section is the lack of discussion of recent progress related to how vertebrate, nonhuman animals (mammal, birds, and fish) interact with toxins. Inclusion of these examples would have provided a tighter link between natural coevolving arms races in wildlife and those emerging in humans that would benefit audiences. In addition, the focus on cytochrome P450 (CYP) detoxification enzymes as the major animal defense against toxins, although warranted because of the great amount of research on them, may present a biased view to readers that this is the most important defense. Readers should be aware that the evolution and function of alternative detoxification pathways in vertebrates (e.g., conjugation pathways) can have synergistic and potentially more important implications for understanding toxicity than CYPs. Despite these few oversights, the chapters and content included in the second section provide compelling evidence consistent with the ultimate theme of the book—that there has always been and will continue to be a coevolutionary battle between toxins and defenses against those toxins.

Part 3 provides an overview of how humans contribute to toxic overloads and how the environment responds. It describes the emergence of evolutionary toxicology as a discipline based on studies documenting the rapid genetic adaptation of wild species to toxic overloads caused by humans. This section highlights the disturbing rate of formation and accumulation of toxins, many of which are not regulated. This section paints a bleak picture of the fate of humans and wildlife to toxins based our past and future contribution to toxins in the environment. There are few solution proposed. Instead, the section proposes that new methodologies such as proteomics and toxicogenomics and the consideration of individuals, populations, communities, and ecosystems will offer some of the answers we need to combat future toxic overloads.

Woven throughout the chapters is the common theme that although the source, composition, concentration, and distribution of chemicals may vary, the cause of toxicity is always due to an overwhelmed defensive network. Understanding the mismatches between toxins and defenses is key to predicting devastating consequences to toxins by organisms. This book provides the starting dialog that is needed between evolutionary ecologists and toxicologists if we want to be prepared for our future toxic world (e.g., green chemistry and nanoparticles). The book provides a suite of difficult questions and leaves the answers to those questions up to the next generation of evolutionary toxicologists—who hopefully read this book.

The book should appeal to a broad audience and will spur future interest in the fields of evolutionary toxicology. The well-written historical accounts of common toxicants and the concise writing will stimulate interest in toxins and defenses by the general public. Yet, there is enough content and detail to keep students of ecology, evolution, molecular biology, environmental biology, wildlife biology, geology, chemistry, and toxicology interested. For example, ecologists will be introduced to potentially novel concepts such as the defensome (the network of molecular defenses against toxins that maintain homeostasis), hormesis (opposite responses to high and low concentration of toxins), attractor state (adaptive capacity of cells to switch between states or function), and the "toxome" (a comprehensive catalog of the genetic mechanisms and pathways of toxicity) that can help test hypotheses related to chemical interactions among soils, plants, herbivores, predators, and the environment. Likewise, toxicologists will gain from understanding the evolution of toxins and the body's defense mechanisms to better understand and predict individual variation in responses to toxins. Expert researchers and novices will all benefit from digesting the multidisciplinary perspectives, highlighted examples and future research questions, and concerns that prevail in each chapter. In every section, there are ample references provided for more in-depth investigations of specific topics. Finally, instructors of organismal biology, earth science, and toxicology will find many interesting examples in this book, specifically in the appendix, to complement lectures or to serve as a foundation to stimulate more in-depth discussion of evolutionary toxicology in upper-division courses.

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Individual-based modeling for the masses

Railsback, Steven F., and Volker Grimm. 2012. **Agent-based and individual-based modeling: a practical introduction.** Princeton University Press, Princeton, New Jersey. xviii + 329 p. $99.50 (cloth), ISBN: 978-0-691-13673-8 (alk. paper); $55.00 (paper), ISBN: 978-0-691-13674-5 (alk. paper).

Key words: agent-based modeling; ecological theory; emergence; individual-based modeling; modeling environments.

In 2005, Volker Grimm and Steven F. Railsback published *Individual-based modeling and ecology* (Princeton University Press, Princeton, New Jersey). While certainly not the first monograph on the topic of individual-based modeling aimed at ecologists, Grimm and Railsback's book emerged at a time when the approach was being more broadly applied and the field was in need of clear conceptual framing. Individual-based models (IBMs)—based on computer simulation of virtual worlds in which individuals interact with each other and components of their landscape—have been employed in both the natural and social sciences ever since computers became powerful enough to run them. This recent and disparate emergence of the field caused individual-based modeling to become a diverse cacophony of approaches, confusing enough to lead some to question the potential value of IBMs. Grimm

and Railsback's 2005 monograph was in large part aimed at preserving the value of the field by suggesting some standard traits of and techniques for individual-based modeling, but nonetheless conceded that: "In contrast to classical theoretical ecology, which is based on calculus and other established mathematical techniques, the procedures and tools for individual-based modeling are still too experimental to be presented in textbook fashion."

Seven years later, these authors have published a textbook, *Agent-based and individual-based modeling: a practical introduction*. What has changed to make an IBM textbook more feasible? Primarily it is the maturation of the field: while individual-based approaches certainly have not reached their full potential, their prevalence, relevance, and overall quality have all increased greatly in recent years. Grimm and Railsback's 2005 monograph has also been influential, as it brought a new generation of ecologists into the individual-based modeling community. The book also served to popularize what the authors call "pattern-oriented modeling," a technique used to refine both the structure and parameterization of IBMs and avoid overfitting. But there have also been two more specific developments that make now the right time for the release of a textbook designed to bring the techniques of individual-based modeling to a larger audience. The first development, the introduction and refinement of the ODD (Overview, Design, Details) protocol, has provided a common means of formulating and communicating IBMs. The second development, the maturation of the NetLogo modeling environment (http://ccl.northwestern.edu/netlogo/), has provided both researchers and teachers with an accessible-yet-powerful platform on which to build IBMs. Appropriately, the ODD, NetLogo, and pattern-oriented modeling form the backbone of *Agent-based and individual-based modeling*.

This textbook's well-crafted design begins with its overall organization. The book is divided into four parts that:

(1) introduce the reader to individual-based modeling as a form of scientific inquiry, the basics of the ODD protocol, and getting started in NetLogo;
(2) use the design concepts underlying the ODD to teach readers how to build their own models using NetLogo;
(3) provide the reader with experience in pattern-oriented modeling; and
(4) guide the reader through the process of model analysis.

It is clear that a lot of thought went into the structure of this book, as it effectively builds the understanding and skills required to do research using IBMs. I found the use of the ODD as an organizational frame for the second part of the book to be particularly valuable: progressing through these chapters, one gains a clear understanding of each of the design principles underlying the ODD. Each chapter is consistently organized, laying out learning objectives before providing core content, NetLogo-based modeling activities, and exercises that structure student learning and reinforce skills learned in earlier chapters. Although not crammed with cited literature, there are plenty of leads in the references that can serve as a beginner's reading list.

It is hard to imagine this textbook existing without NetLogo. A project distinct from the work of Railsback and Grimm, NetLogo is the brainchild of computer scientist and learning researcher Uri Wilensky. Designed generically for use by both natural and social scientists, NetLogo is a potentially powerful environment for building IBMs that is well-documented, very user-friendly, and relatively easy to learn. What *Agent-based and individual-based modeling* does with NetLogo makes this an effective textbook. The defining problem of teaching individual-based modeling has to do with the logistics of IBM formulation: they must be programmed. Whereas it may be a safe assumption that your students have a background in calculus and therefore can grasp the underlying principles of state-variable modeling, most students do not arrive in ecology programs knowing how to program. A course in individual-based modeling therefore faces a serious dilemma: it must teach enough programming to allow students to actually implement IBMs, but it also must not get bogged down in the process of learning a particular programming language and its inevitable complicating details. This textbook walks this line with agility, in part due to being able to rely on the availability of NetLogo's extensive tutorials and documentation, and in part due to very careful selection of programming activities (including exercises affording diverse possibilities for homework or laboratory assignments) that build student confidence and competence. The result is a curriculum that allows students to fully explore the critical concepts underlying the individual-based approach to modeling while gaining familiarity with and confidence in an IBM programming environment.

The inquiry-based approach of *Agent-based and individual-based modeling* makes it attractive to me as both a learner and a teacher. Ecology is often difficult to teach experientially. Because large temporal and spatial scales mediate many ecological processes, ecology educators end up doing far more story telling than experience-creating. Railsback and Grimm have clearly grasped the potential for IBM formulation to give students direct experiences (albeit virtual) with ecological principles. As such, in the hands of an ecologist this book could enable coursework that is about far more than the specific pursuit of IBMs: there is much to be learned about ecology and ecological modeling in general by going through this textbook's exercises. While this textbook attempts to be generically applicable to all fields that employ IBMs (in part through predominant use of the term "agent-based model"), the ecological pedigrees of its authors are apparent throughout most of its exercises, so this textbook should be easy to use within an ecology curriculum.

The book is written and laid out with the same purposefulness, brevity, clarity, and intuitive feel we expect from our best models. Each guided programming exercise is made clear by effective layout, and the textbook is rich with graphics, tables, and figures that help illustrate key ideas and assignments. I also really appreciated the humble and friendly tone struck by Railsback and Grimm, who make the reader feel as though anyone can become an effective IBM researcher. Although I did not find any glaring errors in my reading, the textbook is accompanied by a dedicated website (http://www.railsback-grimm-abm-book.com) that provides errata as well as supporting materials such as sample models, reading lists, and even a few sample exercise answers.

Are there any major flaws in this textbook? From my vantage point the answer is no, but I can envision a substantial group of prospective users who may balk at the high level of commitment demanded by this text. This is not the kind of textbook you can lean too heavily on as an instructor, as it demands a strong working understanding of NetLogo programming and the willingness to allow one's students to work in a less structured classroom. Unless your students (or you as a solo learner) are planning on actively using the programming skills demanded by this text, there may be more efficient ways to learn the basics of this modeling approach.

Who should use this textbook? It is certainly ready to be picked up by anyone with an interest in learning how to implement and analyze IBMs, as the book was designed primarily with the new learner in mind. Established researchers and graduate students looking to add IBMs to their modeling

repertoire (and who take the time to work through the book's many exercises) will certainly find it a valuable teacher. In the hands of a teacher who already works with IBMs, the book will be especially valuable: Railsback and Grimm have done the heavy lifting required to establish a solid IBM course by providing a carefully crafted inquiry-based curriculum. This accomplishment removes a major impediment to the proliferation of IBM courses. Although the book seems aimed at a graduate-level course, I also do not see why an ambitious teacher with motivated students could not use this textbook as the basis of an upper-level undergraduate course in individual-based modeling. *Agent-based and individual-based modeling* has the potential to foster an appreciation of the value and place of individual-based models in our field in the next generation of emerging ecologists (who already have computational leanings).

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Attempting to solve the disconnect between humans and nature with plant-based drugs

Rogers, Kara. 2012. **Out of nature: why drugs from plants matter to the future of humanity.** University of Arizona Press, Tucson, Arizona. vii + 204 p. $19.95, ISBN: 978-0-8165-2969-8 (alk. paper).

Key words: biodiversity conservation; human-environment interaction; plant natural products.

Out of nature seems at first to be a discussion of plant natural product drug discovery written for the general public and as such would have been a highly useful book. Upon further reading, however, the reader will soon wonder where the discussion is going as we are taken from a cursory overview of plant drug discovery into how plant drugs will solve the disconnect between humans and their environment. The prelude could have been utilized to walk us through the author's thought processes but instead was used to discuss sailing on Lake Michigan before briefly explaining the premise of the book.

As expected by the title and the description, the first chapter of *Out of nature* does delve into natural products drug discovery from plants. Unfortunately, the chapter is rife with slightly inaccurate statements. In one example the author states, "Although total synthesis of Taxol likely will never be possible, due to the cost of materials and the complexity of synthesis, partial synthesis using needles rescued the Pacific yew from overharvesting and eliminated at least one threat jeopardizing the habitat of the northern spotted owl." Several total syntheses of Taxol have been achieved, although semi-synthesis from an intermediate isolated from the bark of the European yew is the methodology used to prepare the quantities necessary for clinical use. In another example, the author states, "While there are new, modified compounds shuffling in to replace the old ones, novelty—the discovery of compounds with new core structures—is very rare." Again the author slightly misses the point in that compounds with new core structures are found with relative frequency in nature but that due to patenting issues pharmaceutical companies will often pursue related compounds to extend the patent life. At other times the author trivializes larger and more complex issues, such as with this statement, "Structural diversity is the key to preventing the emergence of resistant organisms, but this was only beginning to be understood at the time." Although structural diversity plays a role in bacterial resistance, the evolution of resistant organisms involves a much more complicated interplay of chemistry and biology.

It is in Chapters 2–4 that the reader is left wondering if the book has been mistitled. It is not that the title is entirely inaccurate but perhaps misleading. If the reader steps away from preconceptions of this book's topic, the writing style and topics of these next three chapters are quite engaging, if perhaps a bit overbearing at times. This portion of the book begins by detailing the relationship that humans have with plants in the context of history, exploration, botany, and ecology. The next chapter discusses biophilia, the concept that humans have an innate love for nature, and although there are some intriguing issues raised, the chapter at times comes off as contrived and leaves the reader again wondering what this has to do with medicines from plants. The following chapter continues this trend by discussing gardening history and garden design, and ends with a discussion of the U.S. National Park system. At best this chapter does not belong in a book about drugs from plants and at worst the writing is disorganized and several of the discussions are misleading. Before returning to a drug discovery focus, Chapter 4 discusses species extinction in the context of human impact, although there is some discussion of gingko extracts and compounds therein.

The fifth chapter is entitled "Out of nature" and gets back to the original premise of the book. There is a good, if brief, discussion of herbal medicine followed by an enumeration of several compounds from plants that have become drugs used in modern medicine for various diseases. The following chapter begins with a discussion of patents and bioprospecting, including highlighting the International Cooperative Biodiversity Groups (IGBG) funded by the National Institutes of Health, the National Science Foundation, and the United States Department of Agriculture. There was mention of some of the troubles with the Mayan ICBG (e.g., unfounded accusations of biopiracy brought by a nongovernmental organization), and the author also highlighted the technology transfer and biodiversity conservation efforts of the Panama and Madagascar ICBG programs. There is then a brief discussion of the regulation of botanical dietary supplements and the Dietary Supplement Health and Education Act