Supporting Information

Shoresh *et al.* 10.1073/pnas.0803032105

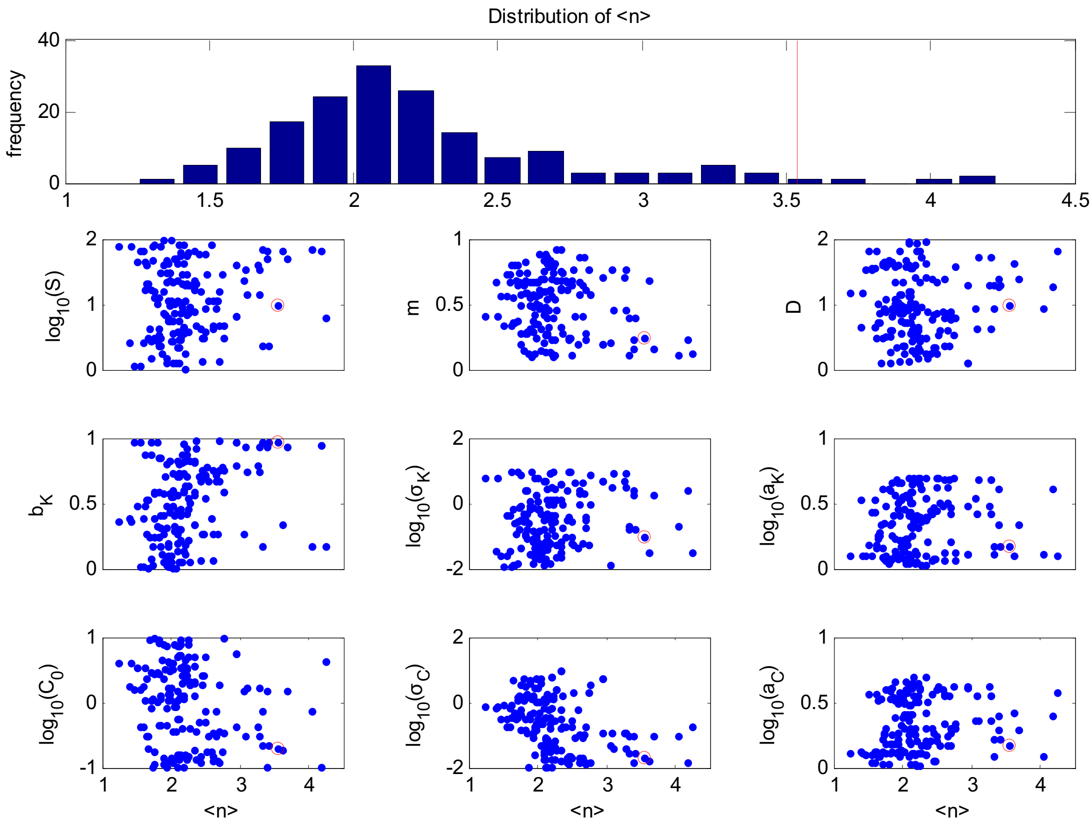

Fig. S1. Insensitivity of results to choices of parameters. The figure shows data from realizations of an environment with 20 essential resources and with 100 different choices of the parameters of the environment and of the mutational process (described in *Methods*). In each of these cases, the number of species was averaged over 500 adaptive steps. The distribution of the sustained number of species is shown on the top. The scatter plots below show the distribution of each of the parameters over this set of simulations (along the vertical axis) and its correlation with the average number of species. The red line in the top plot and the red circles in the scatter plots correspond to the parameters used for the rest of the simulations for reporting our main findings in the paper, which were also extended to a much wider range of the number of species.

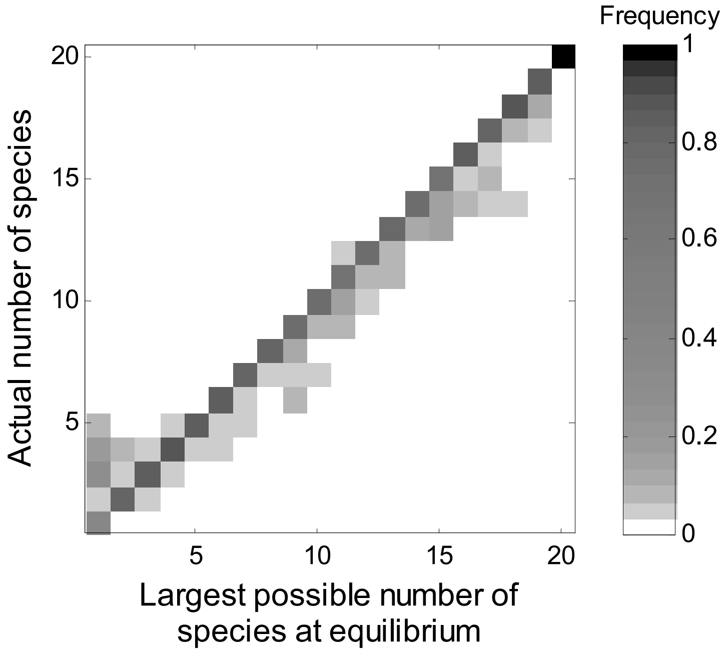

Fig. S2. Community size is determined by species properties and not by dynamical constraints imposed by initial conditions. Shown is data from 100 realizations of evolution in an environment with 20 essential resources. (Data from one such realization are presented in Fig. 3 in the main text.) At each step in the course of evolution, after a beneficial mutation was drawn, we used the values of the species parameters to calculate the size of the largest subset of stably coexisting species that contains the new mutant lineage. For this, we used an exact analytic solution for equilibria of the ecological equations of motion. In addition, we recorded the number of species that actually remained after the system had settled to a new equilibrium. The shade of each square reflects the frequency of states with a given actual number of species (ordinate) normalized by the total number of instances sharing the same maximum possible number of species (abscissa). When the system exhibits persistent fluctuations, the actual number of species can exceed the maximal number possible at equilibrium.

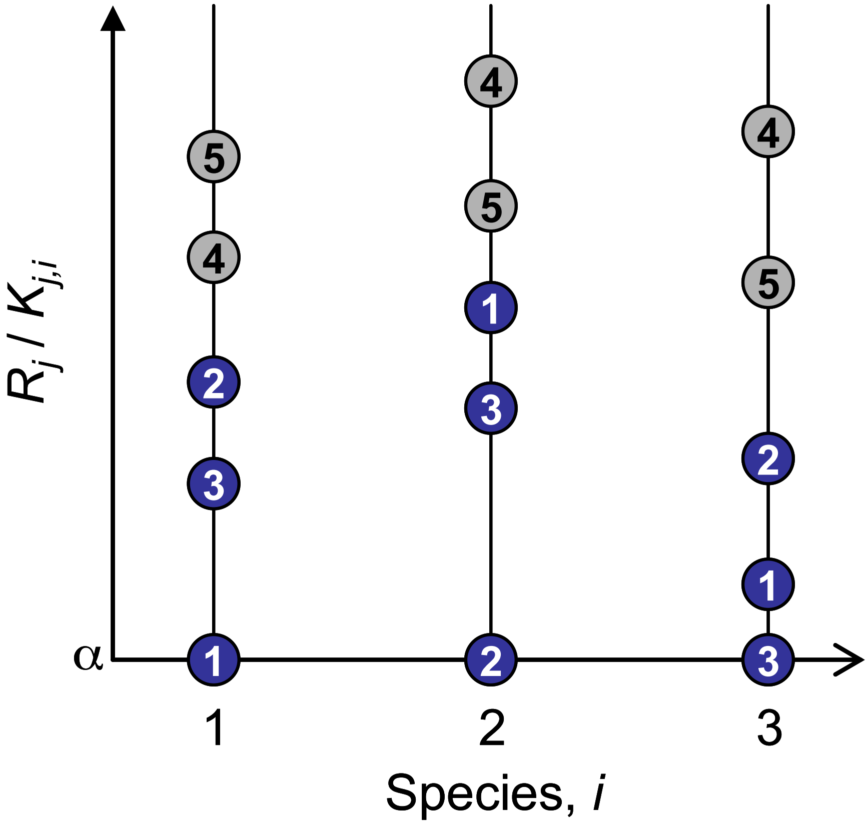

Fig. S3. Normalized concentrations (and therefore specific growth rates) are lower for limiting resources than for non-limiting ones. Each vertical line represents a species. The numbers inside the circles denote the different resources. A resource that is limiting will have in equilibrium a normalized concentration of α (which is the location of the horizontal axis) for the species it is limiting. Here, species 1, 2, and 3 are limited by resources 1, 2, and 3, respectively. Resources that are limiting are indicated by blue circles and non-limiting resources by gray ones.

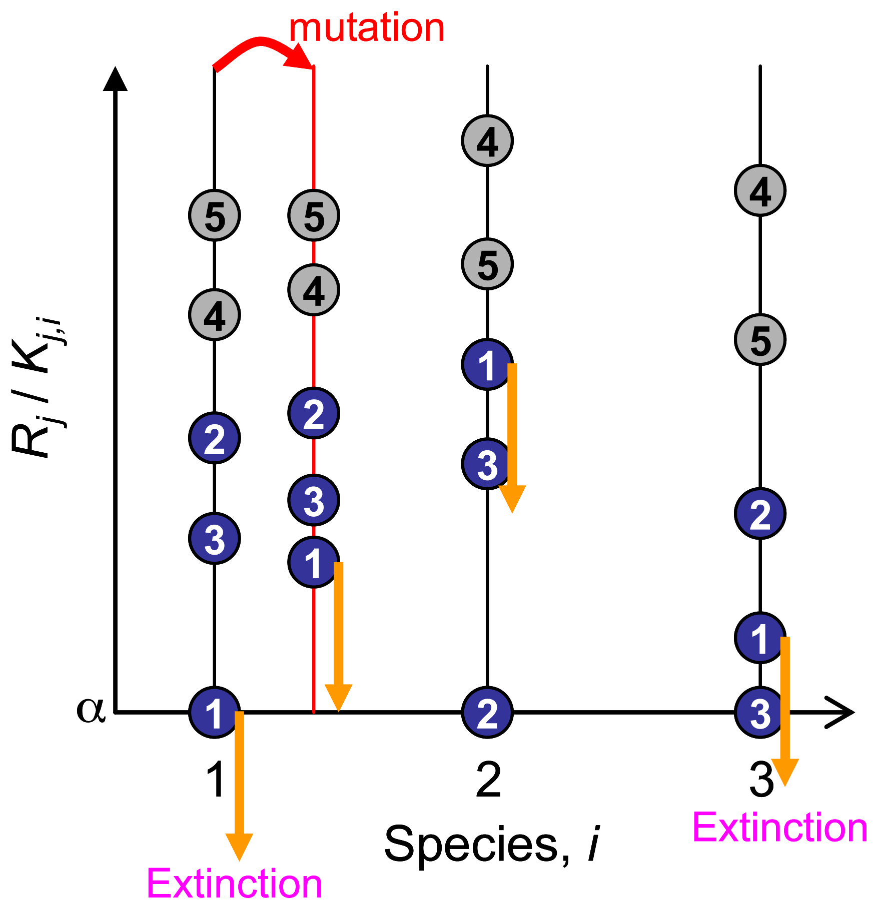

Fig. S4. A mutation leads to the extinction of both the ancestral species and an unrelated species. The vertical red line represents the species carrying a beneficial mutation that allows the mutant species to grow on a lower concentration of resource 1 than the equilibrium concentration before the appearance of the mutant. The orange downward arrows show the expected decrease in the normalized concentrations of resource 1 as it settles on a new, lower equilibrium concentration. The species for which the normalized concentration of resource 1 decreases below α (species 1 and 3) become extinct.

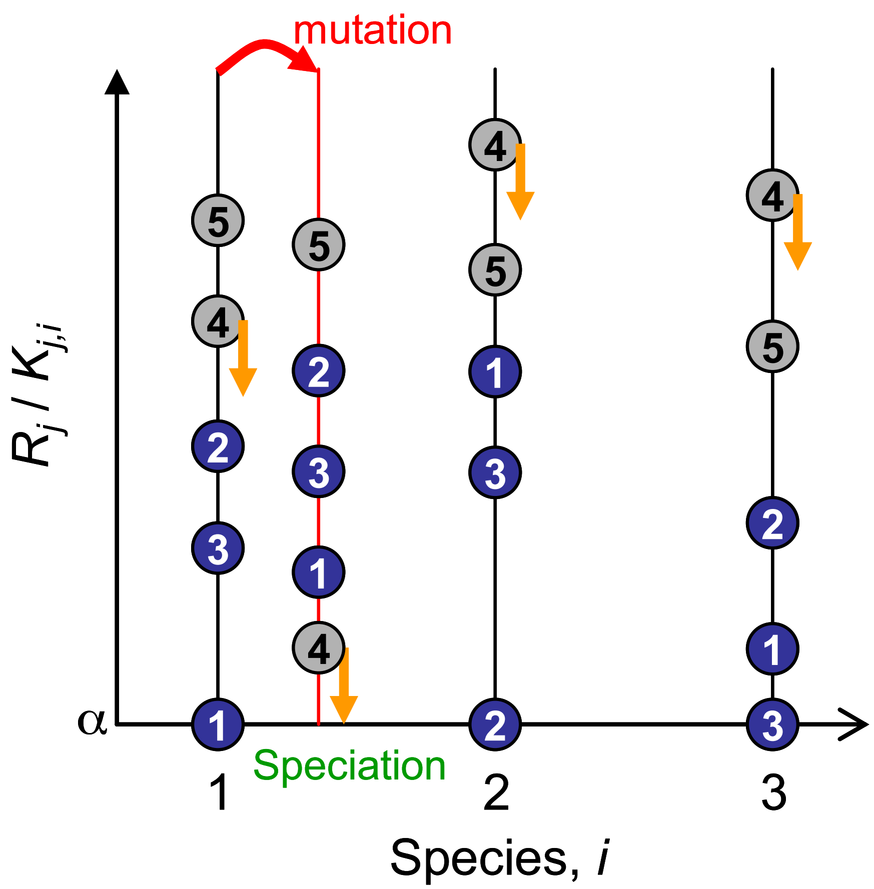

Fig. S5. A new mutation that can spread without eliminating other species. For a mutation not to lead to extinctions, it is necessary that the new limiting resource be one that is not the limiting resource for any other species.

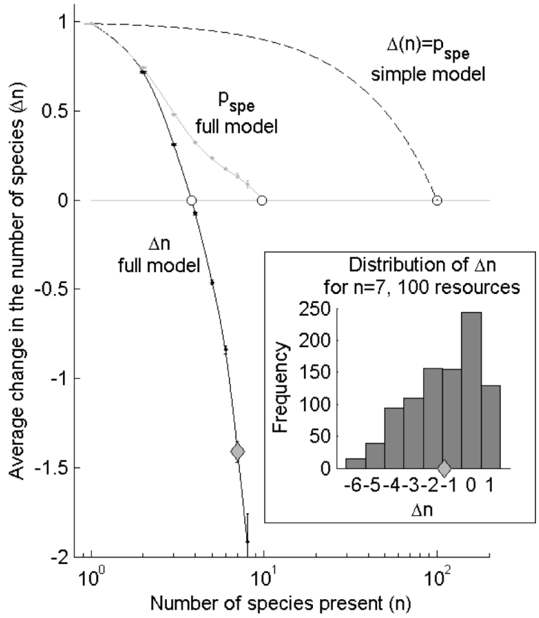

Fig. S6. Balance between speciation and extinction. The expected change in the number of species after the spread of a beneficial mutation is shown for the naïve niche model (dashed line) and for the full model (solid black line) as a function of the number of species coexisting before the appearance of the mutation (data from 20 realizations of an environment with 100 essential resources). The contribution to this curve for the full model that comes from speciation (the probability that $\Delta n = 1$, solid gray line) decreases much faster than in the niche-based model. Inset: The distribution of Δn pooling all adaptive steps starting with seven coexisting species. The diamond indicates the mean of the distribution.

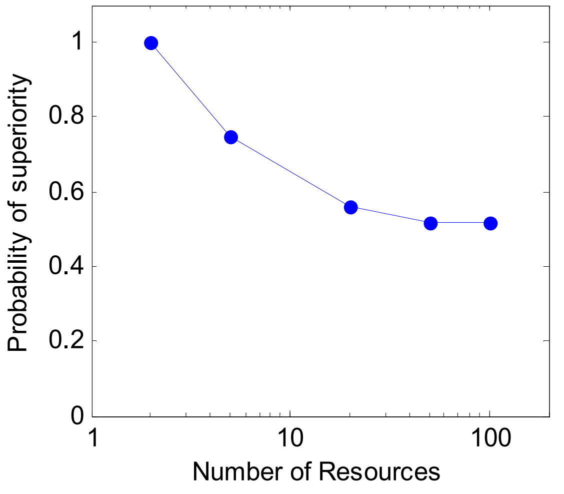

Fig. S7. The importance of superspecies declines rapidly with increasing number of resources. We monitored five evolutionary runs, each consisting of 1000 adaptive steps, for 2, 5, 20, 50, and 100 resources. For each extinction event in these environments, we used additional simulations of the ecological dynamics to determine the degree of superiority, defined as the fraction of species driven extinct that are out-competed by the spreading mutant in one-on-one competition. A degree of superiority of 1 means that the mutant species is superior to all of the species it drives to extinction and is therefore a superspecies (or a partial superspecies). The vertical axis shows the degree of superiority averaged over all adaptive steps in each environment.

Table S1. Results of simulations of the introduction of explicit trade-offs between the requirements for different resources

	Number of resources					
Average number of species	10	20	50	100	200	500
Without trade-offs	2.92	3.64	3.67	3.72	3.83	4.05
With trade-offs	2.74	3.89	3.93	4.31	4.37	4.29

SE is approximately 0.05.

Other Supporting Information Files

SI Appendix