DARWINIAN EVOLUTIONARY DISTRIBUTIONS WITH TIME-DELAYS

Y. Cohen

200 Hodson Hall, University of Minnesota, St. Paul, MN, 55108

Abstract. Evolutionary distributions (ED) refer to the solution of systems of reaction diffusion equations that mimic Darwinian evolution. In their general form, ED-dynamics comprise a set of nonlinear partial differential equations (PDE). To each ED, there belongs a separate adaptive space with its own dimensionality in which phenotypes evolve by mutations (diffusion) along heritable adaptive traits. The mutations are small and random. They occur at birth. The separate adaptive spaces are linked through the reaction terms; *not* through the mutation terms. Some of the systems we investigate cannot lead to Turing instability: they are either stable or not stable only. ED-dynamics with delays indicate that in classical reaction-diffusion models of predator-prey—to the extent that they imitate such systems in Nature—Turing instability is *not* likely to arise. When Turing instability occurs, it is within a narrow range of parameter values. Thus, patterns in the distribution of phenotypes—as a consequence of evolution by natural selection—are *not* likely to be observed in Nature.

Keywords. Darwin; Evolution; Evolutionary Distributions; reaction diffusion; time-delays; mutations.

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1 Introduction

Organisms can be characterized by a set of trait values such as height, skin-color, metabolic rate, immunity to diseases and so on. Organisms that share an identical set of such values are called phenotypes. The theory of evolution by natural selection according to [11] may be distilled to three requirements, which can be viewed as the axioms of evolution by natural selection:

1. *Variation* in trait values which in turn cause

2. *fitness differences* that are

3. *inherited*

[13]. These are necessary and sufficient conditions for Darwinian evolution to occur. Fitness is the outcome of natural selection. The latter operates on trait values and results in increase (or decrease) in the frequency of phenotypes that own these values in the population over time. Inherited traits