An Ecoregion-based Opportunity Area Assessment

MoRAP - May 2000

Partner Sponsors: EPA, ICREST, MDC, MDNR, MODOT, NASA, Raytheon, NRCS, USFS

Background and Project Goals Narrative

Increasing human populations, resource use, and pollution have led to risks to human health, environmental quality, and natural biological diversity. The need for conservation is not in question.Public policy decisions must be made, and the real question is how to ensure that we make the most informed decisions. Our goals are to use GIS tools to analyze available data layers, especially the results from satellite-based land cover classification, within an ecoregional context. The chronology will be essentially as follows:

Year 1 - Ecoregion-based Opportunity Area (OA) assessment and outline of strategies for 'areas at risk' assessment; deliverables will include a report as well as electronic files (GIS) with the assessment results

Year 2 - Refinement of the OA assessment toward production of a landscape atlas using ideas from the Mid-Atlantic Region Assessment (Jones et al. 1997) and completion of the 'areas at risk' assessment with a focus on change and change visualization in urbanizing regions

Year 3 - Further work on the OA assessment and completion of the landscape atlas, completion of the areas at risk assessments, and integration of a rigorous GIS-assisted aquatic natural resource assessment for Missouri

Year 4 - ? Completion of the aquatic natural resources assessment for the region and integration with the original OA and areas at risk assessments

The current request for funds and work plan pertains to Year 1 outlined above. We include the multi-year, global outline simply to illustrate that we intend this work to be a single step forward in an iterative process that will result in better and better regional natural resource assessments for priority-setting. A perfect assessment cannot be accomplished in one year.

We will treat the identification of conservation opportunity areas (OAs) and identification of areas of high risk as two sides of the same coin. In identifying OAs, we will attempt to show relatively large landscapes where conservation action will most likely result in the best long-term benefits for a broad spectrum of environmental variables related to natural resource conservation. On the flip side, in outlining how to identify areas of high risk, we will attempt to show (1) methods for setting priorities for areas that require restoration, and (2) places that are currently relatively intact, but are most likely to be consumed by human activities if no action is taken within the near future. In all cases, we will seek input from partners in order to set priorities for analyses and focus on elements of environmental quality - habitats, regions, and natural resources - of highest concern (e.g. wetlands).

Two basic approaches have been used to identify areas of high conservation value. We outline the general approached to clarify the development of our own logic, and not to suggest that workers have dogmatically adhered to any particular approach. First, areas that contain the most endemic species, or most overall diversity, have been identified. Thus, 'hotspots' of species endemism and biodiversity are suggested as appropriate targets (Myers 1990; Scott et al. 1996). Using this logic, workers have developed algorithms designed to select a polygon from a grid that contains the most

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biodiversity within a given region. Then the next most diverse polygon that contains fewest overlapping species is added to the preserve design, and so on until all target elements are contained within a proposed reserve system (Csuti and Kiester 1996). Overall patterns of biodiversity for all taxa are seldom well known. Also, hotspots of biodiversity many not coincide among taxa (e.g. birds versus mammals; Pendergast et al. 1993), and the region of concern for analysis, as well as the scale of analysis, might impact results (see Davis and Stoms 1996).

A second approach is to explicitly organize the assessment around an ecoregional hierarchy (see Noss and Cooperrider 1994). This requires first a spatial ecoregional classification, and second a classification of conservation targets for each ecoregion (e.g. major abiotic habitat types or enduring features or the landscape; stream valley segment types). A reserve system then may be designed to conserve high quality, viable examples of all enduring features. The assumptions are that ecoregional delineations are valid, that larger scale elements of biodiversity can be reasonably well classified, and that this level of biological organization will 'capture' overall biodiversity and finer scale phenomena, and that priorities for the elements themselves can be set in a relatively objective way. Explicit in this approach is that the context of each ecoregion analyzed is known in terms of how it relates to other ecoregions so that the most appropriate targets can be selected. Finally, some measure of quality must be attached to each target element occurrence in order to fine-tune the initial selection of target landscapes. The two approaches outlined are not mutually exclusive. For example, Noss et al. (1999) combined rare species occurrences and an enduring features analysis in preparing a reserve design for the Klamath-Siskiyou ecoregion.

Finally, we should provide a note regarding the use of ecoregions versus watersheds to conduct assessments based primarily on land cover metrics. Omernik and Bailey (1997) provided a logical argument that stated that hydrologic unit boundaries should not be used in regional assessments. Using land cover data from Missouri, we have shown based on quantitative analyses that ecoregion rather than hydrologic unit boundaries should be used in regional assessments in which land cover metrics play a primary role (Diamond and Gordon 1999). A complete discussion is beyond our current scope, but the bottom line is that this is so because land cover is more uniform within ecoregion that within hydrologic unit boundaries of approximately the same size. The adoption of an ecoregional framework rather than a hydrologic unit framework is a primary difference between our approach and the one employed by EPA in the Mid-Atlantic regional assessment (Jones et al. 1997).

Opportunity Area Assessment: Logical Approach, Work Plan, and Deliverables

Logical Approach:

We'll identify areas within each ecoregion that offer the highest overall opportunities for conservation of natural resources, and, on the flip side, areas that are, overall, the most degraded. To do this, an 'opportunity surface' will be generated for the entire region, such that any given location will have a numerical rank within a grid overlaid on the region. Hence, the identification of 'best' and 'most degraded' will be flexible, based on the model used to define these relative terms. The assessment will be organized around ecoregions because these circumscribe relatively uniform areas in terms of land form, land cover, and land use, and because important environmental issues can be best organized by ecoregion (e.g. non-point pollution from cropland is a major issue in the Glaciated Till Plains ecoregion, but not so in the Ozarks Highlands, where forest clearing is a more important issue). Conservation opportunity areas (OAs) will be summarized and characterized by ecoregion in terms of their location, size, representation of the regional enduring features, and how well they capture important elements of the regional biota. Thus we will provide a global view of the most important areas within the region in terms of environmental conservation. On the flip side, we will use the same methods to identify area in the region that are apparently the most degraded already.

Work Plan Procedures:

1. Gather GIS data layers needed to complete the regional analyses and register all layers to the same map projection (tentatively Albers) and datum (NAD83; additional details to be specified in the Quality Assurance Project Plan). Standard digital layers needed include hydrology (streams), hydrologic units (watersheds), roads, county boundaries, state boundaries, and other available data layers. The most important data layers for analysis will include a uniform, satellite-based land use/land cover layer for the region from the EROS Data Center, a uniform road coverage from the U.S. Bureau of the Census, and an ecoregion boundary layer from the U.S. EPA (see Figure 1). All of these data layers are currently available.
2. Use GIS to create a data layer of core areas (away from the edge of other types) for major land cover types including forest, grassland, cropland, and urban land.
3. Use GIS to create a layer of road density for the region.
4. Intersect core land cover with road density to identify opportunity areas (OAs) for environmental conservation (e.g. forest or grassland with low road density).
5. Summarize all analyses by ecoregion to analyze results in view of the enduring features of the landscape. This will include an overall summary of land cover by ecoregion and major watershed.
6. Attribute the OA polygons with variables related to the regional biota. Missouri will be the pilot example to develop and test this methodology. We will intersect rare species occurrences with OA polygons, and we will model selected bird species occurrences in order to attribute the OA polygons with important bird occurrence records.
7. Develop a logical methodology for identifying areas of highest risk within the region with a focus on urbanizing areas.

Deliverables and Expected Results:

A functional GIS using ArcView software with all data layers and analyses. Partners can then use these data to address a variety of related problems specific to their own agency needs.

An ecoregion by ecoregion list and spatial analysis (e.g. size, location) of polygons that represent the major conservation opportunity areas and of the areas that are most degraded.

Databases appropriate for further analyses and production of a landscape atlas as desired in future years.

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