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**Rare beneficial mutations can halt Muller's ratchet** DANIEL BALICK, Physics Department, University of California, Santa Barbara, SIDHARTHA GOYAL, KITP, UCSB, ELIZABETH JERISON, Physics Department, Harvard Univeristy, RICHARD NEHER, MPI for Developmental Biology, Tubingen, BORIS SHRAIMAN, KITP and Physics Department, UCSB, MICHAEL DESAI, Physics Department and OEB, Harvard Univeristy — In viral, bacterial, and other asexual populations, the vast majority of non-neutral mutations are deleterious. This motivates the application of models without beneficial mutations. Here we show that the presence of surprisingly few compensatory mutations halts fitness decay in these models. Production of deleterious mutations is balanced by purifying selection, stabilizing the fitness distribution. However, stochastic vanishing of fitness classes can lead to slow fitness decay (i.e. Muller's ratchet). For weakly deleterious mutations, production overwhelms purification, rapidly decreasing population fitness. We show that when beneficial mutations are introduced, a stable steady state emerges in the form of a dynamic mutation-selection balance. We argue this state is generic for all mutation rates and population sizes, and is reached as an end state as genomes become saturated by either beneficial or deleterious mutations. Assuming all mutations have the same magnitude selective effect, we calculate the fraction of beneficial mutations necessary to maintain the dynamic balance. This may explain the unexpected maintenance of asexual genomes, as in mitochondria, in the presence of selection. This will affect in the statistics of genetic diversity in these populations.

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