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Stochastic dynamics of adaptative trait and neutral marker driven by eco-evolutionary feedbacks

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How the neutral diversity is affected by selection and adaptation is investigated in an eco-evolutionary framework. We study a stochastic finite population model in continuous time, where each individual is characterized by a trait under selection and a completely linked neutral marker. Population dynamics are driven by births and deaths, mutations at birth, and competition between individuals. Trait values influence ecological processes (demographic events, competition), and competition generates selection on trait variation, thus closing the eco-evolutionary feedback loop. The demographic effects of the trait are also expected to influence the generation and maintenance of neutral variation. We consider a large population limit with rare mutation, under the assumption that the neutral marker mutates faster than the trait under selection. In the limit, a time-scale separation occurs and we prove the convergence of the stochastic individual-based process to a new measure-valued diffusive process with jumps. When restricted to the trait space this process is the Trait Substitution Sequence first introduced by Metz et al. (1996). During the invasion of a favorable mutation, a genetical bottleneck occurs and the marker associated with this favorable mutant is hitchhiked. After that, the marker distribution is approximated by a Fleming–Viot distribution between two trait substitutions. Our results highlight the joint importance of mutations, ecological parameters, and trait values in the restoration of neutral diversity after a selective sweep.

This is a joint work with Sylvain Billiard, Régis Ferrière and Sylvie Méléard.

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