Considerations for the Use of Ecological Indicators in Restoration Effectiveness Evaluation

Key Findings

An excerpt from:

Independent Multidisciplinary Science Team. 2007. Considerations for the Use of Ecological Indicators in Restoration Effectiveness Evaluation. IMST Technical Report 2007-1 Oregon Watershed Enhancement Board, Salem, Oregon.

Full Report is available at :http://www.fsl.orst.edu/imst

Key Findings

- The use of ecological indicators is a promising approach to the assessment and monitoring of broad-scale ecosystem conditions. However, there are few examples of long-term indicator use, especially for effectiveness monitoring, from which to evaluate success. One exception is the use of indices of biological integrity (IBIs) in water quality monitoring.

- If the goal of monitoring is to evaluate management effectiveness, the basis for cause-and-effect determination must be built into sampling design and analysis protocols. An essential starting point is a conceptual model that transparently depicts assumptions about significant factors that affect the indicator, and is supported by relevant research. Attempting to make effectiveness determinations from status-and-trend monitoring data without such a model can be highly problematic.

- It is highly desirable to supplement effectiveness monitoring programs with research plans that address knowledge gaps about ecosystem responses to changing conditions.

- Key questions to address in indicator monitoring framework design (including sampling design and analytical protocols) are:
    - Is the goal of monitoring simply to track status and trends of ecosystem features (descriptive), or is it to evaluate ecosystem responses to particular management actions or stressors (adaptive)?
    - If the goal of monitoring is adaptive, will monitoring results be judged against threshold values (e.g., Total Maximum Daily Loads), or some suite of desirable environmental states (for example, habitat distribution for rare species)?

- Significant technical and analytical issues that require attention during indicator framework development include:
    - The aggregation of factors into multi-metric or multivariate indicators,
    - Determining appropriate sampling design, and statistical methods for analysis of monitoring data,
    - Assessing response variables across temporal and spatial scales,
    - Temporal and spatial variation of indicators,
    - Aggregation of data from disparate data sets.

- For each indicator used, the following information is desirable:
    - How the indicator relates to ecosystem attributes of interest, and how reliable it is for reflecting those attributes,

    - The range of values the indicator can take, and the significance of those values,
    - How the indicator value varies with natural and anthropogenic influences, and the temporal and spatial scales over which those changes occur,
    - Historical trends in indicator values,
    - The spatial extent of the indicator, and the ecological types for which it is applicable,
    - Information about indicator cost-effectiveness, including alternative or emerging measurement technologies, as appropriate.

- In the absence of reference points against which to compare monitoring results, the magnitude of change and significance of trends cannot be evaluated. Reference points are often chosen to depict "natural" conditions, but can also include minimally disturbed, best attainable or most degraded (worst-case) sites, depending on the nature of the monitoring questions.

- Probabilistic random sampling designs appear more efficient at quantifying changes in ecological conditions due to anthropogenic activities than non-random designs. At the same time, in most real-world applications, random designs have tended to better characterize high frequency/low severity situations than low frequency/high severity events, due to the expense associated with a dense sampling network.

- A key facet of an indicator monitoring program is how information is communicated to policy-makers and the public. Clear presentation of transparent and meaningful information to intended audiences is crucial, and there are several examples presented as case studies (Appendix A of this report) that attempt to accomplish these goals.