

Contents

Introduction	1
1 The Theoretical Principles of Population Genetics	5
1.1 Estimation of Gene Frequencies	5
1.2 The Hardy–Weinberg Rule	8
1.3 Random Genetic Drift	10
1.3.1 Sex Ratio and Fluctuation Size.....	10
1.3.2 Variability of Individual Fertility.....	11
1.3.3 Modeling of Random Genetic Drift	13
1.4 Mutation and Migration of Genes.....	16
1.4.1 Mutations.....	16
1.4.2 Migration.....	18
1.5 Natural Selection	19
1.5.1 Basic Equations and Types of Selection	19
1.5.2 Genetic Load of Populations.....	24
1.6 The Influence of Subdivision of a Population on Its Genetic Structure	31
1.6.1 Subdivision and Inbreeding. The Wahlund Effect	31
1.6.2 The Island Model of Population Structure	34
1.6.3 Isolation by Distance.....	36
1.6.4 The Stepping-Stone Structure of Gene Migration	38
1.7 Conclusion	40
2 Heritable Variation in Populations	43
2.1 Population Genetic Polymorphism and the Adaptive Norm Concept	43
2.2 Hereditary Protein Polymorphism	51
2.2.1 The Mechanism of the Action of Genes	52
2.2.2 Types of Mutation and Their Effect on Protein Structure and Functions.....	56
2.3 Levels of Biochemical Polymorphism and Heterozygosity of Natural Populations	69
2.4 DNA Polymorphisms	82
2.4.1 Restriction Enzymes (Restriction Endonucleases)	83
2.4.2 Polymerase Chain Reaction.....	85

2.4.3 DNA Polymorphism Markers	87
2.4.4 Selective Constraints of DNA Variation	101
3 Genetic Processes in Natural Population Systems	105
3.1 Natural Populations as Communities of Genetically Differentiated Subpopulations	107
3.2 Genetic Processes in a Natural Population System.....	118
3.2.1 Ecology, Demography, and Mating Structure	118
3.2.2 Genetic Dynamics of Population Systems and of Their Structural Components	124
3.3 Mathematical Modeling of Simplest Population Systems Represented by Small Subpopulations.....	132
3.3.1 Population System Dynamics Upon Interaction Between Random Drift and Local Gene Migration.....	135
3.3.2 Genetic Dynamics of a Population System with Varying Parameters of Structure and Selection ...	138
3.3.3 Nonequilibrium Genetic Dynamics of Population Systems	143
3.3.4 A Concept of Population Systems and a Modern View of Subdivision	145
4 Genetic Processes in Experimental Population Systems	149
4.1 The Structure of the Models	149
4.2 The Genetic Process in the “Island” Population Model	160
4.3 The Genetic Process in the Stepping-Stone Population Model	169
5 The Role of Natural Selection in the Maintenance of Protein and DNA Polymorphism	187
5.1 Analysis of Stationary Distributions of Gene Frequencies	189
5.2 Analysis of the Genotype Distributions and the Correlations of Gene Frequencies in Successive Generations of the Exact Same Subpopulations	192
5.3 Analysis of Genotype Distributions at Early and Late Stages of Ontogenesis	198
5.4 Interrelated Variability of Monogenic and Polygenic Traits ...	200
5.5 Analysis of Empirical and Expected Interlocus Genetic Variances as a Method of Estimating Selective Significance of Biochemical Polymorphism	209
5.6 Optimal Genetic Diversity of a Population as a Measure of its Adaptive Maximum	217
5.7 Theory of Neutrality in the Light of Recent Data.....	225

Contents	XV
6 Population Genetics and Evolution	233
6.1 The Species and Speciation.....	233
6.2 Do Population-Genetic Studies Suggest the Idea of Evolution?	237
6.3 Genetic Monomorphism of Species as a Real Natural Phenomenon.....	253
6.4 Interspecific Variability Characteristics of Polymorphic and Monomorphic Traits	260
7 Population Genetic Aspects of the Problem	
“Man and the Biosphere”	287
7.1 The Problem of Genetic Monitoring and a Theoretical Approach to Its Solution	288
7.2 Genetic Monitoring of Natural Populations.....	291
7.2.1 Fishing.....	292
7.2.2 Acclimatization	301
7.2.3 Artificial Reproduction.....	305
7.3 Genetic Monitoring of Agricultural Populations	316
7.4 The Stabilization Principles of the Genetic Structure of Agricultural Populations	320
7.4.1 The Effects of Modal Selection of the Cotton <i>Gossypium hirsutum</i>	324
7.4.2 The Pattern of Dressed Karakul Lambskin Related to Morphologically “Average” and “Extreme” Types ...	333
7.5 Genetic Processes in Modern Human Populations: the Environment and the Problem of Genetic Load	342
7.5.1 Test Systems and Mutagenesis	343
7.5.2 Genetic Monitoring.....	346
Conclusion	371
References	379
Subject Index	429