AUTOMATED CARTOGRAPHY IN THE NATIONAL PARKS PLANNING

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In the National Park Service, most planning is conducted to determine the future of the nationally significant areas that have been set aside as units of the National Park System. The purpose of this planning is to develop alternative strategies for achieving the stated management objectives of national parks, to assess these strategies and to provide decisionmakers with sufficient data to allow selection and implementation of the most suitable and feasible strategy. In so doing, the National Park Service must comply with the provisions of the National Environment Policy Act of 1969 and other pertinent statutes, executive orders and Federal policies. Emphasis must be placed on the gathering of sufficient information for thorough assessment of alternative strategies, for forecasting the consequences of these strategies, and for making final decisions.

In brief, the planning process, applicable to all established areas of the National Park Service and to new areas, consists of the following steps:

- Development of a statement for management
- Identification of planning tasks or an outline of planning requirements
- A task directive specifying the method for conducting the planning tasks

- The collection of sufficient information to place the park in its regional context and to permit the formulation, analysis and culling of alternative strategies for meeting management objectives. The collection is called the information base.

- The development of alternative strategies and their analysis

- Selection of the acceptable strategy

- Amplification of proposals included in the selected strategy or the plan itself

Because parks are geographic entities, and most of the information contained in the information base is in the form of maps of the various resources of the park it is natural that automated cartography can be used to aid in the analysis and portrayal of the strategies and alternatives mentioned above.

In 1973, a project was started to prepare the General Management Plan for the Great Smoky Mountains National Park. Not only was this effort to culminate in the production of the plan for the park but it was also designed to recognize the park's impact on the surrounding towns and region as well as the role the surrounding region played in the future management of the park. This regional effort, bringing state, county and local officials as well as other Federal agencies into the planning process was a first for the Service. It was also the first time that a large scale effort would be made to utilize automatic cartography to aid in the planning process.

Through a Memorandum of Agreement between the National Park Service and the National Aeronautics and Space Administration, the Service had established an office at the NASA Mississippi Test Facility, now the National Space Technology Laboratories. The Service was to provide the knowledge of the park, management objectives and funding and the NASA was to furnish the knowledge of data handling, computer manipulation of geographic information and the manpower to produce a large geographic information system. A broad definition of what was to be accomplished was given to the NASA, the work to be done by the technical contractor at the site.

The scope of work called for systems analysis and design, data collection, acquisition, imput, analysis and output to be carried out by the contractor.

The software system selected was obtained from the Pennsylvania State University; a system they had gotten from Harvard University. Harvard had put the system together for their work on the Honey Hill project for the Corps of Engineers. Penn State had modified the software when they used it on the Allegheny Reservoir Study. Additional modifications were made to the programs by the NASA such as providing for the input of digitized map data in line segment format, conversion from line segment to cell format for the analysis routines, use of a neighboring cell's attributes in determining the suitablity for a particular land use of the primary cell, and production of line segment output plots in lieu of line printer maps of the suitablity analyses.

Two separate data bases were established, one regional and one park. In some instances the same data was used in both data bases. The regional data was to be used in the multi-agency planning effort. Approximately fifty Federal, state and local agencies and offices were contacted resulting in the accumulation of some 350 data items. These data were then scrutinized as to their applicability to a particular theme. Seventeen themes made up each data base. Subsequent modifications and corrections resulted in a twenty theme data base for the region and a twenty-five theme park data base. Overlays were produced of the themes at a scale of 1:125,000 for the region and a scale of 1:62,500 for the park. The regional overlays were 4 feet by 7 feet in size; the park's were2.5 feet by 5 feet. Needless to say, because this was a pilot project, things did not all go according to plan. Late deliveries of equipment, software "bugs" and other delays precluded the use of all but the basic map overlays to be used in the planning process. Because of the scale of this effort (costs approached $280,000 for the geographic information portion of the project) there was wide-scale disappointment in the "failure" of the system to work the first time. Some specific problems encountered included the difficulty in reproducing the large overlays for the region, lack of data comparability between Tennessee and North Carolina

and even across county boundaries, accelerated schedules for production of deliverables after project initiation, lack of complete understanding of the consequences of some decisions made by contractor personnel and the fact that an operational task was dependent upon an experimental effort. Nevertheless, the value of the undertaking was recognized and in 1975 another planning project made use of the system developed.

This effort was to produce the General Management Plan for the Deleware Water Gap National Recreation Area, along the Delaware River in New York and Pennsylvania. This project provided an opportunity to plan before any major facilities were in place. The same system was used for the Smokies plan with some modifications made in the software as well as use of better digitizing procedures and the acquisition by the NASA of a state-of-the-art flatbed plotter. Many lessons learned on the Smokies project were applied to the Water Gap such as better control of input data, data source selection, etc. Only one data base was constructed at the park level of detail but data was included where available for a small surrounding region. Nineteen input and derived themes made up the data base. A derived theme is one that is calculated from an input theme, such as proximity to roads or proximity to surface water. In these cases the transportation net or surface drainage was digitized and after conversion to cell, the proximity data derived. Again all data collection, selection and input was accomplished by the NASA technical contractor. The work was done in time for use by the planners and suitability of the park lands to support fifteen different uses and impacts were analysed. The availability of this data base enabled the planners to relocate the proposed visitor center, saving the $165,000 cost of the automated resource inventory in sewage treatment plant redesign and installation, when the originally selected site would not support the anticipated treatment method.

A third planning project utilized the NPS/NASA jointly developed system was done for the John D. Rockefeller Jr. Memorial Parkway. This project ran concurrently with the Delaware Water Gap effort. Due to the heavy digitizer use on the Water Gap and the small size of the Parkway, thematic information was input directly in cell format. In this case, all data to be used in

the analysis was prepared by Service planners and had all been produced at the same scale. The data base comprised twenty input and derived themes. This effort, costing only $14,000 for NASA contractor work and involving no additional software modifications was very successful and shows the efficacy of the system as it had evolved. It also shows how expensive the intial data collection efforts can be. The basic land use analysis system was exercised for twenty-two activities and eight impact assessment plans were developed.

Also in 1975, to support the Yosemite National Park General Management Plan development, the National Park Service contracted with a private industry vendor to supply an interactive geographic resource information system. The system was purchased and installed on the NPS's ADP support contractor's computer for $185,000. Some eighty-eight maps were digitized, about half covering the whole park, others providing more detailed data on Yosemite Valley and other developed areas. The system operated in a totally polygonal mode for data analysis. Digital topographic information was manipulated through the use of the U.S. Forest Service's TOPAS programs but was not supported in suitability analyses. Some of the problems in the use of this system were the high cost of operation (several hundreds of thousands of dollars to provide the analyses and plotter input) and the need for programmer level personnel to adequately run the system interactively.