Floristic Quality Assessment (FQA) Calculator for Colorado – User's Guide –

Introduction

Floristic Quality Assessment (FQA) is a vegetation-based assessment tool that evaluates an area's ecological integrity based on its plant species composition (Wilhelm & Ladd 1988; Swink & Wilhelm 1994; Wilhelm & Masters1996). The method is built on the concept of species conservatism, which refers to a species' tolerance or intolerance to disturbance. The FQA method uses "coefficients of conservatism" or "C-values" assigned to all species in a region or state. C-values range from 0 to 10 and represent an estimated probability that a plant is likely to occur in a landscape relatively unaltered from pre-European settlement conditions (see table below). High C-values are assigned to species that are obligate to high-quality natural areas and cannot tolerate habitat degradation, while low C-values are assigned to species with wide tolerance to human disturbance. C-values of 0 are reserved for non-native species.

**Table 1. C-values and their interpretation.**

C-Values	Interpretation
0	Non-native species. Very prevalent in new ground or non-natural areas.
1-3	Commonly found in non-natural areas.
4-6	Equally found in natural and non-natural areas.
7-9	Obligate to natural areas but can sustain some habitat degradation.
10	Obligate to high quality natural areas (relatively unaltered from pre-European settlement).

The proportion of conservative plants in a plant community provides a powerful and relatively easy assessment of the integrity of both biotic and abiotic processes and is indicative of the ecological integrity of a site. The most basic FQA index is a simple average of C-values for a given site, generally called the Mean C, though more complex indices can be calculated.

C-values for Colorado species were assigned by a panel of botanical experts in 2006 (Rocchio 2007) and updated in 2020 (Smith et al. 2020). This User's Manual describes an easy-to-use database for calculating Colorado FQA indices.

Getting Started

The FQA Calculator is a Microsoft Access database and has been tested under Access versions 2007 and 2010. You must have Microsoft Access 2007 or later installed on your computer in order to use it. Depending on the computer security protocols in place where you work, you may need to place the database file in a "trusted" location and/or go through steps to unblock/enable content before you can use it. For further help, see your organization's computer security/IT person.
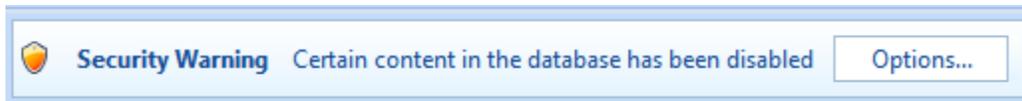
If you get a message like this, click "Options…" and then "enable content." You must enable content before you can use the database.

When you open the FQA Calculator, the first thing you will see is the Main Menu.
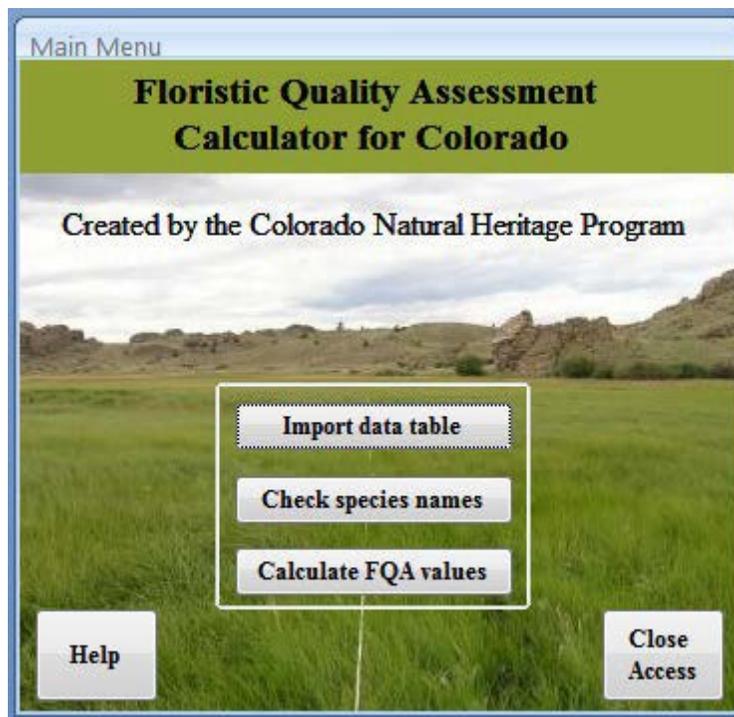
Complete the steps in the order in which they are presented on the Main Menu (sections for each step follow). First you will import your data table into the database. Then you need to check to make sure that the species names used in your table match those used by the calculator (generally Ackerfield 2015). If they do not match, you then need to crosswalk your species names. Crosswalks can be saved and used repeatedly with multiple datasets. After that, your data will then be ready and FQA values can be calculated.
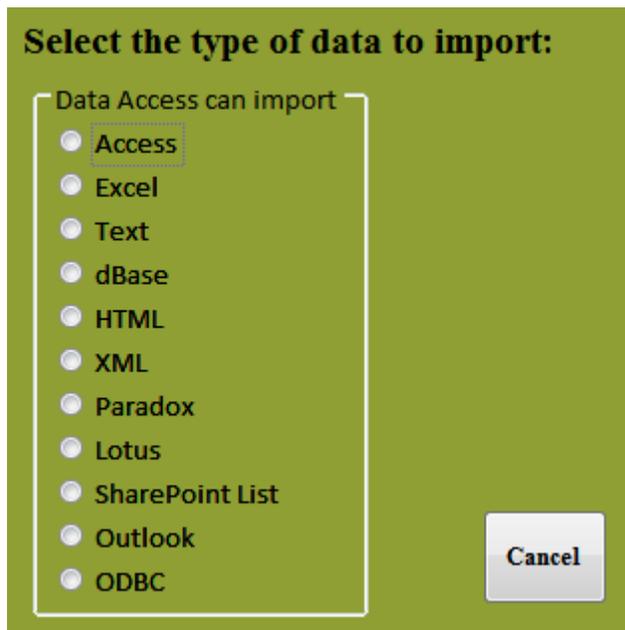
Import Data Table

Click on the "Import data table" button on the Main Menu. Your vegetation plot data must be in a digital file with the following fields:

Field	Description
Plot	Plot name or code. The FQA scores are calculated by Plot.
Species	Scientific Name of species, ideally following Ackerfield (2015)
Cover	Percent cover of this species in this plot, values between 0 – 100

IMPORTANT – The field names of your table **must match** the above. Any other fields in your table will be ignored.

Blanks in the Plot and Species fields will cause errors. Blanks in Cover will not cause errors, but will affect the calculations. The Cover value must be numeric (no non-numeric characters, like percent signs) and must be between 0 and 100, inclusive (non-integer values, like 10.8 or 0.5, are fine).

Any file type recognized by MS Access can be imported, see the list of file types in the screenshot below. You can import more than one data table, but you will need to do them one at a time, and the FQA calculations are done on one table at a time.

Once you select a file type to import, the Access Import Wizard for that type will run. Follow the prompts on the screen.

IMPORTANT – Choose the default option to "**Import the source data into a new table in the current database**." Do *not* append the records to an existing table or link to the data.

Because you are creating a new table, you can name it whatever you want. If you are planning on importing multiple tables into the same copy of the FQA Calculator, be sure to use descriptive names for each table. However, try to avoid unusual characters (punctuation or symbols) in the name.

The last screen of the Access Import Wizard will ask you if you want to save the import steps. Unless youplan on repeatedly re-importing the same table (presumably with edits), just click the Close button and do not bother saving the steps.

Check Species Names

Once you have completed importing a data table, you will be back at the Main Menu. Click the "Checkspecies names" button to see if your species names match the expected nomenclature of from the FQA Calculator, which is primarily Ackerfield (2015) with a few exceptions.
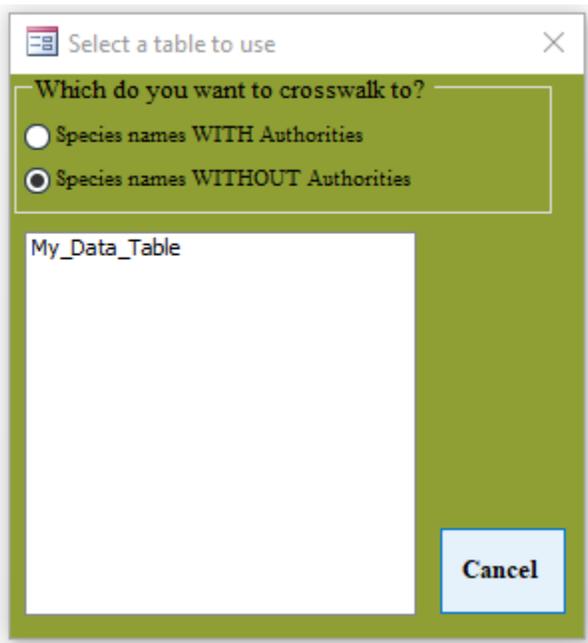
You will be presented with a list of all data tables in the database. First select whether you want to crosswalk your species names using Authorities as part of the name or not. Then click the name of thetable to use.

You will see a list of species names from your table that do not match any species name in the FQA Calculator. If this screen is blank, then all names match and you don't need to do anything more, click "Cancel" to return to the Main Menu. A name may not match because it has a typo (or slightly differentformat such as "spp" versus "spp." to designate subspecies), because it is a synonym, or because it doesn't exist in the FQA Calculator. Use the drop-down list on the right hand column to find the matching name. You can either scroll down the list or start typing to jump down the list. The names presented in the crosswalk focus on Weber and Wittmann 2012, which is commonly used in Colorado. When you select and name, the Weber and Whittmann name will show in the right column, but the FQA Calculator name is being saved in the backend of the database.

If there is no matching/synonym name in the drop-down list, that species cannot be used in the calculations. Click the "No Match" checkbox to tell the calculator to skip that species. If you have a lot ofentries that have no match, you can click the "Mark All as No Match" button to check all records as "No Match" at once to save time. You can then go through and uncheck any that do actually have a match.

IMPORTANT – it doesn't matter if you assign a crosswalk name if the record is also checked as "NoMatch", **all** records marked as "No Match" will be ignored in the calculations.

All of the species names listed on the left must either be assigned a crosswalk species name or be marked as "No Match" before you can continue. Once you have completed the crosswalk, you can saveit to use in the future if you wish.

IMPORTANT – if you want to save the crosswalk, click the "Save" button **before** clicking the "Apply"button. Save the crosswalk with a descriptive name that distinguishes it from your data table. Avoid unusual characters (punctuation or symbols) in the name

Once you are finished with the crosswalk, and have saved it if you want to, click the "Apply" button toapply the crosswalk to your data table and return to the Main Menu.

If you have a saved crosswalk in this copy of the FQA Calculator and want to use it on another datatable, click the "Load" button. You will be asked to choose from a list of all tables that you have created in this database (including your data table, which is why descriptive names are helpful).Click on the saved crosswalk to load it.
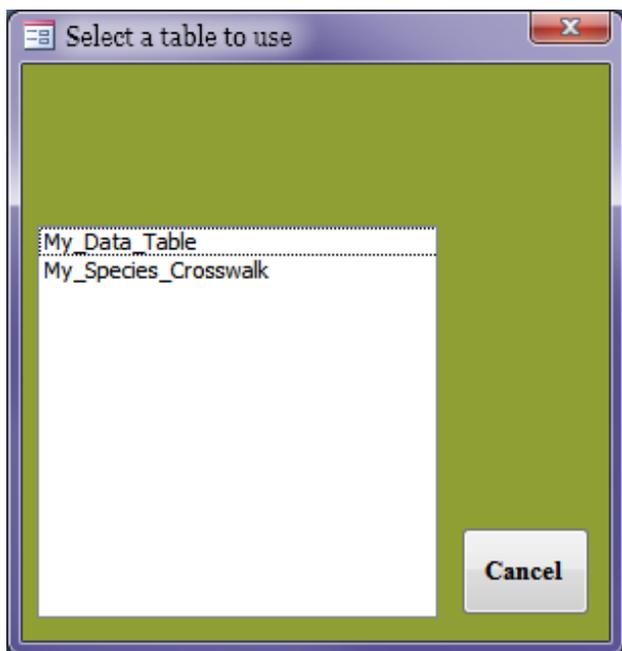
If the species in the saved crosswalk do not exactly match what's in your data table, the loaded crosswalk will be incomplete. Apply it and then run "Check species names" again to see if any species names were missed.

Calculate FQA Values

Once you have completed checking the species names, and have applied your crosswalk, you will be back at the Main Menu. Click on the "Calculate FQA values" button to analyze your prepared data. If youhave been doing this in the sequence described, the FQA Calculator will automatically use the data tableyou just imported and/or applied a crosswalk to. If you hadn't just done these other tasks, you will see alist of tables to select. Click on the table name that you want to run the calculations on.

There are 17 columns in this table, you can either resize the window (if you screen resolution is high enough), or scroll to the right to see all the values. You can also click the "Export to Excel" button to make an Excel spreadsheet of these data. If values are blank, that means there was insufficient data for that plot to complete the calculation.

Terminology, description and calculation of FQA indices.

N_n = count of native species, N_a = count of all species, N_e = count of non-native species, C_i = index of conservatism for the ith species, x_i = percent cover for the ith species.

Indices	Description	Calculation
Species richness	Number of plant species observed	N_a
Native species richness	Number of native plant species observed	N_n
Non-native species richness	Number of non-native plants	N_e
Percent non-native species	Number of native plants divided by the number of all plants multiplied by 100	$(N_n / N_a)(100)$
Mean C	Average C-value of all plants	$\sum_{i=1}^{n} C_i / N_a$
Mean C$_{nat}$	Average C-value of only the native plants	$\sum_{i=1}^{n} C_i / N_n$
Cover-weighted Mean C	Sum of each species C-value multiplied by its cover values, then divided by the sum of cover values for all species	$\sum_{i=1}^{n} x_i C_i / \sum_{i=1}^{n} x_i$
Cover-weighted Mean C$_{nat}$	Sum of each native species C-value multiplied by its cover values, then divided by the sum of cover values for native species	$\sum_{i=1}^{n} x_i C_i / \sum_{i=1}^{n} x_i$
FQI	Mean C of all plants multiplied by the square-root of number of all plants	$\left(\sum_{i=1}^{n} C_i / N_a \right) \sqrt{N_a}$
FQI$_{nat}$	Mean C of native plants multiplied by the square-root of number of native plants	$\left(\sum_{i=1}^{n} C_i / N_n \right) \sqrt{N_n}$
Cover-weighted FQI	Cover-weighted Mean C for all species multiplied by the square-root of all species	$\left(\sum_{i=1}^{n} x_i C_i / \sum_{i=1}^{n} x_i \right) \sqrt{N_a}$
Cover-weighted FQI$_{nat}$	Cover-weighted Mean C for native plants multiplied by the square-root of native plants	$\left(\sum_{i=1}^{n} x_i C_i / \sum_{i=1}^{n} x_i \right) \sqrt{N_n}$
Adjusted FQI	Mean C of native plants divided by 10 multiplied by square-root of native plants divided by the square-root of number of all plants multiplied by 100	$\dfrac{\left(\sum_{i=1}^{n} C_i / N_n \right)}{10} \dfrac{\sqrt{N_n}}{\sqrt{N_a}} (100)$
Adjusted cover-weighted FQI	Cover-weighted Mean C for native plants divided by 10 multiplied by square-root of native plants divided by the square-root of number of all plants multiplied by 100	$\dfrac{\left(\sum_{i=1}^{n} x_i C_i / \sum_{i=1}^{n} x_i \right)}{10} \dfrac{\sqrt{N_n}}{\sqrt{N_a}} (100)$

Database Maintenance, Tips, and Troubleshooting

If you would like to get to the tables, queries, or forms behind the FQA Calculator, press F11 to open the Access Navigation Pane. This is the only way to delete a table if you want to do that.

IMPORTANT – Do **not** delete the table "tFQASpeciesList_lu"! The FQA Calculator will no longer function if this table is not there. Any other tables in the database are user added and may be safely deleted. Likewise, if you change or delete any query, form, or code, the FQA Calculator will likely not work correctly anymore.

If you applied a crosswalk to your imported data table, the species names were over-written where necessary, but the original names are still in the table, in a field called "Original_Names".

You can copy/export your crosswalk table(s) and data table(s) to any other database or as a stand-alone table (Excel, delimited ASCII, etc.).

Microsoft Access is not very good about keeping databases clean. The more you use a copy of the FQA Calculator, the larger the file will get. You may want to occasionally use the "Compact and Repair Database" tool to keep the file size down. Please see the MS Access help for more information.

References

Rocchio, J. (2007) Floristic quality assessment indices for Colorado plant communities. Colorado Natural Heritage Program, Colorado State University, Fort Collins, Colorado.

Smith, P., G. Doyle, and J. Lemly. (2020.) Revision of Colorado's Floristic Quality Assessment Indices. Colorado Natural Heritage Program, Colorado State University, Fort Collins, Colorado.

Swink F. and G. Wilhelm. (1994) *Plants of the Chicago Region.* 4th Edition. Morton Arboretum, Lisle, IL.

Wilhelm, G. and D. Ladd. (1988) Natural area assessment in the Chicago region. Pp 361-375 in R.E. McCabe, editor, Transactions of the 53rd North American Wildlife and Natural Resources Conference. Wildlife Management Institute, Washington D.C.

Wilhelm, G. and L. Masters. (1996) *Floristic Quality Assessment in the Chicago Region.* The Morton Arboretum, Lisle, IL.