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FLORISTIC QUALITY ASSESSMENTS
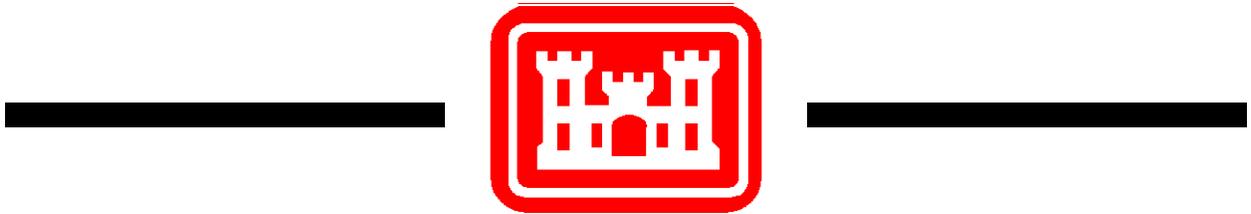
DEPARTMENT OF THE ARMY
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Environmental Quality

FLORISTIC QUALITY ASSESSMENTS

1. Purpose.

    a. This Public Works Technical Bulletin (PWTB) provides
information on the process of conducting a Floristic Quality
Assessment (FQA), which is a quick, easy, objective, and widely-
accepted method to evaluate the ecological condition of a site
based on its native floristic quality. This method is especially
desirable since land management personnel can make the simple
calculations using existing data sets (e.g., Range & Training
Land Assessment Program data) and the available data sources for
various states listed in Appendix B.

    b. All PWTBs are available electronically (in Adobe®
Acrobat® portable document format [PDF]) through the World Wide
Web (WWW) at the National Institute of Building Sciences' Whole
Building Design Guide web page, which is accessible through URL:

        http://www.wbdg.org/ccb/browse_cat.php?o=31&c=215

2. Applicability. This PWTB applies to all Continental United
States Army facilities.

3. References.

    a. National Environmental Policy Act of 1969 (Public Law 90-
190, 42 USC 4321), 1 January 1970.

    b. 32 CFR 651, Environmental Analysis of Army Actions (AR
200-2), 29 March 2002.

4. <u>Discussion</u>.

a. a. The National Environmental Policy Act (NEPA) and decision processes outlined in 32 CFR 651 state that certain actions (e.g., facilities construction, military training, etc.) that generate impacts on the environment require a formal Environmental Assessment. Environmental Assessments generally focus on actions that may compromise the environment and negatively affect the local and regional ecosystem. Natural area managers, installation managers, environmental professionals, and researchers need objective methods to quantify ecological integrity.

b. FQA is a standardized method for natural area assessment utilized by a number of national and local government agencies. This method replaces the subjective measures of quality, such as "high" or "low," with an objective quantitative index. FQA methods were developed to quantify the biological integrity of a site based on the condition of the plant community. The basis for an FQA is the concept of species conservatism. The method uses the aggregate conservatism of all species found on a site as an indication of its ecological integrity. The ease of use, coupled with its objectivity, makes it a practical tool when time, funding, and manpower constraints are present. FQAs can be used for a variety of purposes, including: (1) identifying natural areas, (2) facilitating comparisons among various sites for prioritization, (3) providing long-term monitoring of the natural quality of a site over time, (4) evaluating restoration efforts, and (5) for regulatory analyses (e.g., permitting decisions).

c. This PWTB provides an overview of an FQA, describes the various FQA indices and how they are calculated, identifies sources of information for Coefficients of Conservatism (i.e., "C" values), provides guidance on how to conduct an FQA (including the specific steps to be taken), identifies common problems or issues that one might encounter when conducting an FQA, and presents an example of an FQA using data from a military installation.

d. Appendix A contains definitions of FQA and index scores, including how the index scores are calculated.

e. Appendix B includes sources of information for Coefficients of Conservatism for plant species in various states (if available), including appropriate websites, Excel spreadsheets, and Microsoft Word files.

f. Appendix C contains the "how to" process of conducting an FQA. This discussion includes issues encountered when using different sources of data to create the most robust FQA for an area based on the currently available information.

g. Appendix D provides an example of how to conduct an FQA based on data from a particular military installation. This example includes a discussion of various issues that arose and strategies to mitigate these issues when conducting future FQAs.

5. <u>Points of Contact (POCs)</u>. Headquarters, U.S. Army Corps of Engineers (HQUSACE) is the proponent for this document. The POC at HQUSACE is Malcolm E. McLeod, CEMP-II, 202-761-0632, or e-mail: Malcolm.E.Mcleod@hq02.usace.army.mil.

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APPENDIX A:
Definitions of Floristic Quality Assessments, Including Index
Scores, and How Index Scores Are Calculated

Introduction

The impacts of human disturbances along spatial and temporal
scales strongly affect the survivability of plant species in a
specific area (Rocchio 2007). As such, land and natural resource
managers are keenly interested in the impacts that human
disturbances in general, and military training in particular,
have upon Army installations. Conducting a Floristic Quality
Assessment (FQA) is one method to evaluate these types of
impacts (Rocchio 2007). In addition, this type of assessment can
be utilized for various regulatory and non-regulatory analyses
(Rocchio 2007).

An FQA is a simple, consistent, cost-effective method for
determining the ecological condition of a site in terms of its
native floristic quality (Swink and Wilhelm 1994; Francis et al.
2000; Herman et al. 2001). It can be an appropriate tool to
prioritize various sites of interest when time, funding, and
level of effort available are severely constrained (Northern
Great Plains Floristic Quality Assessment Panel 2001). A
significant benefit is that the FQA can be conducted by a
trained botanist without the need for elaborate sampling
equipment (Rocchio 2007). Alternatively, the FQA can be
calculated using existing data sets from other conservation
organizations (Rocchio 2007). Both methods will require a list
of Coefficient of Conservatism ("C") values from available
resources to complete the assessment (see page A-3 for further
definition of C values).

Species Conservatism

The concept of species conservatism forms the basis of an FQA
(Swink and Wilhelm 1994; Rocchio 2007). Species conservatism is
comprised of two facets: (1) the degree of tolerance to
disturbance and, (2) the degree of fidelity, or faithfulness, to
a particular habitat or environment (Swink and Wilhelm 1994;
Wilhelm and Masters 1995; Taft et al. 1997; Northern Great
Plains Floristic Quality Assessment Panel 2001). The degree of
habitat fidelity is the extent to which an individual species is
likely to be found in areas relatively unchanged from conditions

believed to have existed prior to European settlement in the
early 1800s (Swink and Wilhelm 1994; Wilhelm and Masters 1995;
Herman et al. 2001; Rocchio 2007). In other words, it is a
measure of the level of "naturalness" of an area (Swink and
Wilhelm 1994; Wilhelm and Masters 1995).

Based on species conservatism, FQA methodology acknowledges that
all plant species within a given site reveal information about
the particular location (Herman et al. 2001). As such, the FQA
measures the extent a particular site contains conservative
native species. The FQA considers density and frequency
irrelevant when assessing a site's floristic quality (Swink and
Wilhelm 1994). Research has determined that the additional
effort needed to obtain cover-weighted data is not worth the
extra resources involved in collecting the data (Rocchio 2007).

Applications of Floristic Quality Assessments

Floristic Quality Assessments have several useful applications.
As stated above, these types of assessments can appraise the
degree of "naturalness" of an area (Swink and Wilhelm 1994).
Second, they can evaluate protective measures undertaken for a
particular site (Swink and Wilhelm 1994). Third, the FQA's can
assess the restoration activities at a specific location (Swink
and Wilhelm 1994). Fourth, they allow comparisons to be made
among various sites (Swink and Wilhelm 1994). And finally, the
assessments can be utilized for various regulatory analyses
(e.g., permitting decisions) (Rocchio 2007).

Conservatism vs. Rarity

To truly understand the value of a Floristic Quality Assessment,
it is important to note the difference between the concepts of
conservatism and rarity (Rothrock 2004; Rocchio 2007). A species
may be endangered, but may be found in highly disturbed areas
that clearly are not of high conservative value (Rocchio 2007).
The converse may also be true; that is, many highly conservative
species are not very rare (Rocchio 2007). The identifying
characteristic of a highly conservative site thus depends on the
number of species that reflect the characteristics found in pre-
European settlement conditions (Rocchio 2007). According to
Herman et al. (2001):

> All too frequently, areas where legally protected
> species are absent are considered expendable under
> current formal environmental evaluations. It is
> precisely because Floristic Quality Assessment is not
> based on species rarity or legal status that makes it

a useful tool for assessing the natural quality of an
area [p 12].

It is not safe to assume that disturbed areas were ever
deemed high quality simply because an endangered species
resides there. In fact, some endangered species are
endangered specifically because they need disturbed habitat
to flourish. Given most conservation policies, disturbance
is viewed negatively, and is, therefore, avoided whenever
possible. However, various species (endangered or common)
that require disturbed habitat may gravitate towards land
disturbed as a result of military training activities.

Coefficient of Conservatism

The Coefficient of Conservatism is the main component of the FQA
(Herman et al. 2001; Rothrock 2004; and Rocchio 2007). This
coefficient, also known as the "C of C" value, or merely the "C"
value, is an integer ranging from 0 to 10 (Rocchio 2007).
Species given low C values are highly tolerant to disturbance,
and, in fact, may actually thrive upon disturbance (Rothrock
2004). These particular species exhibit little fidelity to
natural areas and may be found virtually anywhere (Rocchio
2007). As an example, Swink and Wilhelm (1994) noted that common
peppergrass (*Lepidium virginicum*) found in the Chicago region
would be assigned a C value of 0, representing 0% confidence
that the species was from a natural community. In contrast,
species with high C values are highly intolerant to disturbance
and are located in high quality natural sites indicative of
conditions prior to European settlement (Rocchio 2007). An
example in this case could be rush aster (*Aster borealis*); if
found in the Chicago region, it would be assigned a C value of
10 (Swink and Wilhelm 1994). This C value represents 100%
confidence that this particular species was from a natural
community.

Since physiological and ecological differences may exist within
the growing range of a plant, different C values for the species
are likely, depending upon the specific geographic region
(Rooney and Rogers 2002; Rocchio 2007; Robert W. Freckmann
Herbarium website, http://wisplants.uwsp.edu/WFQA.html). In
these cases, a species found near the periphery of its growing
range is likely to have a higher C value compared to that which
it has in the central part of its range (Rooney and Rogers 2002;
Rocchio 2007; and Robert W. Freckmann Herbarium website).

These regional values are assigned *a priori* for each native
species based on field experience of various botanical experts
(Rocchio 2007). "Although these values are assigned
subjectively, they are applied consistently and objectively
since value judgments have already been determined" (Rocchio
2007, p 14). In addition, the subjectivity is moderated to an
extent, as it is based on the collective judgment of experts
(Robert W. Freckmann Herbarium website).

Introduced species, by definition, are not native and were not
part of the pre-European settlement landscape (Rothrock 2004).
As such, these species are either given C values of 0 or are
disregarded in the calculation, depending on the type of
Floristic Quality Index (FQI) calculation used, which is
discussed below (Rothrock 2004). In addition, ubiquitous native
species, with nonexistent fidelity to natural areas, may also
have C values equal to 0 (Rocchio 2007).

Floristic Quality Assessment Indices

Three fundamental indices are used to evaluate the floristic
condition of a site: (1) the Mean C value, (2) the FQI, and (3)
the "Adjusted" or "Alternative" FQI. The Mean C value is
calculated by summing all the C values for native species at the
particular site and dividing by the number of native species
found, shown in Equation 1:

Equation 1. Mean C

$$MeanC = \overline{C} = \frac{\sum_{i=1}^{n} C_i}{N}$$

Degradation of a site over time would result in a lower Mean C
value. This result is because the plants with higher C values
are typically those that are most adversely affected by change
and become lost as the site becomes more degraded (Wilhelm and
Masters 1995; Northern Great Plains Floristic Quality Assessment
Panel 2001; Matthews 2003; and Rothrock 2004).

When attempting to prioritize different sites, however, the
rather simplistic measure of Mean C does not take into account
that larger sites usually contain more species (i.e., greater
species richness) than smaller sites (Wilhelm and Masters 1995).
This difference could result in instances wherein different
sites may have similar Mean C values, but support vastly
different numbers of native species (Wilhelm and Masters 1995;

Northern Great Plains Floristic Quality Assessment Panel 2001).
Therefore, an index is needed that will account for this
distinction (Wilhelm and Masters 1995).

The FQI and the Adjusted FQI are weighted species-richness
estimates that recognize the fact that larger sites tend to
contain more species than smaller ones (Rocchio 2007). However,
to temper the effect that size alone may have on species
richness, the FQI is calculated by multiplying the Mean C value
by the square root of the number of native species at the site
(Equation 2), as opposed to simply multiplying by the number of
native species (Swink and Wilhelm 1994; Northern Great Plains
Floristic Quality Assessment Panel 2001; Rocchio 2007).
Nevertheless, it is generally recommended that comparisons take
place among sites of relatively similar size (Matthews 2003).

Equation 2. Floristic Quality Index

$$FQI = \overline{C} * \sqrt{N}$$

The Adjusted FQI (Equation 3) uses the introduced species in the
computation of the Mean C and FQI, but assigns a "0" value to
these species (Rocchio 2007).

Equation 3. Adjusted Floristic Quality Index

$$AdjustedFQI = \overline{C}_{AllSpecies} * \sqrt{N_{AllSpecies}}$$

As stated above, each C value represents a measure of the
fidelity of the species to pre-European settlement conditions and
its tolerance to disturbance (Wilhelm and Masters 1995; Taft
1997; and Northern Great Plains Floristic Quality Assessment
Panel 2001). As such, its value tends to remain constant, thus
generally precluding the need to update these values. In some
instances, however, C values may be updated or refined as more
experts express their professional opinions regarding a
particular species (Rocchio 2007). This refinement may result in
some slight adjustments of the C values. Therefore, calculating
the specific indices to evaluate protection or mitigation efforts
over time simply requires an individual to: (1) obtain an updated
field inventory, and (2) determine if the specific C values have
been modified.

Similar to other flora assessments, seasonal variations and
different plant community types can affect the FQA indices
(Matthews 2003; Rothrock 2004; and Rocchio 2007). Therefore, care
must be exercised when interpreting results (Rothrock 2004).
Additionally, the FQA indices are not intended for use as
definitive assessments (Francis et al. 2000; Herman et al. 2001;
Northern Great Plains Floristic Quality Assessment Panel 2001;

Rooney and Rogers 2002). They should, instead, serve to complement a variety of other methods in determining the natural integrity of a site and facilitating more robust comparisons among sites (Francis et al. 2000; Herman et al. 2001; Northern Great Plains Floristic Quality Assessment Panel 2001; Rooney and Rogers 2002).

References

Francis, C.M., M.J.W. Austen, J.M. Bowles, and W.B. Draper. 2000. Assessing floristic quality in southern Ontario woodlands. *Natural Areas Journal* 20:66-77.

Herman, K.D., L.A. Masters, M.R. Penskar, A.A. Reznicek, G.S. Wilhelm, W.W. Brodovich, and K.P. Gardiner. 2001. Floristic Quality Assessment with Wetland Categories and Examples of Computer Applications for the State of Michigan – Revised, 2nd Edition. Michigan Department of Natural Resources, Wildlife, Natural Heritage Program. Lansing, MI.

Matthews, J.W. 2003. Assessment of the floristic quality index for use in Illinois, USA, wetlands. *Natural Areas Journal* 23(1):53-60.

Northern Great Plains Floristic Quality Assessment Panel. 2001. Floristic Quality Assessment for plant communities of North Dakota, South Dakota (excluding the Black Hills), and adjacent grasslands. Jamestown, ND: Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/2001/fqa/fqa.htm (Version 26JAN2001).

Robert W. Freckmann Herbarium, University of Wisconsin - Stevens Point website. http://wisplants.uwsp.edu/WFQA.html (accessed 15 April 2008).

Rocchio, J. 2007. Floristic Quality Assessment Indices for Colorado Plant Communities. Prepared for Colorado Department of Natural Resources, and U.S. Environmental Protection Agency, Region 8. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Rooney, Thomas P., and David A. Rogers. 2002. The Modified Floristic Quality Index. *Natural Areas Journal* 22(4):340-344.

Rothrock, Paul E. 2004. Floristic Quality Assessment in Indiana: The Concept, Use, and Development of Coefficients of Conservatism. Unpublished report prepared for U.S. Environmental Protection Agency. Taylor University, Upland, IN.

Swink, Floyd, and Gerould Wilhelm. 1994. Plants of the Chicago region. 4th ed. Indianapolis: Indiana Academy of Science.

Taft, J.B., G.S. Wilhelm, D.M. Ladd, and L.A. Masters. 1997. Floristic Quality Assessment for vegetation in Illinois. *Erigenia* 15:1-95.

Taft, J.B., C. Hauser, and K.R. Robertson. 2006. Estimating floristic integrity in tallgrass prairie. *Biological Conservation* 131:42-51.

Wilhelm, G.S., and L.A. Masters. 1995. Floristic Quality Assessment in the Chicago Region and application computer programs. Morton Arboretum, Lisle, IL.

APPENDIX B:
Sources of Information for Coefficients of Conservatism

Coefficients of conservatism (i.e., C of C values or merely C values), continue to be developed for more states. C values for existing state plant lists continue to be refined and updated. When conducting a floristic assessment, you should attempt to obtain the most recent information for your location. Listed below are websites, addresses, and publications that contain C values for various states that were available when this PWTB was published. Accessing C values from these sources at the time of your assessment will ensure you are using the most current data.

New C values for additional states become available often, so the most expedient way to determine the availability of new information is to conduct an Internet search. Each state has a natural heritage program and/or a conservation data center. Although states differ in where this program is located within the framework of state government, most reside under the Natural Resources, Conservation, Wildlife, or Fish and Game agencies. In addition, botany or plant science departments of major state universities may be able to provide this information as it becomes available.

Colorado:

C values for Colorado can be obtained from the following publication.

Floristic Quality Assessment Indices for Colorado Plant Communities, 29 May 2007 report (See Appendix E: Coefficients of Conservatism for Colorado Flora):

   http://www.cdfinc.com/CRI/Colorado%20FQA.pdf

Delaware:

C values for Delaware can be obtained in Excel spreadsheet and Word document format by contacting William A. McAvoy, Botanist with the Delaware Natural Heritage and Endangered Species Program, Delaware Natural Heritage Program, Division of Fish and Wildlife, Department of Natural Resources and Environmental Control, 4876 Hay Point Landing Road, Smyrna, DE 19977.

   (email: william.mcavoy@state.de.us)

Florida:

C values for Florida can be obtained from the following publication:

Matthew J. Cohen, Susan Carstenn, and Charles R. Lane. 2004. Floristic quality indices for biotic assessment of depressional marsh condition in Florida. *Ecological Applications* 14:784-794.

http://www.esapubs.org/archive/appl/A014/015/appendix-A.htm

Illinois:

C values for Illinois can be obtained in Excel spreadsheet format from John Taft, Plant Ecologist, Illinois Natural History Survey, 1816 S. Oak Street, Champaign, IL 61820 (email: taft@inhs.uiuc.edu).

Green Landscaping also provides C values for Native Plants of the Great Lakes at:

http://www.epa.gov/greenacres//plants/index.html

C values can also be obtained from the following publication:

Bourdaghs, Michael, Carol A. Johnston, and Ronald R. Regal. 2006. Properties and Performance of the Floristic Quality Index in Great Lakes Coastal Wetlands. *WETLANDS* 26(3):718-735. Appendix 1 contains a list of C values:

http://www.cdfinc.com/CRI/great%20lakes%20application.pdf

Indiana:

C values for Indiana can be obtained from the following two publication:

Floristic Quality Assessment for Plant Communities of Indiana: Species List and Coefficients of Conservatism.

http://www.taylor.edu/academics/acaddepts/ees/pdf/fqa_plantlist.xls

The aforementioned document is also listed at the following website:

http://www.in.gov/idem/files/plantlist.xls

Bourdaghs, Michael, Carol A. Johnston, and Ronald R. Regal. 2006. Properties and Performance of the Floristic Quality Index in Great Lakes Coastal Wetlands. *WETLANDS* 26(3):718-735. Appendix 1 contains a list of C values:

http://www.cdfinc.com/CRI/great%20lakes%20application.pdf

Iowa:

C values for Iowa can be obtained from the following publication:

Brudvig, Lars A., Catherine M. Mabry, James R. Miller, and Tracy A. Walker. 2007. Evaluation of Central North American Prairie Management Based on Species Diversity, Life Form, and Individual Species Metrics. Conservation Biology Volume 21, No. 3, 864-874. Table 1 contains various C values.

http://www.blackwell-synergy.com/doi/pdf/10.1111/j.1523-1739.2006.00619.x

C values for Iowa can also be obtained in Excel format from the Iowa State University Ada Hayden Herbarium website:

http://www.public.iastate.edu/~herbarium/coeffici.html

Kansas:

C values for Kansas can be obtained in Excel format from Dr. Craig Freeman, Botanist, Department of Ecology & Evolutionary Biology, University of Kansas, Lawrence, KS 66045 (email: ccfree@ku.edu).

Kentucky:

C values for Kentucky can be obtained in Excel spreadsheet format from Deborah White, Botanist, Kentucky State Nature Preserves Commission, 801 Schenkel Lane, Frankfort, KY 40601 (email: Deborah.White@ky.gov).

The following website also lists Kentucky C values.

http://www.dropseednursery.org/plants.html

Michigan:

C values for Michigan can be obtained from the following two publications.

Floristic Quality Assessment with Wetland Categories and Examples of Computer Applications for the State of Michigan, Revised, 2nd Ed. – October 2001. Appendices C, D, and E.

http://www.cdfinc.com/CRI/Michigan%20FQA.pdf

Bourdaghs, Michael, Carol A. Johnston, and Ronald R. Regal. 2006. Properties and Performance of the Floristic Quality Index in Great Lakes Coastal Wetlands. *WETLANDS* 26(3):718-735. Appendix 1 contains a list of C values:

http://www.cdfinc.com/CRI/great%20lakes%20application.pdf

Minnesota:

C values for Minnesota can be obtained from the following two publications.

Bourdaghs, Michael, Carol A. Johnston, and Ronald R. Regal. 2006. Properties and Performance of the Floristic Quality Index in Great Lakes Coastal Wetlands. *WETLANDS* 26(3):718-735. Appendix 1 contains a list of C values.

   http://www.cdfinc.com/CRI/great%20lakes%20application.pdf

Milburn, S.A., M. Bourdaghs, and J.J. Husveth. Floristic Quality Assessment for Minnesota Wetlands. Minnesota Pollution Control Agency, St. Paul, Minn. (No publication date listed.) Below is the website for the publication. Appendix A contains C values for wetland areas and Appendix C contains various plant synonyms.

   http://www.pca.state.mn.us/publications/wetlandassessment-guide.html

Mississippi:

C values for Mississippi can be obtained from the following publication.

Herman, Brook D., John D. Madsen, and Gary N. Ervin. 2006. Development of Coefficients of Conservatism for Wetland Vascular Flora of North and Central Mississippi. GeoResources Institute Report 4001. Table 3 lists the C values for Wetland Vascular Flora of North and Central Mississippi (pp 9-15).

   http://www.cdfinc.com/CRI/Mississippi%20FQA.pdf

Missouri:

C values for Missouri can be obtained from the following publication:

Ladd, D.M. 1993. Coefficients of Conservatism for Missouri vascular flora. The Nature Conservancy, St. Louis, MO. 53 p.

Montana:

C values for Montana can be obtained from the following publication:

Jones, W.M. 2005. A vegetation index of biotic integrity for small-order streams in southwestern Montana and a Floristic Quality Assessment for western Montana wetlands. Report to the Montana Department of Environmental Quality and U.S. Environmental Protection Agency, Montana Natural Heritage

Program, Helena, MT. See Appendix A for C values for 747 plant species known to occur in wetlands in western Montana.

   http://mtnhp.org/Reports/07_2005_Red_Rock.pdf

Nebraska:

C values for Nebraska can be obtained in Excel format from Gerry Steinauer, School of Natural Resources, University of Nebraska, Lincoln, NE 68583-0961 (email: gerry.steinauer@ngpc.ne.gov).

C values for Nebraska can also be obtained in Excel format from Steve Rothenberger, Professor of Biology, University of Nebraska, Kearney, NE 68849 (email: rothenberges@unk.edu).

New Jersey:

C values for New Jersey can be found at Bowman's Hill Wildflower Preserve Home Page: www.bhwp.org. Actual site of over 2,000 C values can be found at the following website.

   http://www.bhwp.org/db/BHWP_Full_List.pdf?PHPSESSID=3e09b0f56c1f6e25cda9fd651360d7db

North Dakota:

C values for North Dakota can be found at Northern Prairie Wildlife Research Center Home Page: www.npwrc.usgs.gov

Actual site of the 1,583 C values can be found at the following website:

   http://www.npwrc.usgs.gov/resource/plants/fqa/fqalist.txt

Ohio:

C values for Ohio can be obtained from the following publication:

Andreas, Barbara K., John J. Mack, and James S. McCormac. 2004. Floristic Quality Assessment Index (FQAI) for vascular plants and mosses for the State of Ohio. Ohio Environmental Protection Agency, Division of Surface Water, Wetland Ecology Group, Columbus, Ohio. 219 p. (See the Appendices for Coefficient of Conservatism information.)

   http://www.cdfinc.com/CRI/Michigan%20FQA.pdf

The aforementioned report can also be found at the following website.

   http://www.epa.state.oh.us/dsw/wetlands/Ohio_FQAI.pdf

Pennsylvania:

C values for the Piedmont region of Pennsylvania can be found at Bowman's Hill Wildflower Preserve Home Page: www.bhwp.org

Actual site of more than 2,000 C values can be found at the following website:

   http://www.bhwp.org/db/BHWP_Full_List.pdf?PHPSESSID=3e09b0f56c1f6e25cda9fd651360d7db

South Dakota:

C values for South Dakota can be found at Northern Prairie Wildlife Research Center Home Page: www.npwrc.usgs.gov

Actual site of the 1,583 C values can be found at the following website.

   http://www.npwrc.usgs.gov/resource/plants/fqa/fqalist.txt

C values for South Dakota can also be obtained from the following publication:

Higgins, Jeremy J., Gary E. Larson, and Kenneth F. Higgins. Floristic Comparisons of Tallgrass Prairie Remnants Managed by Different Land Stewardships in Eastern South Dakota. Proc. 17th N.A. Prairie Conference: 21-31, 2001. Appendix 1 contains various South Dakota native vascular plant species C values.

   http://images.library.wisc.edu/EcoNatRes/EFacs/NAPC/NAPC17/reference/econatres.napc17.jhiggins.pdf

Virginia:

C values for Virginia can be obtained from Dr. James Perry, Biological Sciences, College of William and Mary, Virginia Institute of Marine Science, P.O. Box 1346, Gloucester Pt., VA 23062-1346 (email: jperry@vims.edu).

West Virginia:

C values for West Virginia can be obtained from the following publication.

Rentch, J.S. and J.T. Anderson. 2006. A floristic quality index for West Virginia wetland and riparian plant communities. pp. 67. Appendix 2 contains a list of C values:

   http://community.wvu.edu/~jsr008/FQI_WV.pdf

Wisconsin:

C values for Wisconsin can be obtained from the following two publications.

Bernthal, T.W. 2003. Development of a Floristic Quality Assessment methodology for Wisconsin. Report to the U.S. EPA (Region V). Wisconsin Department of Natural Resources, Madison, WI. Note the appendix containing the C values is listed in a separate website (see below):

   http://dnr.wi.gov/wetlands/documents/FQAMethodWithAcknowledgements.pdf

The appendix of the aforementioned document, containing the C values for Wisconsin, is listed below.

   http://dnr.wi.gov/wetlands/documents/FQAAppendix.pdf

Bourdaghs, Michael, Carol A. Johnston, and Ronald R. Regal. 2006. Properties and Performance of the Floristic Quality Index in Great Lakes Coastal Wetlands. *WETLANDS* 26(3):718-735. Appendix 1 contains a list of C values.

   http://www.cdfinc.com/CRI/great%20lakes%20application.pdf

Additional sources for the C values for Wisconsin can be found at the following websites:

Robert W. Freckmann Herbarium

   http://wisplants.uwsp.edu/CofC.pdf

Wisconsin Department of Natural Resources

   http://dnr.wi.gov/wetlands/documents/FQAAppendix.pdf

APPENDIX C:
The "How To" Process of Conducting a Floristic Quality
Assessment

This appendix lists the general steps involved in conducting a
Floristic Quality Assessment (FQA).

Data Sources

1. Installation Floral Inventory:

A component of the Integrated Training Area Management (ITAM)
program involved conducting baseline floristic inventory surveys
at all major Army installations in the Continental United States.
These reports are retained by land management personnel. The
recently published PWTB 200-1-52 U.S. Army Installation Floristic
Inventory Database, 30 November 2007, summarizes the efforts to
create a database integrating the vascular plant lists from the
following Tier 1 installations: Forts Benning, Bliss, Bragg,
Campbell, Carson, Drum, Hood, Hunter Liggett, Irwin, Knox,
Leonard Wood, Lewis, Polk, Riley, Rucker, Sill, Stewart, and
Wainwright. The database can be obtained from the file transfer
site, ftp://erdcftp.erdc.usace.army.mil/pub/PERM/plantdatabase
using Microsoft Access. A Word document providing user
instructions for the database is also located at the site.

2. USDA Plants Database:

http://plants.usda.gov/

Methodology

Conducting an FQA involves the following steps:

1. Obtain existing installation vegetation survey data or
    collect data from site of interest. Commonly available
    vegetation data that already exist for military installations
    are Range and Training Land Assessment (RTLA) data. The
    information required is presence/absence data by plant
    species. Information required for each species consists of:
    (a) Family, (b) Genus, (c) Species, and (d) Common name. It
    is more efficient to conduct the FQA if these data are in
    electronic format. If collecting vegetation data for an area
    of interest, any method of collection is acceptable that
    records species presence/absence.

2. Review the list of potential state resources listed in Appendix B for applicable C values. If sources for a particular state are not available, contact the state Department of Natural Resources (or conservation, wildlife, or fish and game) or the botany or plant sciences departments of major universities within the state for other potential sources of C values. If no data sources are available for the particular state, consider using neighboring states' data, if available. However, as mentioned previously in Appendix A, the C values for a plant may vary, depending on the biological range of the specific plant. Thus, care must be taken when using other states' data and interpreting the results.

3. Attempt to "exactly" match as many of the RTLA species with the C value sources of information.

4. For those species without an "exact" match, use the USDA plants database website at http://www.plants.usda.usda.gov to search for potential synonyms of the species on the RTLA list. This search is most easily accomplished by searching the website using the vegetative identification symbol, which is generally much shorter in character length compared to the scientific or common name of the species. Using this symbol should reduce the probability of any typographical errors that may occur.

5. If synonyms are not found, evaluate the materiality of each species based on the number of observations reflected in the data set. If the number of observations is immaterial for a particular species, consider deleting the species from the data set. If the number of observations appears to be significant, however, consider whether a typographical error might have occurred during data entry. Search for possible synonyms based on various typographical errors that might have occurred (either by letter or number).

6. Calculate the various FQA indices: Mean C, FQI, and Adjusted FQI for each sample plot. The formulas for these calculations are listed in Appendix A. Also given in Appendix A are potential uses of these indices, including: determining the degree of "naturalness" of an area, evaluating protective measures undertaken for a particular site, assessing the restoration activities at a specific location, allowing comparisons among different sites, and utilizing the information for various regulatory analyses.

7. Summarize the FQA plot indices by comparisons of interest. Average FQA values might be summarized by (a) comparing impacted and undisturbed sites, or (b) tracking a site over time to follow recovery from an activity.

APPENDIX D:
Example of a Floristic Quality Assessment
Using Data from Fort Riley, Kansas

Introduction

Land managers at Fort Riley, KS wanted to assess if the floristic quality of their training lands were decreasing over time. The installation was interested in using existing vegetation survey data to minimize the cost of the assessment.

Methodology

The first step of conducting the Floristic Quality Assessment (FQA) involved obtaining data from the Fort Riley, KS Range and Training Land Assessment (RTLA) program, formerly referred to as the Land Condition Trend Analysis (LCTA) program. The analysis used data from approximately 157 plots measured annually from 1993 through 2001. This database contained 404 different species of native and non-native flora inhabiting Fort Riley. As an overall summary, Figure D-1 is a graphical representation of how the C values were obtained for the different species and what problems were encountered while assigning values.
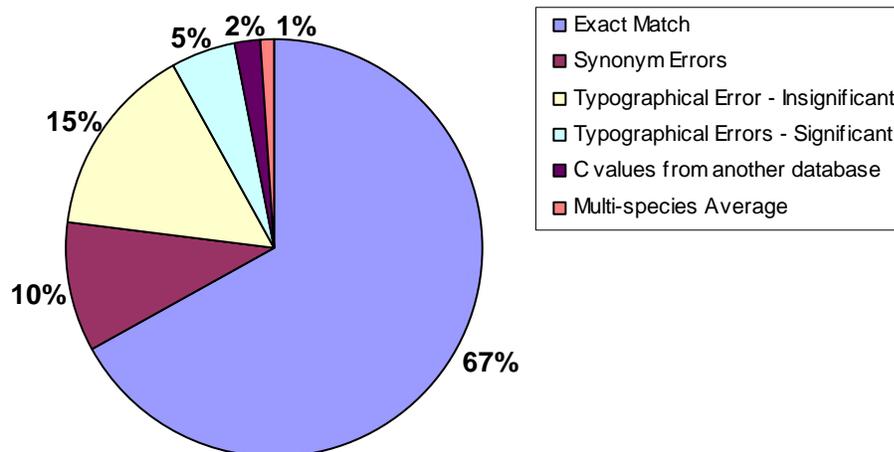

Figure D-1. Composition of the 404 different native and non-native species in the Fort Riley RTLA database.

The second step in the FQA process identified potential data sources specific to the particular state. In this case, botanists from the Kansas Biological Survey and the R.L. McGregor Herbarium had assigned a numerical value, representing

the Coefficient of Conservatism (i.e., the C value) to the approximately 1,700 native vascular plants in Kansas. This information was obtained as an Excel spreadsheet from Dr. Craig Freeman at Kansas University in Lawrence.

The third step determined if there were "exact" matches between the species listed in the RTLA database and Dr. Freeman's spreadsheet. In our case, 269 of the 404 different species matched exactly (67%), wherein the C values were easily obtained.

Further investigative efforts were thus needed to obtain C values for the remaining 135 (i.e., 404-269=135) species. Possible reasons for not having exact species name matches between the two datasets are (1) species name changes, (2) typographical errors in one database, and (3) plant misidentification. The intermediary step to match these particular species from the RTLA database to Dr. Freeman's spreadsheet used information from the U.S. Department of Agriculture's (USDA) plants database website (http://www.plants.usda.gov). This website not only lists species based on their most current name, but also lists synonyms that are, or have been, used to identify the particular species.

Thus, the fourth step in the process involved using the U.S. Department of Agriculture (USDA) website to determine if the RTLA database used synonyms of the species listed in Dr. Freeman's spreadsheet. This procedure was accomplished using the following steps:

- Once at the USDA plants database website homepage, click on the "State Search" on the left side of the screen.

- Begin the query by entering the "Search Criteria." See Figure D-2 for a screen capture of this particular web page.
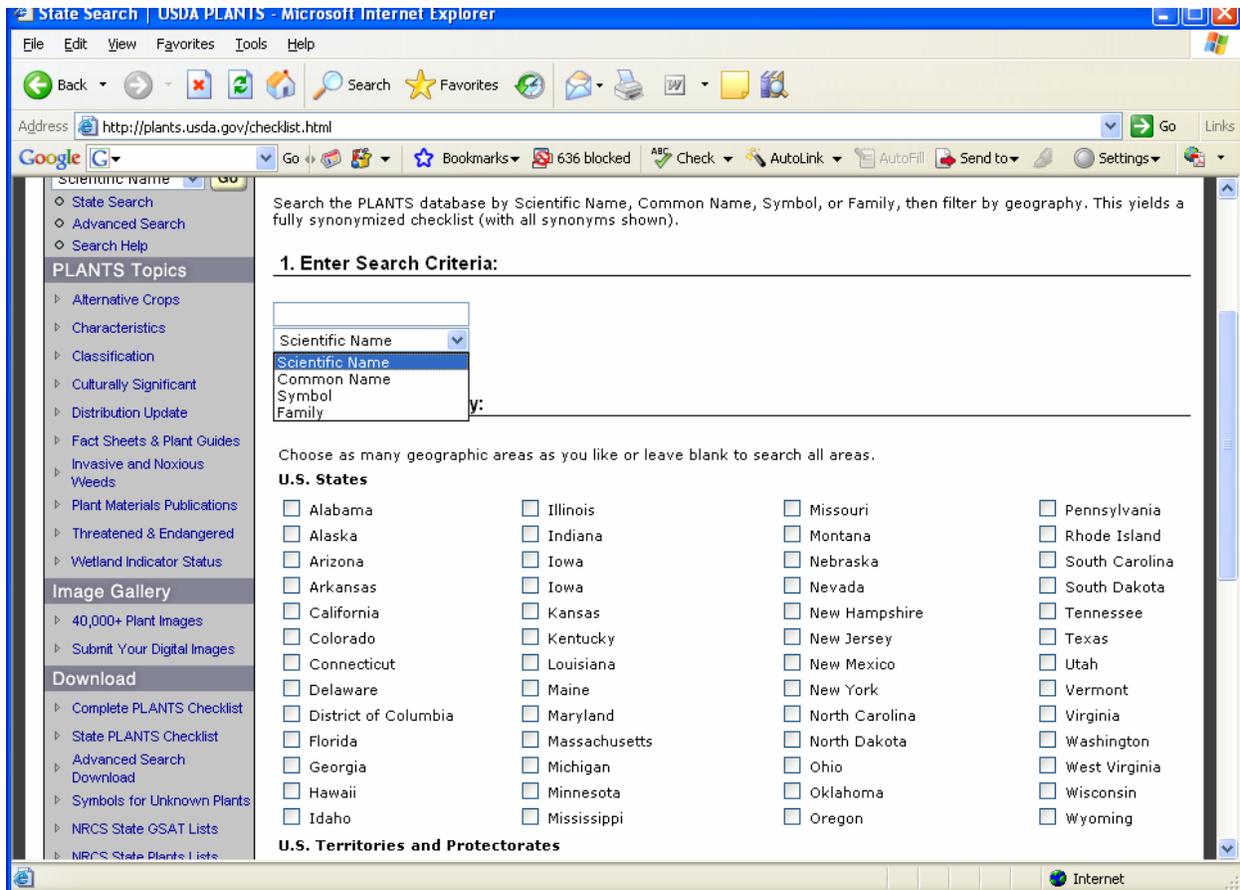
Figure D-2. Screen capture of the "Search Criteria."

- Enter either the "Scientific Name," "Common Name," "Symbol," or "Family" name. If known, it is advisable to enter the "Symbol" (i.e., the vegetative identification symbol, typically 4 to 6 characters in length) as it is usually the shortest in terms of character length and, therefore, has less chance of causing a typographical error.

- Use the "Filter by Geography" feature to limit the states in which the search takes place. See Figure D-3 for a screen capture of this particular web page. However, it may be beneficial to keep the "Filter by Geography" blank to enable one to view all the states including, perhaps, some surrounding states that the species in question may inhabit. This rationale stems from situations in which it may prove difficult to find the C value for a species in a particular state. In these cases, one may reasonably expect to use a C value from a neighboring state, if the species in question is a native inhabitant.
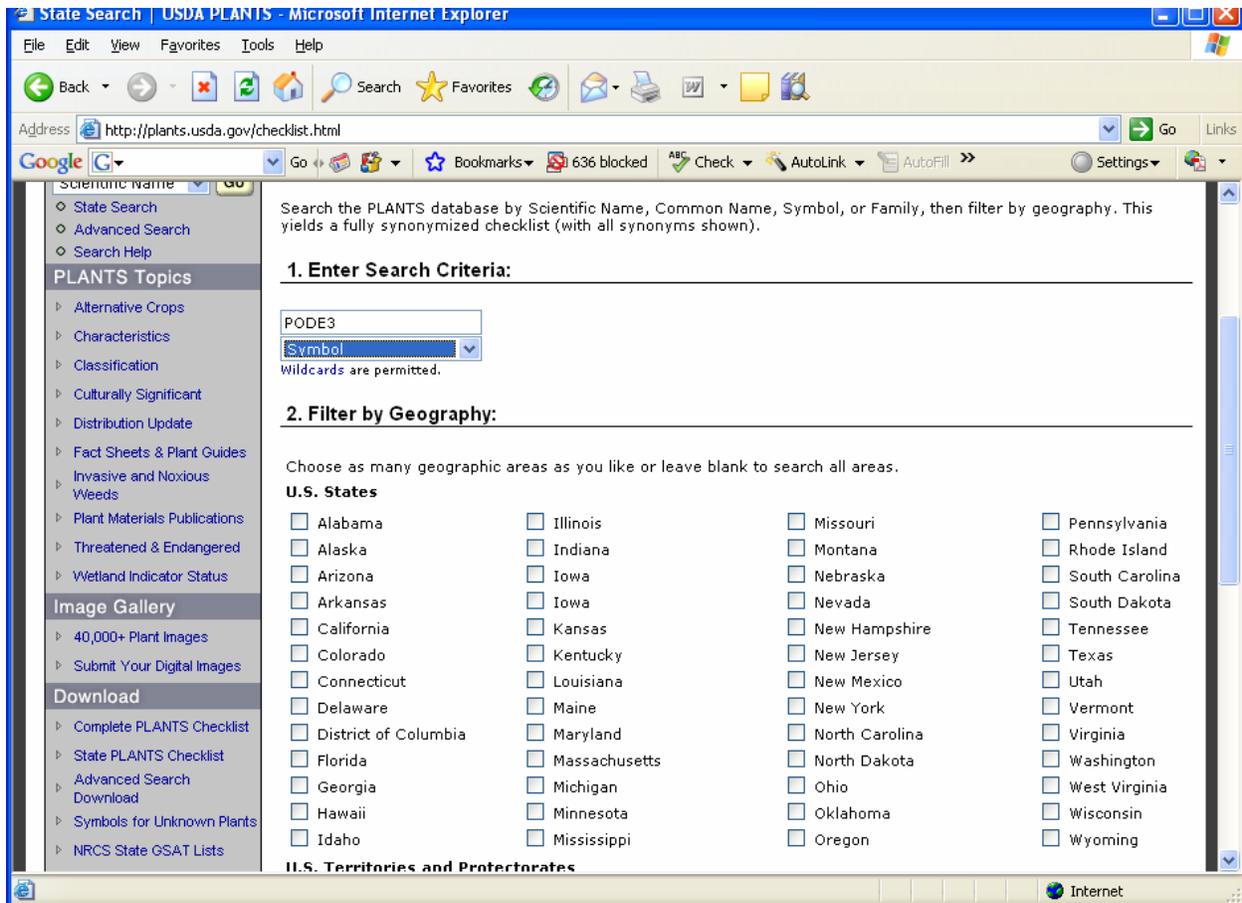
Figure D-3. Screen capture of the "Filter by Geography."

It should be noted that both older scientific and common names as well as vegetative identification symbols are listed under the "Synonyms" section of the USDA website. The most current scientific name, common name, and symbol information is shown at the top of the page on the USDA website for a particular species. Therefore, even when the RTLA vegetative identification symbol, scientific name, or common name is typed into the website query, the page that "pops up" on the USDA website will have the most current scientific name, common name, and symbol information displayed at the top of the page. The older information can be found by simply scrolling down the page to the "Synonyms" section.

The www.plants.usda.gov website offers a wealth of information, including photographs or drawings of the species, a list of synonyms and the associated scientific names, and maps of their distribution range (both native and introduced) within the United States and Canada. See Figure D-4 for an example screen capture of a distribution range.
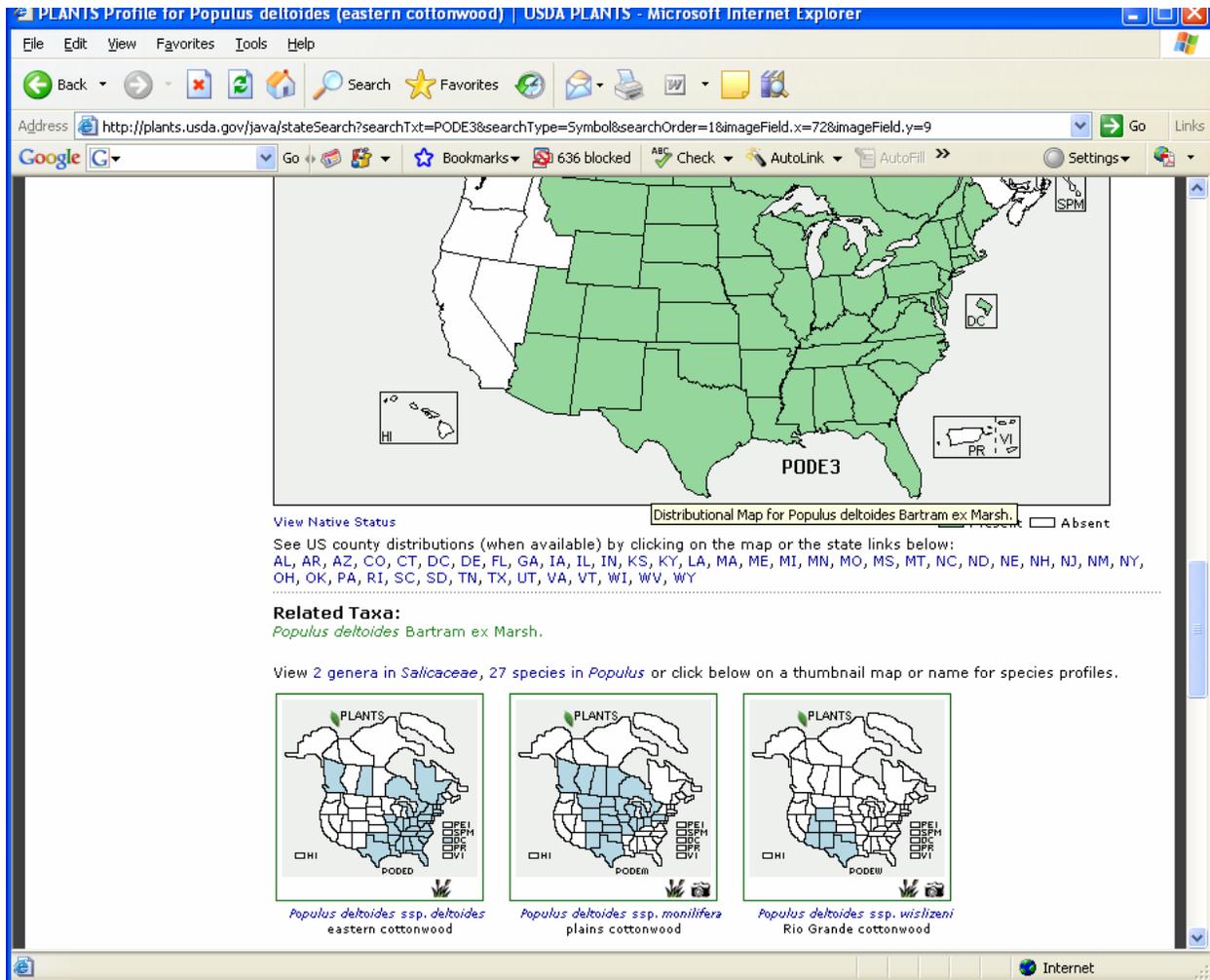
Figure D-4. Screen capture of the "Distribution" of a particular plant species.

For more detailed information, an individual may "click" on a particular state (if available) to view specific counties in which the species is located. See Figure D-5 for an example of a screen capture of this particular web page.
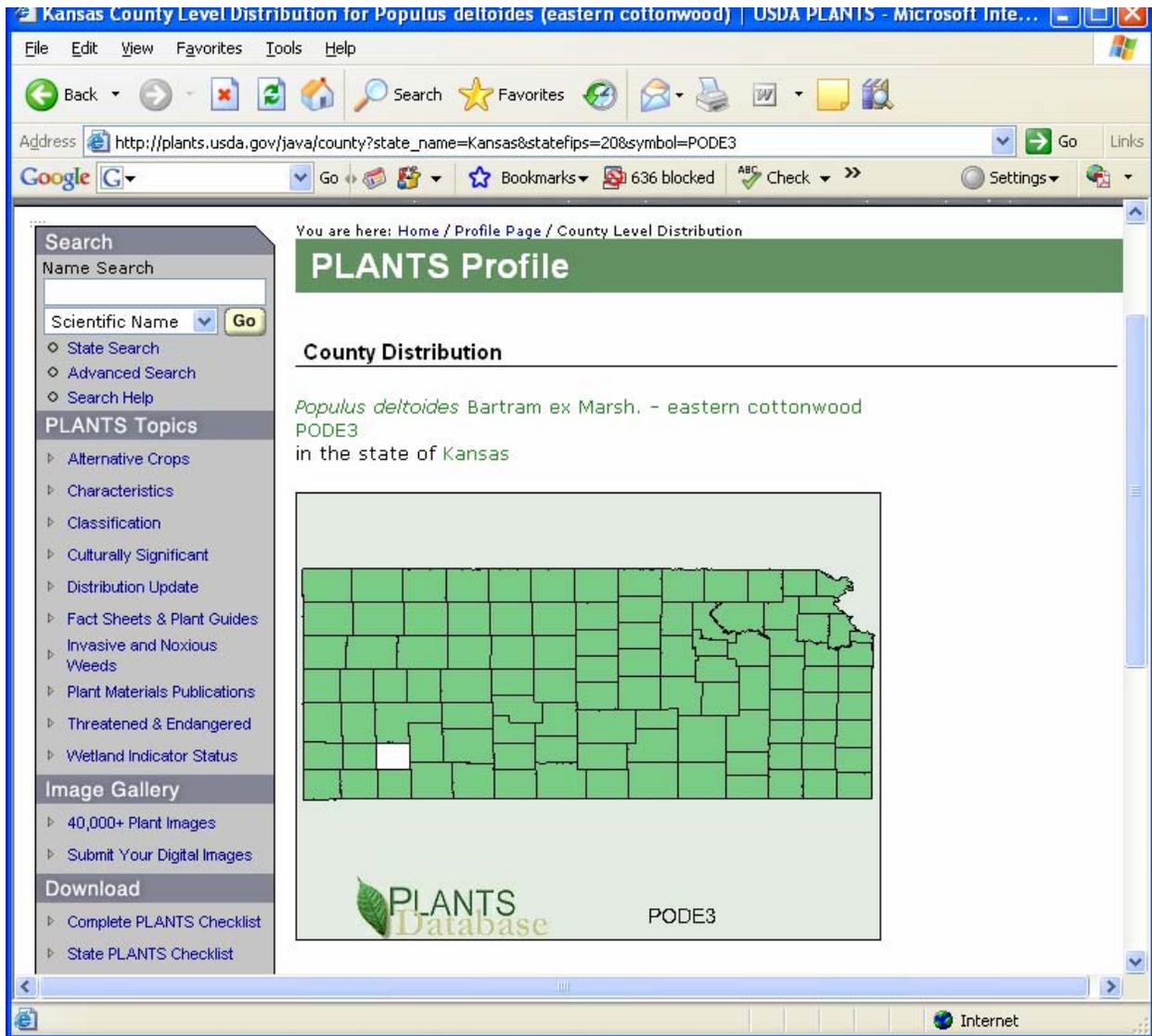
Figure D-5. Screen capture of the "County Distribution" of the particular plant species.

In this example FQA, 40 of the 135 remaining unmatched species had a synonym obtained from the USDA website that matched Dr. Freeman's spreadsheet.

Upon review of the vegetative identification symbols on the USDA website, it was determined that 60 of the 95 (135-40=95) remaining species symbols were most likely incorrectly entered into the RTLA database. This is a plausible explanation as the field crews typically consisted of multiple researchers, one calling out the identification symbol while the other input this information into a hand-held device. Assuming that the researcher correctly identified each observed plant, errors

could occur if: (1) the "inputting" researcher did not hear the
identification symbol correctly, or (2) the individual
accidentally typed an incorrect identification symbol into the
RTLA database. Further investigation revealed the number of
observations of these species was immaterial relative to the
total number of observations reported in the RTLA database.
Therefore, these 60 species were deleted from our analysis.

The remaining 35 species (95-60=35) consisted of the following:

Twenty-one were deemed typographical errors. Therefore, a
different vegetative identification symbol, similar to the
vegetative identification symbol listed in the database, was
used.

Ten used the same species from a different database source
(usually from the North Dakota/South Dakota database).

Four were categorized as "Multi-species." These were dealt with
in one of two ways. One method computed the average of the
various species listed. The other method used the USDA website
to determine if one of the species was more likely to be located
within one or both of the Fort Riley counties (i.e., Riley or
Geary County). In the latter situations, the particular species
was used to find the appropriate C value in Dr. Freeman's
spreadsheet.

While 35 species seems like a large percentage that required
additional effort to resolve, these species represented less
than one half of one percent of the data collected in the field.
The amount of time you spend cleaning up your data will depend
on a number of factors. However, this example illustrates the
type of issues you might encounter and the magnitude of those
issues.

Results

The Mean C and the Adjusted FQI indices (see Appendix A for
these equations) were calculated for 1989 through 2001 (except
for years 1990-1992 when comparable data were not available).
Figure D-6 shows annual training load at Fort Riley for the
study years, as given above. The results indicated that the Mean
C ranged from a low of 3.0 in 1999 to a high of 3.2 in 1989.
Figure D-7 shows adjusted FQI for 1989 through 2001 (except for
1990-1992 as noted above). The Adjusted FQI ranged from a low of
12.4 in 1989 to a high of 15.5 in 1997. Adjusted FQI was
negatively correlated with training load, implying that higher
training loads were associated with lower nativeness. Changes in

training load accounted for about 60% of the variation in annual
Adjusted FQI values. While Adjusted FQI was negatively
correlated with training load, the absolute value of Adjusted
FQI remained relatively constant over the study period.
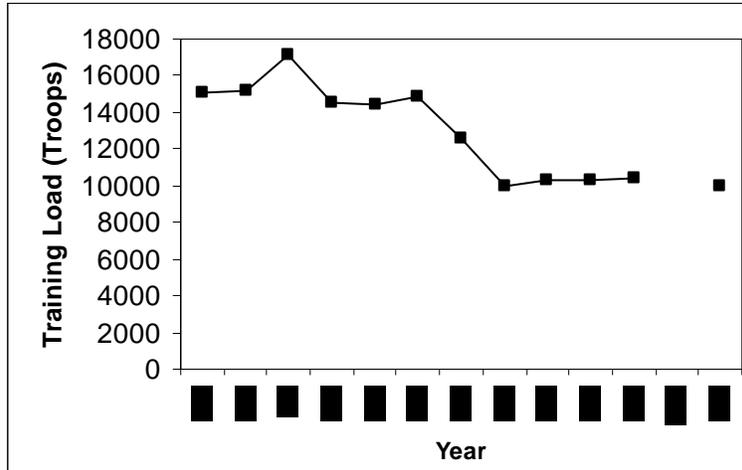
Figure D-6. Changes in training load measures at Fort Riley
between 1989 and 2001. Training load quantified as number of
troops annually stationed at the installation.
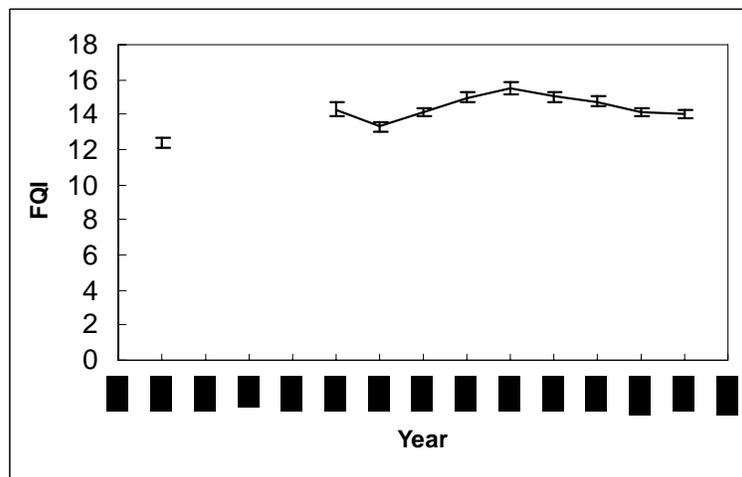
Figure D-7. Adjusted FQI at Fort Riley for measurement years
1989, and 1993-2001. Error bars represent ± one standard error.

Conclusion

Based on the results of the FQA, the floristic quality or
"naturalness" of the training lands at Fort Riley, KS has had

neither a significant long-term increase nor decrease over the
time period 1989 and 1993-2001.

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