heterogeneity in a common garden. Cheplick also develops excellent examples from many other sources throughout the text. Pillars of plant population biology—Turreson; Clausen, Keck andHeisey; Snaydon; Bradshaw and others—are featured prominently, but also included are strong examples from recent studies focusing on, for example, serpentine adaptation, molecular genetics of adaptation, and ecotypic adaptation to soil moisture in *Avena barbata*. Overall, coverage is broad and well balanced.

Cheplick emphasizes empiricism and microevolution in this book. You won't find any phylogenetic trees among the figures, and "phylogeny," as well as "speciation" and "life history" are among the terms missing from the index, surprisingly, for a book on evolution. Although Cheplick includes an uncontroversial rationale for why phenomena such as selection, local adaptation, and microevolutionary processes should be considered part of plant evolutionary ecology, the justification for omissions from this circumscription, such as those mentioned above, could use clearer articulation. Evolutionary ecology is admittedly a big topic, and Cheplick seems to have managed it by drawing a bright line around the population.

Nonetheless, much of what is covered bumps up conspicuously against speciation or other macroevolutionary phenomena. Ecotypic differentiation and local adaptation portend reproductive isolation, and several species used to illustrate local adaptation in the text (e.g., *Lasthenia*, *Mimulus*, *Anthoxanthum*, to mention a few) have published estimates showing reproductive isolation or restricted gene flow among ecotypes or populations. Perhaps this is more noticeable because of a spate of recent studies implicating ecological phenomena in the evolution of reproductive isolation and species. Similarly, after a nice section summarizing evidence for pollinator-mediated selection on flowers, Cheplik nods toward studies with *Aquilegia* and *Lithophragma* to underscore the potential for coevolutionary dynamics between pollinators and flowers, but falls short of sharing evidence, for example, supporting hypotheses of co-speciation between *Ficus* and Agaonidae or between *Yucca* and Prodoxidae. The distinction here seems to fall on a rather fine line. In the same chapter, Cheplick provides an excellent summary of evidence for population- and genotypic-level plant adaptation to herbivores, as well as studies involving *Datura* and *Solanum* showing how different herbivore species can impose contrasting patterns of selection on resistance. Given this context, it seems odd not to mention examples of evolution within plant lineages in herbivore defense —May Berenbaum's classic work with coumarin evolution or Anurag Agrawal's work with milkweeds come to mind.

Despite such shortcomings, Cheplick's treatment is a thorough reference for the areas covered. This book will certainly remain at hand on my bookshelf, and I recommend it to my students.

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Opening our minds to conserve open spaces

Curtin, Charles G. 2015. **The science of open spaces: theory and practice for conserving large, complex systems**. Island Press, Washington, DC. xiii + 255 p. (paper) $40.00, ISBN: 978-1-59726-993-3 (acid-free paper).

Key words: collaboration; fragmentation; landscape ecology; resilience; scale.

In 1968 Allen Kneese, an environmental economist with the organization Resources for the Future, coined the term "problemshed" to describe the need to integrate varied disciplines and perspectives in framing "desirable institutional arrangements for environmental management" (Kneese 1968). Steven Born, emeritus professor of urban and regional policy at the University of Wisconsin-Madison, has often invoked the term to denote "a way of thinking more broadly about resource problems than geographic and ecological entities, e.g., recognizing external users, resource exports, problems spanning boundaries, etc." (S. Born, pers. comm.). The term occasionally resurfaces, especially in the realm of water policy and management. It may well find even broader use in the future, for it gets to heart of the matter: to solve complex problems and encourage resilience in our ecosystemic relations, we must learn to think and connect and act at the appropriate scale of time and space, and we must be able to think flexibly across all scales.

This is the essential premise of Charles Curtin's *The science of open spaces*. Curtin writes that "collaborative research, conservation, and resource stewardship plays out across different scales. …[and] understanding the implications of scale is key to sustaining social or ecological systems of any size." His focus is on large landscapes and their dynamic, interacting social and ecological processes. His term for this is *open spaces*, through which he seeks "to invoke not only the challenge of physical size but also of time, ecology, culture, and all elements therein. This is a fundamentally different approach to science that reconceptualizes both problems and solutions to generate more timely and effective means of addressing the conservation challenges we face today." In this, Curtin is both drawing upon and extending the interdisciplinary innovations of the last generation (landscape ecology, agroecology, conservation biology, ecological economics, etc.). And he taps into the common cause they share: countering the fragmentation of our landscapes, cultures, and understanding. He writes, "Ecological and social fragmentation are closely linked; it is impossible to sustain human culture and well-being when the ecological fabric in which they are embedded is diminished."

Curtin's text is studded with many such pithy observations. They emerge not only from Curtin's knowledge of systems science, hierarchy theory, and adaptive management; he has also distilled and field-tested them through his work as a place-based conservation biologist, embedded in communities struggling and aspiring to achieve sustainability. Curtin has worked with the science program of the collaborative, rancher-led Malpai Borderlands Group in the wide-open rangelands along the Arizona/New Mexico/Mexico boundary (full disclosure: so have I); and with collaborative fisheries management initiatives along the Maine coast. Two case-study chapters describe these places and experiences, providing the foundation upon which he constructs his conceptual framework.

Although heavily invested in these efforts personally, Curtin strives to step back for an objective look at lessons learned.

In the Malpai country, he found that science served a valuable role in bringing diverse people and organizations together, but that "the ability to develop effective ways of gathering knowledge, learning from mistakes, and sustaining programs requires institutions that can translate people's goals and values into concrete, meaningful action." That seemingly straight-forward conclusion reflects the difficulty of finding new ways to embed science in lasting and meaningful ways, among institutions (private, public, academic, non-profit, financial, etc.) for which research may not be a primary priority. Off the coast of Maine, the lessons reflected the challenges involved in effective governance of the commons. "[A] few simple rules and clear guiding principles" can provide the basis for "adaptive dynamics necessary to sustain large, complex systems," Curtin concludes. However, absent a shared understanding of such fundamentals and an internalized capacity to learn and grow, governing bodies risk "inadvertently institutionalizing existing pathologies."

Curtin builds upon these case studies in two broad-ranging chapters, Chapter 4, "Conceptual underpinnings for preserving open spaces" and Chapter 5, "Resilience and the sociological synthesis." In them he examines foundational concepts, weaving together many threads from ecosystem ecology, resilience theory, chaos theory, hierarchy theory, complex adaptive systems analysis, and other fields. Readers may be familiar with many of the principles and sources here: shifting baselines and trophic structures, system energetics, fractals, and the adaptive cycle model; Charles Elton, Aldo Leopold, the Odums, Gregory Bateson, Tim Allen, C. S. Holling, Fikret Berkes, Kai Lee, and Donald Ludwig (among others). Most readers, however, will not have put such effort into tracing the evolution, contrasts, and connections among these ideas and figures. One of the real strengths of Curtin's discussion is his appreciation of historical milestones and precedents to the cutting edge that he examines in the rest of the book. However, his presentation is not without its weaknesses and gaps. In particular, it would have benefitted had Curtin devoted more attention to Elinor Ostrom and other thinkers and theorists focused on the care of the commons (Ostrum receives only one brief mention). This is a bit ironic, as this book deserves to find an appreciative audience there.

In the concluding Chapter 6, Curtin comes back down to ground, addressing "Practical aspects of sustaining open spaces." In tracing the implications of his experience and his theoretical framework for conservation practice, Curtin builds upon a fine insight (or, as he calls it, a "fundamental paradox"): "relatively small-scale reserves are limited by biological constraints, large-scale landscapes by social and economic ones.. … [F[or the most part any natural area that is small enough to be easily managed will likely never be large or whole enough to be ecologically sustainable. "To resolve, or at least address, this paradox, Curtin offers a set of basic concepts (drawing upon the work of Donella Meadows) to inform "durable approaches to policy and managing open spaces:" recognize the significance—and mutability—of paradigms and values; define shared goals clearly; encourage self-organizing processes, rather than top-down ones; understand how rules (and the power structures that shape them) influence outcomes; keep open the connections between information and action; get to know your feedback loops; note that system changes and responses are a function of both temporal and spatial scales; and pay attention to the critical role that buffers play in managing (or mismanaging) systems. These concepts (and the design principles and pitfalls that Curtin draws from them) may seem more abstract than practical, but they will ring true for anyone who has shared his experience of pursuing collaboration in the conservation of large landscapes.

Scientists, theorists, conservationists, policy-makers teachers, and students alike will find *The science of open spaces* useful and challenging. I hope especially that economists hoping to interact more productively with ecologists and conservationists within our shared *problemsheds* will also take time to absorb it. It is the kind of book that, as one reads, one bounces one's own experience off of it. I suspect this is what Curtin hoped for in writing it: like most of us, he has sought to make the most of his personal experience as a scientist concerned with the conservation of open spaces, and striving to see clearly through complexity. His effort, and the results he presents, will strongly resonate with readers.

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Spotlight

Recent Publications of Interest

Duellman, William E.. 2015. Marsupial frogs: Gastrotheca & allied genera. Johns Hopkins University Press, Baltimore, Maryland. xv + 407 p. $120.00 (hardcover), ISBN: 978-1-4214-1675-5. This comprehensive book provides keen insights into the ecology and evolution of marsupial frogs. Until recently the taxonomy and ecology of Gastrotheca and its allies was poorly understood; given the important role of frogs as indicators of biodiversity and vulnerability to global change, this book provides a useful resource.

Berta, Annalisa. 2015. Whales, dolphins & porpoises: a natural history and species guide. The University of Chicago Press, Chicago, Illinois. 288 p. $45.00 (cloth), ISBN: 978-0-226-18319-0. This handsomely illustrated compendium of the natural history and behavioral ecology of ninety cetacean species includes accounts of recently discovered species, such as Omura's whale (*Balaenoptera omurai*). Habitat and range maps also depict migration corridors; figures include illustrations of species-specific dive patterns and other distinguishing behaviors.