Using GIS and Multi Criteria Decision Analysis to Select Restoration and Preservation Sites for the Missouri River Cottonwood Management Plan

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1. Introduction


2. Sieve Mapping - What is it?

Sieve mapping is a multi-criteria, GIS-based planning approach that allows participants to relativize value contributions of an area (land availability, ecosystem integrity, level use costs, etc.) to the achievement of goals and objectives. This approach is advantageous in that it: 1) supports a participatory planning approach that values the expertise of numerous stakeholders and interests groups in a detailed, yet adaptive manner. 2) Expert-based sieve mapping offers one solution to integrating diverse information sources, attitudes and knowledge of system-wide drivers and stressors within a highly engaging visual medium that informs decision making in a cost effective and timely manner.

3. Case Study: 2009 Missouri River Cottonwood Management Plan

In response to the US Fish and Wildlife Service’s Biological Opinion (BOI) rendered in response to the Action Plan issued by the U.S. Army Corps of Engineers (see Table 1) the Corps has initiated a planning-level effort to produce a spatially explicit planning products and procedures. These efforts are supported by the development of expert-elicited suitability criteria that can be linked to GIS assessment procedures and a more transparent, collaborative, spatially explicit approach to locating, prioritizing, and selecting targets for restoration and preservation with implications placed on sustainability and cost-effective solutions.

Here we introduce CRISUS: Cottonwood Restoration Informational Site Selection System, a participatory GIS-based planning decision support system developed by the U.S. Army Engineer and Research Development Center (ERDC) that employs expert elicitation to identify spatial explicit “siting” criteria within a Multi-Criteria Decision Analysis (MCDA) framework to screen for potential restoration and preservation targets. MCDA offers an approach to scoring, weighting, and ranking disparate criteria relating to a particular issue using experts, stakeholders and interest groups. The MCDA process considers the importance and value of each criterion, then assigns weights and ranks to the criteria, then implements an algorithm to generate a composite site recommendation map for the study.

5. Mapping the Results

A GIS-based thematic map was developed for each criterion (vector format). These maps were then rasterized and reclassified to indicate the relative suitability of each cell with respect to the criterion. A normalized scale of 0 to 1 was assigned to capture the range of optimal conditions (0) and unsuitable conditions (1). Map algebra was used to combine the reclassified grids into a single composite map based on the MCDA composite scores and ranks. A Red-Amber-Green map was produced highlighting the areas of Low-Medium-High restoration/preservation potential (map in center).

6. Evaluation of the Application

To date, thirteen sites have been selected for various consideration in terms of restoration and preservation activities. Additional sites are being considered in the out years to offset ongoing degradation conditions. The CRISUS technique will continue to be used over the life of the project to highlight potential action areas as needed.

CRISUS project carries out a series of 4 specific returns on this investment:
1. elicits complex trade-offs to be performed on multiple and varied “siting” factor by multiple, diverse scientists, decision makers, and stakeholders.
2. Multiple criteria value judgments to be incorporated into the analysis by weighting factors according to their perceived relative importance.
3. Conceptualizes a multiobjective framework for analysis
4. has all the advantages associated with GIS-based construction including substantially advanced processing that produces visually interactive maps that can be easily ported to new locations and promotes technology transfer across multiple stakeholders and partners via ArcGIS tools.

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