Species' evolutionary choice—disperse or adapt?

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Dispersal and adaptation are two fundamental evolutionary strategies available to species given an environment. Generalists, like dandelions, send their offspring far and wide. Specialists, like alpine flowers, adapt to the conditions of a particular place.

Ecologists have typically modeled these two strategies, and the selective pressures that trigger them, by holding one strategy fixed and watching how the other evolves. New research published in the journal *Evolution* illustrates the dramatic interplay during the co-evolution of dispersal and adaptation strategies.

"This model helps us gain intuition for situations where multiple, interacting traits are evolving simultaneously," says SFI Omidyar Fellow

Andrew Berdahl, who co-authored the paper with SFI Science Board member Simon Levin and collaborators Colin Torney and Emmanuel Shertzer.

Their model shows how even minor changes in an environment can create feedback and trigger dramatic shifts in evolutionary strategy.

On a homogenous landscape, like a prairie or desert, dispersal is typically the favored strategy because offspring are likely to encounter a similar habitat wherever they go, the researchers show. Conversely, highly diverse, heterogenous environments, like mountains, favor specialization because dispersing species have a lower probability of settling on an already suitable habitat.

A highly dispersing generalist species will continue to scatter even as environmental heterogeneity increases, but only to a point; at a certain threshold, patterns within a population shift to favor a number of rarely dispersing, specialist lineages, each adapted to a specific habitat. This shift can be highly discontinuous.

Once a generalist population starts to specialize, the resulting drop in dispersal induces further pressure to specialize. This positive feedback loop between reduced dispersal and local adaptation triggers a dramatic shift in the evolved strategies and creates a relative point-of-no-return.

Their conclusions have important implications.

"Environments are becoming more homogenized through [human] development," says Berdahl. "At the same time, we're also fragmenting habitats with roads and dams, which impedes dispersal. The model illustrates that there's the potential to flip states and not be able to flip back."

In other words, simply restoring environmental conditions to a previous state may not trigger a commensurate shift in a species' evolutionary strategy, he says.

More information: "On the evolutionary interplay between dispersal and local adaptation in heterogeneous environments."
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