## Spatial Pattern Analysis in Plant Ecology

MARK R.T. DALE University of Alberta, Edmonton, Canada



## Contents

Preface		page ix
1	Concepts of spatial pattern	1
	Introduction	1
	Pattern and process	1
	Causes of spatial pattern and its development	6
	Concepts of spatial pattern	12
	Concluding remarks	29
2	Sampling	31.
	Introduction	31
	Sampling for pattern in a fixed frame of reference	32
	Sampling for pattern relative to other plants	45
	Location of sampling	48
	Concluding remarks	49
3	Basic methods for one dimension and one	
	species	50
	Introduction	50
	Data	50
	Blocked quadrat variance	56
	Local quadrat variances	58
	Paired quadrat variance	71
	New local variance	78
	Combined analysis	83
	Semivariogram and fractal dimension	90
	Spectral analysis	91
	Other methods	95
	Concluding remarks	98

V1	Contents

4	Spatial pattern of two species	100
	Introduction	100
	At most one species per point	101
	Several species per point	103
	Blocked quadrat covariance (BQC)	104
	Paired quadrat covariance (PQC) and conditional probability	106
	Two- and three-term local quadrat covariance (TTLQC	
	and 3TLQC)	113
	Comparison of methods	116
	Extensions of covariance analysis	120
	Other approaches	121
	Relative pattern: species association	123
	Concluding remarks	124
5	Multispecies pattern	125
	Introduction	125
	Multiscale ordination	128
	Semivariogram and fractal dimension	136
	Methods based on correspondence analysis	137
	Euclidean distance	139
	Comments	142
	Spectral analysis	143
	Other field results	143
	Species associations	147
	Concluding remarks	165
6	Two-dimensional analysis of spatial pattern	168
	Introduction	168
	Blocked quadrat variance	169
	Spatial autocorrelation and paired quadrat variance	169
	Two-dimensional spectral analysis	174
	Two-dimensional local quadrat variances	177
	Four-term local quadrat variance	178
	Random paired quadrat frequency	186
	Variogram	190
	Covariation	192
	Paired quadrat covariance (PQC)	193
	Four-term local quadrat covariance	195
	Plant-environment correlation	198
	Cross-variogram	198
	Landscape metrics	200

	Other methods	202
	Concluding remarks	204
7	Point patterns	206
	Introduction	206
	Univariate point patterns	207
	Anisotropy	227
	Bivariate point patterns	231
	Multispecies point pattern and quantitative attributes	237
	Concluding remarks	241
8	Pattern on an environmental gradient	242
	Introduction	242
	Continuous presence/absence data	248
	Quadrats: presence/absence data	270
	Density data	272
	Concluding remarks	. 275
9	Conclusions and future directions	277
	Summary of recommendations	277
	What next?	279
	Three dimensions	279
	Relation to spatial structure of physical factors	286
	Obvious extensions	288
	Temporal aspects of spatial pattern analysis	288
	Wavelets ,	290
	Questions and hypotheses	293
	Concluding remarks	296
Bi	bliography	297
	Glossary of abbreviations	
List of plant species		319
Index		325

Contents · vii