INTRODUCTION TO FORESTRY SCIENCE

Third Edition

L. DeVere Burton

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Introduction to Forestry Science, Third edition
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PREFACE

The forests of North America are among our most valuable and treasured natural resources. They contribute wealth to the economy, wood products for the benefit of society, outdoor environments for our enjoyment, and living environments for plants, animals, and birds. Healthy watersheds and fresh, clean air are other positive benefits derived from forests. Because forest resources are in high demand, they are also vulnerable to abuses. They are vulnerable because some human activities are capable of upsetting the delicate relationships that exist among living organisms such as trees, animals, forest plants, and nonliving forest resources such as soil and water.

This textbook is written for the purpose of teaching the principles of science that contribute to healthy forests. Science is the foundation upon which the management of forest environments should be based. It is unfortunate that science is sometimes ignored and that political considerations are allowed to shape and control forest management policies. It is important that a balance be struck that allows our forests to be used for productive purposes while also fostering forest management practices that maintain and improve the environment.

A serious attempt has been made in this textbook to present both sides of major environmental issues. It is the contention of the author that we should seek "middle ground" in resolving environmental conflicts and that it is wise to avoid radical positions on either side of these issues. It is also wise to consider the long-term effects that some management strategies are likely to have on forests, forest environments, wildlife, and humans. A forest, and the forest environment that surrounds it, is incapable of responding to a political edict or popular idea that lacks a scientific basis. In most instances, trees and forest plants grow and develop in predictable ways based on the principles of science. However, human understanding of science and application of scientific principles often do not equate to the same thing. We must learn to apply management practices to forests that are based on science principles as they exist, not as we wish them to be. Forest managers must also deal with realities. For example, it is unrealistic to expect that people will abruptly cease to use resources that have historically provided income and security for their families.

This textbook is divided into seven sections.

Section One—Introduction: Getting Acquainted with the Forest
Section Two—Forest Safety
Section Three—Forest Management
Section Four—Forest Products
Section Five—New Directions and Technologies in Forestry
Section Six—Dendrology: The Scientific Study of Trees
Section Seven—Trees of the Forest

The first section discusses the importance of forests, and it names and describes the different forest regions. Section Two is a study of forest safety practices. Section Three deals with forest management practices and the management of other natural resources. Section Four addresses production and processing of forest products, and Section Five discusses the new directions and technologies in forest management. It includes a chapter on the relatively new branch of forestry known as urban forestry. Section Six presents scientific information about the structure and life processes of trees. It also includes the study of relationships between trees and their environments and the effects of insects, diseases, and pests on forest health. Section Seven provides photographs and describes the characteristics of specific tree species that are most commonly associated with forestry.

Included in each chapter are features entitled Objectives, Key Terms, Forestry Profiles, Science Profiles, Career Options, Looking Back, Questions for Discussion and Review, and Learning Activities. Each chapter is filled with photographs and illustrations that will aid students as they seek understanding of the concepts presented.

The most significant changes in this new edition include:

- Additional tree species are included in Section Seven.
- Species are listed alphabetically based on the common name.
- New science and forest profiles augment those of previous editions.
- Numerous new photographs and graphic elements have been included throughout the textbook.
- The chapters have been reordered to accommodate the feedback received from teachers.
- The basic computer information has been removed from the chapter on space-age forest technologies.
- The textbook will continue to look familiar to those who use it, but it will have a fresh look and provide updated data and statistics.

Current efforts at school reform stress integration of technical and academic curricula. The Tech Prep initiative is an example of a career education movement that takes advantage of opportunities to teach science, math, and other subjects in the context of a career. The forestry curriculum helps students to know how they will use what they have learned. This textbook is intended to facilitate integration of science in curricula that deal with principles of forestry.

ACKNOWLEDGMENTS

This book is dedicated to students and teachers who enjoy learning and working in the woods and forests of North America. It is also written in tribute to the individuals and organizations that use and manage our forest resources in a responsible manner to ensure forests for future generations. The decisions of forest managers will have lasting impacts on our forests for good or ill far into the future. It is to the foresters of tomorrow that these pages are dedicated, in the hope that those who manage the forests in the twenty-first century will learn from the successes and mistakes of the past.

Special thanks are offered to the people who have contributed resources, pictures, expertise, and encouragement during the writing of this textbook. Gratitude is offered to my family and friends, and appreciation is extended to colleagues and to all who contributed to this project. Thanks to those who have reviewed the text and edited the manuscripts. Likewise, thanks to those writers whose works have provided information of a technical nature, and thanks to the individuals who have contributed photographs and other services:

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ABOUT THE AUTHOR

L. DeVere Burton, author of *Introduction to Forestry Science,* 3rd Edition, is a lifelong educator who has been engaged in agricultural education since he was a high school student. He recently retired to write full time. His career includes Director of Research and State Supervisor of Agricultural Science and Technology with the Idaho State Division of Professional-Technical Education. He retired from public education as Dean of Instruction at the College of Southern Idaho. He served as President of the National Association of Supervisors of Agriculture Education and participated as a member of several national curriculum-related task forces for the National Agricultural Education Council. He has also served as an adult consultant to the National FFA Nominating Committee.

The author was a high school agriculture teacher for 15 years and has been involved as a professional educator in agricultural education since 1967. He experienced teaching assignments in both large and small schools and in both single- and multiple-teacher departments. He taught at four different schools and at a leading land grant university. He was involved in agriculture program supervision from 1987 to 1997. All of these experiences have contributed to his philosophy that "education must be fun and exciting for those who learn and for those who teach."

A wide range of experiences has prepared the author for his career as an educator in agriculture and natural resources. He was raised on a farm in western Wyoming that bordered on forest lands where he experienced many pleasant hours in the canyons and along the streams that were part of the forests of his youth. During his years as a university student, he worked in the forest industry as a logger and sawmill worker. Other jobs held by the author include testing milk for butterfat content; caring for livestock on a combination beef, swine, and trout ranch; maintenance/warehouse worker in a feed mill; manager of a dairy; finish carpenter; and animal research assistant. He also worked in the food processing, metal fabrication, and concrete construction industries and owned and managed a purebred sheep and row crop farm for several years.

Dr. Burton earned his BS degree in Agricultural Education from Utah State University in 1967. He was awarded an MS degree in Animal Science from Brigham Young University in 1972. His PhD degree was earned at Iowa State University in 1987, where he was also an instructor in the Agricultural Engineering Department.

Dr. Burton is the author of four textbooks and has edited another, with several contributing authors. They include *Agriscience & Technology, Fish and Wildlife: Principles of Zoology and Ecology, Introduction to Forestry Science, Agriscience Fundamentals and Applications, and Environmental Science Fundamentals and Applications*. These textbooks were written for the purpose of strengthening the science content and expanding the breadth of the curriculum in the nation's agriculture and natural resource education programs.

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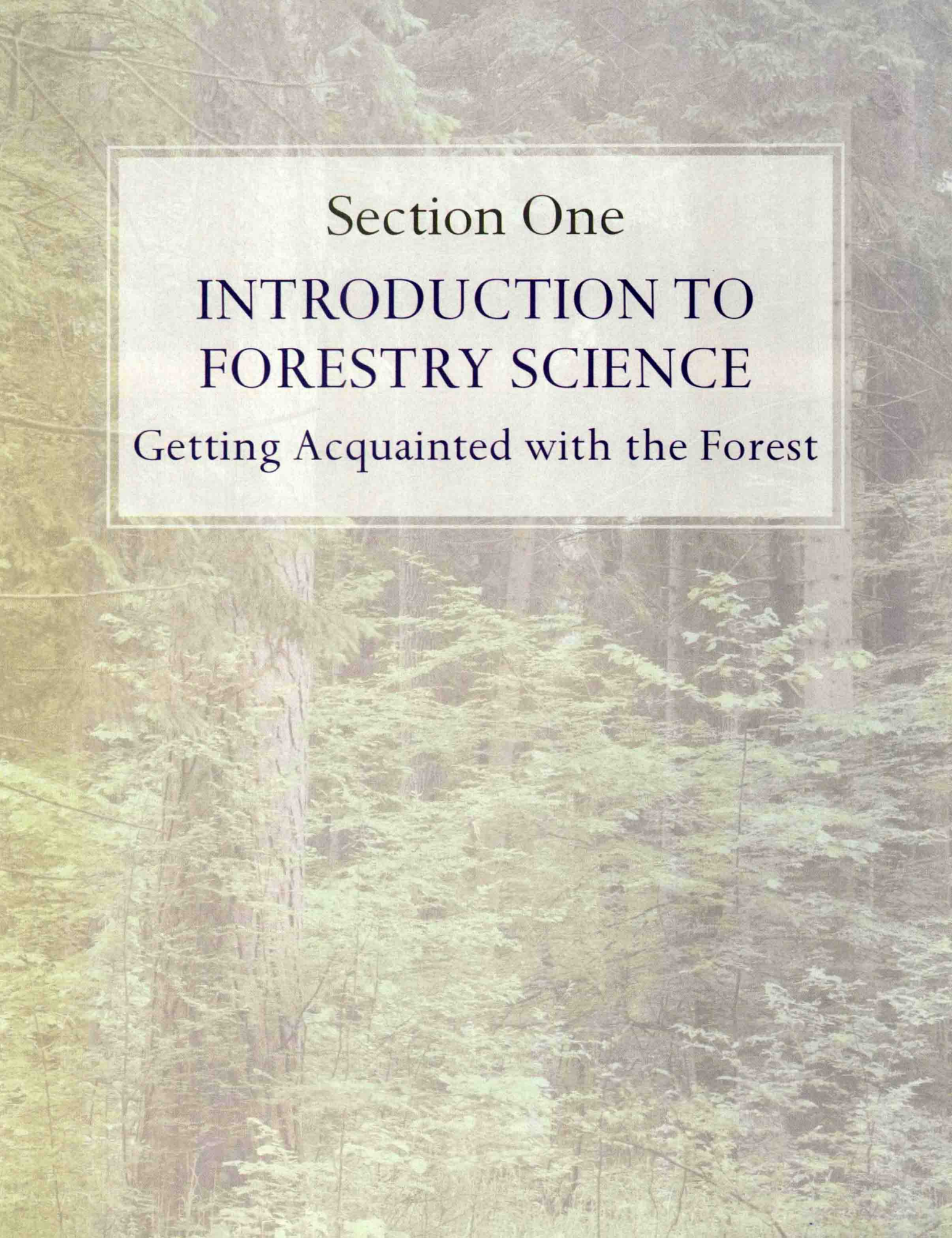
Section Six
DENDROLOGY: THE SCIENTIFIC STUDY OF TREES

Section Seven
TREES OF THE FOREST



Section One

INTRODUCTION TO FORESTRY SCIENCE

Getting Acquainted with the Forest



Chapter 1

INTRODUCTION TO FORESTRY

KEY TERMS

forestry
forest
monoculture
biodiversity
strata
canopy
understory
shrub
shrub layer
herb layer
forest floor
biological value
transpiration
watershed
renewable resource
nonrenewable resource
gross domestic product (GDP)
coke
particulate matter
biomass
short-rotation woody crops (SRWC)
short-rotation intensive culture (SRIC)
multiple use
riparian zone
silt
silt load

OBJECTIVES

After completing this chapter, you should be able to

- identify important forest products that contribute to the comfort and health of people and to the economies of nations
- describe the kinds of plants that compose the vegetative strata found in a forest environment
- list the major life forms that contribute to the biological value of a forest
- suggest some natural functions of a forest that affect its biological value
- describe how a watershed functions and explain why a forested watershed is superior to a watershed that lacks forest plant cover
- identify ways that forest environments contribute to stable populations of wild animals
- distinguish between renewable resources and nonrenewable resources
- account for the major uses of forest resources in the United States
- list ways that forest products such as wood and other biomass materials are used as sources of energy
- explain the multiple-use concept of management for public lands

MANAGEMENT OF THE FOREST ecosystem is a complicated and controversial profession in our politically charged world (Figures 1–1 and 1–2). The social and political sciences have become as important in forest management as the biological sciences that are the basis for modern forest management practices. Biological, political, and social sciences along with business and management skills contribute to the field of study known as **forestry**.

IMPORTANCE OF FORESTS

Thirty percent of the land area in the world is forest land, and forest products are very important to the economies of the developed countries of the world. The importance of the forests of North America and the world goes far beyond the production of wood products such as paper, cardboard, lumber, plywood, and structural beams. Forests also provide solvents, medicines, fuels, and many other products that are important for our health and comfort (Figure 1–3). Forests and other forms of plant life restore oxygen in our atmosphere through photosynthesis. Forests function as huge biological filter systems that clean the environment by removing impurities from air and water. They also function in the elemental cycles and in the water cycle.

Biological Value of Forests

A **forest** consists of an area where trees are the most dominant living organisms. The kinds of trees that are found in forests sometimes consist of a single species. Such a forest is described by the term **monoculture** (Figure 1–4). A forest that is made up of more than one kind of tree is an example of **biodiversity** (Figure 1–5). Forest environments also include many plants other than trees. Several layers of vegetation called **strata** are found in a forest (Figure 1–6). The tall broadleaf trees form the ceiling or **canopy** at the highest levels. The area beneath the canopy is filled in with smaller trees that make up the **understory** of the forest. Small woody plants called **shrubs** often inhabit the lower strata of a forest. This layer of the forest strata is called the **shrub layer**. The shortest plants—such as ferns, grasses, and flowering plants—are collectively called the

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Figure 1–1 Most Americans believe that it is important to manage forests in ways that will ensure their availability to future generations.

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Figure 1–2 Forest management has become much more difficult in recent years as a result of conflicts over appropriate uses of forest resources.