

Contents

Preface	v
Dedication	xiii

Chapter 1. Dendrochronology and Dendroclimatology

I. Introduction	1
II. Historical Background	4
III. Scope of Dendrochronology	10
IV. Some Basic Principles and Concepts of Dendrochronology	14
V. Dendroclimatic Procedures and Analyses	28
VI. Examples of Analysis	38
VII. Further Definitions and Concepts	46
VIII. The Climate–Growth System and its Dendroclimato- logical Significance	52

Chapter 2. Growth and Structure

I. Introduction	55
II. Gross Structure	56
III. The Vascular Cambium	63
IV. Growth—A Variable Process	68
V. Variations in Shoot Growth	70
VI. Variations in Radial Growth	74
VII. Phenology and its Relation to Ring Growth	103
VIII. Systematic Variations in the Width and Cell Structure of Annual Rings	107
IX. Growth of Roots	113
X. Significance of Growth and Structure to Dendro- climatology	115

Chapter 3. Basic Physiological Processes: Movement of Materials and Water Relations

I. Limiting Factors and Plant Processes	118
II. Some General Terms and Basic Concepts	120
III. Cell Water Status	123
IV. Transpiration	127
V. Soil Moisture	133
VI. The Soil System and Factors Affecting its Development .	136
VII. Absorption of Water	140
VIII. Internal Water Relations of Trees	142
IX. Moisture Stress and Tree Form	147
X. Soil Factors Affecting Root Growth, Ring-width Sensitivity, and Longevity	148
XI. Uptake of Mineral Salts	151
XII. Translocation	152

Chapter 4. Basic Physiological Processes: Food Synthesis and Assimilation of Cell Constituents

I. Introduction	156
II. Photosynthesis and Respiration	157
III. Synthesis of Foods and Assimilation	159
IV. Measurement of Photosynthesis and Respiration . . .	162
V. Factors Affecting Photosynthesis and Respiration . . .	163
VI. The Annual Net Photosynthetic Regime for a <i>Pinus</i> <i>Ponderosa</i> on a Semiarid site	178
VII. Some Implications of these Physiological Measurements .	182
VIII. The Distribution of Foods and Interactions with Growth	184
IX. Essential Mineral Salts	189
X. Growth-regulating Substances	190
XI. Physiological Preconditioning and Correlating Systems .	193
XII. Changes in the Physiological Seasons with Varying Elevation of the Tree Sites	202

Chapter 5. The Climate-Growth System

I. Introduction	207
II. The Energy and Water Balances	208
III. Site Factors which can Modify the Energy Balance . .	213

IV. Biotic and Other Nonclimatic Factors: Dendrochronological Examples	219
V. Modeling Relationships in the Ring-width and Climatic System	223
VI. A Model for Factors Affecting Cambial Activity and hence Ring Width	226
VII. Modeling the Effects of Temperature and Precipitation on Ring Width	231
VIII. The Concept of the Climatic "Window"	238
IX. The Concept of the Response Function	240
X. Suitability and Limitations of the Growth Model	242

Chapter 6. The Statistics of Ring-Width and Climatic Data

I. Reliability of Measurements	246
II. General Statistics	254
III. Standardization	261
IV. Filtering Techniques	268
V. Other Methods for Assessing the Growth Curves	277
VI. Analysis of Variance	282
VII. Analysis of Chronology Error.	290
VIII. Correlation Analysis	293
IX. Power Spectrum and Cross-Power Spectrum Analyses	295
X. Variability in Statistical Characteristics of Ring Widths Among Sites	300
XI. Statistical Characteristics of Ring Widths Within a Tree.	304

Chapter 7. Calibration

I. Introduction	312
II. The Procedure of Calibration	313
III. The Role of Statistics and Sample Size	321
IV. Degrees of Freedom and the Effective Sample Size	323
V. Selecting the Statistical Model	325
VI. The Diversity in Variable Selection	327
VII. Testing the Association between Variables	329
VIII. Multivariate Techniques	340

Chapter 8. Interpretation of Climatic Calibrations, Reconstruction, and Verification

I. Introduction	376
II. Response Functions	377
III. Strengths and Weaknesses of Response Function Analysis	400
IV. Significance of Response Function Capability.	401
V. Assessing Effects on Growth of Varying Climate	402
VI. Climatic Reconstruction and Verification	405
VII. Inferences from Chronologies with Different Growth Responses	407
VIII. Reconstruction Using Multivariate Transfer Functions	412

Chapter 9. Reconstructing Spatial Variations in Climate

I. Introduction	434
II. The General Nature of Dendroclimatographic Analysis	437
III. The Statistical Model	438
IV. A Feasibility Study	439
V. Recalibration	450
VI. Climatological Studies	455
VII. Summarization of Reconstructions for Winter Using the Pressure Types	470
VIII. Verification of Reconstructions for Winter	476
IX. Summarization of Reconstructions for Summer using the Pressure Types	488
X. Verification of Reconstructions for Summer Using Independent Tree-ring Data	491
XI. Verification Using Journals, Historical Data, and Various Proxy Records of Climate	499
XII. Applications to Climatological Problems	500
XIII. Present and Future Prospects of Dendroclimatology	503

Appendix—Scientific and Common Names of Trees	507
Bibliography	511
Glossary	530
Author Index	547
Subject Index	553