Design and Implementation of Estimation-based Monitoring Programs for Flora and Fauna: A Case Study on the Cherokee National Forest

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Abstract: Science-based monitoring of biological resources is important for a greater understanding of ecological systems and for assessment of the target population using theoretic-based management approaches. When selecting variables to monitor, managers first need to carefully consider their objectives, the geographic and temporal scale at which they will operate, and the effort needed to implement the program. Generally, monitoring can be divided into two categories: index and inferential. Although index monitoring is usually easier to implement, analysis of index data requires strong assumptions about consistency in detection rates over time and space, and parameters are often biased—not accounting for detectability and spatial variation. In most cases, individuals are not always available for detection during sampling periods, and the entire area of interest cannot be sampled. Conversely, inferential monitoring is more rigorous because it is based on nearly unbiased estimators of spatial distribution. Thus, we recommend that detectability and spatial variation be considered for all monitoring programs that intend to make inferences about the target population or the area of interest. Application of these techniques is especially important for the monitoring of Threatened and Endangered (T&E) species because it is critical to determine if population size is increasing or decreasing with some level of certainty. Use of estimation-based methods and probability sampling will reduce many of the biases inherently associated with index data and provide meaningful information with respect to changes that occur in target populations. We incorporated inferential monitoring into protocols for T&E species spanning a wide range of taxa on the Cherokee National Forest in the Southern Appalachian Mountains. We review the various approaches employed for different taxa and discuss design issues, sampling strategies, data analysis, and the details of estimating detectability using site occupancy. These techniques provide a science-based approach for monitoring and can be of value to all resource managers responsible for management of T&E species.

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