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Floristic Quality Index: An Assessment Tool for Restoration Projects and Monitoring Sites in Coastal Louisiana

Introduction

The Coastwide Reference Monitoring System (CRMS) program was established to assess the effectiveness of individual coastal restoration projects and the cumulative effects of multiple projects at regional and coastwide scales (Steyer and others, 2003). In order to make these assessments, analytical teams have been assembled for each of the primary data types sampled under the CRMS program, including vegetation, hydrology, landscape, and soils. These teams consist of scientists and support staff from the U.S. Geological Survey and other Federal agencies, the Louisiana Office of Coastal Protection and Restoration (OCPR), and university academics. Each team is responsible for developing or identifying parameters, indices, or tools that can be used to assess coastal wetlands at various scales. The CRMS Vegetation Analytical Team has developed a Floristic Quality Index (FQI) for coastal Louisiana to determine the quality of a wetland based on its plant species composition and abundance (Cretini and others, 2011).

Adaptation of the Floristic Quality Index to Coastal Louisiana

The FQI has been developed and used for several regions throughout the United States to provide an objective assessment of the vegetation quality or biological integrity of wetland plant communities. The FQI was first developed as a weighted average of the native plant species at a site (Swink and Wilhelm, 1979; eq. 1 in fig. 1). It is based on a coefficient of conservatism (CC) score that is scaled from 0 to 10 and is applied to each plant species in a local flora. The score reflects a species' tolerance to disturbance and specificity to a particular habitat type. Species adapted to disturbed areas are often not habitat specific and, as such, have a low CC score. In contrast, habitat-specific species are generally not tolerant to disturbances and, as such, have a high CC score. A group of experts on local plants agrees upon and assigns CC scores.

Equation 1 $$FQI_{std} = \left(\frac{\sum (CCi)}{\sqrt{N_{native\ \ species}}} \right)$$

Equation 2 $$FQI_{\mathrm{mod}\,t} = \left(\frac{\sum (COVER_{it} \times CCi)}{100} \right) \times 10$$

Equation 3 $$FQI_{\mathrm{mod}\,t} = \left(\frac{\sum (COVER_{it} \times CCi)}{\sum (TOTAL\ \ COVER_t)} \right) \times 10$$

CC_i is the coefficient of conservatism for species *i*;

$N_{native\ species}$ is the total number of native species within a monitoring station;

$COVER_{it}$ is the percent cover for a given species (*i*) at a monitoring station at a given time (*t*); and

$TOTAL\ COVER_t$ is the cumulative percent species cover within a monitoring station.

Figure 1. Equations used to calculate the floristic quality index (FQI). Equation 1 is the standard equation developed by Swink and Wilhelm (1979). Equations 2 and 3 are the modified FQI developed for coastal Louisiana wetlands. Equation 2 is used when $TOTAL\ COVER_t$ is 100 or less. Equation 3 is used when the percent cover ($TOTAL\ COVER_t$) in a monitoring station exceeds 100 because of overlapping canopies.

The original FQI was modified for coastal Louisiana to include percent cover (see Folse and others [2008] for sampling protocol) and all plant species (native and nonnative) within a given area. The modified FQI (see eqs. 2 and 3 in fig. 1) was applied to the herbaceous vegetation data from monitoring stations within the CRMS sites and from Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) projects. These stations are distributed across swamp forests and marshes (fresh, intermediate, brackish, and saline) in coastal Louisiana.

To adapt the FQI to coastal Louisiana, a comprehensive list of 849 wetland plant species occurring in coastal Louisiana was first compiled and distributed to a group of 40 experts on local plants. Then, the panel of experts assigned CC scores to each species by using the descriptions presented in table 1.

Table 1. Criteria for assigning coefficient of conservatism scores to plant species in coastal Louisiana.

[CC, coefficient of conservatism]

CC score	Louisiana description
0	Invasive plant species
1–3	Plants that are opportunistic users of disturbed sites
4–6	Plants that occur primarily in less vigorous coastal wetland communities
7–8	Plants that are common in vigorous coastal wetland communities
9–10	Plants that are dominants in vigorous coastal wetland communities

A subpanel of eight local experts combined the scores and resolved inconsistencies in scoring from the larger group. Groups of plants including floating or submerged aquatics and nonrooting, parasitic plants are not assigned percent-cover values during CRMS vegetation sampling (Folse and others, 2008); thus, species within these groups were excluded from the analysis and were not assigned CC scores.

The modified FQI is calculated by using equations 2 and 3 in figure 1. Equation 2 is used when $TOTAL\ COVER_t$ is 100 or less. By using equation 2, a low FQI score (for example, 7–10) will be calculated in cases when the area including the monitoring station consists of species found in vigorous wetlands but the amount of cover ($TOTAL\ COVER_t$) is low because of environmental stressors, such as drought or prolonged flooding. Equation 3 is used when the percent cover ($TOTAL\ COVER_t$) in the area including a monitoring station exceeds 100 because of overlapping canopies. After computation, FQI scores are scaled from 0 to 100. FQI scores are calculated for monitoring stations (fig. 2). FQI scores for other spatial scales (that is, CRMS site, CWPPRA project, hydrologic basin) are calculated by averaging the modified FQI scores of monitoring stations that occur within the desired geographic expanse. For example, the overall FQI score for a CRMS site is calculated by averaging the FQI scores from the 10 monitoring stations located within the site. When plotted over time, the FQI scores for a given site reflect changes in both species composition and percent cover values (fig. 3).

Year	Scientific name	Percent cover	CC score	Percent cover x CC score
2009	*Distichlis spicata*	45	9	405
	Paspalum vaginatum	25	7	175
	Spartina patens	6	9	54
	Total	76		634

Equation 2

FQI = 634/100 = 63.4

Figure 2. An example calculation of a Floristic Quality Index (FQI) score for vegetation at a monitoring station (4-m^2 quadrat shown in photo) within the Coastwide Reference Monitoring System in 2009. The plant species within the area of a monitoring station are identified and assigned a percent cover value by field biologists. In this case, an FQI score is then calculated by using equation 2 in figure 1 because total cover in the area is less than 100. Coefficient of conservatism (CC) scores were assigned by a panel of experts on Louisiana plants.

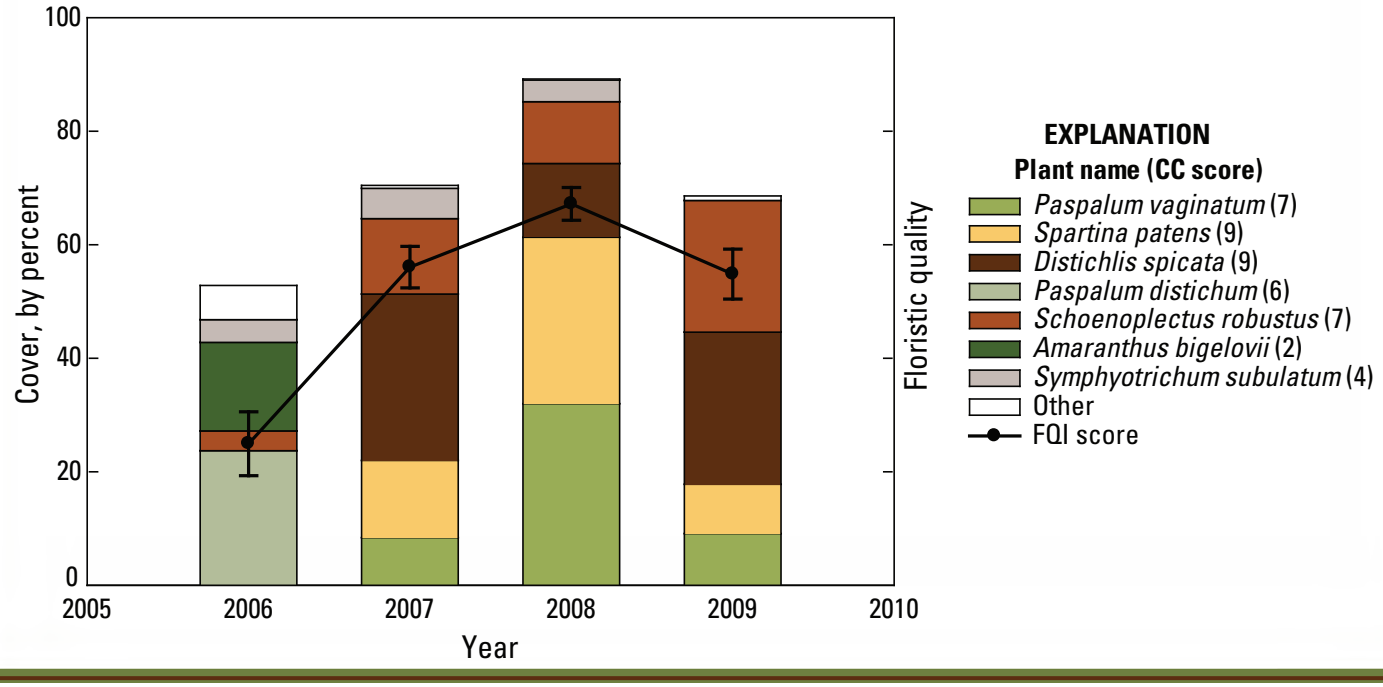

Figure 3. A graph presenting species composition profiles and Floristic Quality Index (FQI) scores by year at a Coastwide Reference Monitoring System (CRMS) site. Such graphs are available on the "Report Card" tab of the basic viewer on the CRMS Web site (http://www.lacoast.gov/crms2/Home.aspx; click on "Mapping" to get to the basic viewer, then to get to graph, single-click the yellow symbology on the map). Coefficient of conservatism (CC) scores were assigned by a panel of experts on Louisiana plants

Dissemination

FQI scores are calculated annually for each CRMS marsh site and for the herbaceous layer in CRMS swamp sites. Scores for each year are displayed graphically, along with species composition data, on the CRMS Web site (http://www.lacoast.gov/crms2/Home.aspx) (fig. 3). These graphs can be found by clicking "Vegetation" on the "Report Card" tab within the basic viewer.

The "Report Card" tab will house other types of assessment graphics as they are developed. Figure 4 is an example of a graphic under development that shows how FQI scores can be used to assess vegetation condition across various spatial scales.

Implications

There is a critical need to develop scientifically credible indices for assessing the effectiveness of restoration projects and programs in Louisiana. The FQI shows promise as a useful indicator of vegetation condition. The use of indicators in assessment requires identification of restoration targets (desired conditions), which need to be defined for coastal Louisiana at the project and program level. The range of wetland condition in coastal Louisiana can be established from reference data provided by the CRMS program. Once the range of wetland condition is defined, the restoration and management community can reach consensus on a set of restoration targets. These targets can be used to assess restoration progress and can aid in determining an ecosystem condition that provides optimal structural and functional characteristics, resilience to disturbances, and potential for self maintenance.

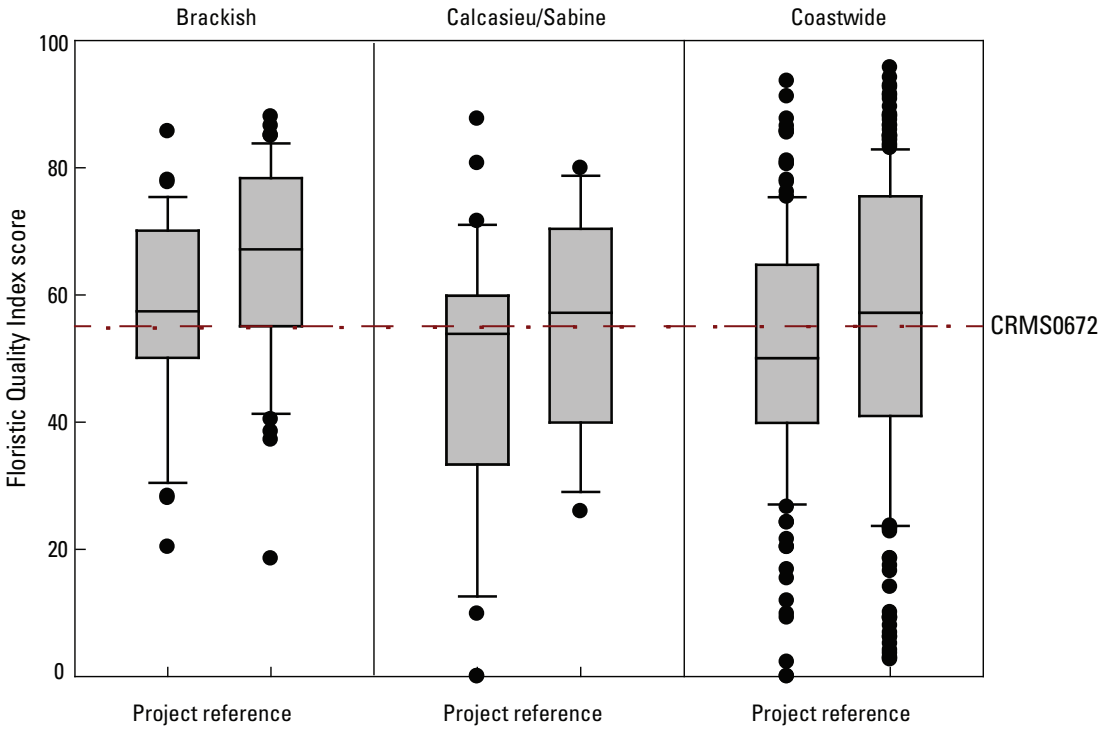

Figure 4. A boxplot displaying distribution of the 2009 Floristic Quality Index (FQI) scores for all Coastwide Reference Monitoring System (CRMS) sites within brackish marshes, the Calcasieu/Sabine hydrologic basin (Louisiana Coastal Wetlands Planning, Protection and Restoration Act Program, n.d.), and coastwide. The dashed horizontal line indicates the FQI score for one CRMS site that is within a brackish marsh in the Calcasieu/Sabine basin. This type of display, which is under development, could be used to assess a CRMS site among other sites in the same marsh type, hydrologic basin, and across the coast.

References

Cretini, K.F., Visser, J.M., Krauss, K.W.,and Steyer, G.D., 2011, CRMS vegetation analytical team framework—Methods for collection, development, and use of vegetation response variables: U.S. Geological Survey Open-File Report 2011-1097, 60 p.

Folse, T.M., West, J.L., Hymel, M.K., Troutman, J.P., Sharp, L.A., Weifenbach, Dona, McGinnis, Tommy, and Rodrigue, L.B., 2008, A standard operating procedures manual for the Coast-wide [sic] Reference Monitoring System-Wetlands—Methods for site establishment, data collection, and quality assurance/quality control: Baton Rouge, La., Louisiana Coastal Protection and Restoration Authority, Office of Coastal Protection and Restoration, 191 p.

Louisiana Coastal Wetlands Planning, Protection and Restoration Act Program, n.d., Coastal Louisiana basins: Louisiana Coastal Wetlands Planning, Protection and Restoration Act Program Web site, accessed November 9, 2010, at http://lacoast.gov/new/About/Basins.aspx.

Steyer, G.D., Sasser, C.E., Visser, J.M., Swensen, E.M., Nyman, J.A., and Raynie, R.C., 2003, A proposed coast-wide reference monitoring system for evaluating wetland restoration trajectories in Louisiana: Environmental Monitoring and Assessment, v. 81, p. 107–117.

Swink, Floyd., and Wilhelm, G.S., 1979, Plants of the Chicago region (3d ed., revised and expanded with keys): Lisle, Ill., The Morton Arboretum.

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