BOOK REVIEWS

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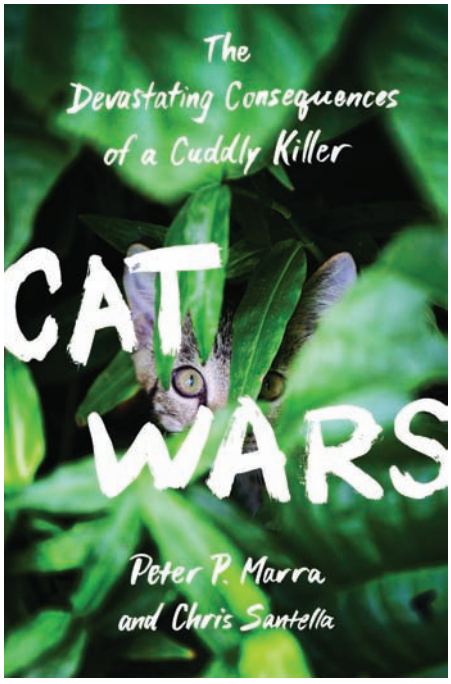

ECOLOGY

Cat Wars: The Devastating Consequences of a Cuddly Killer. By Peter P. Marra and Chris Santella. 2016. Princeton University Press. (ISBN 978-0-691-16741-1). 212 pp. Hardcover. $24.95.

A book all about cats? Whether you love them or not, this book will enlighten you about the complex issues surrounding these "cuddly killers."

Cat Wars provides a case study on the impact of an invasive species on biodiversity, infectious diseases, and the ethical issues involved in sacrificing the well-being of one species for another. In so doing, this book could appeal to educators from a variety of backgrounds.

The authors begin with a history of the impact of pet-loving humans on the rise in the global free-ranging cat population. Domestic cats (*Felis catus*) are nonnative to many of the areas they inhabit. In fact, as the authors point out, domestic cats are on the "list of the world's 100 worst invasive alien species" (p. 21), as it is estimated that they have "contributed to or caused thirty-three (14 percent) of the 238 global reptile, bird, and mammal extinctions" (p. 20). The authors cite historical accounts and scientific studies regarding the impacts of cats on biodiversity. The exact number of animals killed by cats each year is difficult to estimate, as the number of free-ranging cats is unknown. The authors provide excellent examples of population modeling as they seek to quantify the impact. Educators will find that *Cat Wars* provides them with concrete and current examples of biodiversity, extinction, and population modeling to which students can easily relate.

In addition, the authors explore the domestic cat as "agents of disease" (p. 75). From the plague (*Yersina pestis*) to possible contributions to some cases of schizophrenia (*Toxoplasma gondii*), cats have been implicated in transmission of disease. While the authors provide a summary of the roles of cats in the transmission of the plague and rabies, they focus heavily on cats as the primary host of the protozoan *Toxoplasma gondii*. They discuss parasite-host interactions, parasite life cycles, predator-prey interactions, and public health. They investigate the possibility that *T. gondii* may manipulate the behavior of infected rats and mice, thereby overriding their innate aversion for the predator cat and increasing the likelihood of cat infection and, therefore, parasite survival. The book, and the studies cited within it, provide opportunities for educators to discuss infectious diseases and public health in the context of a subject with which students will already have some familiarity.

Finally, the authors explore the controversy surrounding different strategies for controlling the exploding cat population worldwide and the devastating effects they are having on biodiversity, especially with regard to bird populations. The ethical dilemma of euthanasia as an option, as well as the less effective trap-neuter-return strategy, is discussed. In *Cat Wars*, the authors bring to life the real issues facing scientists and society when it comes to bioethics, preservation of species, and public health.

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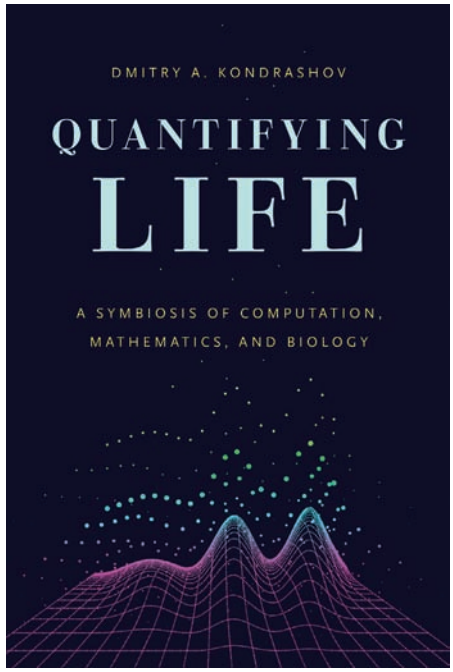

MATHEMATICS AND BIOLOGY

Quantifying Life: A Symbiosis of Computation, Mathematics, and Biology. By Dmitry A. Kondrashov. 2016. University of Chicago Press. (ISBN 978-0-226-37176-4). 417 pp. Softcover. $35.00.

Imagine a textbook. Is it more of a tome than a book, heavy and daunting in its unwavering claim to knowledge? Most textbooks are, which

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is likely why so many are struggling to find relevance in today's nimble world of digital media and online education. Sure, the Internet requires some work to sift out reliable sources, but its conveniences and ubiquity are continuing to win out over printed text. As you surely know, this trend has made its way into classrooms too, where a single resource is less common than ever, and teachers are being asked to assemble courses all their own. Now back to that textbook you are imagining. Do you really want to invest yourself and your students in it? Dmitry Kondrashov's *Quantifying Life* makes a compelling case that in spite of all of this, you really should.

Let's step back for a moment, to the spring of 2013, when famed biologist E. O. Wilson published an essay in the *Wall Street Journal* with the punchline that "discoveries emerge from ideas, not number-crunching." He touched a nerve, mine included, in arguing that scientific and quantitative intuition are not only distinct, but should be fostered separately. *Quantifying Life* begins with the words of Siddhartha Mukherjee: "science begins with counting." If you too believe that the descriptive nature of science is inherently quantitative, and want to begin exploring what that really means, I implore you to give Dmitry Kondrashov's symbiosis of computation, mathematics, and biology a chance.

Weighing in at just over 400 pages, *Quantifying Life* manages to feel more like a novel than a textbook in your hands. And to my delight it reads more like one too, somehow managing to be conversational and approachable without sacrificing rigor. It is divided into four general sections, each involving tools to quantify more complex forms of life than the last. Kondrashov first tackles single variables, from simulating random numbers to plotting their dynamics, before scaling up to relationships between variables. The final two sections are devoted to entire systems of variables and understanding their behaviors, first with chains of variables moving discretely through time, and then finally as differential equations that describe variables changing continuously. Each of these is in turn divided into chapters with their own sets of learning goals and hands-on programming exercises to grapple with. All together these sections feel like a traditional textbook, but references between chapters act more as interesting connections than prerequisites. In this way *Quantifying Life* can serve as that first reference you reach for when your brow furrows just as easily as source material for that quantitative unit you've always wanted to teach. And for those just looking to curl up with a good read, its cadence and refusal to turn into dense blocks of text or incomprehensible equations will quickly have you lost in thought, conjuring up models of life and tests of reality.

Dmitry Kondrashov has written a Jack-of-all-trades textbook that is as interdisciplinary in its approach to education as it is in its broadly interdisciplinary subject matter. Most wonderfully, this remains true for more than just teachers. Are you a high school student looking to connect the dots between your science and math classes? *Quantifying Life*'s gentle from-the-ground-up approach to integrating programming and mathematics with biology is just what you've been searching for. Are you a graduate student in the life sciences feeling that ever-stronger pull toward quantitative methods? *Quantifying Life*'s intuition and application-oriented approach can help embolden you to bring statistical and computational rigor into your research. Or are you just secretly jealous of modelers you read about, always churning out equations and code, but get anxious at the thought of teaching yourself basic statistics? Again, *Quantifying Life*'s conversational tone and unpretentious style can help ferry you through the foundations of modern modeling without you realizing how advanced the topics actually are. Most miraculously, no matter how you come to this book, it feels coherent and on point, somehow avoiding becoming a master of none.

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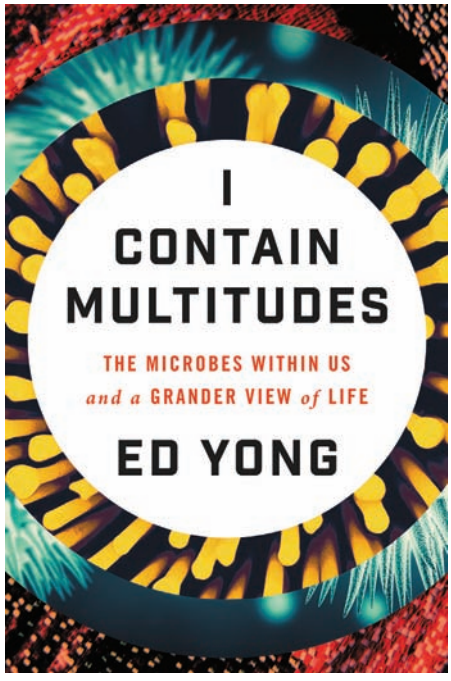

MICROBIOLOGY

I Contain Multitudes. By Ed Yong, 2016. Ecco/Harper Collins Publishers. (ISBN: 978-0-06-236859-1). 368 pp. Hard Cover. $27.99.

"About microbes & quoting Whitman, 'I Contain _____.'" was the $2000 clue in the "Complete the Title" category on the January 2, 2017, episode of television game show *Jeopardy*. Contestant Katie Carter's correct answer was "Multitudes." Having just started to review this book, I realized that its reference on the show indicated that it had already become a part of our literary culture.

Throughout most of its history, Earth's only life was microbial. Today we tend to think of nature as a vast and diverse interactive collection of plants and animals all over the planet. Actually, we share Earth with uncounted numbers of microbes, from the deepest ocean trenches to the clouds in the sky. There are more bacteria in a human gut than stars in our galaxy. People often hold the stereotype that all microbes are germs, signs of filth, and sources of dreadful diseases. Most, however, are non-pathogenic, and many are valuable to us. Numerous species exist in symbiotic relationships with the bodies of plants and animals and are the rule rather than the exception. Scientists now realize that, instead of focusing on solitary organisms, microbes must be studied as "communities living in habitats," specifically host organisms.

This book could change the way we think about microbes by unlocking a wealth of fascinating information on ways they are involved in the lives of animals. A sample of just a few things that most people don't realize about microbes might include the following. Bacteria help maintain the blood-brain barrier by forming cell clusters that block large molecules and living cells from passing into the brain. Microbes convert some insects from one gender to another. In humans, the villain-hero *Helicobacter pylori* causes ulcers and stomach cancer but protects against esophageal cancer. For a baby to get the most nourishment from breast milk, the bacterium *Bifidobacterium infantus* must be present. Tropical diseases like elephantiasis and river blindness are caused by nematodes, but it is the symbiotic bacteria released from the nematodes that trigger the immune response in the host, producing the disease symptoms. Many gut microbes involved in digestion contain genes swapped with other species through horizontal gene transfer. Changes in the human microbiome may be involved in obesity, allergies, kwashiorkor, marasmus, and inflammatory bowel disease (IBD). The immune system is not directed by genes alone, but microbes help to shape it and