Serpentine: The Evolution and Ecology of a Model System

Author(s) :Erik S. Jules
Source: Rhodora, 113(956):523-526. 2011.
Published By: The New England Botanical Club, Inc.
DOI: http://dx.doi.org/10.3119/0035-4902-113.956.523
URL: http://www.bioone.org/doi/full/10.3119/0035-4902-113.956.523

RHODORA, Vol. 113, No. 956, pp. 523–526, 2011

BOOK REVIEW

Serpentine: *The Evolution and Ecology of a Model System* by Susan Harrison and Nishanta Rajakaruna, eds. 2011. 464 pp. illus. ISBN 978-0-520-26835-7 $70.00 (hard cover). University of California Press, Berkeley, CA.

As an undergraduate student, I was lucky enough to land a summer internship with Jonathon Shaw, a bryologist interested in evolutionary and ecological questions. We collected mosses from the vicinity of a zinc smelter in Pennsylvania, where the effluent leaving the smokestacks had reduced over 80 km^2 of oak-hickory forest to a nearly barren wasteland. Our question was fairly simple: had populations of a cosmopolitan, weedy moss (*Ceratodon purpureus*) become genetically differentiated from populations found on "normal" soils not laced with heavy metals? That is, had the populations "adapted" via an evolutionary event? As I was to realize much later, we were continuing a long and wondrous history of research aimed at understanding how natural selection operates on harsh soils, where nutrients are limiting and heavy metals are found at toxic levels.

Twenty-four years after that summer internship, I am still impressed that studies on harsh sites like mines and "serpentine," both of which share the traits of low nutrient availability and high concentrations of metals, have played a pivotal role in our understanding of some basic biological concepts concerning the rate of evolutionary change and the spatial heterogeneity of genetic variation. Along with the work done by luminaries such as Turesson (1922) and Clausen et al. (1940), research on mining and serpentine soils has shown us how rapid and pervasive differentiation among plant populations can be, and also has informed several important arenas of science, including the evolution of endemism, the role of ecological productivity and plant competition, and even the theory of plate tectonics. As such, it is of no surprise that the new book by Susan Harrison and Nishanta Rajakaruna, *Serpentine*: *The Evolution of a Model System*, has important lessons that will be important not just for people who work on serpentine, but rather for anyone interested geology, evolution, and ecology.

This new book is not the first to be published about serpentine. A few oft-cited books, including Brooks' (1987) *Serpentine and its Vegetation*: *A Multidisciplinary Approach*, and Roberts and Proctor's (1991) *The Ecology of Areas with Serpentinized Rock*: *A World View* have remained important resources for beginning students of serpentine, and include detailed descriptions of serpentine sites and their associated vegetation. The explicit goal that Harrison and Rajakaruna pursue quite successfully with their new book, is rather different from other serpentine books. Their goal is not to describe any particular serpentine region or flora, nor is it to simply review what work has been done on serpentine systems, but rather to address how quite a few broad scientific questions have been addressed using serpentine as a model system. Their book will serve anyone from the advanced undergraduate level and beyond.

The table of contents immediately gives the reader a sense of the breadth of the book, which includes 19 chapters on a wide variety of topics. The chapters are split into two equal halves of the book, with the first set focused on earth history and evolution and the second half focused on ecology and conservation. For someone already familiar with the field of serpentine science, however, the table of contents was the cause of my only real frustration with the book. Although 32 authors contributed, they are not listed below the titles of their chapters in the table of contents. So, for instance, in scanning the book for some work by Hugh Safford, I had to guess at which chapter he'd written and then turn to that page. Although this is a minor detail, I suppose it had the positive effect of forcing me to scan the entire book slowly, to see which authors were associated with which paper.

With so many chapters, I'll not try to review or summarize them all. But I can say with confidence that most anyone reading this review will find at least a few gems upon picking up the book. For me, a highlight came at the very beginning with an account of how ultramafics helped develop the theory of plate tectonics. It's difficult to imagine a better description than the very personal account by Eldridge Moores, who was deeply involved in this work, starting in the 1960s. Besides a fascinating chapter by Dawn Cardace and Tori Hoehler about extremophile microbes in subsurface areas undergoing serpentinization, the remainder of the book focuses primarily on the ecology and evolution of plants or interspecific interactions involving plants (e.g., herbivory, pollination). The chapter by Ryan O'Dell and Rajakaruna provides an excellent context, summarizing the various mechanisms that have evolved to allow plants to tolerate serpentine soils, and the possible pathways to speciation on serpentine. The table they developed is a wonderfully helpful summary of plant taxa for which empirical studies of intraspecific variation found on and off serpentine have been conducted. Jessica Wright and Maureen Stanton's chapter provides a virtual recipe book for how to conduct a good assessment of local adaptations using common garden and reciprocal transplant experiments.

Kara Moore and Sarah Elmendorf lead off the second part of the book, on ecology and conservation, with a review of how competitive and facilitative interactions among plants may vary along stress gradients, using serpentine as a model system. Their chapter does a nice job of doing what Harrison and Rajakaruna had been looking for: the chapter would be a great introduction for a graduate student interested in basic plant-plant interaction theory, whether or not they plan to study serpentine. Hugh Safford and Chris Mallek's chapter is the very best summary I've seen of how disturbances, such as fire and herbivory, will impact vegetation on low-productivity soils as compared to "normal," higher productivity soils. The last chapter in the section, by Ryan O'Dell and Victor Claassen, was one I've been hoping to see for a while; it's a nice summary of restoration efforts on serpentine sites. I've mentioned details from only seven of 19 chapters in the book; there is much more for the interested reader to discover.

The hardbound book that I reviewed was nicely constructed and laid out. Tables and figures were well done, and I have the sense the book will serve as a resource for many years because of its high quality of scholarship. Of course, the book cannot serve as the one "go-to" book for someone wanting to learn about serpentine; for instance, it was not intending to describe the basic natural history of any particular serpentine region. There are other resources that might nicely complement Harrison and Rajakaruna's book for budding serpentine biologists, including a relatively new book by Alexander et al. (2007), *Serpentine Geoecology of Western North America: Geology, Soils, and Vegetation*. Harrison and Rajakaruna's book, nonetheless, gives us something new and important—a very compelling case for why the study of serpentine is important for ecologists and evolutionary biologists, regardless of whether or not their own area of research involves serpentine.

LITERATURE CITED

Alexander, E. B., R. G. Coleman, T. Keeler-Wolf, and S. P. Harrison. 2007. Serpentine Geoecology of Western North America: Geology, Soils, and Vegetation. Oxford Univ. Press, New York, NY.

Brooks, R. R. 1987. Serpentine and its Vegetation: A Multidisciplinary Approach. Dioscorides Press, Portland, OR.

Clausen, J., D. D. Keck, and W. M. Hiesey. 1940. Experimental Studies on the Nature of Species. I. Effect of Varied Environments on Western North American Plants. Carnegie Institute of Washington, Washington, DC.

Roberts, B. A. and J. Proctor. 1991. The Ecology of Areas with Serpentinized Rock: A World View. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Turesson, G. 1922. The genotypical response of plant species to the habitat. Hereditas 3: 211–350.

—Erik S. Jules, Humboldt State University, Arcata, CA.