

Proposal: Modeling accessibility and poaching behavior for protection of at-risk plants

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Resource protection only can be effective if resource managers know where the resources are, how abundant they are, and where they are the most vulnerable to exploitation. In FY2002 and FY2003 we developed and validated GIS-based models predicting the distribution of American ginseng, black cohosh, and bloodroot in Shenandoah National Park, Great Smoky Mountains National Park, and Blue Ridge Parkway (Young, et al. 2003). This project was conducted as part of the Appalachian Chain Demonstration Project where the goal was to develop science-based enforcement strategies as a model for protection of at-risk natural resources. Field searches in SHEN using the distribution models as a guide were 3.3 (black cohosh) to 11.2 (ginseng) times more likely to result in finding the species of interest than were random searches. Field searches in 2002 and 2003 using the predicted distribution models resulted in 93 new locations for American ginseng, 89 new locations for bloodroot, and 159 new locations for black cohosh. These results suggest that the plant distribution models are successfully predicting locations of prime habitat for these species.

We also demonstrated how plant distribution models could be combined with other GIS data to support law enforcement. We created a simple model of accessibility using GIS by taking into account proximity to roads and trails and the difficulty of travel over steep terrain. Plant distribution models were overlaid with this index of accessibility to highlight areas that were predicted to be prime habitat and that were also easily accessible. While this model was only constructed for two test areas in SHEN, it demonstrated the potential to highlight areas most vulnerable to poaching pressure. Further development of such models may be useful to law enforcement personnel for targeting enforcement actions to areas most likely to be exploited by poachers. However, predicting potential poaching pressure is a complex problem and will require an evaluation of past poaching behavior and an analysis of landscape and sociological factors that are correlated to poaching incidents (for example: park entry and exit points, favored parking and travel routes, economic attributes of the local communities, market forces, etc.).

Mapping and analysis of spatial patterns of criminal behavior is gaining acceptance in the law enforcement community due to the increasing availability of GIS software capable of quickly analyzing large amounts of data to derive meaningful patterns that can be used to guide enforcement activities (Harries, 1999). Specialized analytical techniques have been created using GIS expressly for finding “hot spots” or clusters of criminal activity in a community and for predicting where new crimes are likely to occur (e.g., “CrimeStat”, NIJ 1999; “CrimeMap” Gorr 2001). This “geographic profiling”, as it is commonly known, has been successfully applied to community policing but has rarely been applied to natural resource protection. Other modeling techniques such as expert-assisted models (Saaty 1977) may be useful for incorporating known aspects of poaching behavior to GIS models of accessibility and habitat quality.

We propose to develop methods to integrate previously generated GIS models of predicted prime habitat for American ginseng, bloodroot, and black cohosh with GIS models of accessibility and past poaching behavior to produce a model of resource vulnerability in SHEN and GRSM. We will develop a digital database of past poaching behavior (including species poached, source and destination of criminal activity, etc.) by digitizing paper records now held at SHEN (D. Hurlbert, personal communication) and GRSM and by interviewing park law enforcement personnel. We will analyze this database to assess clusters of poaching activity and characteristics of poachers. We will examine road and trail networks for traffic patterns, entry and exit into the park, and parking potential. We will develop models of accessibility by examining the difficulty of movement across terrain, including obstructions due to vegetation, steep slopes, cliff faces, and disturbance. These models will be combined to produce predicted “hot spots” of poaching activity, and to identify park resources most vulnerable to exploitation. We will work closely with law enforcement personnel to validate these models and to test their applicability to monitoring and enforcement activities.

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