

## PARADIGMS UNDEFINED

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## Tooth and Claw

**Antipredator Defenses in Birds and Mammals.** Tim Caro. University of Chicago Press, Chicago, 2005. 591 pp., illus. \$38.00 (ISBN 0226094367 paper).

**P**redation is an important factor shaping the natural world around us. Very few animals are neither predator nor prey. It is stating the obvious to say that being preyed on has a detrimental effect on the fitness of an individual, but even the threat of predation can have a major effect on reproductive fitness. A lucky rabbit may live to grow old and die peacefully in its sleep, but you can be certain that a large part of its life was taken up with vigilance against the fox, time that could perhaps have been spent gathering food or finding a mate. It is thus no surprise that antipredatory adaptations are both commonplace and diverse.

These adaptations do not get the attention that their ecological and evolutionary importance deserves, and I'm not certain why. It may be that because they are so much the stuff of elementary ecology courses, many mistakenly think that antipredatory defenses are well understood and that no exciting and important work remains to be done in this field. It may be that we prefer not to think about just how "red in tooth and claw" the natural world is. Or it may be that many researchers are put off by the ethical challenges of studying predation in the laboratory and the logistical challenges of studying something as unpredictable in time and space as predation in the field. No matter why, there is a mismatch between the importance of predation and its ability to attract bright minds and research funding. I hope this excellent book goes some way to changing this.

In a sense, this book does exactly what you'd expect from the title, *Antipredator Defenses in Birds and Mammals*: It provides a comprehensive overview, available nowhere else, of the antipredatory defenses of these two very intensively studied groups of animals. One of the reviews

excerpted on the volume's back cover describes it as encyclopedic, and in a sense this is true; I've had it for six months, and every time I've reached for it to check on something, I've found what I was looking for. This book is comprehensive, but it also goes beyond thorough cataloging. The author, Tim Caro, provides a strong overarching structure that helps readers understand the question of why an animal might evolve one defense in preference to another. This structure comes from the highly influential framework of John Endler, which breaks the predation event down into a sequence of situations, starting before the predator has even detected the prey, and moving through detection, identification, pursuit, capture, subjugation, consumption, and even postingestional consequences for the predator. Hence a recurrent theme of the book is that defenses can be truly understood only in comparison to plausible alternatives and in the context in which they are deployed in the sequence of predation. The book gathers further conceptual strength from the author's willingness to go beyond the headline conclusions of published works, and to take the bones of data collection apart to see how the conclusions stand up. Finally, the book ends with a bold and thoughtful chapter on the author's vision for the way ahead for research in this area. This chapter alone justifies the modest cover price of the book.

It seems logical to ask why the author has confined himself to birds and mammals. I think some specialization is necessary if proper depth is to be maintained. I was recently involved in writing a book that also explored antipredator defenses (Ruxton et al. 2004), and we confined ourselves to a small subset of antipredator adaptations (crypsis, warning signals, and mimicry), in the hope that three authors could possibly gain some mastery over the relevant literature. As a single author with an interest in preserving his sanity, Caro had to specialize. He is currently a professor in the Department of Wildlife, Fish and Conservation Biology

and the Center of Population Biology at the University of California; his research has mostly been concerned with large mammals. He has been personally involved in some of the most influential works on antipredatory traits in this group. It was logical to extend the focus to birds, since birds and mammals share many antipredatory traits, and birds are probably the most studied group when it comes to antipredatory defenses. By specializing in these two taxa, Caro could gain mastery over a diverse literature, giving appropriate attention to the latest breakthroughs and to often-neglected earlier works. Further, Caro is not overly strict in his taxonomic specialization. Where vital works in support of his arguments come from taxa other than birds and mammals, he sensibly admits these, while staying true to his main taxonomic focus.

In short, this book is clearly and intelligently written by someone with a broad understanding of antipredatory traits in diverse taxa. It could be read with profit by active researchers in predation looking for stimulation; by those with a more general interest in mammals and birds who are looking for a readable, reliable, and comprehensive reference in this area; and by undergraduates in courses related to ecology and animal behavior. The thoughtful text is well supported by highly appropriate graphs, diagrams, and tables selected from the relevant primary literature, and by a comprehensive set of indexes. I can think of no better recommendation than the considerable number of my colleagues who have bought their own copy after having found themselves reluctant to ask me yet again to lend them mine!

GRAEME D. RUXTON

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## Reference cited

Ruxton GD, Sherratt TN, Speed MP. 2004. *Avoiding Attack: The Evolutionary Ecology of Crypsis, Warning Signals and Mimicry*. Oxford (United Kingdom): Oxford University Press.



## THE BIG SLEEP

**Life in Ancient Ice.** John D. Castello and Scott O. Rogers, eds. Princeton University Press, New Haven, CT, 2005. 336 pp. \$69.50 (ISBN 0691074755 cloth).

**L**ife in *Ancient Ice*, edited by John Castello and Scott Rogers, arose from an international workshop of the same title in 2001. Despite the time that has passed since the original workshop, the issues and content discussed in the book are still current. Nineteen chapters follow the introduction, with subjects that range from the types and sources of microbes in polar environments (including permafrost, glacier, and lake ice) to the types of organisms found within ice cores. The authors discuss issues such as the contamination, preservation, and viability of microbes, including viral pathogens, and the use of icy ecosystems on Earth as analogues for those potentially on other extraterrestrial bodies.

A reader new to the topic will be impressed by the myriad of microbial life forms that exist in present-day icy environments, such as the ice cover of the lakes of the Antarctic Dry Valleys, the sea ice around Antarctica, and permafrost around the globe. A more *au fait* reader will be impressed that cryopreservation of viable organisms can approach timescales of hundreds of thousands or millions of years. For example, fungi may stay viable for 400 thousand years in Antarctic ice, and yeasts in Siberian permafrost may be viable after 3 million years. These assertions are likely to stimulate the imagination of new researchers, who could perhaps think laterally about the potential of ice cores in the study of evolutionary biology and the extraction of commercially exploitable chemicals,

such as antifreeze proteins, anticancer drugs, and antibiotics. The fact that some of these long-stored yet viable organisms are not true psychrophiles, or cold-adapted organisms, further sparks the imagination and curiosity. Finally, those with a keen research interest in this area will eagerly scour the book for information on protocol (e.g., obtaining ice core samples without drilling fluids to minimize contamination), new literature, new methodologies, and the easy proximity of comparative data on a variety of microbes to give them an edge with new grant applications.

It is the nature of a book with chapters by a number of authors that some of the text is more polished than other parts, and that different chapters will resonate with different readers. My personal favorites are the chapters on cyanobacteria in lake ice cover by Priscu and colleagues and on fungi in glacier ice by Ma and colleagues, and the chapters on yeasts, fungi, and phototrophs in permafrost by Faizutdinova and colleagues, Ivanushkina and colleagues, and Vishnivetskaya and colleagues, respectively. These make the reader think outside the box. The new norm is to expect ice to act as an ecosystem as long as liquid water, whether at freezing point or supercooled, is present. The new norm is also to expect cold ice masses to act as a repository for potentially viable ancient organisms. The jury seems to be out at present about the longevity of preservation. The chapters on yeasts (by Sarmer and colleagues) and viruses (by Castello and colleagues) in ice cores in Greenland confirm this new norm, and the potential preservation of viral pathogens of humans in ice sheets (by Shoham) is a logical progression. It is one that requires careful consideration. Christner and colleagues document the characteristics of bacteria found in a range of ancient ice cores, showing how

their properties help them to remain viable in what would otherwise be thought to be an inhospitable environment.

The material in this book is both stimulating and challenging. The concluding chapter by Castello and Rogers cautions that many, but not all, of the microbes found in ice cores may be contaminants. The challenge for the next generation of ice core microbiologists is to convince their own community that the coring methodology and ice sample treatments are rigorous, and that the very low numbers of microbes found are indeed representative of those in uncontaminated ice. My hunch, as an interested geochemist, is that viable organisms are preserved in ancient ice, and that the coming decade will see a proliferation of new work to corroborate the view of Castello and Rogers.

MARTYN TRANTER

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## PARADIGMS UNDEFINED

**Ecological Paradigms Lost: Routes of Theory Change.** Beatrix Beisner and Kim Cuddington, eds. Elsevier Academic Press, Burlington, MA, 2005. 464 pp., illus. \$79.95 (ISBN 0120884593 paper).

**T**he genesis of *Ecological Paradigms Lost*, according to editors Beatrix Beisner and Kim Cuddington, took place in a conversation with a graduate student at an ESA meeting where the editors were “dismayed” at the student’s lack of historical knowledge. Beisner and Cuddington argue that an understanding of a discipline’s history is important. An ignorance of history can lead to the repetition of past mistakes, which is an inefficient way of advancing knowledge. Moreover, knowledge of history better equips scientists, policymakers, and citi-

zens for the present, providing us with rich tools and understanding.

With these ideas in mind, the editors formed two goals for the volume. First, prominent ecologists would provide historical overviews of changes in the theories of different ecological sub-disciplines. Second, the editors would address the question of whether the paradigms underwent categorical shifts as they developed, or whether they simply became more complex over time.

These are admirable goals. Historical analysis is difficult, and it can be difficult to justify its study to students (or to busy researchers). The ignorance that Beisner and Cuddington deplore may be as common among their peers as among graduate students; I am as guilty as anyone else of having too poor an understanding of the history of the disciplines I tread.

Beisner and Cuddington organized a lineup of treatises on population modeling, epidemiological models, the

stability–diversity debate, evolutionary ecology, and ecosystem ecology, pairing prominent ecologists with philosophers to lay out the rise and fall of paradigms. The inclusion of the philosophers seemed like a stroke of genius: I hadn't really known that philosophers considered our science at all, much less that more than one could be found to comment upon it. By page 5, my excitement had grown at the prospect of a historical compass.

By the beginning of the first section, my excitement began to wane. In fact, aside from a notable uptick 200 pages later, courtesy of Eric Pianka and Henry Horn (chapter 11, "Ecology's Legacy from Robert MacArthur"), my excitement declined for the next 400 pages. I won't quantify when the excitement strayed south of zero.

Unfortunately, the standard I use for books about about paradigm shifts in science—*The Ice Finders*, by Edmund Blair Bolles—was too high to allow me to read *Ecological Paradigms Lost* without disappointment. *The Ice Finders* is a short text that chronicles the ideological battles between Louis Agassiz and Charles Lyell regarding continental glaciers. Set in a time when scientific explanations were rapidly replacing biblical explanations for natural phenomenon, Bolles's book lays out in incredible detail the exchanges between the two, and in rich detail we witness Lyell's theory collapse as Agassiz's rises. I have read nothing that better captures the pique of scientists as they grapple with competing theories.

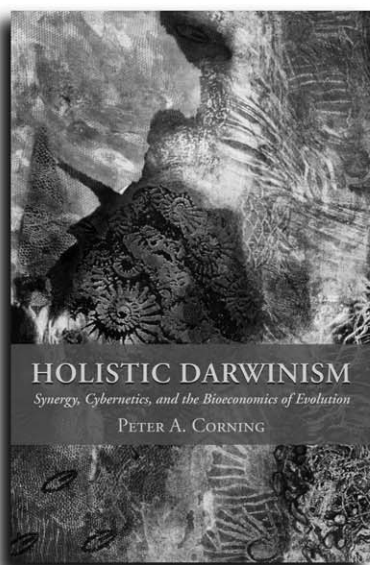
At the end of *Ecological Paradigms Lost*, the editors state that the main lesson learned from the previous sections was that "Kuhnian paradigm shifts rarely occur in ecology and that theory development is best described as an evolutionary process, which can lead to a multiplicity of approaches." A better summary is that the authors hadn't identified any paradigm shifts. The editors create a dichotomy between paradigm shifts and evolution of paradigms, but it might be premature to assume that paradigms evolve.

More important is the question of why paradigm shifts were not discovered. The editors all but state that the book's findings should be considered a null result. In

# HOLISTIC DARWINISM

*Synergy, Cybernetics, and the Bioeconomics of Evolution*

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part 2, two scientists provide opposing viewpoints on approaches to modeling, and then a philosopher comes in and states that both approaches are useful. The tensions discussed don't define opposing paradigms and have little bearing on the development of paradigms. Something similar happens in the next section regarding epidemiological models. Unanswered is the question of whether these mathematical models really reflect our conceptual models and the criteria used to substantiate a paradigm shift. For the stability–diversity debate, we learn about how much of the debate was produced over differences in how stability was defined. Definitional shifts occurred, but not paradigm shifts.

I agreed with much of the editors' summary. For example, by the time I arrived at the section on ecosystem ecology (my bread and butter), I didn't even care about the topics reviewed (T. F. H. Allen and colleagues discuss "the observer–observation complex," Garry Peterson describes "resilience analysis" in ecosystem management, and Kevin de Laplante discusses postmodernism and postnormalism) or the gaps in the discussion (I didn't once find the words "carbon" or "nitrogen"). The analysis of paradigm shifts just wasn't working.

In part, this book got ahead of itself. Before discussing paradigm shifts, the paradigms themselves need to be carefully described. Assessing the paradigms in *Ecological Paradigms Lost* is difficult because the concept of paradigms isn't even defined until page 420, and then only as "a particular way of doing science in a given subdiscipline." I'm not a philosopher, but that just didn't match my understanding of paradigms as sets of interrelated assumptions on the functioning of a system that form a conceptual framework. With paradigms themselves so poorly defined, no wonder it was hard to evaluate whether paradigms had shifted. In many respects, the authors don't discuss paradigms; they generally discuss methodology, approaches, or individual assumptions.

The question that needs to be asked first is not whether ecological paradigms shift, but what the paradigms are. It is clear that paradigms in this field are hard

to define. Are there really (or were there ever) competing paradigms in ecology, or are there just a lot of people who believe different things?

Each section of *Ecological Paradigms Lost* certainly has something to offer the specialist. The Pianka and Horn chapter is the only one I would recommend universally. The chapter is an unpretentious and personal account of the authors' relationships with Robert MacArthur and the legacy of respect, encouragement, and thoughtfulness he left behind. From these two writers, we get a glimpse of how both, with MacArthur, helped define theories. In their anecdotes, we get a glimpse of how ecological paradigms might shift. If this book had been filled with personal narratives that discuss how ideas are generated and how one's own ideas change over time, we might better understand how the collective understanding of a discipline shifts over time.

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## NEW TITLES

**Galápagos: A Natural History.** John Kricher. Princeton University Press, Princeton, NJ, 2006. 256 pp., illus. \$19.95 (ISBN 069112633X paper).

**The Heretic in Darwin's Court: The Life of Alfred Russel Wallace.** Ross A. Slotten. Columbia University Press, New York, 2006. 614 pp., illus. \$22.95 (ISBN 0231130112 paper).

**How Nature Speaks: The Dynamics of the Human Ecological Condition.** Yrjö Haila and Chuck Dyke, eds.

Duke University Press, Durham, NC, 2006. 344 pp., illus. \$23.95 (ISBN 0822336960 paper).

**Parrots of the World: An Identification Guide.** Joseph M. Forshaw. Princeton University Press, Princeton, NJ, 2006. 400 pp., illus. \$65.00 (ISBN 0691092516 cloth).

**Principles of Animal Locomotion.** R. McNeill Alexander. Princeton University Press, Princeton, NJ, 2006. 384 pp., illus. \$39.50 (ISBN 0691126348 paper).

**River and Stream Ecosystems of the World.** C. E. Cushing, K. W. Cummins, and G. W. Minshall. University of California Press, Berkeley, 2006. 834 pp., illus. \$75.00 (ISBN 0520245679 paper).

**Self-organization in Complex Ecosystems.** Ricard V. Solé and Jordi Bascompte. Princeton University Press, Princeton, NJ, 2006. 392 pp., illus. \$45.00 (ISBN 0691070407 paper).

**Spiders of North America: An Identification Manual.** Darrell Ubick, Pierre Paquin, Paula E. Cushing, and Vince Roth, eds. American Arachnological Society, Dollco Printing, Ottawa, Canada, 2005. 377 pp., illus. \$45.00 (ISBN 0977143902).

**Trends in Bioinformatics Research.** Peter V. Yan, ed. Nova Science Publishers, New York, 2006. 156 pp., illus. \$79.00 (ISBN 1594547394 paper).

**Trends in Chronobiology Research.** Frank Columbus, ed. Nova Science Publishers, New York, 2005. 234 pp., illus. \$129.00 (ISBN 1594544824 cloth).

**Wildlife Ecology, Conservation, and Management.** 2nd ed. Anthony R. E. Sinclair, John M. Fryxell, and Graeme Caughley. Blackwell, Malden, MA, 2006. 282 pp., illus. \$79.95 (ISBN 1405107375 paper).