An Analytical Framework for FCE – Break-out Group

Joel Trexler (Lead)

As noted in our mid-term site review, hydrological drivers of Everglades productivity gradients are a central and guiding theme of FCE-1 and 2. In fact, manipulation of hydrology by restoration of historical water flows from upstream of Everglades National Park is the primary motivation for our research agenda. Because of this, temporal analysis of change of parameters tied to ecosystem function and productivity before and after major restoration activities is the underpinning of our study design and research agenda funded by NSF. For this reason, a Before-After-Control-Impact (BACI) conceptual and analytical design is a natural structure for data gathering and analysis. We have, in essence, been funded by NSF to monitor an ecosystem-scale intervention with unequal manipulation in a pair of parallel, but rather different, drainages. This suggests a relative straight-forward analytical design that we need to flesh out in more detail starting at this year's All Scientists Meeting.

To stimulate discussion on this topic, I present the following bullet points:

1. There can be no doubt that FCE research is conducted in a context that is far from the idealized manipulative experiment of classical experimental design. The messiness this creates is more than compensated by the real-world scale and nature of the project.
2. While many authors have noted the potential pitfalls of applying the classical analytical framework (e.g., ANOVA) to such a study, I argue that there are ample analytical and conceptual resources to overcome these limitations; we need to both acknowledge limitations and move forward to develop a simple analytical design used in common across working groups to test our FCE hypotheses.
3. Challenges to be overcome include:
    a. A lack of replication of 'impacted' and 'control' drainages (we work at the landscape-scale and landscapes are inherently idiosyncratic and unreplicatable);
    b. An unlikely 'hard' time point for transitioning between 'before' and 'after' hydrological manipulations, as well as notable inter-annual variability in our key drivers beyond anyone's control;
    c. No simple delineation of 'impacted' and 'control' drainages because restoration activities are occurring upstream of both Shark River and Taylor Sloughs and there exists a poorly understood but certain intermingling of ground waters from Shark River to Taylor Slough basins.
4. I propose that we establish a working group to recommend a common analytical framework for analysis of FCE data aimed toward evaluating our core hypotheses. Key questions will be:
    a. What is the cut-off for 'before' and 'after' comparisons? Should it be the date of opening flow through a Tamiami Trail bridge or based on some hydrological criterion?
    b. What analytical framework will be recommended? Ideally, it will be developed to the point of a computer program that can be made available for use with/without modification by multiple groups in FCE.

c. Can we assemble 'before' data to estimate typical variance patterns for a collection of key dependent variables for each group? Ideally, this would lead to an a priori power analysis and projection of detectable effects of changing upstream flow relevant to FCE core hypotheses.
d. Are we gathering adequate hydrological and water quality drivers to document environmental manipulation resulting from restoration? Can we develop conceptual models linking these drivers to response variables, as in a path analytical framework?
e. Can we complete this exercise in 6 months or in time to be reviewed and considered by FCE scientists well in advance of next year's ASM?