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The evolution of plant syndromes on islands

Evolution in Isolation: The Search for an Island Syndrome in Plants by Kevin C. Burns 2019, Cambridge University Press, 219 pp., ISBN:9781108422017, <https://www.cambridge.org/>

Over the course of the European explorations of the world's oceans following Columbus' first epic crossing of the Atlantic in 1492, ship's naturalists returned with detailed accounts and specimens of the plants and animals encountered on their voyages. It soon became apparent that the islands of the world were biologically distinctive, not only from each other but from nearby continental landmasses. Not only did islands appear to hold selective sub-sets of the forms of life found on the continents, but they also featured peculiar forms, including flightless birds such as the now extinct Dodo and unusually large or small animals. These peculiarities fascinated natural scientists such as Alfred Russel Wallace, Charles Darwin, and their contemporaries, and over time, a number of seemingly emergent island syndromes took hold in the literature (Carlquist 1974, Quammen 1996, Whittaker & Fernández-Palacios 2007). Repeated selection for the same traits or trait combinations as a function of isolation suggests the possibility of identifying key controlling forces within evolution while variation around such island rules or syndromes may permit the identification of further, moderating forces. In short, island syndromes provide classic illustration of the power of islands as 'natural experiments' in evolutionary biology. Unfortunately, nature is messy, and even some of the best-known syndromes have exceptions. Indeed, the first challenge is to ensure that we have a real pattern and are not repeatedly focusing in on the few examples that do support a syndrome when it may actually be the exception rather than the rule.

In his splendid new book *Evolution in Isolation: the search for an island syndrome in plants*, Kevin Burns rises to the challenges above, providing an entirely readable and detailed appraisal of a large suite of hypothesised island syndromes in plants. Recognising that for many readers, familiarity with some of the peculiar traits of island animals will be greater than their knowledge of island plants, the book begins with an introductory chapter on emblematic island animals, covering such topics as the naivety of island animals (Darwin himself described being able to push a Galapagos hawk off a tree with the muzzle of his gun), the loss of dispersal ability, the frequent occurrence of giant tortoises on islands and the question of whether they evolved their large size in situ or prior to colonization, and the so-called

island rule. As an aside, in my view, there are enough emergent 'rules' in island biogeography that it would be better to distinguish the latter as the island body size rule: it states, in essence that small creatures tend to evolve larger size and large creatures smaller size than their mainland ancestors following island colonization. This pattern was first described and is best supported for mammals (Lomolino et al. 2017), and it has been the subject of intense scrutiny. As Burns notes, when extended to other taxa, "results are not straightforward". Burns uses this opening chapter to set out the approach adopted for his scrutiny of island syndromes in plants, one which he states builds "upon the foundations of Sherwin Carlquist's natural history genius...", whose work he clearly found inspirational while also questioning the generality of putative island plant syndromes through adoption of "the hypothetico-deductive scientific method." Which is to say, not only does he review the evidence for each trait or syndrome as a robust pattern in nature, but he also carefully evaluates the logic and support for the various explanatory ideas that have been put forward to explain how each may have emerged repeatedly on widely scattered islands in different oceans.

Following the introductory chapter, Burns proceeds, across the five following chapters, to review five sets of plant characteristics in insular settings: differences in defence; differences in dispersal; aspects of reproductive biology; size changes; and the loss of fire-adapted traits. Within these headings a range of more specific properties or traits are considered. Throughout, his approach is cautious and careful. Syndrome predictions are clearly outlined, case studies are not rushed, and are presented in sufficient detail to allow the reader to weigh the evidence for themselves. The illustrations provided are all well-chosen, providing easily understood graphs, figures, and photographs. Along the way, a wealth of fascinating natural history detail is provided and the nuances in the evidence are unpacked and evaluated. A valuable feature of the book is the extent to which unfamiliar terms such as heteroblasty are carefully introduced and explained on first mention. Each chapter is provided with a balanced and clear conclusion.

The final chapter provides a perhaps unusual way to synthesize as it focuses on describing five

iconic species that typify particular aspects of the island syndrome in plants. The selection is useful in demonstrating the ways in which different traits may combine and how it may be possible to begin to discern which particular traits may be the key ones in developing robust explanations of how the island syndrome(s) emerge. Burns closes the book with a clear summary of 16 specific components, subdivided into two doubtful components (it may surprise some readers to know that one of these is the loss of dispersibility), ten possible components, and four most probable components, which comprise both leaf and seed gigantism, Baker's law (crudely, that self-compatibility and the capacity to establish on islands via long distance dispersal are linked), and defence displacement.

In conclusion, Burns is to be congratulated for bringing a systematic and clear-thinking approach to the collation, selection, and presentation of the scattered literature on island evolutionary traits in plants. The text is easy to follow and should be accessible to undergraduates of island biogeography and related disciplines, while providing much of interest to more advanced readers. In this reviewer's opinion, he has done much to prove the point he makes in the final paragraph of the book where he writes: "[t]he search for an island syndrome in plants can be a rigorous scientific discipline with much to teach the world of science." I am confident that this book will serve to draw in natural scientists to contribute to this endeavour.

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