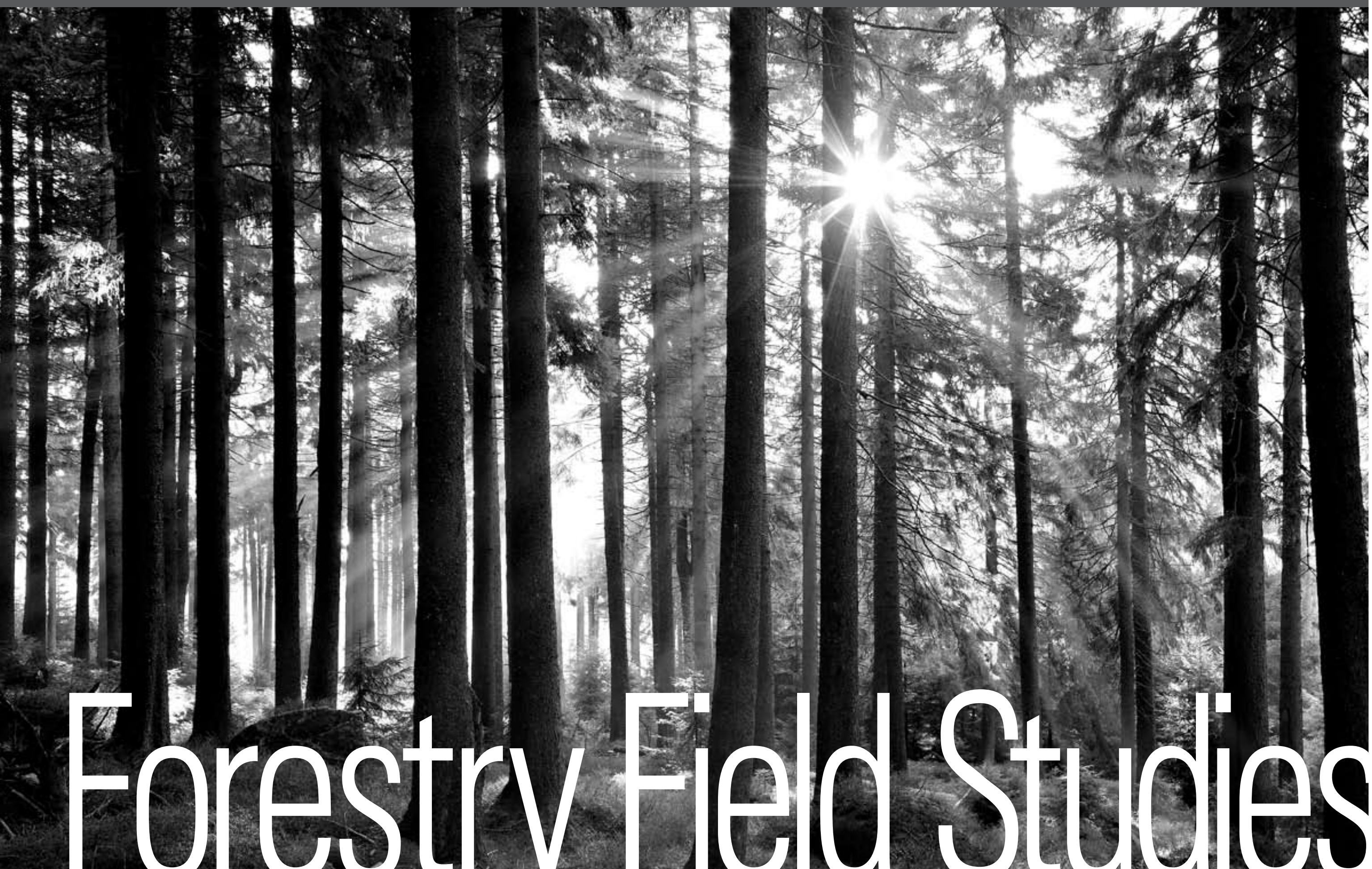
Forestry Field Studies

A MANUAL FOR SCIENCE TEACHERS

By David D. Glenn and Donald I. Dickmann



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PREFACE

Why forestry field studies? As experienced teachers of scientific ecology and forestry concepts, we believe that a forest or woodlot can provide teachers and their students with the perfect laboratory for understanding some of the basic principles of environmental science and community ecology. These studies were designed and used for many years as a unit in an Advanced Placement environmental science course. They also could be in biology, botany, forestry, or ecology classes at the high school or beginning college levels. The activities place students in a natural environment collecting real data to better understand a real place, something sorely lacking in most high school or beginning college curricula.

Most schools are not very far from a woods of some sort. In certain regions, school districts own their own forests, often underutilized. Some teachers can use a nearby park; others will have the fortune to work in a larger county, state, federal, private, or corporate forest that is within driving distance. To conduct the field activities outlined in this manual, the forest or woodlot could be large or small; deciduous, coniferous, or both; proximal to the school or distant from it. The tree species or forest types available for study are not important; these studies are more about systems and communities than they are about particular trees.

Much research has shown that science instruction and the desired outcome of student understanding are best accomplished by doing in-depth studies on a few concepts, rather than the traditional encyclopedic overview of many subjects. If completed, the field studies presented in this manual represent such an in-depth approach, the goal being a comprehensive examination of a well-defined forest ecosystem. Additionally, these studies represent a valid field experience as defined by the College Board in the course description for Advanced Placement Environmental Science (*http://apcentral.collegeboard.com/apc/public/repository/ap-environmental-science-course-description.pdf*). This description states that field activities should

- always be linked to a major concept in science and to one or more areas of the course outline;
- allow students to have direct experience with an organism or system in the environment;
- involve observation of phenomena or systems, the collection and analysis of data and other information, and the communication of observations and results.

PREFACE

Many of the above ideals of science education are embraced by forestry field studies. Relevant, valid, hands-on work by students collecting real data that they can analyze and interpret is an important aspect of these studies. Just getting students out of the confines of the classroom and into the woods is in itself a worthy effort, let alone having them work on data collection and analysis in a meaningful way. We have noted over the years that the almost universal reaction of students to time spent in the woods is positive; they want to be learning outdoors. For many students this will be a first-time experience; for some it may be a life changing one.

Among the paramount concepts of biology and ecology that can be incorporated into forestry field studies are secondary succession, community structure and function, elemental cycles, population dynamics, biodiversity, global warming, and watershed issues. Additionally, forestry field studies provide the perfect model for introducing the concept of sustainable management of natural resources, which should be part of every student's science education. Working in woodlots provides students with a fixed, workable area in which they can consider important resource management issues such as wildlife habitat, outdoor recreation, biodiversity, and commercial wood production. Because trees are renewable these studies make the concept of sustainability real, relevant, and worthy of consideration. The practical benefit is that students can use their own data to make management recommendations for the forest resource they measured and analyzed. This experience also may open a student's mind to career tracks heretofore not considered.

This manual is organized to take a teacher systematically through a comprehensive set of field exercises, from preparation to written report. We begin by discussing some basic ecology and forestry principles in Chapters 1 and 2. These discussions are meant to be a "refresher course" and do not cover these subjects in a textbook or encyclopedic fashion—for that, see the chapter bibliographies and readings listed in Appendix E. In Chapter 3 we cover some necessary pre-fieldwork preparation. Chapters 4 through 7 describe the actual fieldwork and are essentially units of an all-day session in the woods. If time, budget, or logistics does not permit an all-day field trip, however, one or more units can be chosen to fit a particular situation—we do not intend these exercises to be all or nothing! We conclude with a discussion of the post–field trip data analysis, report writing, and wrap-up.

Spending a day working in the woods doing systematic, observational science using professional tools is just plain fun and exciting, both for students and their teachers. Although the "virtual" experience via some electronic gizmo has become a paradigm of the 21st century, the sights, sounds, smells, and hands-on feeling of a *real* woods have no virtual counterpart. When you and your students experience the woods, you will know what we mean.

ACKNOWLEDGMENTS

This book has been a dream of mine for a very long time. Many people contributed to the science, pedagogy, and logistics of the field studies we describe. First, I'd like to recognize and thank my wife, Sue Ann, for totally supporting this project and for putting up with the incredible amount of time I spent away from home working with students. She also contributed some of the artwork in this book. My colleagues at Rochester Adams High School—especially Scott Short and Joe Wieten—helped me with many of the logistics involved in the field studies. Ned Cavney, retired forester with the Michigan Department of Natural Resources, helped me understand some of the basics of forestry. Bruce Austin, parks and recreation manager for Rochester, Michigan, shared with me his practical experiences in forestry, which helped us develop many of the field studies. Brad Upton, owner of Dillman and Upton lumber company in Rochester, underwrote travel to a workshop to Vancouver, British Columbia, that helped me understand the commercial aspects of forestry. My coauthor has been brilliant on this project and I can't thank him enough. And last, but certainly not least, thanks to all of the hundreds of students I was privileged to work with in the field, doing what foresters, ecologists, and wildlife biologists do.

—Dave Glenn

First and foremost, I thank my coauthor for the enthusiasm and passion he brought to this project. I spent a day with him and his students in a woods in Auburn Hills, Michigan, observing them doing the exercises we describe, and this experience cemented my involvement. Those high school kids were doing forestry work, gathering their own data, and loving it! I also would like to thank my friend Bob Crawford for guiding me through the use of his high-resolution slide scanner. Dan Keathley, chair of the Department of Forestry at Michigan State University, provided me with the safe haven of an office, even though I am retired, as well as access to copying and printing equipment. Finally, my wife, Kathleen, gave unqualified and enthusiastic support for this project and always was willing to give advice based on her encyclopedic knowledge of the English language and the publication process.

—Don Dickmann

CHAPTER 4
Vegetation Analysis

Mapping the structure of the vegetation in study plots is important for several reasons. First, with all the detailed data collected, students easily can lose perspective of the bigger picture; they can get lost in the trees and not see the forest, so to speak. By doing this analysis they will develop a three-dimensional perspective of their plots. Second, vegetative mapping provides students with a resource to better understand the data collected. The maps they produce might provide clues as to why aspects of the data collected may vary from point to point. Lastly, vegetative mapping provides the teacher with a road map of the plot against which other data, such as standing board feet or environmental information, can be cross-checked to validate student fieldwork.

Figure 4.1. Using a distance measuring wheel to determine the perimeter dimensions of a study plot.

Creating an Overhead Look

Students should create a sketch of their study plot as if they were looking at it from above, straight down. Using a distance measuring wheel (with brush guard) or a measuring tape, they should first record the length of each edge of the plot (Figure 4.1). Since the perimeter of the plot has already been flagged, they should easily be able to walk around the edges. Next, they should mark the locations and relative sizes of trees and shrubs on paper (Figure 4.2). Graph or engineering paper works best because a scale easily can be established on the paper, which helps in recording. Students should estimate the spread of each tree's leafy crown, as seen from below, and then sketch it in its proper location on the paper. Note the paradox of creating an overhead view by looking up from below (Figure 4.3). Be sure to emphasize that tree crowns frequently overlap and shrubs or small trees often underlie the crowns of large trees. Trees on a plot boundary are mapped if at least half of their trunk diameter is inside the plot, even if much of their crown lies outside the plot. It is very important that students survey their plot in a systematic way—for example, by zigzagging through it at set intervals—so that they do not miss any trees or map trees more than once.

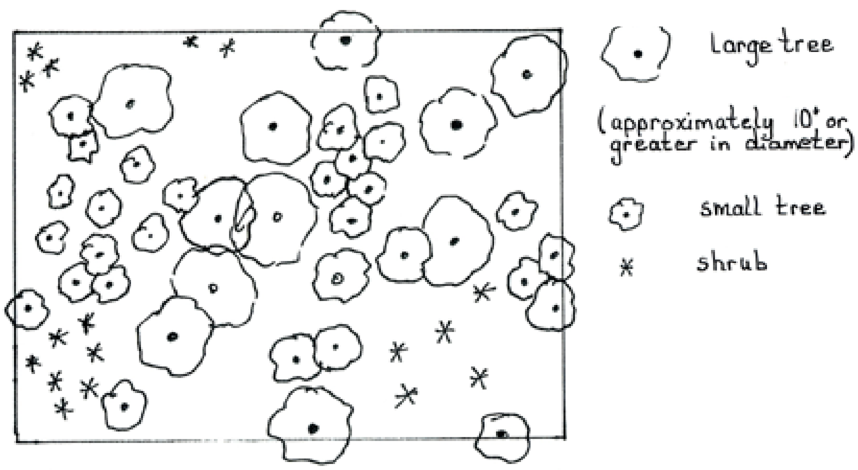

Figure 4.2. Hypothetical overhead map of a study plot showing the location of trees and shrubs of various sizes.

Unless otherwise indicated, all photos by D. Glenn

Defining Vertical Structure

Most woodlots consist of several vertical layers or **strata** of trees and shrubs. From the ground to the uppermost treetops, a typical profile would include (1) a low **understory**, (2) a **subcanopy** stratum of small suppressed or tolerant tree species, and (3) an **overstory** stratum. One of the first jobs a forester does in the analysis of a woodlot is to define the overstory stratum, which is occupied by the largest and most valuable trees (Figure 4.4). Trees that form the overstory stratum are referred to as **dominants** and **codominants**. Although there often is more than one canopy level in a stand, stands of pioneer species that come in after a severe disturbance or plantations simply may have an overstory and understory, with little in between (Figures 1.8, 1.11, and 1.13). The understory is made up of young tree seedlings and saplings (advance reproduction), small tree species, and shrubs (Figure 1.7). Sometimes a superdominant stratum above the general level of the overstory occurs (Figure 4.5; see also Figure 1.14).

Trees should not be included in a superdominant stratum unless they are considerably larger and clearly of an earlier generation than the trees of the main overstory. Occasionally a tree may be on the borderline between the overstory and subcanopy. If the tree offers significant competition to trees in the overstory (i.e., if its leaves or needles are touching or interlaced with those of the overstory trees), consider it part of the overstory.

Figure 4.3. The horizontal dimensions of a tree's crown usually can be estimated with reasonable accuracy from the ground, although it gets tricky when adjacent tree crowns overlap.
Photo by D. Dickmann.

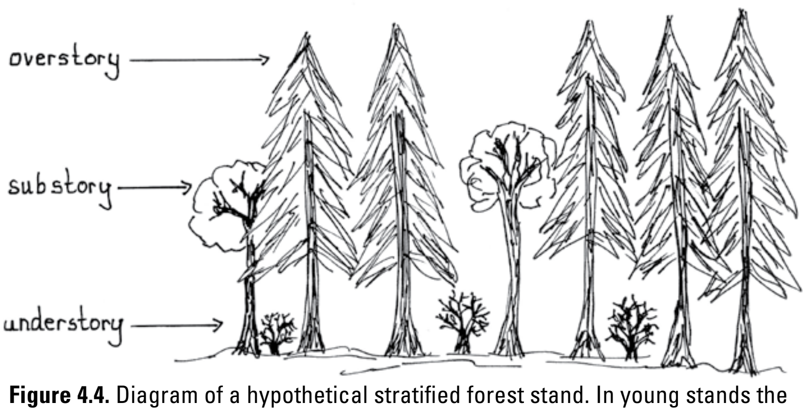

Figure 4.4. Diagram of a hypothetical stratified forest stand. In young stands the subcanopy stratum may be missing.

To define the vertical stand structure of their study plots, students should make a drawing of the trees as if they were looking at the forest from one side (e.g., see Figures 1.10 and 1.16). This may be difficult to do because the profile of large trees is difficult to assess from ground level and the tops of the trees may not be visible. But students should do the best they can. Their drawings should resemble those in Figures 4.4 and 4.5 and be labeled in the same way. It is important that the crown for each visible tree be reflected in the sketch. Note that some crowns may be touching or even overlapping. Dead trees may be drawn if present, but they should be labeled as dead. All canopy strata—overstory, subcanopy, superdominants, understory—also should be labeled on the drawing.

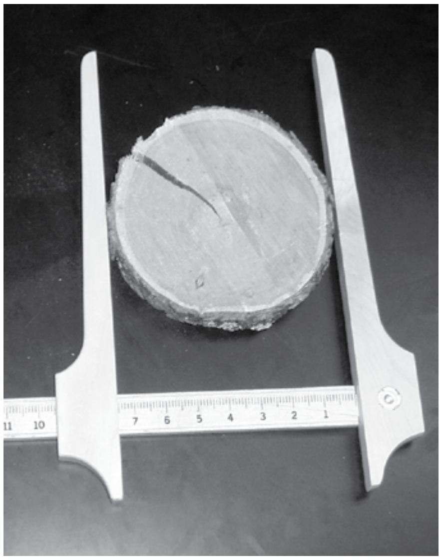

Figure 4.6. Instruments for measuring tree DBH. Top—tree calipers; bottom—diameter tape (D-tape).

Bottom photo by D. Dickmann.

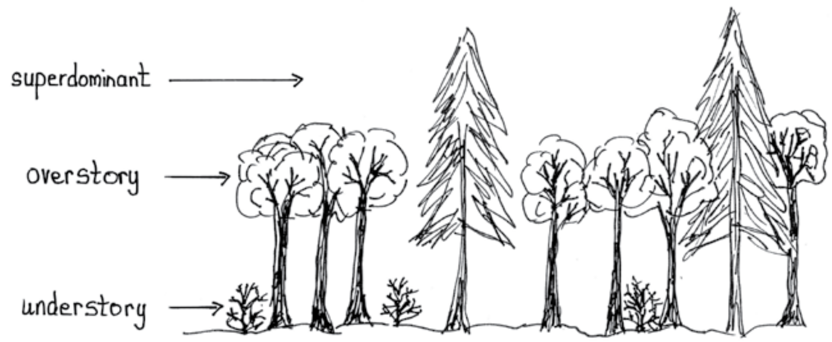

Figure 4-5. Diagram of a hypothetical stratified stand in which the upper stratum consists of large, widely spaced superdominant trees.

Tree Size Classification

The overhead and vertical structure of each study plot can be quantified to some degree by determining the size (DBH) class of each tree. These generalized size classes are related to some degree to tree age, although trees of the same diameter are rarely the same age. Students should use a caliper or diameter tape (Figures 4.6 and 4.7) to tally all the trees in each of their study plots according to their age class:

- Sapling (1 to 4 inches DBH)
- Poletimber (5 to 9 inches DBH)
- Sawtimber (10 inches or greater DBH)

This general classification has been useful in many ecology and forestry studies.

As an optional demonstration for each group, the instructor could use an increment borer to extract a core from a tree and have students count the growth rings to determine the age of the tree. The width of the rings also represents the year by year diameter growth rate of the tree. Increment borers are expensive, tricky to use, and easily damaged, so we do not recommend that students use them. Nonetheless, the demonstration could show students that tree ages and diameter growth rate are quantifiable without felling the tree, although the process is time-consuming and sometimes difficult.

Figure 4.7. Using tree calipers to determine tree DBH.

Study Plot Data Sheet—Age Class Classification

Age Class	Study Plot #1 Species or Forest Type		Study Plot #2 Species or Forest Type	
	# of Trees	Percentage of Total	# of Trees	Percentage of Total
Saplings (1–4 inches DBH)				
Poletimber (5–9 inches DBH)				
Sawtimber (10+ inches DBH)				
Total # of trees				

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