Notes on the Third Edition of the Floristic Quality Assessment of Michigan

Bradford S. Slaughter[1], Michigan Natural Features Inventory, Michigan State University Extension; and Anton A. Reznicek, Michael R. Penskar, and Beverly S. Walters, Herbarium, University of Michigan

OVERVIEW AND FLORISTIC SUMMARY

In fall 2014, we released the 3rd Edition of the Floristic Quality Assessment of Michigan (MFQA) (Reznicek et al. 2014), replacing the 2nd Edition released in 2001 (Herman et al. 2001). For the first time, the MFQA coincides with a complete revision of the Michigan Flora (Reznicek et al. 2011; Voss and Reznicek 2012), resulting in the same list of taxa and consistent nomenclature for both products. The list of taxa, including wetness coefficient values (*W*) and coefficients of conservatism (*C*), will be periodically uploaded to the open source, online *Universal FQA Calculator* (Freyman and Masters 2013) to facilitate quick calculation of FQAs. As of July 2015, *Michigan Flora Online* (Reznicek et al. 2011) treats 2,873 vascular plant taxa at the specific level, including 1,808 native species (Table 1), compared to 2,729 taxa and 1,815 native taxa treated in Herman et al. (2001). Slight differences between lists in *Michigan Flora Online* and the *Universal FQA Calculator* are expected as updates are made to the former page, but periodic reconciliation of the lists will ensure no significant divergence.

TABLE 1.
Summary of vascular plant taxa included in Michigan Flora Online as of July 2015 (Reznicek et al. 2011).

	Native		Non-Native	
Physiognomic Class	#	% of cohort	#	% of cohort
Trees	106	5.9	62	5.8
Shrubs	146	8.1	94	8.8
Vines	47	2.6	52	4.9
Annual	*12*	*0.7*	*22*	*2.1*
Biennial	*1*	*0.1*	*0*	*0.0*
Perennial	*18*	*1.0*	*13*	*1.2*
Woody	*16*	*0.9*	*17*	*1.6*
Ferns and Fern Allies	107	5.9	1	0.1
Forbs	992	54.9	724	68.0
Annual	*127*	*7.0*	*300*	*28.2*
Biennial	*46*	*2.5*	*67*	*6.3*
Perennial	*819*	*45.3*	*357*	*33.5*
Grasses	155	8.6	113	10.6
Annual	*51*	*2.8*	*26*	*2.4*
Perennial	*129*	*7.1*	*62*	*5.8*
Sedges	255	14.1	17	1.6
Annual	*26*	*1.4*	*3*	*0.2*
Perennial	*229*	*12.7*	*14*	*1.3*
Total	**1808**	**62.9**	**1065**	**37.1**

COEFFICIENT OF CONSERVATISM (*C*) VALUES

For this 3rd Edition of the MFQA, a significant number of coefficient of conservatism (*C*) values were updated to reflect recent collections and sight records. In particular, we focused on species that were previously assigned high *C* values (8-10) that have since been found to occur more frequently in disturbed habitats (Figure 1). The distribution of Michigan *C* values for native taxa is similar to that of other Midwestern states and regions (e.g., Swink and Wilhelm 1994; Rothrock 2004; Ladd and Thomas 2015; although see Parker et al. 2014 for a slightly different distribution),

FIGURE 1.
The state threatened *Asclepias purpurascens* (purple milkweed) occurs in high quality upland and wetland habitats, but also persists and sometimes thrives in disturbed thickets and along roads. Its *C* value was tweaked from 10 to 9 in the 3rd Edition of the MFQA to reflect its sporadic presence in degraded habitats.

[1]Correspondence author: slaugh14@msu.edu

with one peak near the middle of the distribution (*C*= 5) and another at *C*= 10 (Figure 2). The distribution of native wetland plant *C* values mirrors the overall distribution. The median and mean *C* values for native taxa are 6 and 6.5, respectively; wetland taxa specifically have a slightly higher median (7) and mean (6.9) *C* value.

WETNESS COEFFICIENT (*W*) VALUES

Wetness coefficient (*W*) values are assigned on a five-point scale: Upland (UPL; *W*= 5); Facultative Upland (FACU; *W*= 3); Facultative (FAC; *W*= 0); Facultative Wetland (FACW; *W*= -3); and Obligate Wetland (OBL; *W*= -5). For this update of the MFQA, previously assigned intermediate values (e.g., FACU+; FACW-) were eliminated in keeping with the recently updated National Wetland Plant List (NWPL; 2012). We provide a single wetness coefficient (*W*) for each taxon that we believe best captures its habitat preferences within the state as a whole. However, Michigan spans portions of two geographic regions defined by the NWPL, the Northcentral and Northeast Geographic Region and the Midwest Region (Lichvar 2012). For most taxa, the assigned *W* value corresponds to the value for the Northcentral and Northeast NWPL, which characterizes most of the state outside a small area in southeastern Lower Michigan coinciding with the Jackson Interlobate (Albert 1995; Lichvar 2012). Users of the MFQA are encouraged to consult the NWPL *W* values for both regions, which will be particularly important for assessments of sites falling within the small part of the state mapped within the Midwest Region. In a few cases, species that have greater wetland fidelity in Michigan than reflected in either regional list were assigned *W* values appropriate for the state (Figure 3). In contrast, *W* values for species that with us are more characteristic of upland habitats than reflected in the regional lists were not adjusted so as to conform to national regulatory standards (Figure 4).

The distribution of *W* values differs for native vs. non-native taxa (Figure 5). Native taxa are fairly evenly distributed across the wetness spectrum, with approximately equal numbers of upland species ($n_{\text{UPL+FACU}}$=803) and wetland species ($n_{\text{OBL+FACW}}$=763), and a mean of FAC (*W*= 0). On the other hand, non-native taxa of upland affinity vastly outnumber wetland taxa, by a nearly 10:1 ratio ($n_{\text{UPL+FACU}}$=876 vs. $n_{\text{OBL+FACW}}$=91) (Figure 5). Although Michigan supports relatively few non-native wetland plant species, several of those that do occur are among our most pernicious, destructive invasive taxa, including *Lythrum salicaria*, *Myriophyllum spicatum*, *Phragmites australis* subsp. *australis*, and *Typha ´glauca*.

FIGURE 2.
Michigan *C* value distribution for all taxa and for wetland taxa (facultative wetland or obligate wetland species).

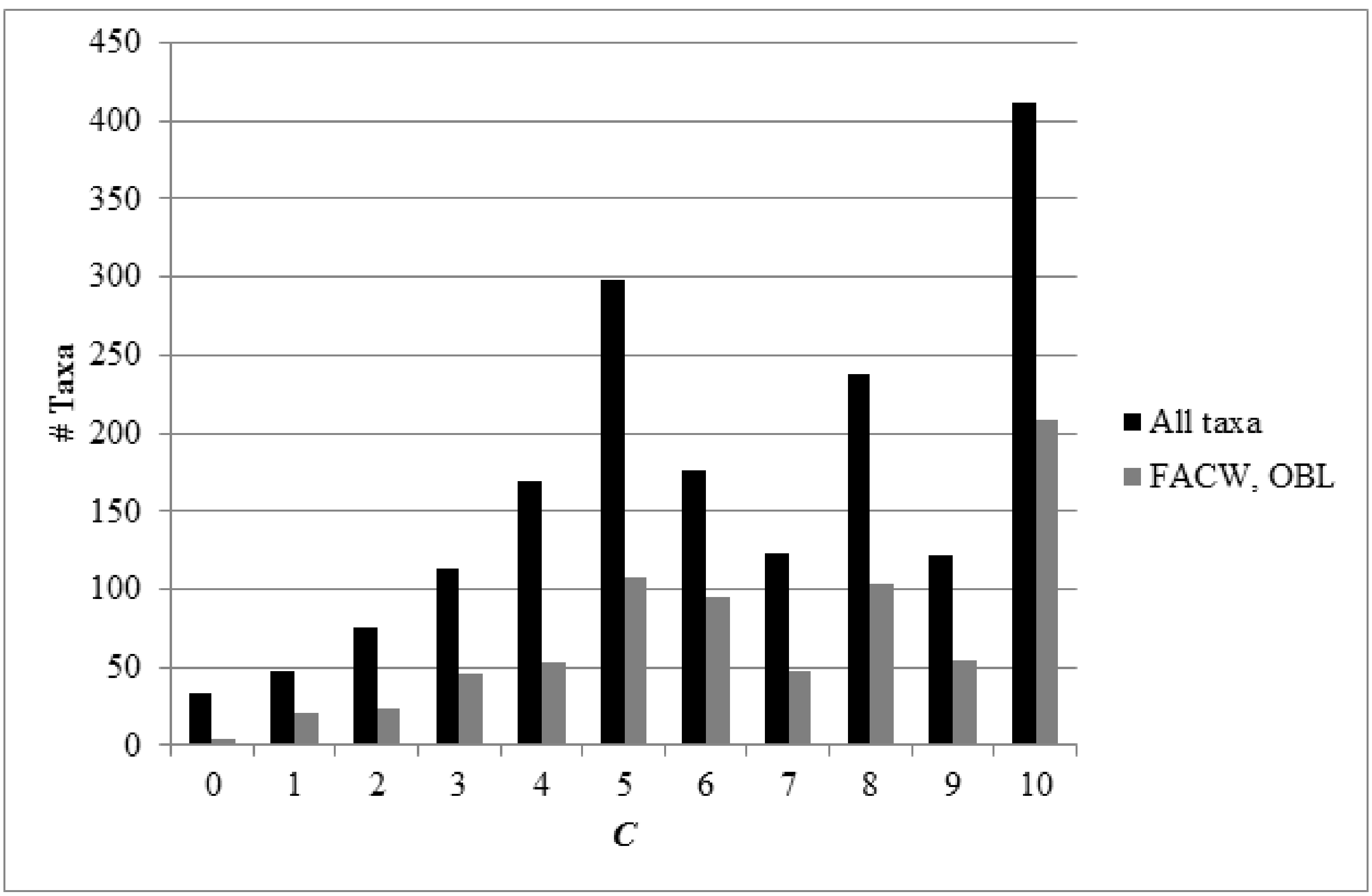
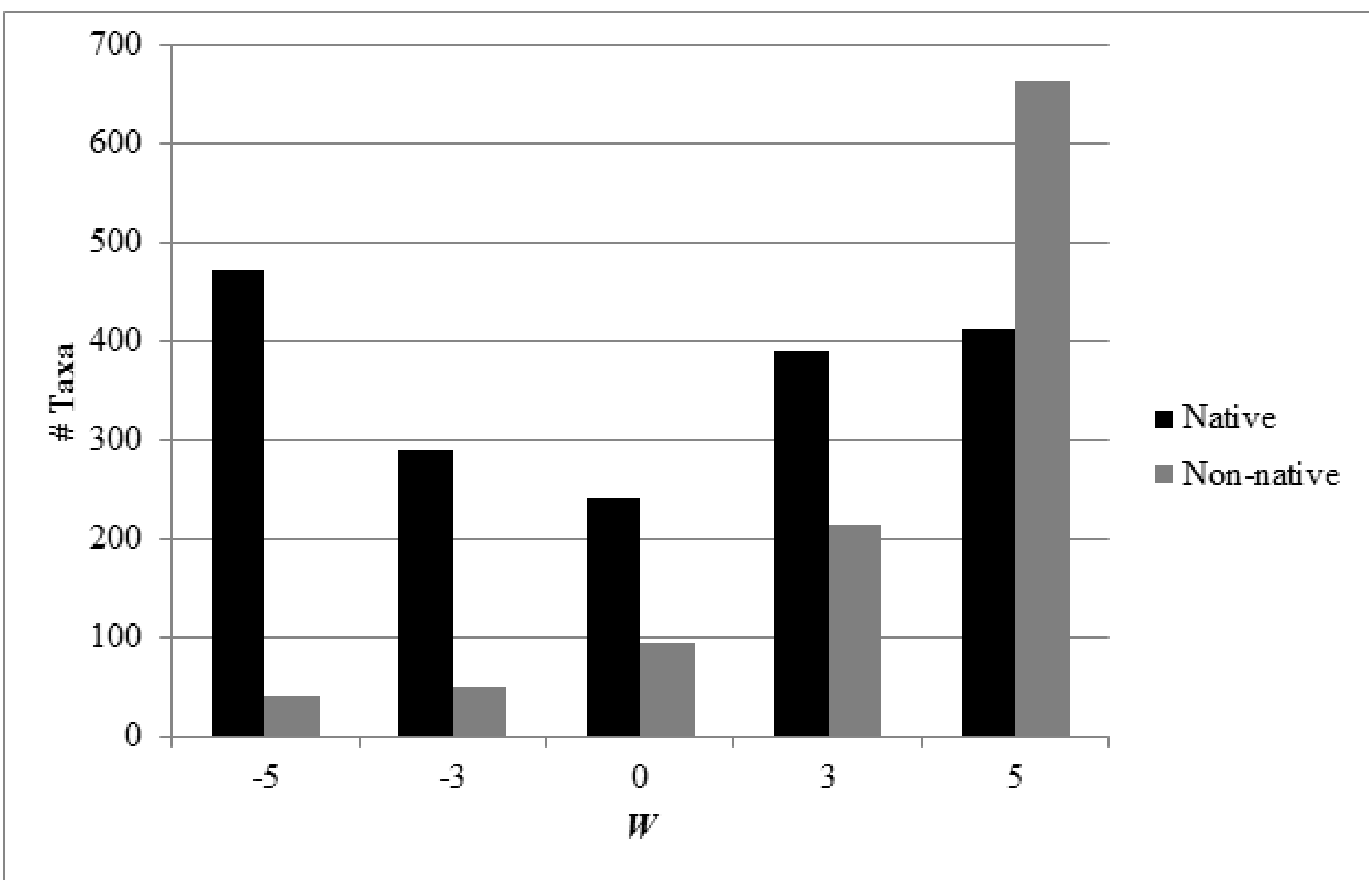


FIGURE 3.
The state threatened *Myrica pensylvanica* (northern bayberry) is apparently native in a few calcareous fens and adjacent tamarack swamps in southern Lower Michigan. It was assigned OBL wetland status in Michigan, but occurs on sandy beach ridges and other upland habitats east of Michigan and is considered FAC in both the Northcentral & Northeast and the Midwest Geographic Regions of Lichvar (2012).

FIGURE 4.
The state special concern *Cypripedium arietinum* (ram's head lady-slipper) is assigned FACW wetland status in Michigan to conform to Lichvar (2012), but it is here primarily a species of upland, partially wooded dunes and beach ridges along the northern Great Lakes shoreline (Reznicek et al. 2011).

FIGURE 5.
Michigan *W* value distribution for native and non-native taxa.



INTERPRETATION AND APPLICATION

In addition to its traditional, widespread use in identifying wetlands and in assessing success of wetland mitigation activities (Herman et al. 2001) (Figure 6), there is continued interest in and adoption of the tool for evaluations of ecological integrity (Herman et al. 2001; Mack 2009; Bried et al. 2012; Spyreas et al. 2012; Bried et al. 2013, 2014; DeBerry and Perry 2015; Matthews et al. 2015). Herman et al. (2001) suggest that Michigan sites with a Floristic Quality Index (*FQI*; calculated as *FQI* = $\overline{C}$n) of 35 or greater "possess sufficient conservatism and richness that they are floristically important from a statewide perspective," and that sites with *FQI* of 50 or greater are "extremely rare and represent a significant component of Michigan's native biodiversity and natural landscapes." However, *FQI* scores are sensitive to area, landscape patterns, and physiognomy (Matthews et al. 2005), limiting their usefulness in assessing the relative conservation value of different sites. Indeed, sites of sufficient size that support primarily degraded habitats such as old field or cleared, grazed wetlands often approach or exceed *FQI* scores of 50 (Michigan Natural Features Inventory [MNFI], unpublished data).

Mean *C* values have been suggested as a less biased indicator of relative site conservation value (Matthews et al. 2005). An analysis of species lists taken during single-day meander surveys by MNFI scientists in several natural community types demonstrates modest within-type variance of $\overline{C}$ values, but significant differences in between-type $\overline{C}$ values (Figure 7), consistent with findings by Andreas et al. (2004). We suggest the collection of standardized plant lists to derive statistically robust $\overline{C}$ reference values for all 77 natural community types described by MNFI (Cohen et al. 2014). In the absence of systematically collected vegetation data and statistically robust benchmarks, reported FQI and $\overline{C}$ scores should be used carefully as but one component of an ecological integrity assessment. ■

REFERENCES

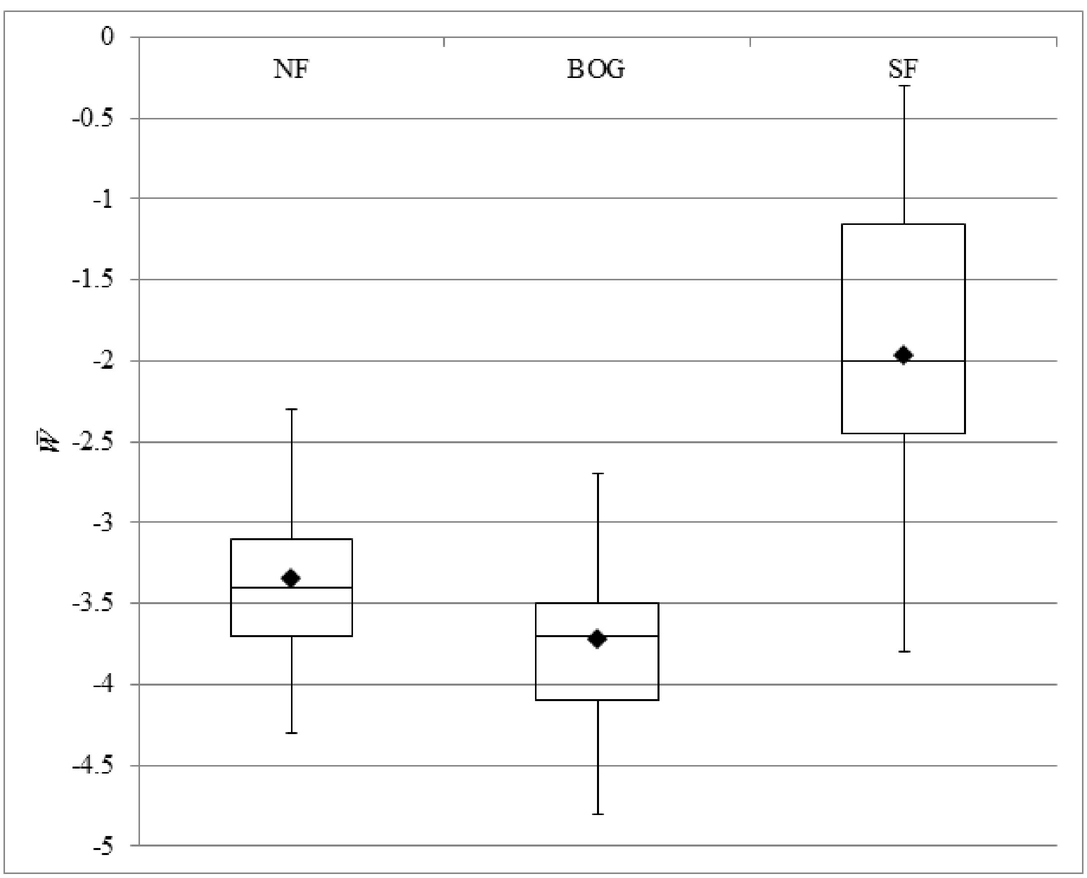
Albert, D.A. 1995. Regional landscape ecosystems of MI, MN and WI: A working map and classification. U.S. Forest Service, North Central Forest Experiment Station, St. Paul, MN. 250 pp.

Andreas, B.K., J.J. Mack, and J.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, OH. 219 pp.

Bried, J.T., K.L. Strout, and T. Portante. 2012. Coefficients of Conservatism for the vascular flora of New York and New England: Inter-state comparisons and expert opinion bias. *Northeastern Naturalist* 19 (Special Issue 6):101-114.

FIGURE 6.

Distribution of $\overline{W}$ scores for northern fen (NF; *n*=17); bog (BOG; *n*=25); and hardwood and hardwood-conifer swamps (SF; *n*=27) based on unpublished MNFI data. $\overline{W}$ values for all of these natural communities strongly indicate wetland conditions. The higher average $\overline{W}$ value and broader distribution of values for swamp forests may indicate overall drier conditions and greater biotic and abiotic heterogeneity among these sites compared to northern fen and bog. ♦ indicates overall $\overline{W}$ (NF, $\overline{W}$ = -3.3±0.1; BOG, $\overline{W}$ = -3.7 ± 0.1; SF, $\overline{W}$ = -2.0±0.2).



Bried, J.T., S.K. Jog, and J.W. Matthews. 2013. Floristic quality assessment signals human disturbance over natural variability in a wetland system. *Ecological Indicators* 34:260-267.

Bried, J.T., S.K. Jog, A.R. Dzialowski, and C.A. Davis. 2014. Potential vegetation criteria for identifying reference-quality wetlands in the south-central United States. *Wetlands* 34:1159-1169.

Cohen, J.G., M.A. Kost, B.S. Slaughter, and D.A. Albert. 2014. *A field guide to the natural communities of Michigan*. Michigan State University Press, East Lansing, MI. 362 pp.

DeBerry, D.A., and J.E. Perry. 2015. Using the floristic quality concept to assess created and natural wetlands: Ecological and management implications. *Ecological Indicators* 53:247-257.

Freyman, W.A., and L.A. Masters. 2013. The Universal Floristic Quality Assessment (FQA) calculator [computer program]. Available http://universalfqa.org (Accessed: 7 July 2015).

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. 19 pp. + appendices.

Ladd, D., and J.R. Thomas. 2015. Ecological checklist of the Missouri Flora for Floristic Quality Assessment. *Phytoneuron* 2015-12:1-274.

Lichvar, R.W. 2012. The national wetland plant list. Report No. ERDC/CRREL TR-12-11US, Army Corps of Engineers, Engineer Research and Development Center, Hanover, NH. 224 pp.

Mack, J.J. 2009. Development issues in extending plant-based IBIs to forested wetlands in the Midwestern United States. *Wetlands Ecology and Management* 17:117-130.

Matthews, J.W., P.A. Tessene, S.M. Wiesbrook, and B.W. Zercher. 2005. Effect of area and isolation on species richness and indices of floristic quality in Illinois, USA wetlands. *Wetlands* 25:607-615.

Matthews, J.W., G. Spyreas, and C.M. Long. 2015. A null model test of Floristic Quality Assessment: Are plant species' Coefficients of Conservatism valid? *Ecological Indicators* 52:1-7.

Parker E.C., M. Curran, Z.S. Waechter, and E.A. Grosskopf. 2014. Wisconsin FQA (Floristic Quality Assessment) databases for Midwest and Northcentral-Northeast Regions for Universal FQA Calculator Web site (http://universalfqa.org/).

Reznicek, A.A., E.G. Voss, and B.S. Walters. 2011. *MICHIGAN FLORA ONLINE*. University of Michigan, Ann Arbor, MI. Available http://www.michiganflora.net/home.aspx (Accessed: 7 July 2015).

Reznicek, A.A., M.R. Penskar, B.S. Walters, and B.S. Slaughter. 2014. Michigan Floristic Quality Assessment database. Herbarium, University of Michigan, Ann Arbor, Mich., and Michigan Natural Features Inventory, Michigan State University Extension, Lansing, MI. Available http://www.michiganflora.net/home.aspx (Accessed: 7 July 2015).

Rothrock, P.E. 2004. *Floristic Quality Assessment in Indiana: The concept, use, and development of Coefficients of Conservatism*. Final Report for ARN A305-4-53, EPA Wetland Program Development Grant CD975586-01. 96 pp.

Spyreas, G., S.J. Meiners, J.W. Matthews, and B. Molano-Flores. 2012. Successional trends in Floristic Quality. *Journal of Applied Ecology* 49:339-348.

Swink, F., and G. Wilhelm. 1994. *Plants of the Chicago region*. 4th Ed. Indiana Academy of Science, Indianapolis, IN. 921 pp.

Voss, E.G., and A.A. Reznicek. 2012. *Field manual of Michigan flora*. University of Michigan Press, Ann Arbor, MI. 1008 pp.

FIGURE 7.

Distribution of $\bar{C}$ scores for northern fen (NF; *n*=17); bog (BOG; *n*= 25); and hardwood and hardwood-conifer swamps (SF; *n*=27) based on unpublished MNFI data. Northern fen and bog are characterized by many specialist taxa restricted to low-nutrient, alkaline or acidic wetlands, whereas swamp forests tend to support higher species richness but more habitat generalists. ♦ indicates overall $\bar{C}$ (NF, $\bar{C}$= 6.6±0.1; BOG, $\bar{C}$= 6.3±0.2; SF, $\bar{C}$= 4.5±0.1).