Study Design for Wetland Monitoring

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Monitoring Data

- Detect and characterize the condition of existing wetlands
- Describe whether wetland condition is improving, degrading or unchanged
- Define seasonal patterns in wetlands
- Identify thresholds for system stressors

Monitoring Programs

Sampling design is dependent on the management question being asked:

- Stratified random sampling may be best for general monitoring
- Before/After Control/Impact (BACI) may be best for evaluating restoration efforts
- Targeted sampling may be best for developing IBIs or nutrient criteria thresholds.

Considerations for Sampling Design

- Describe the management question
- Select Sites
- Identify and characterize reference wetlands
- Determine index period for monitoring

The Management Question

Clearly defining the question:

- Encourages use of appropriate statistical analyses
- Reduces the occurrence of false positive errors
- Increases the efficient use of management resources.

Site Selection

Sampling sites should be selected based on land-use in the region so that wetland watersheds range from minimally impaired to high levels of development with multiple stressors.

Reference Conditions

The term reference here refers to those wetland systems that are least impacted by anthropogenic effects.

The Index Period

The growing season, or the period of time when impacts are most likely to occur.

Sampling Protocol

- Stratified Random Sampling Design
- Targeted Sampling Design
- BACI Design

Stratified Random Sampling

- Random selection of wetland systems from entire population within a region
- Requires minimal prior knowledge of wetlands within the sample population for stratification
- May require more resources (time and money) to randomly sample wetland types because more wetlands may need to be sampled
- System characterization for a class of wetlands is more statistically robust
- Rare wetlands may be under-represented, or absent from the sampled wetlands
- Potentially best for regional characterization of wetland types, especially if water quality conditions are not known

Targeted Sampling

- Targeted selection of wetlands based on problematic (wetland systems known to have problems) and reference wetlands
- Requires prior knowledge of wetlands within the sample population
- Utilizes fewer resources because only targeted systems are sampled
- System characterization for a class of wetlands is less statistically robust, though characterization of a targeted wetland may be statistically robust
- May miss important wetland systems if they are not selected for the targeted investigation
- Potentially best for site-specific and watershed-specific criteria development when water quality conditions for the wetland of interest are known

BACI Design

- Selection of wetlands based on a known impact
- Requires knowledge of specific impact to be analyzed
- Utilizes fewer resources because only system with known impacts and associated control systems are sampled
- Characterization of the investigated systems is statistically robust, but the information gained cannot be generalized to other wetland systems not included in the study
- Information gained in this type of investigation is not transferable to wetland systems not included in the study
- Potentially best for monitoring restoration or creation of wetlands and systems that have specific known stressors

Other Things to Keep in Mind

- The type of sampling design determines the type of statistical analysis appropriate for data collected.
- The number of samples is determined by the power of the statistical analysis desired or required.
- The sampling frequency is determined by the question being asked.

Websites of Interest

- http://www.mpl-pwrc.usgs.gov/powcase/index.html
- http://trochim.human.cornell.edu/tutorial/flynn/multivar.htm
- http://www.tufts.edu/~gdallal/STUDY.HTM
- http://www.umass.edu/tei/mwwp/studydes.html