

Contents

List of Figures	xiii
List of Tables	xvii
Preface	xix
Acknowledgments	xxi
List of Abbreviations	xxiii

1	Introduction	1
	Some Interesting Applications of Dendrochronology	1
	Some Basic Principles and Definitions in Dendrochronology	2
	Subfields of Dendrochronology	4
	Limitations of Dendrochronology	4
	Objective	8
	Summary	8
2	Some Basic Principles and Concepts in Dendrochronology	10
	Principle of Uniformitarianism	10
	Principle of Crossdating	11
	Principle of Limiting Factors	15
	Principle of the Aggregate Tree Growth Model	17
	Concept of Autocorrelation	18
	Concept of the Ecological Amplitude	20
	Principle of Site Selection	21
	Principle of Replication	23
	Concept of Standardization	23
	Summary	27
3	History of Dendrochronology	28
	The Early Years	28
	The 1700s and the 1709 Frost Ring	28
	The 1800s: Tree Rings Become Common Knowledge	32
	The Early 1900s, Douglass, and Huber	37
	The Modern Era and International Organization	40
	Summary	41

4	Growth and Structure of Wood	43
	Tree Physiology	43
	Basic Wood Structure	44
	Cell Features and Types	45
	Forms of Wood Structure	45
	Reaction Wood	46
	Growth Initiation and Absent Rings	46
	Growth Throughout the Year	47
	Ring Anomalies	47
	Summary	49
5	Field and Laboratory Methods	72
	Gear	72
	Field Methods	75
	Site Selection	75
	Random Versus Targeted Sampling	76
	Plots, Transects, or Targeted Sampling	76
	Coring a Tree	77
	Testing for a Compressed Core	79
	Taking and Packaging a Core	80
	Removing an Increment Borer from the Tree	80
	Spanish Windlass Technique for Retrieving a Stuck Borer	82
	Cleaning an Increment Borer	83
	Sharpening an Increment Borer	84
	Laboratory Methods	87
	Preparing Core Samples	88
	Mounting Cores	88
	Untwisting Cores	88
	Sanding Cores	92
	Preparing Cross Sections	94
	Analysis of Cores and Cross Sections	96
	Skeleton Plotting	96
	List Method	100
	Memorization Method	101
	Combining Dating Methods	101
	Measuring Methods	101
	Measuring Systems	102
	Measuring Rings	104
	Pith Indicators	104
	Work Time Distribution	104
	Summary	105
6	Computer Programs and Statistical Methods	106
	Statistics in Dendrochronology	107
	Series Intercorrelation	107

Mean Sensitivity	107
Gleichläufigkeit (Sign Test)	107
Running \bar{r}	109
Expressed Population Signal	109
Subsample Signal Strength	109
Measuring Programs	110
MeasureJ2X	110
Keystroke Tutorial for MeasureJ2X	111
Dendrochronology Program Library	113
FMT	113
COFECHA	115
Keystroke Tutorial of COFECHA	117
Reading the Output of COFECHA	119
Conclusions on COFECHA	133
EDRM	133
ARSTAN	133
Keystroke Tutorial for ARSTAN for Windows	140
Reading the Output of ARSTAN	141
Regional Curve Standardization	141
YUX	143
Climate Analysis Packages	143
PRECON	145
DENDROCLIM 2002	146
OUTBREAK	148
Spectral Analysis	149
EVENT	149
Conclusion	151
7 Dendroarchaeology	152
Archaeological Methods	154
Sample Collection	154
Chronologies Used in Dendroarchaeology	161
Applications of Dendrochronology to Archaeology	162
Construction Dates	165
Dating Artifacts	167
Climate Reconstructions	167
Ecological Reconstructions and Anthropogenic Ecology	169
Fire in the Southwestern United States	170
Fire in the Eastern United States	170
Culturally Modified Trees	170
Insect Outbreaks	172
Mast	172
Dendrogeomorphology in Archaeology	172
Future of Dendroarchaeology	173

8	Dendroclimatology	174
	Methods of Dendroclimatology	175
	Applications of Dendroclimatology	178
	Climate Indices	180
	Climatic Gradient Studies	182
	Latitudinal Gradient	182
	Treeline Studies	182
	Dendrohydrology: Water Table Height and Flood Events	184
	Segment-Length Curve	187
	Archaeological Uses of Climate Reconstructions	187
	Use of Climate Reconstructions for Future Prediction	188
9	Dendroecology	189
	Methods of Dendroecology	189
	Stand-Age Structure	189
	Ring-Width Analysis	190
	Tree Scars	191
	Basal Area Increment	191
	Applications of Dendroecology	191
	Gap-Phase Dynamics	191
	Forest Productivity and Succession	192
	Old Forests	193
	Dendropyrochronology	194
	Surface Fire	195
	Stand-Replacing Fire	199
	Ground Fire	200
	Seasonal Resolution of Fire Scars	201
	Fire in the Southwestern United States	201
	Fire in Scandinavia	201
	Fire in Canada	204
	Dendroentomology	205
	Stem Analysis	209
	Conclusions on Dendroentomology	211
	Wildlife Populations and Herbivory	213
	Distributional Limits of Species	215
	Treeline and Subarctic Studies	216
	Interactions of Multiple Disturbances	216
	Other Applications of Dendroecology	217
	Conclusion	218
10	Dendrogeomorphology	219
	Sources of information	221
	Reaction Wood	221
	Death Dates	222
	Establishment Dates	222

Wound Events	223
Coarse Woody Debris	224
Roots	224
Subfields of Dendrogeomorphology	224
Dendrovolcanology	224
Dendroglaciology	226
Mass Movement	227
Dendroseismology: Plate Boundaries, Faults, and Earthquakes	228
Limitations of Dendrogeomorphology	230
Conclusion	230
11 Dendrochemistry	231
Methods of Elemental Analysis	231
Radial Translocation	233
Other Confounding Factors	234
Event Reconstructions	234
Elements That Are Useful in Dendrochemistry	235
Conclusions on Dendrochemistry	235
Radiometric Isotopes	235
Stable Isotopes	236
Limitations	243
Standard Procedures	244
Fractionation	245
Other Usable Elements	248
Conclusion	249
12 Frontiers in Dendrochronology	250
Stable Isotopes	251
Multiple Proxies	251
Image Analysis of Reflected Light	252
Wood Anatomy	252
Tropical Dendrochronology	253
Unique Environments	255
Sclerochronology	256
Conclusion	256
Appendix A. Tree and Shrub Species That Have Been Used by Dendrochronologists	257
Appendix B. Age of the Oldest Trees per Species	275
Appendix C. Pith Indicators	283
Appendix D. Field Note Cards	285
Appendix E. Web Resources	289
References	291
Index	325