Indicator species of floristic quality in Illinois wetlands:
success story or a textbook preconception?

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Background

Bioassessment methods are incredibly useful for monitoring ecosystem health, but they are often expertise-dependent. Indicator plant species are less demanding of expertise and have limited, but promising, investigation in Midwest wetland systems (e.g. Oklahoma, Ohio). So, our objective was **to find indicator species of high floristic quality wetlands using bigger data, more stratification, and a new study area.**

Floristic Quality Assessment (FQA) is an example of an "expertise-dependent" bioassessment method. Each taxon is assigned a Coefficient of Conservatism (C) in an ecoregion. Once species lists are complete, two indices are traditionally calculated using FQA protocol: Floristic Quality Index (FQI) and $\bar{C}$.

$$FQI = \sqrt{N} \times \bar{C}$$

Methods

Data
Wetland plant list data were collected by two separate programs at the Illinois Natural History Survey: the Wetland Science Program (WSP) (N=2,810) and the Critical Trends Assessment Program (CTAP) (N=236). These datasets are treated separately due to differences in observers, site selection, and sampling intensity.

Indicator Value (IV) Analysis
IV Analysis is a function that assesses the species' occurrence and abundance at a target site. We used the R package *indicspecies* to test all possible indicator species singletons, pairs, and triplets. For 100 iterations of IV Analysis, the stratum's target and non-target sites were proportionally divided into a training and validation dataset without replacement. Then, we removed indicators whose patterns of occurrence and abundance were nested within the patterns of stronger indicators. After each iteration, four simple validation tests of true- and false-positive error were conducted. Here we display indicators that consistently passed one validation test and whose C ≥ 4 and n ≥ 10. "n" denotes the number of iterations where A ≥ 0.6 and B ≥ 0.25 for that indicator.

WSP Northern Non-forested Indicator	$\bar{C}$			FQI			C
	n	A	B	n	A	B	
Asclepias incarnata	-	-	-	100	0.814	0.390	4
Scirpus atrovirens	99	0.693	0.342	100	0.809	0.464	4
Juncus dudleyi	-	-	-	95	0.803	0.337	4
Ulmus americana	-	-	-	93	0.729	0.335	5
Cornus obliqua	-	-	-	76	0.832	0.322	4
Schoenoplectus tabernaemontani	-	-	-	33	0.719	0.315	4

CTAP Northern Non-forested Indicator	$\bar{C}$			FQI			C
	n	A	B	n	A	B	
Carex stricta	93	0.842	0.577	100	0.887	0.635	5
Eupatorium perfoliatum	38	0.814	0.494	99	0.864	0.560	4
Eutrochium maculatum	82	0.907	0.509	90	0.926	0.543	5
Campanula aparinoides	10	0.963	0.488	12	0.966	0.477	8
Iris shrevei	-	-	-	94	0.900	0.548	5
Asclepias incarnata	-	-	-	31	0.722	0.706	4
Scirpus atrovirens	-	-	-	17	0.793	0.487	4
Spartina pectinata	-	-	-	13	0.848	0.483	4
Mentha canadensis	-	-	-	11	0.841	0.458	4
Sagittaria latifolia	65	0.766	0.554	-	-	-	4
Scutellaria galericulata	15	1.000	0.472	-	-	-	6

A =

"specificity", "positive predictive value", "relative abundance" … "the probability that a site is in the target site group given this indicator is present"

WSP Southern Non-forested Indicator	$\bar{C}$			FQI			C
	n	A	B	n	A	B	
Cephalanthus occidentalis	100	0.725	0.565	100	0.750	0.601	5
Ulmus americana	100	0.735	0.460	99	0.775	0.511	5
Quercus palustris	12	0.893	0.357	11	0.891	0.359	4
Elymus virginicus	-	-	-	98	0.742	0.405	4
Scirpus atrovirens	-	-	-	20	0.689	0.359	4

WSP Northern Forested Indicator	$\bar{C}$			FQI			C
	n	A	B	n	A	B	
Glyceria striata	89	0.989	0.449	36	0.729	0.388	4
Elymus virginicus	-	-	-	98	0.713	0.624	4
Ulmus americana	-	-	-	21	0.647	0.863	5

B =

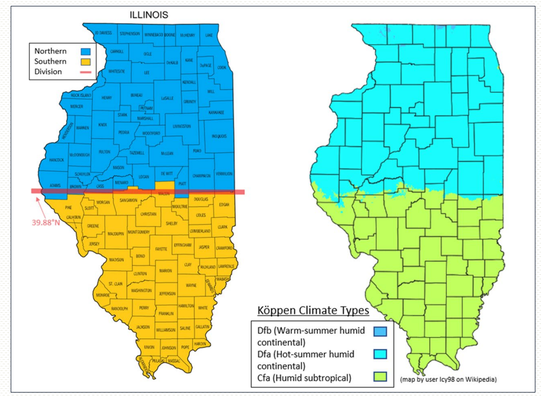
"fidelity", "sensitivity", "relative frequency" … "the probability of indicator presence in the target site group"

WSP Southern Forested Indicator	$\bar{C}$			FQI			C
	n	A	B	n	A	B	
Chasmanthium latifolium	100	0.800	0.464	97	0.796	0.455	4
Quercus palustris	72	0.683	0.664	99	0.775	0.688	4
Betula nigra	77	0.751	0.411	57	0.751	0.407	4
Ruellia strepens	51	0.745	0.406	98	0.811	0.471	6
Quercus bicolor	63	0.842	0.405	47	0.824	0.397	7
Celtis laevigata	14	0.792	0.385	16	0.804	0.389	5
Acer rubrum	60	0.825	0.398	-	-	-	5
Ilex decidua	12	0.820	0.383	-	-	-	6
Symphyotrichum ontarionis	-	-	-	81	0.738	0.458	4
Cephalanthus occidentalis	-	-	-	68	0.691	0.614	5
Glyceria striata	-	-	-	64	0.712	0.503	4
Lycopus virginicus	-	-	-	53	0.810	0.396	5
Carex grayi	-	-	-	50	0.707	0.509	6
Carya laciniosa	-	-	-	49	0.972	0.394	7
Cinna arundinacea	-	-	-	27	0.688	0.566	5
Quercus macrocarpa	-	-	-	18	0.790	0.389	5
Carex squarrosa	-	-	-	11	0.912	0.386	5

Stratification

Wetland sites were stratified based on three criteria:

1. Latitude – North vs. South at 39.88ºN
2. Forestation – forested vs. non-forested
3. Floristic Quality Assessment – the upper quartile of $\bar{C}$ or FQI is the target site group.



Results & Conclusions

- Some species are relatively abundant and exclusively occur at both high FQI and high $\bar{C}$ sites, while other species only indicate one of these target site groups.
- No pairs or triplets passed our thresholds for A, B, n, or C which is stark given results from previous work using IV Analysis.
- There is significant variability between the two datasets even if they are stratified the same way.
- Overall, evidence is mixed for indicator species of high floristic quality wetlands.

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