Population subdivision with migration can facilitate evolution on rugged fitness landscapes ANNE-FLORENCE BITBOL, DAVID SCHWAB, Princeton University — Natural selection drives organisms towards higher fitness, but crossing fitness valleys or plateaus may be necessary to progress up a rugged fitness landscape. In a subdivided population, quasi-independent explorations of the fitness landscape can be run in parallel, and furthermore, stochastic effects have an increased importance due to the smaller size of subpopulations. Thus, valley or plateau crossing may be facilitated locally, and migration can then spread beneficial mutations. We show that population subdivision with migration significantly accelerates the crossing of fitness valleys and plateaus over a wide parameter range, both with respect to a non-subdivided population and to a single subpopulation. Our generic and minimal model does not require environmental heterogeneity or specific geographic structure, and includes only subdivision with migration. Using Markov chain theory, we obtain analytical expressions of the conditions under which valley or plateau crossing by the subdivided population is as fast as that of its fastest subpopulation. We verify this prediction through stochastic simulations. Our results, obtained for fitness valleys and plateaus, also hold for weakly beneficial intermediate mutations.

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