Eco-evolutionary feedbacks and the mathematics and pace of evolutionary change

Fitness functions are at the heart of ecology and evolution as they determine population dynamics, the strength of selection and the rate of adaptive evolution, and interactions between species. I describe models based on fitness functions to show how ecological and evolutionary change are intimately linked. Analyses of my models reveals: i) multi-generational predictions of evolution are sensitive to assumptions about phenotypic plasticity and non-genetic inheritance, ii) factors that act to reduce the per time-step population growth rate by modifying fitness functions will speed up evolution. Such factors include density-dependence and many forms of species interactions. iii) for a given constant fitness function, evolution will occur fastest when it is cryptic. For this to occur, non-genetic inheritance and/or phenotypic plasticity must act to change the environmental component of the phenotype at a rate that exactly counter phenotypic change due to evolution and iv) eco-evolution is likely widespread and is easily studied using evolutionarily explicit structured population models. These models can be constructed to include multiple traits, multiple interacting species, and trade-offs.