Consequences of migration pulsedness on genetic divergence

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Abstract

Spatial isolation between sub-populations of the same species is one of the principal sources of genetic differentiation and a possible cause of speciation. When such sub-populations remain partially connected, the resulting gene flow acts as a force opposing divergence and tending to homogenize the two gene pools. Existing theory mostly consider migration as a constant exchange rate between populations. However, the isolation degree between sub-population is often governed by non constant phenomena such as climatic fluctuations, or accidental long-distance transportation of individuals by sea or wind. Such processes can be periodic or completely stochastic, and therefore gene flow is likely to be highly temporally variable. Some theoretical arguments have suggested that the more variable the migration rate, the higher the expected genetic divergence, but few studies have addressed this question, and they restricted themselves to neutral genetic variation. In this work we study the consequences of a pulsed gene flow pattern for the genetic divergence of two partially connected sub-populations. We model pulsed migration (episodic events of genetic exchange) between two population, and how it interacts with genetic drift, mutation and potentially selection to determine the genetic divergence rate. Four genetic scenarios are considered: (i) neutral divergence ; (ii) divergent selection where populations specialize on each habitat and migrants are mal-adapted (local adaptation) ; (iii) accumulation of deleterious recessive mutations (buildup of inbreeding depression) ; and (iv) hybrid incompatibility (accumulation of incompatible mutations).We study analytically a simplified mathematical model and validate predictions by confronting it with stochastic Monte-Carlo simulations. By quantifying the probability of genetic identity between the two populations, we find that depending on the genetic scenario and other parameters, genetic divergence may be higher or lower with pulsed migration than with continuous migration. **Keywords:** pulsed migration, selection, mutation, genetic divergence, FST, Monte-Carlo simulation, Moran model, population genetics

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