Analysis of real world eco-evolutionary data using computational modelling and statistical inference

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Abstract

We present a quantitative method towards analyzing eco-evolutionary data where trait values z are recorded over a fixed time period. Statistical methods towards deriving confidence intervals towards parameter estimation are discussed and we see how we can arrive at a plausible estimate for environmental difficulty by means of the TEST (*Temporal Evolutionary Simulation Tool*) model. We briefly discuss the probabilistic inference regarding the mechanism of selection in light of the model.

Introduction

Under Charles Darwin's traditional theory of natural selection, a population of individuals in some locus is expected to develop towards increased fitness with respect to their environment as time passes. In his landmark publication, *On the Origin of Species*, Darwin informally defines natural selection by the following:

> [...] If variations useful to any organic being ever occur, assuredly individuals thus characterized will have the best chance of being preserved in the struggle for life; and from the strong principle of inheritance, these will tend to produce offspring similarly characterized. This principle of preservation, or the survival of the fittest, I have called natural selection.

Douglas Futuyama, a prominent figure in the field of evolutionary biology, defines adaption, a term closely linked with natural selection, as "*a characteristic that enhances the survival or reproduction or organisms that bear it, relative to alternative character states*". Fitness is an attribute which reflects the reproductive success or survivalistic ability of an individual. In this paper, we will denote fitness by ω, where ω_i represents the corresponding fitness of some individual with an index i in the population.

The term trait value is denoted by z and represents the quantitative measure of some biochemical, morphological, physiological or anatomical structure or construct which is subject to genetic variation. As we will see,