General Session

Gap Analysis Program Overview[1]

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Defenders of Wildlife is a national, nonprofit organization with about 100,000 members. The organization is best known for its efforts to conserve predators like wolves and bears, and to reintroduce them into areas where they no longer exist. During the last few years, the organization's agenda has broadened to address concerns about loss of biodiversity and ecosystem function. Since it began in 1988, Defenders of Wildlife has supported the Gap Analysis Program (GAP) because we believe that it is very important to have quality information about the distribution of biological resources to make good decisions about how to conserve them. We initiated and manage the Oregon Biodiversity Project as a pilot effort to use Gap Analysis and other information in broad-scale conservation planning.

Description of Gap Analysis

GAP is a sophisticated tool involving the use of satellite imagery and computer technology to map the distribution and status of regional biodiversity. GAP's goals vary, but our organization believes that an important goal for GAP is to provide focus and direction for proactive management strategies at the community and landscape levels. It identifies 2 elements of biodiversity, vegetation types and terrestrial vertebrates, which may not be adequately represented in species management areas. These gaps may be filled by changes in land management.

According to the GAP program leader, Dr. J. Michael Scott of the National Biological Service's Idaho Cooperative Research Unit at the University of Idaho, GAP has 4 goals: to map terrestrial land cover for the United States, to map predicted distributions of vertebrates, to identify unprotected elements of biodiversity, and to identify areas of biodiversity for further study. Defenders of Wildlife believes that the ultimate GAP goal is to prevent any other species from being listed as threatened or endangered.

GAP has many potential benefits for resource managers:

[1] This narrative is adapted from a slide presentation.

—It crosses public and private land ownership boundaries.

—It addresses all species, not just game animals.

—GAP provides a context in which to make more site and species-specific decisions.

—It establishes a consistent format for mapping vegetation and species ranges.

—It helps managers set acquisition priorities and make better land management decisions.

—GAP recommendations can help local planners identify important habitats.

—It encourages public/private partnerships in the research and implementation stages.

A "gap" can be a vegetation type, species, species-rich area, or an area of importance for a group of species like Neotropical migrants that are unprotected or under-represented within the existing network of conservation lands. The GAP process can help provide focus and direction for conservation activities, help institute a hierarchical approach by providing information on the broad scale distribution of resources, and create lasting partnerships between the public and private sectors. Results can be used to evaluate management practices, ensure representation of all habitats and species, and can be ultimately used to change management practices where appropriate to meet biodiversity goals.

GAP programs are managed by the National Biological Service's Cooperative Research Units in most states. There are now between 300–400 cooperators in about 40 states, including universities, agencies, private industry, and conservation organizations. GAP is based on the theory that limited resources can be used more effectively if focused primarily on broad habitat needs rather than a few individual animals or single species.

GAP Methodology

The process begins by creating 1:100,000-scale maps, with a minimum mapping unit of 100 ha. This scale is somewhat coarser than the National Wetland Inventory maps (1:24,000) and finer than the scale used by Environmental Protection Agency's (EPA) E-Map program. In some states, mapping is completed at much finer detail later after initial coarse-scale maps are completed. GAP products are primarily useful for land use planning at the regional or state level.

After the GAP data layers are created, accuracy is assessed, then gaps in the protection of habitats and species can be identified. The primary data layers are vegetation or land cover, terrestrial vertebrate species ranges, land ownership, and land management. Four categories of land management are used, ranging from wilderness areas and other lands with statutory protection for

biodiversity values (category 1) to private lands developed for industrial and residential uses (category 4).

Vegetation is derived from TM satellite imagery and other data. GAP personnel engineered an interagency purchase of imagery for the entire United States with "wall-to-wall" coverage, saving millions of dollars. The images are interpreted and verified by ground-truthing, aerial videography, and expert review. After 2 or more states are completed, they can be edge-matched and stitched together to facilitate cross-boundary ecoregional analysis.

Species range maps are created using wildlife-habitat relationship models and a hexagonal grid system for uniform distribution across the United States. The range maps show predicted distribution of species in polygons. Species data can be used to display areas of the highest concentrations of species in many different ways, e.g., all species or various taxonomic groups.

Most state GAP projects classify lands according to the level of protection offered for biodiversity values. However, this scale is controversial, and efforts are underway to develop a broader range of management classifications to acknowledge the contribution made by lands managed primarily for other purposes, including private lands. Vegetation types can be juxtaposed with special management areas to show which ones are not well-represented within the existing mixture of conservation lands. For example, the frequently-referenced Mike Scott Hawaii map shows $<10\%$ overlap between the areas rich in endangered Hawaiian birds and existing parks and refuges. This map has inspired The Nature Conservancy and U.S. Fish and Wildlife Service to purchase thousands of hectares of land for Hawaiian birds.

Implementing Gap Analysis

One of the greatest challenges to the regional application of GAP to land conservation is the discrepancy in completion dates between states. Within the lower Mississippi 9-state region, only Arkansas has completed the basic data sets. Tennessee, Louisiana, Texas, Missouri, and Illinois are underway. Mississippi, Alabama, and Kentucky have not started. Mapping land cover is one, but not the only, step in Gap Analysis. Mapping land cover takes 2 to 3 years, followed by the other steps in the process. Completion time depends on funding and level of technical support.

Despite its potential utility and benefit to land managers, using GAP and other various Geographical Information System (GIS) data for broad-scale land management decisions will be challenging for a number of reasons. The primary problem is that there are few institutions in place whose job it is to manage interdisciplinary, cross-boundary, and especially, multi-state planning. At its best, GAP is an interdisciplinary effort involving ecologists, geographers, social scientists, planners, computer programmers, designers, writers, etc. Many barriers between different disciplines make the development and application of GAP data complex.

Funding interagency, interdisciplinary programs is difficult since most budget processes are narrowly structured in historical boxes. Few people are trained or have the equipment to collect, manipulate, and understand complex GIS data sets. Tasks that seem simple take forever and often do not produce expected results. To be integrated, various ecological and social data sets need to be made compatible. It must be someone's explicit responsibility to facilitate this integration.

Implementing GAP, or for that matter, effectively using any GIS system, requires attention to many issues that may not be obvious at the beginning. Before initiating a biodiversity project, it is helpful to consider the different kinds of issues that will need to be addressed.

Research is one element. Gap is essentially a research project that involves collecting data, analyzing it, and validating the predictions. Once the information is compiled, it needs to be communicated to a range of audiences through electronic and traditional means. The voluminous data sets need to be managed, updated, and made accessible to people who need them, along with other relevant information.

Once the results are available, they can be incorporated into resource policy, management, and funding decisions. Conservation actions taken on the ground need to be evaluated to make sure they are accomplishing anticipated goals.

The national GAP program has not clearly defined where its responsibilities end and users' responsibilities begin. Many institutional traditions are in transition, and these questions are not easily answered. The lower Mississippi project will need to be very creative in building bridges between science, technology, policy, and land management to accomplish its goals.

Fortunately, many southeastern states have already developed very sophisticated approaches to these issues. Missouri, for example, is a leader in biodiversity conservation. The Missouri Department of Conservation, U.S. Department of Agriculture (USDA) Forest Service, and U.S. Fish and Wildlife Service joined forces to develop the Missouri Resource Assessment Partnership (MoRAP). This partnership is a technical facility designed to integrate various GIS data sets at several scales. It will handle ecological and socioeconomic information.

Tennessee has also been a leader in biodiversity conservation. The goals of the Tennessee Biodiversity Program are to coordinate planning and management and to use biodiversity data at the local level. The project is managed by the Tennessee Conservation League and a project steering committee. Other committees deal with forestry, agriculture, and policy issues. The target audiences for the program are resource professionals and educators. The project is developing manuals for local planners, creating maps, and conducting workshops.

Elements of a Successful Biodiversity Project

To be successful, a state or regional biodiversity project needs certain things:

1. High-quality information on the ecological and socioeconomic characteristics of the area are essential as a starting point.
2. A process for planning, involving people, and making decisions is important, as well as a structure that facilitates efficient project management.
3. Communication with non-technical audiences including many resource agency personnel, policymakers, the news media, some educators, and the general public is important. Major land management decisions will not be made without the support of these groups.
4. Cooperative, committed attitudes are essential. Squabbles over money, ego, and turf kill many fine projects.
5. Significant technical support is needed to back up a large, regional planning effort.
6. Data need to be managed in consistent formats, arranged in a spatial hierarchy from coarse to fine. Many aspire to this goal and few reach it.
7. Institutional support is needed from all cooperators. Use adaptive management to learn from mistakes and improve decision-making in the future.
8. There is no point in planning if the plans are not implemented. A commitment to implementation is essential.
9. Public and private partners are needed to work in a cooperative way, and participation by diverse interests is important.
10. Significant funding is needed to support a regional biodiversity conservation effort. Funding can be shared by different partners.

Specific Recommendations for the Lower Mississippi Initiative

Having undertaken a project similar to the Lower Mississippi conservation initiative being proposed here, I offer several suggestions. First, collecting, analyzing, and interpreting the data needed to support this effort will be an overwhelming task. The effort should be housed in one place, with the proper equipment and with appropriately trained people and sufficient funding to do the job. Secondly, an interdisciplinary team should be assembled at the beginning of the project to handle the ecological aspects, public involvement, communications, training, and other issues. Staff can be drawn from different organizations and agencies or hired specifically for the project. Finally, the initiative deserves the support of every conservation organization, public and private, local, statewide and national. Its ultimate success will depend on our collective ability to elevate biodiversity conservation in our national priority scheme, and to secure funding for its implementation on the ground. GAP can help identify the priority areas for conservation, but a significant investment will be required to protect and manage these lands. The Wildlife Diversity Initiative is a potential source of funding for projects to help prevent species from becoming endangered.