Evolution of Genes and Traits

From Molecular Biology to Game Theory

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Abstract

What factors shape the evolution of populations? This thesis addresses this issue from different perspectives. For people concerned with the genetic makeup of the human and other genomes, it is of great interest to understand how the demographic history has shaped the pattern of differences among present-day members of the populations. For people concerned with the behaviour of animals in populations, it is of interest to see how evolution can favour some trait or other, depending on the structure of the interactions.

Natural selection governs evolution over very long time-scales. Over shorter time-scales, however, neutral processes analysed in this thesis determine much of the genetic diversity in organisms. Even when populations of genes evolve neutrally, external processes such as population size changes, or when population are divided into sub-populations with little contact between them, has a profound influence on the pattern of genetic differences that exists within populations.

At the level of individuals, we explore evolutionary models of animal behaviour and interactions. Strategies for acting in the environment evolve because of selection and mutations. The central questions are: how can one define cooperation in this type of environments, how can the animals achieve and sustain cooperation in a robust way? Can the long-term evolutionary dynamics be characterised by stationary populations?

Keywords: Evolution, neutral, gene history, population structure, population dynamics, game theory, Prisoner's Dilemma.