GENETIC DIVERSITY AND DIVERSITY OF ENVIRONMENT: MATHEMATICAL ASPECTS

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1. Introduction

This paper is more mathematical than that of Professor Dobzhansky [3]. However, it is similar in raising more questions than answers. It is designed to present the same set of problems in a way that it is hoped will be somewhat more precise and "comfortable" to mathematicians, although time and space do not permit any very detailed presentation except for a few elementary examples.

We shall be concerned mainly with natural selection. There are two main kinds, intrapopulational and interpopulational. Most attention has gone to intrapopulational selection, which is highly opportunistic and short sighted. An individual at a certain stage in the life cycle leaves more offspring that reach the same stage in the life cycle, and thus its genes are increased in number in the next generation. If the selective pressures keep changing from generation to generation, the population keeps trying to be adapted to conditions prevailing in the previous generation. Furthermore, there is no way for a gene or gene combination that will be good at some future time, say of catastrophe, but leaving relatively fewer descendants now, to become established. If, however, it can hang on, even at low frequency until the catastrophe, it may become established.

On the other hand, all populations and species we see now are descendants of populations that have survived all of geologic time. The populations that opportunism drove into dead ends are dead, and those that solved short term problems in a way that happened to be good over the long term survived. This is the process of long term interpopulation selection. The mathematics of interpopulation selection has been largely ignored. Selection between species was considered by Voltera, Lotka, and others, and between potentially interbreeding Mendelian population by Wright [38] to some extent. Levins, [16] to [20], and Lewontin [22], [24] have considered optimal strategies for populations. Those populations that hit on good strategies will be preserved, so that existing populations should mirror, in many ways, the optimal strategies. Even if optimal

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