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Book Review

***The ecology of collective behavior*. By Deborah M. Gordon. Princeton University Press (2023). Pp. 184. Price £25 paperback, £84 hardback.**

In her latest book, *The ecology of collective behavior*, Deborah Gordon lays out a compelling 'research programme' for how to study collective behaviour. The central premise of the book is that the regulation of collective behaviour should be studied within the ecological context in which animals live and in which they evolved. Gordon masterfully explains that understanding collective behaviour requires considering both the environment in which a behaviour occurs as well as the constraints on the biological system. Behaviours emerge from intertwining external and internal forces and are more elaborate than a simple sum of these external and internal drivers. The main hypothesis that Gordon presents in Chapter 2, and returns to throughout the book, is that the way in which a collective behaviour is regulated is determined by its ecology. Specifically, Gordon discusses the regulation of collective behaviour through three mechanisms: changes to the rates in which system components interact, regulation of interactions through positive and negative feedback and the ways in which a system is subdivided. Thus, highlighting elements of regulation through interaction rates, intensity and distribution. Gordon proposes predictions for how these regulatory principles may respond to three types of environmental gradients: the stability of the environment, energy flow (how much resources a system spends to gain new ones) and the spatial distribution of resources (clustered versus clumped). Throughout the book she discusses the details of these various hypotheses and predictions by bringing examples from a wide array of biological systems, including plants, cells, humans and nonhuman animals, including, of course, the ant species that have been the subject of her long-term research. The diversity and quantity of examples means that readers can find the examples that resonate with them and help them most to crystalize Gordon's thesis. Each example is touched on briefly and is simplified for nonexperts in Gordon's characteristic enjoyable and clear writing style. Her thesis suggests that the gradients of all three environmental features work in the same direction: if an environment is stable, then it also has scattered resources, and more energy needs to be spent to gain new energy – similar to the ecology of the harvester ants that Gordon has studied for nearly half a century. While there are clear examples for such an alignment of gradients, this idea opens up opportunities for new reach directions because the ecological gradients that Gordon examines can be orthogonal: stable environments may have clustered resources; systems that spend less energy to gain energy may use scattered, rather than clumped, resources. Placing the environmental gradients along multiple, orthogonal dimensions provides fertile ground for further, more technical reviews and studies that examine nuanced relationships between environmental features. Such studies can both test and suggest further hypotheses about how the ways in which ecological gradients interact can impact the regulation of collective behaviour. Overall, the book is thought provoking and stimulating, offering a clear and well-structured foundation for future research on how biological systems operate within their ecological contexts.

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