

CONTENTS

Preface	xi
1 Models of age-structured populations	1
1.1 Introduction	1
1.2 The description of age-structured populations	3
1.2.1 <i>Populations with discrete age-classes</i>	3
1.2.2 <i>Continuous-time populations</i>	12
1.2.3 <i>The estimation of demographic parameters</i>	16
1.3 Time-independent and density-independent demographic parameters	23
1.3.1 <i>The dynamics of the population process for the female population</i>	24
1.3.2 <i>Populations with stable age-distributions</i>	31
1.3.3 <i>The dynamics of the population process for more complex types of population</i>	45
1.4 Time-dependent and density-dependent demographic parameters	47
1.4.1 <i>Time-dependent demographic parameters</i>	48
1.4.2 <i>Density-dependent demographic parameters</i>	51
1.5 Systems of several populations	65
1.5.1 <i>Continuous-time populations</i>	65
1.5.2 <i>Discrete age-class populations</i>	68
2 The genetics of populations without selection	70
2.1 Introduction	70
2.2 Approach to genetic equilibrium	71
2.2.1 <i>An autosomal locus: the discrete age-class case</i>	72
2.2.2 <i>An autosomal locus: the continuous-time case</i>	79
2.2.3 <i>A sex-linked locus</i>	83
2.2.4 <i>Two autosomal loci</i>	85
2.3 The effects of finite population size	88
2.3.1 <i>General considerations</i>	88
2.3.2 <i>Effective population number with age-structure</i>	90
2.3.3 <i>The probability of fixation of a gene</i>	92
2.3.4 <i>The frequencies of consanguineous matings in an isolated population</i>	105

3 Selection: construction of a model and the properties of equilibrium populations	118
3.1 Introduction	118
3.2 Construction of a model of selection	120
3.2.1 <i>Genotypic parameters</i>	120
3.2.2 <i>Models of the mating process</i>	121
3.2.3 <i>Genotypic frequencies</i>	123
3.2.4 <i>Non-random mating with respect to age</i>	128
3.3 Populations in genetic equilibrium	130
3.3.1 <i>Dependence of genetic equilibrium on demographic stability</i>	130
3.3.2 <i>Equilibrium fitness measures</i>	134
3.3.3 <i>Equilibrium in a single-locus system under selection</i>	136
3.4 Biological applications of the results	142
3.4.1 <i>Factors influencing relative fitnesses</i>	145
3.4.2 <i>The measurement of fitness in human populations</i>	148
4 Selection: dynamic aspects	153
4.1 Introduction	153
4.2 Approximate equations with weak selection	154
4.2.1 <i>The density-independent case</i>	155
4.2.2 <i>The density-dependent case</i>	165
4.3 Local stability analyses	168
4.3.1 <i>Gene frequencies near 0 or 1 with density independence</i>	169
4.3.2 <i>Gene frequencies near 0 or 1 with density dependence</i>	172
4.3.3 <i>Gene frequencies near 0 or 1 with temporally varying environments</i>	173
4.3.4 <i>The probability of survival for a non-recessive mutant gene</i>	177
4.3.5 <i>Local stability of a polymorphic equilibrium</i>	180
4.4 The asymptotic results of selection	184
4.4.1 <i>Simplified asymptotic analyses</i>	186
4.5 Selection on a quantitative character	188
4.5.1 <i>General considerations</i>	188
4.5.2 <i>Prediction of the response to selection</i>	189
4.6 Conclusions	194
4.6.1 <i>Density-independent populations</i>	195
4.6.2 <i>Density-dependent populations</i>	200

5 The evolution of life-histories	204
5.1 Introduction	204
5.2 Age-specific gene effects and the evolution of senescence	205
5.2.1 <i>Selection intensity and age of gene action</i>	206
5.2.2 <i>The evolution of senescence</i>	214
5.3 The evolution of reproductive patterns in relation to age	223
5.3.1 <i>Selection and time of breeding</i>	223
5.3.2 <i>Optimal life-histories</i>	231
5.4 Conclusions	252
5.4.1 <i>The evolution of senescence</i>	252
5.4.2 <i>Reproductive patterns and age</i>	254
5.4.3 <i>Sex differences and life-history evolution</i>	261
5.4.4 <i>Some general aspects of life-history theory</i>	265
Appendix 1 Generating functions and their properties	269
Appendix 2 Asymptotic values of Δp_i and $\Delta^2 p_i$	272
References	275
Index	289