

CAN ECOLOGY INFORM MOLECULAR BIOLOGY?

Abstract

Submission Type: Individual paper

Themes: Cellular and Molecular Biology; Ecology

Molecular biologists often borrow ecological concepts to describe the complexities of molecular interactions within cells and embryos. For example, individual molecules are sometimes said to be part of *ecosystems* that integrate them in a complex network of relations with many other entities (Gilbert, 2006). Similarly, cytological gears are frequently described as occupying—and sometimes engineering—their own *niches* (Gilbert and Epel, 2009). The aim of this article is to scrutinize the application of these ecological metaphors in the molecular sciences, a practice that, despite its longstanding history, has seldom been discussed in detail. The first part of the essay argues that the cellular *milieu* is analogous to the biosphere in important and surprising respects. I begin by drawing methodological parallels in the individuation of molecular and ecological units. Next, I argue that the cytological machinery instantiates characteristic ecological relations, such as predation, competition, mutualism, and density-dependent effects. Finally, I spell out some structural parallels between ecological environments and cellular modules metaphorically called ‘ecosystems.’ In the second part, I explore some ways in which ecological concepts can inform theoretical and experimental developments in the actual practice of molecular biologists. My first conclusion is negative. If the purpose of these metaphors is simply to debunk the obsolete view that molecular mechanisms and processes are rigid, self-regulated, deterministic gears, then there is no real reason to appeal to ecosystems; the simpler notion of a *system* will do just as well. At the same time, I argue that ecological notions plays an important role in conceptualizing external (environmental) influences on the ontogeny of the phenotype: ecological models capture the ‘openness’ of the cellular environment.

References

- Gilbert, S. F. (2006). The ‘re-discovery’ of morphogenetic fields. In *DevBio: a companion to Developmental Biology, 8th edition*. Sunderland, MA: Sinauer Associates.
- Gilbert, S. F. and D. Epel (2009). *Ecological Developmental Biology. Integrating Epigenetics, Medicine, and Evolution*. Sunderland, MA: Sinauer Associates.