Large fluctuations and fixation in evolutionary games

MICHAEL ASSAF, MAURO MOBILIA — One of the most striking effects of fluctuations in evolutionary game theory is the possibility for mutants to fixate (take over) an entire population. In this work we use a semi-classical theory to study fixation in evolutionary games under non-vanishing selection, and investigate the relation between selection intensity and demographic (random) fluctuations. This approach allows the accurate treatment of rare large fluctuations and yields the probability and mean time of fixation beyond the weak-selection limit, often considered in previous works. The power of the theory is demonstrated on prototypical models of cooperation dilemmas with multiple absorbing states, and we find excellent agreement between the theoretical predictions and numerical simulations. Furthermore, we show that our treatment is superior to the Fokker-Planck approximation for finite selection intensity. M. Assaf and M. Mobilia, J. Stat. Mech. P09009 (2010). M. Mobilia and M. Assaf, Euro. Phys. Lett. 91, 10002 (2010).