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Project Summary

Forest Health Monitoring 1991 Georgia Indicator Evaluation and Field Study

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The Forest Health Monitoring (FHM) 1991 Georgia Pilot study was undertaken to conduct field research for advancing forest monitoring science within the Environmental Monitoring and Assessment Program (EMAP). Indicator developmental and operational monitoring research was conducted simultaneously on plots. The pilot study was designed to test methods for quantifying vegetation structure, photosynthetically active radiation (PAR), dendrochronology, and selected root fungi. The objective of the vegetation structure study was to compare the operational and informational characteristics of area-based and point-based methods for quantifying vertical and horizontal vegetation structure and to recommend a measurement system for vegetation structure for 1992 and beyond. The primary objective of the PAR study was to develop an efficient and reliable method of using ceptometers and quantum sensors for measuring forest canopy light environments in various stand conditions. The objectives for dendrochronology were to determine if the sampling intensity and tree selection protocols were adequate for quantifying diameter at breast height (dbh) growth rates and trends on a regional basis. The objectives for the root disease study were to determine the presence and severity of root disease using two root sampling methods (the two-root method and the cubic foot root collection method) and compare the methods, and also to evaluate the cubic foot method for quantifying ectomycorrhizal fungi. The objective of the tree height study was to determine if the accuracy and precision of tree height measuring devices were adequate for providing a measure of tree height change over time. The report presents the results and recommendations based on those results.

This Project Summary was developed by EPA's Atmospheric Research and Exposure Assessment Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The Forest Health Monitoring (FHM) 1991 Georgia Pilot study was undertaken to conduct field research for advancing forest monitoring science within the Environmental Monitoring and Assessment Program (EMAP). Indicator developmental and operational monitoring research was conducted simultaneously on plots.

The pilot study was designed to test methods for quantifying vegetation structure, photosynthetically active radiation (PAR), dendrochronology, and selected root fungi. Testing the methods included comparing different data collection procedures for individual indicators, estimating sampling efficiency (both of the sampling design and the sampling unit design), and evaluating spatial variability. In addition, the accuracy and precision of tree height instruments were determined. A brief overview of the study area is given in the following section. More detailed informa-

tion is presented in the *Results and Recommendations* section, which is organized by indicator.

Procedure

The field work was conducted on a systematic grid consisting of 63 plots across the state of Georgia. Figure 1 shows a map of Georgia with county boundaries and demo plot locations. Although there were 63 potential plot locations, the land use for many was something other than forested (e.g., agricultural, urban, marsh). Several of the indicator studies utilized only 20 of the forested plots in western Georgia. Figure 1 shows the pilot plot locations.

Results and Recommendations

Vegetation Structure

The objective of the vegetation structure study was to compare the operational and informational characteristics of area-based and point-based methods for quantifying vertical and horizontal vegetation structure and to recommend a measurement system for vegetation structure for 1992 and beyond.

The general superiority of the quadrat method for sampling vascular plant species richness at both plot and regional levels was the most significant of several methodological differences found between the quadrat and pole methods. Comparisons of quadrat and pole diversity indices and species accumulation curves supported this finding. This finding is important because estimates of species richness are the most basic and sensitive measurements of the status of biotic diversity. Although estimates of species richness are basic and straightforward, they are not simple. Field personnel must have a working knowledge of the regional flora, the ability to identify vascular plants under field conditions based on experience or using regional taxonomic keys, and the ability to collect and press unknown plant specimens for later identification.

In contrast, even though superior to the pole method, the quadrat method implemented in this study usually sampled only 70 to 80% (range 66 to 107%) of a crudely estimated total plant species richness of the plot and regional level. Therefore, suggestions to reduce sample numbers per plot must be thoroughly evaluated before implementation, since the reliability of species richness and other diversity calculations increases with sample size. The quadrat method for measuring vegetation structure was recommended for use in future FHM field seasons based on these findings.

Photosynthetically Active Radiation (PAR)

The primary objective of the PAR study was to develop an efficient and reliable method of using ceptometers and quantum sensors for measuring forest canopy light environments in various stand conditions. Several equipment problems were worked out so that PAR data collection can be considered reliable. The importance of measuring diffuse PAR in open areas in addition to ambient PAR became evident. Statistics indicated that 7 points gave as good an estimate of PAR as 19 points, thereby reducing field work and time.

Dendrochronology

The objectives for dendrochronology were to determine if the sampling intensity and tree selection protocols were adequate for quantifying diameter at breast height (dbh) growth rates and trends on a regional basis. Based on the variance component analysis, the sample intensity is adequate. A graphical analysis of growth patterns showed that cores, grouped by species and age, showed similar patterns of growth within groups. Specific species should be sampled where possible (loblolly pine, for example), to minimize between-species variability in growth.

In addition, recommendations were made for improving equipment, field sampling, core handling, and preparation. The recommendations should improve core quality and expedite the measurement and analysis process. A specific recommendation was that cores should be prepared, measured, and analyzed by one laboratory.

Root Disease

One objective was to determine the presence and severity of root disease using two root sampling techniques: the two-root method and the cubic foot root collection method. The results showed that the two-root method was more effective than the cubic foot method in detecting root disease pathogens.

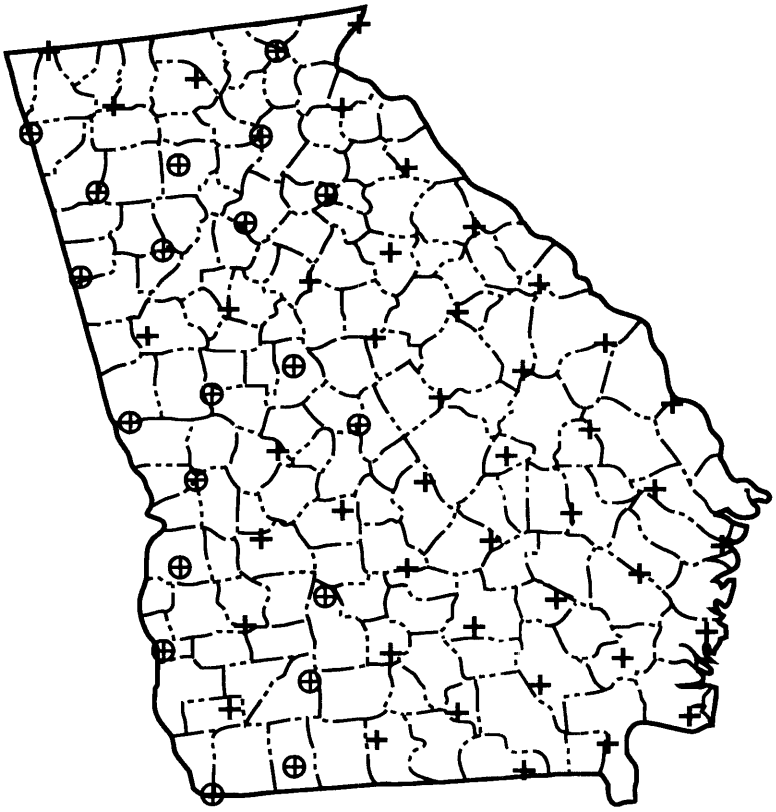

Figure 1. *Locations of the 1991 Georgia Pilot plots. The 20 plots used by several indicators are circled.*

Another objective was to evaluate the cubic foot method for quantifying ectomycorrhizal fungi. The field sampling procedure was simple, but the laboratory work was cumbersome and labor-intensive. The core sample was considered too large, and the variability between cores was high. A smaller volume soil sample and/or a soil subsampling procedure were suggested to improve the procedure.

Tree Height

The objective was to determine if the accuracy and precision of tree height measuring devices were adequate for providing a measure of tree height change over time. The authors concluded that a 10% error in measuring tree height was common, especially for trees over 12 m in height. A 10% measurement error is unacceptable for accurately estimating height change over a 5-year period, therefore tree height is not recommended as an indicator at this time.

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Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

This report represents data from one year of field operations of the Environmental Monitoring and Assessment Program (EMAP). Because the probability-based scientific design used by the EMAP necessitates multiple years of sampling, there is uncertainty associated with these data. This uncertainty will decrease as the full power of the approach is realized. Similarly, temporal changes and trends cannot be reported, as these require multiple years of observation. Please note that this report contains data from demonstration studies in one geographic region. Appropriate precautions should be exercised when using this information for policy, regulatory, or legislative purposes.

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The complete report, entitled "Forest Health Monitoring 1991 Georgia Indicator Evaluation and Field Study," (Order No. PB94-152394; Cost: $19,50; subject to change) will be available only from

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