

CONTENTS

<i>Preface</i>	<i>page</i> xi
<i>Acknowledgements</i>	xiii
1 Introduction	1
The tropical rain forest	1
Tropical trees	2
Species	2
Tropical rain-forest diversity	6
Adaptation	9
The importance of phylogeny	10
The ecological classification of tropical rain-forest trees	13
2 The growing tree	15
Trees: form, mechanics and hydraulics	15
Tree stature	15
Wood	18
Tropical timber	21
The mechanical design of trees	24
Buttresses	28
Leaning trees	34
Tree fall	35
Sap ascent	35
Tree hydraulics	37
Tree architecture	40
Allometry	41
Bark	46
Roots	46
Root hemi-parasites	48

viii	Contents	
	Mineral nutrition	50
	Mycorrhizas	52
	Nitrogen fixation	56
	Other methods of obtaining extra nutrients	57
	Comparative use of nutrients	58
	Element accumulation	60
	Leaf form and physiology	60
	Size, shape and other structural characteristics	62
	Leaf protection	67
	The defences of tropical forest trees	69
	Classification of plant defences	81
	Foliar bacterial nodules	82
	Leaf development: coloured young leaves	83
	Leaf longevity	86
	The influence of shade	90
	High light conditions	94
	Other factors influencing leaf performance	95
	Species groups based on leaf characteristics	96
3	Tree performance	103
	Age, size and growth in tropical rain-forest trees	103
	The dynamics of tree populations in the rain forest	105
	Mortality in trees	105
	Tree growth in the forest	108
	Tree performance in relation to light climate	111
	Mortality, growth and adult size	114
	The use of growth and mortality data to recognise species groups	116
	Relative performance of species of similar life history	118
	What limits tree growth?	119
	Herbivory	121
4	Reproductive biology	122
	Reproduction	122
	Vegetative reproduction	122
	Sexual systems	123
	Genetic diversity	125
	When to flower?	127
	Pollination	130
	Pollination syndromes	131
	Tropical flowers	144

Contents	ix
Relative importance of different pollinators	145
Figs	146
Dispersal mechanisms	147
Autochory	147
Anemochory	148
Hydrochory	149
Zoochory	150
Dispersal syndromes	155
Secondary dispersal	162
Efficacy of seed dispersal	163
Clumped or scattered seed distributions	168
Seed survival	168
Tests of the escape hypothesis	171
Other advantages of dispersal	176
The search for the Janzen–Connell effect	177
Co-evolution	178
5 Seeds and seedlings	180
Seeds	180
Seed size	180
Seed rain and the soil seed bank	186
Seed germination	188
Other influences on seedling establishment	194
Germination safe sites	194
Seedlings	194
Seedling and sapling form	195
Seedling dependence on seed reserves	197
Seedling mortality	199
Growth and survival with respect to light	204
Seedling responses to shade	208
Seedling shade tolerance	211
The traits of shade tolerance	213
On being light-demanding	216
The relevance of shade tolerance	216
Sudden changes in light availability	218
Water	220
Mineral nutrients	221
Defence in juveniles	224
6 Classificatory systems for tropical trees	227
Height at maturity	227

x	Contents	
	The pioneer–climax dichotomy	233
	Diagnostic characters	234
	Reproduction	236
	Demography	237
	Growth and form	238
	Physiology	241
	General	242
	Conclusion	243
	Combining the two axes	244
	Long-lived pioneers or late-secondary species	245
	Parallels between pioneers and shade-tolerant understorey species	246
	Where does this leave us?	247
	<i>References</i>	248
	<i>Index of scientific names of plants</i>	281
	<i>Index of scientific names of animals</i>	288
	<i>General index</i>	290