Enriching research in ecology and evolution through nine 'flavors' of history

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In a recent article in *The Quarterly Review of Biology*, "Beyond Equilibria: The Neglected Role of History in Ecology and Evolution," author Hamish G. Spencer argues for a revitalized view of history. This historical view is a response to current research in the field of ecology and evolution, which is dominated by an ahistorical view of dynamic systems. In this ahistorical view, mathematical models are extensively used to describe and analyze systems at an equilibrium. Such equilibrium-focused analyses are currently privileged, because they allow researchers to generalize their models of a system: that is, these equilibrium-focused analyses enable researchers "to distill the essence of a system into principles that apply elsewhere." While the article acknowledges the value of equilibrium-focused analyses, such analyses tend to unfairly evaluate biological history as dependent on non-generalizable particularities. As a result, current research in ecology and valuate tends to avoid historical forms of analysis.

In response to this common assumption about history, the article argues that there are at least nine "flavors" or understandings of history. These understandings of history, in turn, allow researchers to generalize their findings and the observe scientific laws at work. These nine understandings of history are as follows: (1) history as contingency, (2) history as chance, (3) history as chaos, (4) history as capriciousness, (5) history as approach, (6) history as constraint, (7) history as construction, (8) history as turnover, and (9) history as template.

The first five understandings of history are closely related, because they

analyze random co-occurrence and unpredictability. First, in an understanding of history as contingency, researchers can approach a system as an "occurrence of events conditional on a vast array of properties." Second, by incorporating history as contingency, researchers are better equipped in analyzing empirical observation over time, such as how fish of different sizes distribute themselves in an environment with a limited amount of nutrients. This analysis of history of contingency is closely tied to a second understanding of history as chance, or stochasticity, because biological systems are subject to random chance. Subsequently, in understanding history of chaos, researchers can analyze a system as incorporating unexpected deterministic behavior, which can be analyzed by mathematical models. Finally, in an understanding of history as capriciousness, ecologists can analyze a system beyond adherence to principles of statistically reliability. For instance, a larger sample size might not result in a mean that is closer to the true mean of a given distribution—a phenomenon that falls under the category of capriciousness.

The next four conceptualizations of history offer a further critique of equilibrium-focused analyses in ecology and evolution. First, in an understanding of history as an approach, researchers can analyze a system as approaching a state of equilibrium, but not at the state of equilibrium itself. Second, in an understanding of history as constraint, researchers can analyze the dynamics of a system as being constrained by "what has already taken place to build the system," such as the reduction of genome size among a particular species living in a specialized environment. Third, in an understanding of history as construction, researchers can begin by understanding that "equilibrial properties are an incomplete—and sometimes misleading—summary of the way the system behaves." Fourth, in understanding history as turnover, researchers can understand a system as perpetually being influenced by new actors, thereby questioning whether a "biological system is (or can ever be) at equilibrium."

Finally, in understanding history as a template, researchers can understand the historical contingencies of a system for both scientific analysis and modeling: for instance, phylogenetic models can be understood as "providing evolution with a template on which to work."

In conclusion, the article suggests that these "flavors" of history can be simultaneously at work in a given biological system. Rather than treating history in ecology and evolution as a set of non-generalizable particulars, researchers can further their analysis of biological systems by "teasing out the many roles various different flavors of history play in nature."

More information: Hamish G. Spencer, Beyond Equilibria: The Neglected Role of History in Ecology and Evolution, *The Quarterly Review of Biology* (2020). DOI: 10.1086/711803

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