillas, Ana  
 Frederick, Clare  
 Govus, Tom  
 Lee, Michael  
 Leibfreid, Teresa  
 McAninch, Shepard  
 Moore, Bill  
 Nordman, Carl  
 White, Rickie

**Figure B-7.** Screen showing list of names.

If your name is not listed, press “My name is not listed” at the top and fill in your name and information (Figure B-8):

Manage Contacts

Contact Details

Last Name: Smith  
 First Name: Chris  
 M Init: R  
 Organization: National Park Service  
 Position Title: Ecologist  
 Active?: ☒  
 Address Type: mailing and physical  
 Address: 48 N. 31st Avenue  
 Address2:  
 City: Larue  
 State: KY  
 Zip Code: 42728  
 Country: United States  
 Email Address: chris.smith@...  
 Work Phone: 270-555-5555  
 Work Extension: 5555  
 Date Added: 1/8/2013 10:54:04 AM  
 Notes:

Log in Cancel

Contact 1 of 1 No Filter Search

**Figure B-8.** Contact Details screen.

Then press “Log in.”

## The Main Menu

**Tip:** if you see the Microsoft Access ribbon at the top of the screen, you can minimize it by pressing Ctrl-F1 or right-clicking on the ribbon and selecting “Minimize the Ribbon” to give you more vertical screen space (Figure B-9):

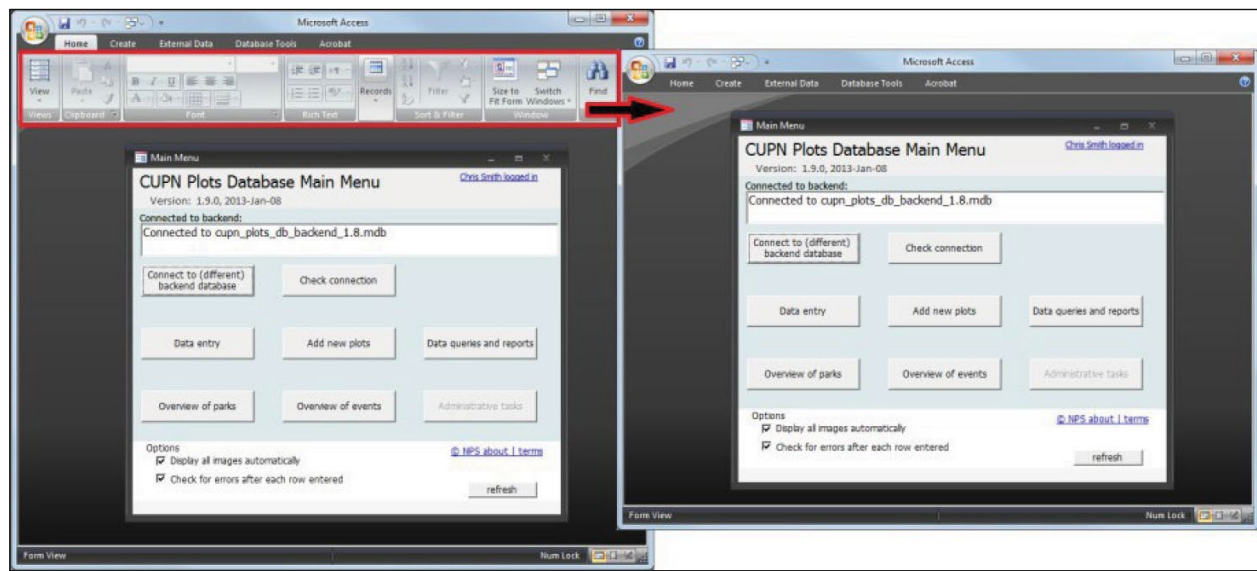


**Figure B-9.** A NPS Plots Database Main Menu screen before and after clicking “Minimize the Ribbon.”

After logging in (which may happen automatically the next time you log in), you will see the main menu, where you can do the following:

1. See who is logged in, click to change who is logged in.
2. The database version and date.
3. The current back-end connection path.
4. Buttons to change or check the back-end connection.
5. “Data entry” allows you to edit events already entered.
6. “Add new plots” allows you to specify new plots (locations) that have been sampled in the field.
7. “Data queries and reports” shows a menu of available reporting and querying options of many different types.
8. “Overview of parks” summarizes entered data by park.
9. “Overview of events” summarizes what has been entered for each event.

10. “Administrative tasks” is only enabled if you have been granted administrative privileges. This links administrators to powerful database functions for managing the data.
11. The “Options” area allows you to specify your preferences, such as whether to display images and photographs of your events on forms and/or whether to perform error checking after each row (or event) is entered. The “refresh” button updates these preferences in case you have altered them elsewhere in the database.
12. The copyright and terms is a link which displays the terms of use, copyright, and contributors page.

## Data entry

From the Main Menu, click the “Data entry” button. Enter data in the tabs that correspond to the pages of the paper data entry forms. Please see video walk through for examples and details.

### Errors, and ignoring errors

When you add a new row of data to most tabs in the main entry, errors will be checked automatically after you finish. If errors are found, they’ll be shown at the far right with an underlined number with a red background. This is different from the errors button and number at the bottom of the form, which is for the entire event (all SOPs). Click the number to see the errors found (Figure B-10).

The screenshot shows the 'SECN Database: Main Entry' window. At the top, there's a 'Find plot:' dropdown set to 'FOPU011' and a 'Start Date:' field set to '8/29/2019'. Below this are tabs for different SOPs (Standard Operating Procedures). The 'SOP 4 - Tree Measurements' tab is active. It contains a data entry form with fields for 'Species Code', 'DBH', 'Tree Status', 'Crown Class', 'Vigor', 'Dieback', 'Damage/Condition Codes', 'Decay Class', 'Snag Ht (m)', and 'Data Entry Notes'. A table below the form shows two rows of data for 'Abies balsamea'. At the bottom right, there's a red box highlighting the 'Errors' button and the 'errors' field, which shows '0'.

**Figure B-10.** Logical error-checking in the SECN Vegetation Plots Database.

Most errors should be fixed by a member of the SECN vegetation team. Sometimes they can’t be fixed or are only an alert about unusual data rather than an error. If you are an administrator, you can ignore an error by checking the check box to the far right, highlighted in Figure B-11. This error will no longer be counted. Ignored errors are listed in gray italics, both in the number of errors on the main form and in the errors popup form.

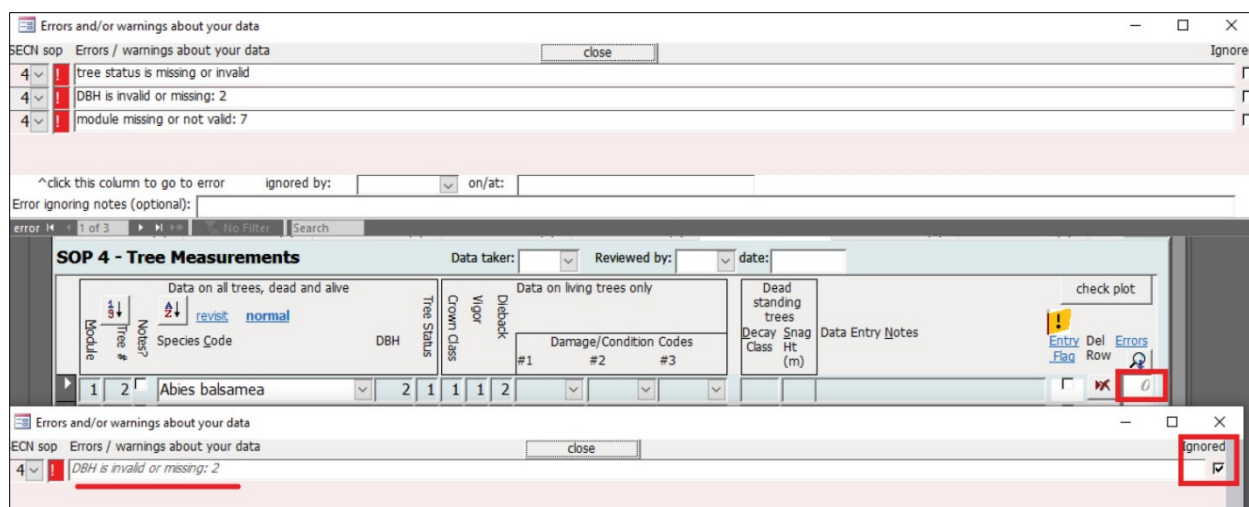


**Figure B-11.** Ignoring errors in the SECN Vegetation Plots Database.

## Administrative tasks

Click the “Administrative tasks” button on the main menu (see Figure B-6, blue highlighted rectangle) to access more powerful features like deleting plots, adding users, resampling plots, and the other features described below (Figure B-12).

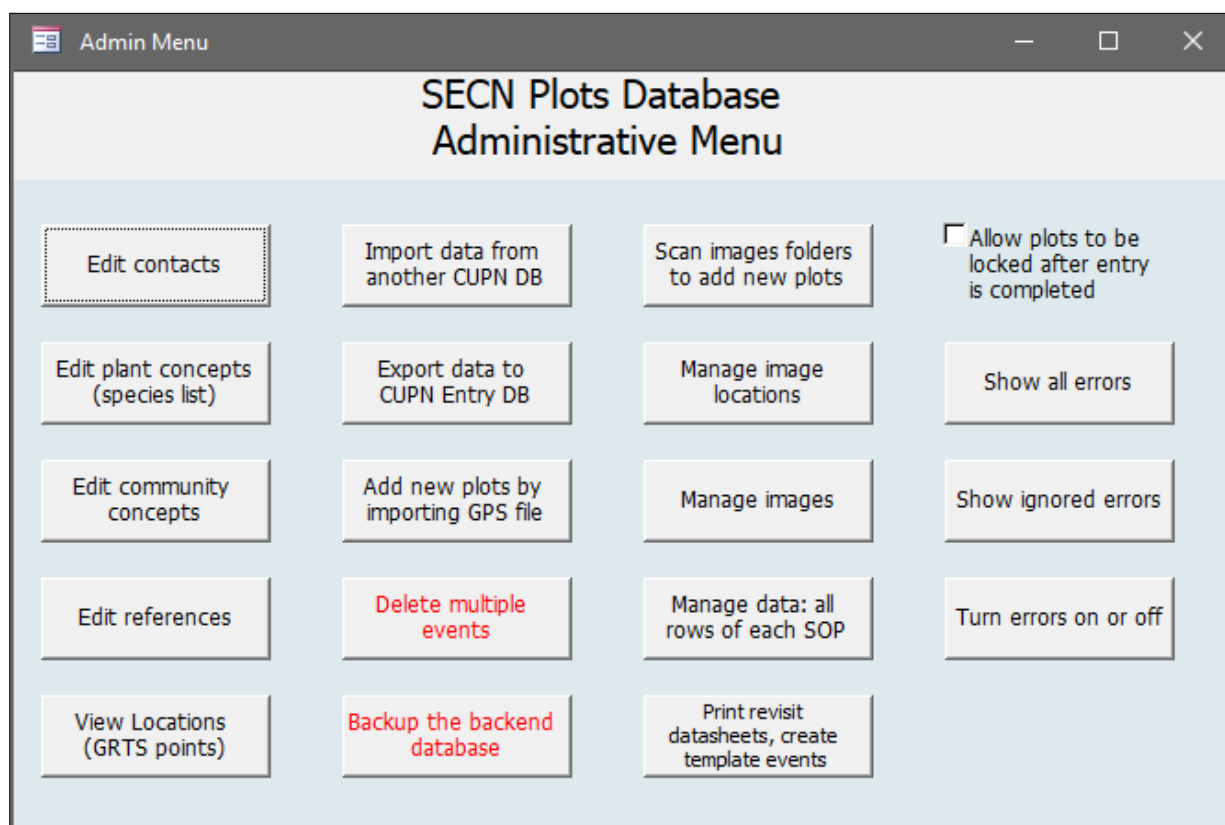
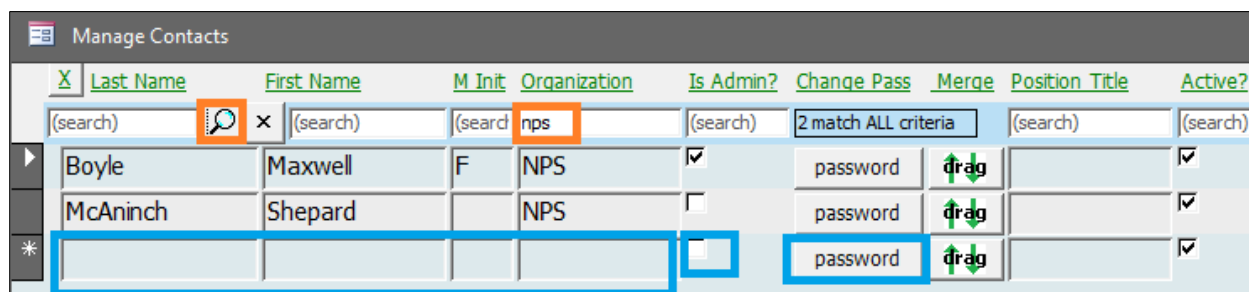


**Figure B-12.** The Administrative Menu of the SECN Vegetation Plots Database.

## Adding new people, editing roles, adding or changing passwords

From the admin menu, click “Edit contacts”. The form that follows is fairly typical for the SECN database, with a search area at the top, and green header links that allow sorting by different fields (Figure B-13). Enter some criteria into a white box and press enter on your keyboard or click the magnifying glass to search for terms matching what you’ve entered. The search functions operate in a similar manner as popular search engines on the web. Search for “terms in quotes” to find exact matches of several words in order. Prefix a word with a minus to find phrases that do not match it. You can include several terms with “OR” between them to search for one of several phrases. The logic is “and” between the different fields.

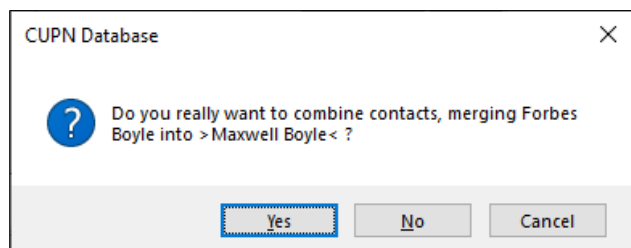
Use the bottom row to add a new person, highlighted in a blue box above. For this form, you can click the “Is Admin” box to give that user administrative privileges and the “password” box to specify a password (recommended).



| Last Name | First Name | M Init   | Organization | Is Admin?                           | Change Pass          | Merge    | Position Title | Active?                             |
|-----------|------------|----------|--------------|-------------------------------------|----------------------|----------|----------------|-------------------------------------|
| (search)  | (search)   | (search) | nps          | (search)                            | 2 match ALL criteria | (search) | (search)       | (search)                            |
| Boyle     | Maxwell    | F        | NPS          | <input checked="" type="checkbox"/> | password             | drag     |                | <input checked="" type="checkbox"/> |
| McAninch  | Shepard    |          | NPS          | <input type="checkbox"/>            | password             | drag     |                | <input checked="" type="checkbox"/> |
|           |            |          |              | <input type="checkbox"/>            | password             | drag     |                | <input checked="" type="checkbox"/> |

**Figure B-13.** Editing contacts in the SECN Vegetation Plots Database.

If you’ve added two contacts who are really the same person, you can merge them together by dragging one onto another row (Figure B-14):



CUPN Database

Do you really want to combine contacts, merging Forbes Boyle into >Maxwell Boyle< ?

Yes No Cancel

**Figure B-14.** Screenshot showing merging contacts.

## Editing domain lists

From the admin menu, select “edit domain lists.” The full list of domains appears and is editable by clicking “open” next to the list (Figure B-15). If values are already in use in the database, they will not be editable until those values are updated. The best strategy for such updates is to add the new domain value, update any lists using the old domain value to use the new value, then remove the old domain value.

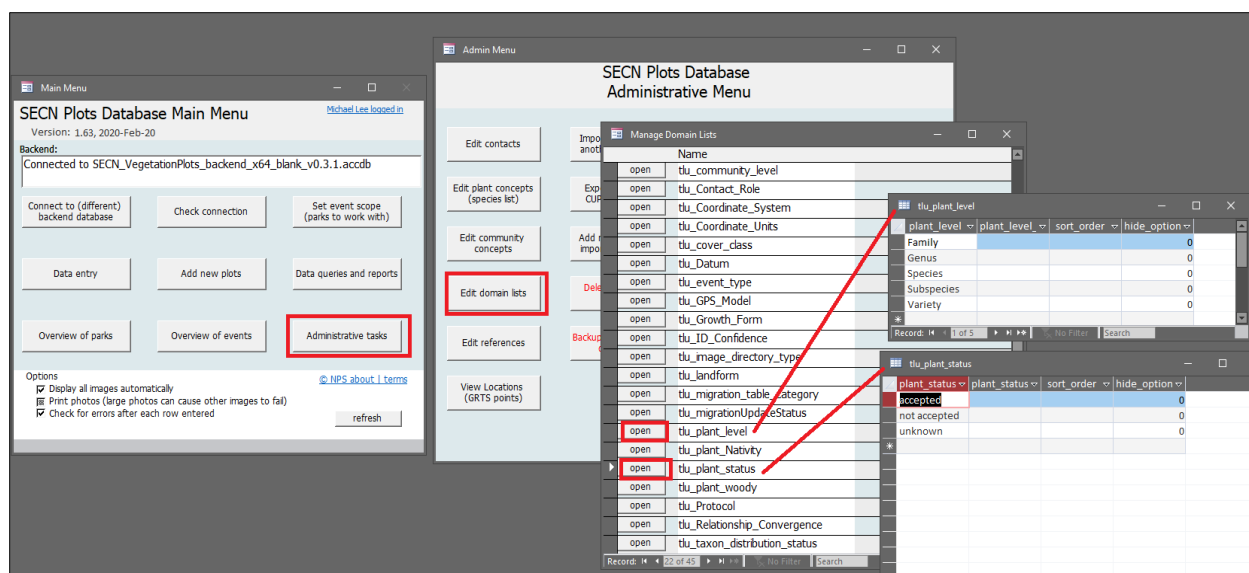


**Figure B-15.** Domain lists contained within the SECN Vegetation Plots Database.

## Configuring image folders

The database can find images automatically, if they match the plotID and date in the exact format: PARK-GRTS\_DATE(YYYYMMDD)\_(suffix).(extension). For example, CAHA001\_20200630\_VegetationMonitoring\_E.jpg for a plot photo

The database looks in preconfigured image folders to find and display these images. To setup or edit these, go to Admin Menu > Manage image locations (Figure B-16).

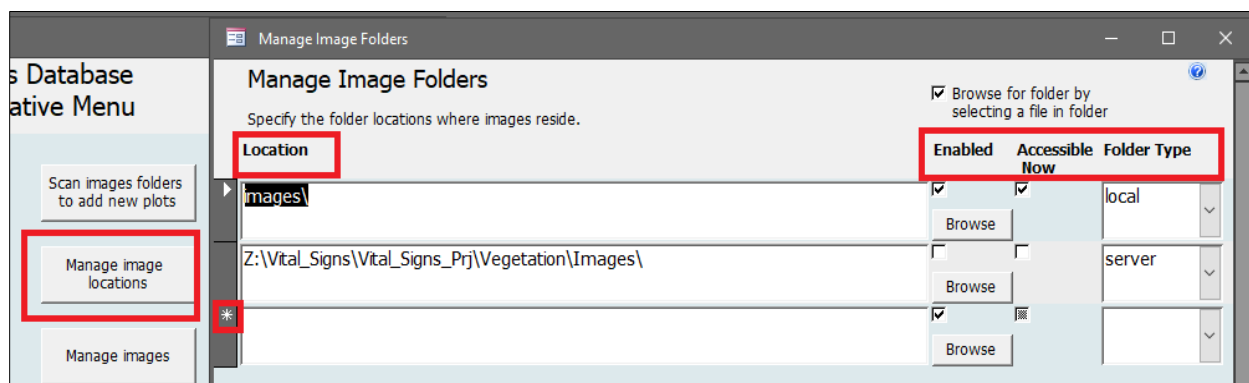


**Figure B-16.** Setting up links for folder locations storing photopoints in the SECN Vegetation Plots Database.

Each row represents a folder the database will check for files. If the “Enabled” box is checked, it will try to look there, uncheck to disable this directory. “Accessible Now” will be checked if the database can find the folder. Open this folder to have the database check again. Folder type is either “local” or “server.” The database looks in local folders first, as that should be faster. You can add

new rows on the bottom row, marked with an asterisk. This allows more locations to be scanned for images.

### Creating a new plant concept

Main Menu > Administrative Tasks > Edit plant concepts (species list). Click the “new record” arrow button at the bottom of the form, with an asterisk next to it (Figure B-17). Enter the information about the new plant concept, including the shortcut code you’d like to enter for it (Figure B-18). To refresh the picklist you’re on in any form, press F9 on the keyboard.

| Plant Name                | Plant Reference | ITIS Taxonom | Growth Form | Entry Shortcut | Nativity   |
|---------------------------|-----------------|--------------|-------------|----------------|------------|
| (search)                  | (search)        | (search)     | (search)    | (search)       | (search)   |
| xHesperotropsis           | Weakley 2020    |              |             | xHES           | Non-Native |
| xHesperotropsis leylandii | Weakley 2020    |              |             | xHESLEY        | Non-Native |
| Abdra                     | Weakley 2020    |              |             | ABDR           | Native     |

Record: 1 of 11022

No Filter Search

New (blank) record

**Figure B-17.** Table of editable plant names located within the SECN Vegetation Plots Database.

| Plant Name                         | Plant Reference | ITIS Taxonom | Growth Form | Entry Shortcut | Nativity | H Pri Exot | Woody    | Common Name               | Plant Status | Family Name  | Plant Level | Plant Parent | Plant Comments |
|------------------------------------|-----------------|--------------|-------------|----------------|----------|------------|----------|---------------------------|--------------|--------------|-------------|--------------|----------------|
| (search)                           | (search)        | (search)     | (search)    | (search)       | (search) | (search)   | (search) | (search)                  | (search)     | (search)     | (search)    | (search)     | (search)       |
| Juniperus                          | Weakley 2020    |              |             | JUNI           | Unknown  |            |          | Red Cedar, Juniper, Savir | accepted     | Cupressaceae | genus       | Cupressaceae |                |
| Juniperus [virginiana + siliicola] | Weakley 2020    |              |             | JUNIV+S        | Native   |            |          |                           | accepted     | Cupressaceae |             | Juniperus    |                |

**Figure B-18.** Adding a new taxonomic concept to the SECN Vegetation Plots Database plant list. In this example, you might want to edit the domain list “plant\_level” so that “composite species” is an option for this form.

## Appendix B Literature Cited

Boyle, M. F., M. B. Gregory, M. W. Byrne, P. Capece, and S. Corbett. 2019. Terrestrial vegetation monitoring in Southeast Coast Network parks: Protocol implementation plan. Natural Resource Report NPS/SECN/NRR—2019/1930. National Park Service, Fort Collins, Colorado. <https://irma.nps.gov/DataStore/Reference/Profile/2263392>