

CONTENTS

ACKNOWLEDGEMENTS	13
I INTRODUCTION	15
I.1 Research background and objectives of this study	15
I.1.1 More than just Hudson Bay!	15
I.1.2 Climate-culture interaction	15
I.2 Study area	15
I.3 Thesis outline	16
I.4 Time-scales, terminology, dating precision	16
PART 1 DEFINITIONS AND FOUNDATIONS	19
II WHAT IS RAPID CLIMATE CHANGE?	20
II.1 Climate systems	20
II.1.1 Winter	20
II.1.1.1 North Atlantic Oscillation	20
II.1.1.2 Mediterranean Lows	21
II.1.1.3 Siberian High	22
II.1.1.4 Red Sea Trough	22
II.1.1.5 Monsoon	23
II.1.2 Summer	23
II.1.2.1 Persian Trough	23
II.1.2.2 Etesian winds	24
II.2 Early Holocene	24
II.2.1 Levantine Moist Period	24
II.2.1.1 Dead Sea	24
II.2.1.2 Sapropel (S1a)	28
II.2.1.2.1 Nile discharge	28
II.2.1.2.2 Enhanced Eastern Mediterranean precipitation	29
II.2.2 Perturbation Period	31
II.2.2.1 The 8.2 ka calBP (Hudson Bay) event	31
II.2.2.1.1 Evidence for the 8.2 ka calBP event in the Eastern Mediterranean	32
II.2.3 Late Pluvial Period	34
II.3 Rapid Climate Change (RCC)	34
II.3.1 Mechanism	35
II.3.2 Intervals	36
II.3.3 Impacts	37
II.3.3.1 Little Ice Age (AD 1400–1900)	37
II.3.3.1.1 Aegean and Anatolia	37
II.3.3.1.2 Levant	43
II.3.3.2 RCC (8600–8000 calBP)	43
II.3.3.2.1 Speleothems	44
II.3.3.2.2 Palynological data	44
II.3.3.2.3 Solar variability	44
II.3.3.2.4 Dead Sea	45
II.4 Summary	45
III CLIMATE AND CULTURE CHANGE	48
III.1 Introduction	48
III.2 Climate-culture interaction	48
III.2.1 A question of timescales	49
III.2.2 Complexity and non-linear dynamics	49
III.2.2.1 Resilience in complex systems	50
III.2.2.2 Self-organisation in complex systems	50
III.2.3 Preliminary conclusions	50
III.3 Adaptive cycles	51

III.4	Vulnerability	52
III.4.1	Biophysical vulnerability	52
III.4.2	Social vulnerability	53
III.4.2.1	Pressure and release	53
III.4.2.2	Architecture of entitlement	54
III.5	Vulnerability in the context of adaptive cycles	55
III.5.1	α -phase – reorganisation	55
III.5.2	r-phase – growth/interaction	56
III.5.3	K-phase – specialisation/rigidity	56
III.5.4	Ω -phase – decline	56
III.5.5	Insights and implications	56
III.6	Reciprocal dynamics of natural and social processes	57
III.6.1	Identifying hazards	57
III.6.1.1	Famine	57
III.6.1.2	Epidemics	58
III.6.1.3	Cold-related deaths	59
III.6.1.4	Case study: Central Anatolia (AD 1873–1875)	59
III.6.2	Buffering mechanisms	60
III.6.2.1	Kel Ewey Tuareg	61
III.6.2.1.1	Economy	61
III.6.2.1.2	A definition of drought	62
III.6.2.1.3	Strategies and responses	63
III.6.2.2	Religion and ritual	65
III.6.3	Archaeological sources	65
III.6.3.1	Diversification	66
III.6.3.2	Mobility	66
III.6.3.3	Storage	66
III.6.3.4	Feasting	66
III.6.3.5	Conflict	67
PART 2	CASE STUDIES	69
IV	SOUTHERN LEVANT	70
IV.1	Introduction	70
IV.2	Geography and climate	70
IV.2.1	Western Israel/Palestine (Zone 1)	71
IV.2.2	Northern Transjordanian highlands (Zone 2)	71
IV.2.3	Central and southern Transjordanian highlands (Zone 3)	72
IV.2.4	Lower Jordan Valley and Negev (Zone 4)	72
IV.2.5	Eastern Desert (Zone 5)	73
IV.3	Chronological framework	73
IV.3.1	Late Pre-Pottery Neolithic B (LPPNB)	73
IV.3.2	Final Pre-Pottery Neolithic B (FPPNB)/Pre-Pottery Neolithic C (PPNC)	74
IV.3.3	Pottery Neolithic/Late Neolithic (LN)	74
IV.3.4	Early Chalcolithic (ECh)/Middle Chalcolithic (MCh)	75
IV.4	Absolute chronology	75
IV.4.1	Late Pre-Pottery Neolithic	75
IV.4.2	Pottery Neolithic/Late Neolithic	76
IV.4.2.1	Post-Yarmoukian hiatus?	76
IV.4.2.2	Chalcolithic recovery	80
IV.4.2.3	Summary	80
IV.5	Settlement patterns	80
IV.5.1	Non-standardised settlement data	83
IV.5.2	Standardised settlement data	84
IV.5.3	Western Israel/Palestine (Zone 1)	84
IV.5.3.1	Late Pre-Pottery Neolithic B	84
IV.5.3.2	Pre-Pottery Neolithic C	84
IV.5.3.3	Pottery Neolithic	85
IV.5.3.4	Early Chalcolithic and Middle Chalcolithic	92

IV.5.4	Northern Transjordanian highlands (Zone 2)	92
IV.5.4.1	Late Pre-Pottery Neolithic B	92
IV.5.4.2	Pre-Pottery Neolithic C	95
IV.5.4.3	Pottery Neolithic	96
IV.5.4.4	Early Chalcolithic	98
IV.5.5	Central and southern Transjordanian highlands (Zone 3)	99
IV.5.5.1	Late Pre-Pottery Neolithic B	99
IV.5.5.2	Final-Pre-Pottery Neolithic B	100
IV.5.5.3	Pottery Neolithic	100
IV.5.5.4	Early Chalcolithic and Middle Chalcolithic	101
IV.5.6	Lower Jordan Valley and Negev (Zone 4)	101
IV.5.6.1	Late Pre-Pottery Neolithic B	101
IV.5.6.2	Late Pre-Pottery Neolithic B/Pre-Pottery Neolithic C	101
IV.5.6.3	Pottery Neolithic	101
IV.5.6.4	Early Chalcolithic and Middle Chalcolithic	105
IV.5.7	Eastern Desert (Zone 5)	105
IV.5.7.1	Late Pre-Pottery Neolithic B	105
IV.5.7.2	Final Pre-Pottery Neolithic B/Pre-Pottery Neolithic C	105
IV.5.7.3	Pottery Neolithic	105
IV.5.7.4	Early Chalcolithic and Middle Chalcolithic	107
IV.5.8	Summary	107
IV.5.8.1	Late Pre-Pottery Neolithic B	107
IV.5.8.2	Final Pre-Pottery Neolithic B/Pre-Pottery Neolithic C	111
IV.5.8.3	Pottery Neolithic	111
IV.5.8.4	Early Chalcolithic and Middle Chalcolithic	111
IV.6	Animal subsistence	112
IV.6.1	Faunal data	113
IV.6.1.1	Late Pre-Pottery Neolithic B	113
IV.6.1.1.1	First appearance of domestic sheep (<i>Ovis aries</i>)	113
IV.6.1.1.2	Transjordanian highlands: Domestic cattle and wild boar	116
IV.6.1.1.3	Enduring significance of hunting	117
IV.6.1.1.4	Hunters in the Eastern Desert	117
IV.6.1.2	Final Pre-Pottery Neolithic B/Pre-Pottery Neolithic C	117
IV.6.1.2.1	Dispersal of domestic cattle	117
IV.6.1.2.2	Suids in the Hula basin	118
IV.6.1.2.3	Increase of domestic sheep (Transjordan)	119
IV.6.1.3	Pottery Neolithic	119
IV.6.1.3.1	Ovicaprines prevalence	119
IV.6.1.3.2	Decline in hunting, rise of pastoralism?	119
IV.6.1.3.3	Specialist hunting sites	119
IV.6.1.3.4	Consolidation of domestic cattle breeding	120
IV.6.1.3.5	Earliest pig domestication	121
IV.6.1.3.6	Equids	121
IV.6.1.3.7	PN diachronic trends – Yarmoukian sheep and Jericho IX goat	121
IV.6.1.4	Early Chalcolithic and Middle Chalcolithic	121
IV.6.1.4.1	Full domestic animal repertoire	121
IV.6.1.5	Summary	122
IV.6.1.5.1	Late Pre-Pottery Neolithic B	122
IV.6.1.5.2	Final Pre-Pottery Neolithic B/Pre-Pottery Neolithic C	124
IV.6.1.5.3	Pottery Neolithic	124
IV.6.1.5.4	Early Chalcolithic and Middle Chalcolithic	124
IV.6.1.5.5	Negev	125
IV.7	Religion and ritual	126
IV.7.1	Diachronic comparisons	126
IV.7.1.1	Late Pre-Pottery Neolithic B	126
IV.7.1.2	Final Pre-Pottery Neolithic B/Pre-Pottery Neolithic C	126
IV.7.1.3	Pottery Neolithic (Yarmoukian)	127
IV.7.1.4	Pottery Neolithic (Jericho IX/Lodian, Nizzanim)	128
IV.7.1.5	Early Chalcolithic (Wadi Rabah)	128
IV.7.2	Rainmaking ceremonies	128
IV.7.2.1	Ethnographic evidence	128
IV.7.2.1.1	Anatolia	128
IV.7.2.1.2	Iran	129

IV.7.2.2	Archaeological evidence	129
IV.7.2.2.1	Insights from evolutionary psychology	129
IV.7.2.2.2	Material symbolism	130
IV.7.2.2.3	Animal imagery	132
IV.7.2.2.4	Feasting	133
IV.7.2.2.5	Music, dance and song	134
IV.7.3	Summary	135
IV.8	Vulnerability of southern Levantine Neolithic systems to RCC: A discussion	136
IV.8.1	Adaptive cycles and the late Neolithic of the southern Levant	136
IV.8.2	Vulnerability assessment	139
IV.8.2.1	Late Pre-Pottery Neolithic B/Pre-Pottery Neolithic C (9300–8600 calBP)	139
IV.8.2.2	Pottery Neolithic (8600–7600 calBP)	142
IV.8.2.2.1	Late Yarmoukian Crisis	147
IV.8.2.2.2	Late Yarmoukian refuge at Nahal Qanah cave?	151
IV.8.2.2.3	Social vulnerability in the Pottery Neolithic	152
IV.8.2.3	Early/Middle Chalcolithic (7600–7000 calBP)	153
IV.8.3	Late Neolithic ‘Rubble Layers’	153
IV.8.3.1	RCC-hypothesis	154
IV.8.3.2	Results from ‘Ain Ghazal’	156
IV.8.3.2.1	Section 1 (S1)	156
IV.8.3.3	Results from Basta and Ba’ja	159
IV.8.3.4	Summary	162
V	ANATOLIA	163
V.1	Introduction	163
V.2	Geography and climate	163
V.2.1	Inner Anatolia	164
V.2.1.1	Konya Plain	166
V.2.1.2	South-western Cappadocia	167
V.2.2	Lakes District (Pisidia)	167
V.2.3	Aegean	167
V.2.4	Marmara	168
V.3	RCC in Anatolia	169
V.3.1	Palaeoclimate data	169
V.3.1.1	Konya Plain	169
V.4	Chronological framework	171
V.4.1	Key sites and absolute chronology	171
V.4.1.1	Key sites: Pre-Pottery Neolithic	171
V.4.1.1.1	Aşıklı Höyük	171
V.4.1.1.2	Boncuklu Höyük	171
V.4.1.1.3	Can Hasan III	172
V.4.1.1.4	Çatalhöyük East	172
V.4.1.1.5	Kaletepe	173
V.4.1.1.6	Musular	173
V.4.1.1.7	Suberde	173
V.4.1.2	Key sites: Early Pottery Neolithic	173
V.4.1.3	Key sites: Late Neolithic	174
V.4.1.3.1	Can Hasan I	174
V.4.1.3.2	Pınarbaşı Site B	174
V.4.1.3.3	Tepecik-Çiftlik	175
V.4.1.3.4	Bademağacı Höyük	176
V.4.1.3.5	Erbaba	176
V.4.1.3.6	Hacılar	176
V.4.1.3.7	Höyücek	176
V.4.1.3.8	Kuruçay Höyük	176
V.4.1.3.9	Çukuriçi Höyük	177
V.4.1.3.10	Ege Gübre	177
V.4.1.3.11	Hoca Çeşme	177
V.4.1.3.12	Ulucak Höyük	177
V.4.1.3.13	Yeşilova Höyük	178
V.4.1.4	Key sites: Early Chalcolithic	178
V.4.1.4.1	Çatalhöyük West	178

V.4.1.5	Key sites: Fikirtepe culture	179
V.4.1.5.1	Aktopraklık C	179
V.4.1.5.2	Menteşe	180
V.4.1.5.3	Ilıpınar	180
V.4.1.6	Absolute chronologies	180
V.4.1.6.1	Pre-Pottery Neolithic (10200–9000 calBP)	180
V.4.1.6.2	Early Pottery Neolithic (9000–8600 calBP)	182
V.4.1.6.3	Late Neolithic (8600–8000 calBP)	185
V.4.1.6.4	Early Chalcolithic (8000–7500 calBP)	187
V.4.1.6.5	Fikirtepe culture (8400–7500 calBP)	187
V.5	Adaptive cycles in Neolithic Anatolia	187
V.5.1	Pre-Pottery Neolithic	188
V.5.2	Early Pottery Neolithic	190
V.5.3	Late Neolithic	191
V.5.4	Early Chalcolithic	191
V.6	Assessing vulnerability at Çatalhöyük	191
V.6.1	RCC at Çatalhöyük (8.6–8.2 ka calBP)	192
V.6.1.1	Sheep herders and hunters	192
V.6.1.2	Cooking wares	193
V.6.1.3	Open space and ‘discrete structures’	193
V.6.1.4	Obsidian and its specialists	194
V.6.2	LN–ECh transition (8.2–8.0 ka calBP)	194
V.6.2.1	More goats?	194
V.6.2.2	Elaborate pottery and modest homes	194
V.6.3	Summary	195
V.6.3.1	Goats, secondary products and hunting (biophysical vulnerability)	196
V.6.3.2	Households and specialists (social vulnerability)	196
V.6.3.3	Continuity and discontinuity	197
V.7	Climate-induced conflicts in the Anatolian Neolithic	197
V.7.1	Neolithic conflict	197
V.7.1.1	Conflict and Neolithisation	197
V.7.1.2	Conflict and LN dispersal	198
V.7.1.2.1	Territoriality	199
V.7.1.2.2	Politically motivated expansion	200
V.7.2	Conclusions	200
V.8	Reorganisation as adaptation: RCC and its role in Neolithisation of southwestern and western Anatolia	201
V.8.1	Increased mobility	201
V.8.1.1	‘Head for the coast!’	201
V.8.1.2	Colonists, outcasts or refugees?	203
V.8.2	Implications in the ‘core area’	203
V.8.2.1	Late Neolithic crisis (6300–6000 calBC)	204
V.8.2.1.1	Shifts and desertions	204
V.8.2.1.2	Social tensions	204
V.8.2.1.3	Delayed dispersals	204
PART 3	NEW INSIGHTS	207
VI	Summary and conclusions	208
VI.1	Early Holocene climate	208
VI.1.1	Levantine Moist Period	208
VI.1.2	Perturbation Period (RCC and 8.2 ka calBP event)	208
VI.2	Assessing vulnerability of Neolithic communities to RCC	209
VI.2.1	RCC–chronologies	210
VI.2.2	Scenarios	211
VI.3	Final remarks	212
APPENDIX	List of abbreviations	213
	Radiocarbon ages	214
REFERENCES	233