EVOLUTION

# A small leap for adaptation

How does a trait evolve from A to B? Does it take many small steps, or one big one, or does it take one largish step followed by a few small ones? These questions are difficult to answer, mainly because adaptive events are only observed after they have taken place. An experimental evolution study in *Pseudomonas* spp. has captured the first adaptive event as it happens — the fitness advantage of such mutations is high, and so that first step to adaptation is more of a jump.

The view that evolution is a gradual process has been challenged by evidence that large-effect mutations can also underlie adaptive changes. But developing a general rule of adaptation is not easy, especially because beneficial mutations occur rarely. Experimental evolution presents a unique advantage: many beneficial mutations can be recovered, and their adaptive fitness can be compared to that of the ancestral population.

In this study, populations of the bacterium *Pseudomonas fluorescens* were grown in a harsh, carbon-limited medium for approximately 100 generations. The selection coefficients of the 68 fixed beneficial mutations that were recovered followed a bell-curve distribution; they also occurred at a higher rate than expected ($3.8 \times 10^{-8}$ per cell division) and had a much greater selective advantage (2.1).

The fact that the first beneficial steps in evolution are larger than previously supposed has theoretical importance, but it also has a direct bearing on modelling the evolutionary trajectory of microbes that are harmful to human health.

*Tanita Casci*

**ORIGINAL RESEARCH PAPER** Barrett, R. D. H. *et al.* Mutations of intermediate effect are responsible for adaptation in evolving *Pseudomonas fluorescens* populations. *Biol. Lett.* 14 February 2006 (doi:10.1098/rsbl.2006.0439)
**FURTHER READING** Orr, H. A. The genetic theory of adaptation: a brief history. *Nature Rev. Genet.* **6**, 119–127 (2005)