Paleoecologic Tools for Restoration: Setting Performance Measures in South Florida's Estuaries

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A primary goal of the Comprehensive Everglades Restoration Plan (CERP) is to restore more natural hydrologic conditions to the wetlands and estuaries of South Florida. For the estuaries, this means restoring the quantity, timing and distribution of freshwater that is delivered to Florida Bay, Biscayne Bay and the southwestern coastal area. The Southern-Estuaries Sub-Team, a component of the CERP Restoration, Coordination and Recovery effort, is responsible for setting performance measures and targets for the estuaries. The Sub-Team has utilized both paleoecologic analyses of faunal assemblages from sediment cores and the Natural Systems Model (NSM ver. 4.6.2), developed by the South Florida Water Management District, in an effort to set salinity performance measures that reflect natural hydrologic conditions. Both methods, however, have drawbacks. Faunal assemblage analysis provides empirical data but no statistical measures of confidence nor information on daily and seasonal responses to meteorological events. Large-scale models are based, at least to some extent, on theoretical data; however, they can provide information on seasonal responses.

A method has been developed that couples paleoecologic data with multivariate linear regression models (MLRM) based on observed hydrologic relationships between the wetlands and Florida Bay (Marshall, Wingard, and Pitts, 2009); thus overcoming problems associated with individual modeling or paleoecological analysis. In phase one of the method, molluscan assemblage analyses are used to determine the paleo-salinity regime for the ~1900 AD pre-disturbance estuary. The NSM is adjusted to the ~1900 paleo-salinity and used to produce simulated daily and seasonal salinity values. In phase two, linear regression equations are developed from modern observations in freshwater wetlands (flow and stage) and estuaries (salinity). These equations predict the salinity within the estuary, given a stage height (or flow) within the wetlands. The final phase couples the simulated paleo-salinity regime with the equations to produce estimates of flow, stage, and hydroperiod in the historical Everglades wetlands.

To add to the confidence associated with the coupled model, a method has been developed to produce a cumulative weighted percent average salinity value for each sample within a core, similar to methods used in paleoceanography to derive sea surface temperature estimates (see for example, Dowsett, et al., 2005). The basis of this method is a modern database, which is used to establish salinity tolerances for the paleo-species. The end result provides statistical measures of confidence for each sample. These data can then be input into the MLRMs and the resulting output can be used to establish performance measures for flow and stage in the terrestrial Everglades, and salinity in the estuaries.

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