but then leaves us with the vague and unsatisfying conclusion: “The influence of temperature on unionoids is thus pervasive and complicated, so it is not easy to specify the optimal thermal regime for a unionoid” (p. 55). This is mostly a writing style issue, but it does tend to overstate somewhat the extent of our ignorance about several topics in mussel ecology.

Part II also contains a number of original analyses and modeling exercises that further explore the relationship of specific factors to mussel abundance. Some of these analyses are very strong and bring out important new points or different ways of looking at problems. In particular, the epidemiological models for studying mussel–fish interactions (p. 76–84) and the models for evaluating potential food limitation (p. 98–103) make some interesting predictions and could be fruitful approaches for future research. Other model predictions are less novel (e.g., smaller populations are at higher risk of extinction than large ones) or are supported by so few data as to be of questionable value (e.g., Figure 16, based on parameters that are “entirely speculative”). Nevertheless, these analyses all set up testable hypotheses for future research, and this is one of the most important functions of the book.

Part III, “Making the Monster Walk,” is the ostensible culmination of the model-building exercise. The first chapter in Part III (“Three Models for Mussel Ecology”) is a general discussion—although couched within the realm of freshwater mussel ecology—of different approaches to ecological modeling. The final chapter (“Is a Comprehensive Model Possible?”) attempts to reconcile these various approaches and propose some more concrete examples of what multifactor models for mussels might look like and what they might be expected to accomplish. Here, the book is somewhat schizophrenic, as if Strayer cannot quite bring himself to abandon the goal of a single, unifying theory. On page 141 he states, “I think that careful empirical analyses have good potential for predicting the distribution and abundance of unionoids from multiple controlling factors.” This is followed, one page later, by “I do not believe that any of the three popular approaches to integration [one being empirical analyses]... is likely to lead to a satisfactory predictive understanding of unionoid distribution and abundance.” Finally, he concludes (p. 154) “I believe that the construction of a comprehensive, mechanistic model is a hopeless enterprise” (whew!), but continues to grasp for “some sort of integrative framework.”

Even though, in the end, the monster never walks, this book is illuminating and thought provoking. While reading it, I constantly found myself thinking, “Hey, that could be tested” or “That would make a great study.” In this way the book is a charge to biologists to conduct mussel research in a coordinated, focused way that will directly inform the major problems of mussel ecology and conservation. This kind of efficiency is critical given the desperate plight of these animals. Nevertheless, although it is true that mussel ecology lags behind other fields, Strayer is perhaps a bit too critical of its lack of progress and direction (p. 156). As in any collection of people, mussel researchers each have their own professional responsibilities and mandates to answer to as well as their own personal interests. But apart from the old notion of mussels being outside the scope of ecology (a notion Strayer effectively dispels), the major problem with mussel ecology is that the field has simply not had the critical mass of researchers to really get off the ground. But this is changing rapidly as more talented people catch the mussel bug. In *Freshwater Mussel Ecology: a Multifactor Approach to Distribution and Abundance*, David Strayer provides direction for this burgeoning field, and I hope this timely book will entice still more ecologists to study and help save these fascinating animals.

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**Speciation in Birds and More**


In perhaps no other group of organisms is the sheer exuberance of evolution on display quite like it is for birds. Birds fill our world with a riot of color and song; they have dashing and complex social lives that inspire anthropomorphisms in armchair enthusiasts and ethologists alike. Given their visibility and prominence in landscapes ranging from tropical forests to urban gardens, the tremendous diversity of birds is immediately obvious to even the most casual observer of the natural world. Explaining this diversity is the focus of Trevor Price’s masterful new book, *Speciation in Birds*.

As one might infer from the title, the focus of the book is speciation: the process by which one species splits into two. And this book is perhaps the most detailed and synthetic overview of the speciation process ever published for any single group of organisms. *Speciation in Birds* is very well written, with beautiful color illustrations that remind the reader of the exceptional avian diversity that demands an explanation. There are a number of nice touches that contribute to the high level of readability of this book. I especially appreciated the use of common names throughout the text (with cross-referenced scientific names provided in the index). The layout and tone feels fresh, and the extensive use of graphs and...
maps helps convey complex ideas. Readers lacking advanced training in evolutionary biology will appreciate the introductory chapter and appendices that clarify several potentially confusing topics: What are "species" of birds? How are species identified with DNA sequence data? How are DNA sequences used to generate evolutionary trees? How are the times of speciation events estimated based on these trees?

But make no mistake: this is a serious study of speciation for students of biological diversity at any stage of their careers, and—despite the accessibility of the book—there is nothing superficial about the author's treatment of topics ranging from ecological speciation to the genetics of reproductive isolation. It would be a mistake to view this as a book solely about birds. The rich conceptual content transcends taxonomy and applies to virtually all organisms with sexual reproduction. The book is crammed with new analyses and new insights into old problems. As such, this is much more than a review of speciation in birds, and I predict it will help move speciation research in a somewhat different direction in the coming decade. Some will find this book provocative. The author's general view that the evolution of reproductive isolation in birds typically is an outcome of direct or indirect natural selection is not subtle. Nevertheless, the infusion of perspective here is far from distracting, and most readers are likely to come away deeply impressed with the considerable body of evidence Price has amassed in support of his view.

The book begins somewhat traditionally by addressing the geographic context of speciation. This is fitting, given that geographic models of speciation were largely inspired by patterns of avian diversity. The author then discusses ecological aspects of speciation, beginning with the role natural selection might play in generating reproductive isolation between populations. Although chapter 5 is nominally devoted to "ecological speciation," the ecological theme recurs throughout the book, and it is on this subject that the book is at its best. In chapter 6 Price shows there are really two (fundamentally distinct) ecological models of speciation, providing perhaps the clearest discussion of this topic that I have ever seen.

The remainder of the book treats all of the usual topics, such as hybridization and postzygotic isolation, but a number of other topics are also discussed. Chapter 7 is a fascinating overview of the manner by which behavioral flexibility and innovation might contribute to population divergence and speciation. Five chapters are devoted exclusively to the role of social selection in speciation, including sexual selection, divergence of species recognition characters, the evolution of song, and behavioral and vocal imprinting. Returning to the grand theme of ecology in diversification, chapter 12 explains how environmental differences between populations can lead to divergence in social signals, which then lead to reproductive isolation. Another of the book's strengths is the author's ability to bring together an array of otherwise disconnected observations from the literature on animal husbandry and natural history, particularly in the sections on hybridization and genetic incompatibility.

One especially exciting connection made in the book is the relationship between species traits and rates of speciation. This is an important issue, with the potential to change how the arrow of causality between traits and species diversification is viewed. Many evolutionary biologists would argue (justifiably) that to understand speciation, one must also understand divergence in species recognition traits and sexually selected characters. This is because these sorts of traits play fundamental roles in mate choice. If a population splits into two populations and those isolated populations diverge in characters used in mate recognition, then—even if the populations come back into contact—they may have become so different in these social signals that individuals no longer recognize members of the other population as potential mates. The reversal of causality comes when one recognizes that some species are more prone to diverging in these sorts of characters than other species. All things being equal, these species are thus more likely to undergo speciation events. Extrapolated across macroevolutionary timescales, this implies that certain types of traits may become more frequent precisely because of their effects on speciation rates. Although the relationship between sexual selection and speciation rates in birds remains unresolved, other traits—like behavioral flexibility—do appear to promote speciation. Understanding why so many birds show dramatic behavioral flexibility or spectacular sexually selected characters (e.g., the Peacock's tail) may thus require tests of whether those sorts of traits may have become widespread because of their effects on speciation rates.

Although this book clearly emphasizes conceptual issues in speciation, there are at least two ways in which it is relevant to conservation. First, the book contains a subtle nod to the fact that diversification on islands frequently yields spectacular evolutionary outcomes, yet much of this diversity is threatened or lost owing to recent human activity. Because of extinction in historical times, the ability of researchers to study the massive pan-Pacific radiation of flightless rails probably has been lost forever. Today only a tiny fraction of the once-impressive rail diversity (perhaps exceeding 500 species) persists. The same applies to diversification of Hawaiian honeycreepers, arguably the most extraordinary ecological and morphological avian radiation ever, where roughly half of all species have been lost in recent history.

A second point is that understanding speciation may itself be important for biodiversity conservation. A
number of cases are known whereby anthropogenic habitat alteration is effectively reversing the speciation process. As Price points out, changed agricultural practices may be driving the breakdown of speciation in Snow Geese, which once maintained geographically distinct blue and white races, but which now are hybridizing and may be collapsing into a single gene pool. Several other examples are given (chapters 16, 17) in which human activity may be causing a reversal of speciation. At a minimum, a better understanding of the breakdown of reproductive isolation may provide insight into the genetic and demographic mechanics of how hybridization contributes to the loss of biodiversity.

On the whole, this is an excellent and highly readable book that bears on one of the most important questions in all of science: the origins of biological diversity. The author has an uncanny ability to tie the biology of speciation to traditionally separate fields, including community and behavioral ecology. As such, the book has something to offer evolutionary biologists and ecologists of any stripe. Moreover, the seamless integration of natural history with a sophisticated body of speciation theory will appeal to anyone with an interest in understanding the inspiring diversity in the world around us, avian and otherwise.

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The Meaning behind Malformed Frogs


For more than a decade, reports of grotesquely deformed frogs have caused public concern and scientific controversy. Following the 1995 discovery of frogs with missing, extra, and malformed limbs by a group of Minnesota middle-schoolers, scientists have invested considerable time, energy, and resources toward understanding the causes and implications of amphibian malformations. Are malformations a threat to amphibian populations, which continue to decline in many parts of the world? Could malformations in frogs be indicative of an insidious threat to human health? Although significant progress has been made addressing these questions, many outstanding issues remain, and the mystery of deformed frogs has neither gone away nor has it been entirely solved.

Over the last decade, advances in the study of amphibian malformations have occurred on 2 primary fronts: quantifying the extent of the issue and identifying its likely causes. To date, severe malformations have been recorded in 71 amphibian species in over 40 U.S. states, with particular concentrations in the western United States, upper Midwest, and northeastern United States into southern Canada. Reported malformations primarily affect the hind limbs of frogs and toads that recently emerged from standing water habitats, such as lakes, ponds, and wetlands. The frequency of malformations can be extremely variable over time and across space, with individual wetlands acting as hotspots in some years but not in others. Investigations into the causes of malformations, which at times have led to inspired debate, have focused primarily on UV-B radiation, chemical contaminants, predator attacks, and trematode parasitism. It is now clear that all these factors are capable of causing limb abnormalities in amphibians, particularly when administered in laboratory experiments. With respect to limb malformations, probably the most extensively studied causative agent is infection by the trematode parasite Ribeiroia ondatrae, which attacks the developing limb tissue of larval amphibians. Integrated laboratory experiments and field surveys reveal that trematode infection is a widespread cause of limb malformations in the western United States and some areas in the Midwest. In other areas, however, Ribeiroia has not been detected or occurs only at low levels, leaving open the question about what factor is responsible for observed malformations. Several recent studies suggest that the levels of UV-B exposure in amphibian habitats are often too low to directly induce abnormalities, which has caused focused to shift toward the potential roles of chemical contamination and predator attacks.

In his new book, Malformed Frogs: the Collapse of Aquatic Ecosystems, scientist Michael Lannoo draws renewed attention to the issue of amphibian deformities and its unanswered questions, offering his own perspective on the successes and failures underlying the investigation. This is only the second book to focus on malformed frogs, and it is the first to be written by a scientist. Over the course of 7 chapters, Lannoo guides his readers through a diverse collection of topics related to malformed amphibians, including amphibian development and morphology, chemical contaminants and toxicology, the causes of human malformations, and how each topic informs the study of amphibian deformities. Throughout, Lannoo employs a casual and entertaining writing style that makes this book an easy read for both scientists and the lay public. He draws heavily on quotations from eclectic sources, ranging from the Bible to Supreme Court briefs, which often provides a novel perspective, but at times can be distracting. The book is illustrated with extensive radiographs of deformed frogs and offers the most up-to-date accounting of which amphibian species have been reported with malformations in the United States. In a generous tribute, Lannoo asks that all proceeds from the book go to the Memorial Fund for Dr. Daniel Sutherland.