Population Size, Type Number, and Evolutionary Outcomes

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Abstract

It is often supposed that population size is, by way of drift, connected to such evolutionary outcomes as the probability of fixation, heterozygousity, the number of polymorphic loci, and the number of alleles per loci, among others. Discussion is complicated by at least three issues: the nature of the 'connection' between population size and outcomes (causal, nomic or conceptual); the proper precisification of drift vis-à-vis that connection (does population size cause or quantify drift); and the way in which drift itself is conceived (process or product) and its paradigmatic instantiations categorized (see e.g. Beatty, 1984; Reissman and Forber, 2004; Millstein, 2006; Guildenhuys, 2009; Matthen, 2010). In this paper I attend to a particular subset of 'drift-like' phenomena, distinguished by the fact that population size influences the probability distribution over the difference between offspring frequencies and their expectation. Having done so, I use simulated data from individual based models to investigate the causal dependence relations between population size, type-population size, type frequencies, expected reproductive success, variance in reproductive success, the probability of arbitrary deviations from expectations, and fixation rate. The results bear on discussions in philosophy of biology, and also on certain features of biological practice. In the one case, conditional support is offered to those who interpret 'drift' as a cause, but only modulo some important caveats about variable selection, while in the other, the results inspire some critical reflection about the theoretical and empirical role of measures of effective population size.

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