

Accounting for Nature

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show various combinations of fin folds, unpaired fins, and other features. Hans C. E. Larsson writes about MODEs (modules of developmental evolution) and discusses how such developmental modules might help us understand the skeletal features of the sarcopterygian fin. Jason S. Anderson reviews the evidence for how the embryology and development of modern amphibians helps us understand the phylogeny of the non-amniote tetrapods—according to his analysis, the lissamphibians are not all descendants of the dissorophids (only the frogs and salamanders are related to them; other groups apparently had origins in nontemnospondyl amniotes).

Robert R. Reisz reviews the status of the basal diadectomorphs and how they fit in the complicated transition from anthracosaurs to amniotes. Although his coverage was very thorough, I was a little surprised to find no mention of *Westlothiana* in the context of the most primitive known amniotes. Reisz sees the diadectomorphs as a monophyletic sister taxon to amniotes, closer than conventional anthracosaurs like *Seymouria* or *Gephyrostegus*. This implies some very long ghost lineages to account for the topology of his tree, which is no surprise since most anthracosaurs and diadectomorphs are known from the excellent specimens of the rich fossil beds of the Permian, yet the transition took place in the Early Carboniferous, from which well-preserved fossils were much less common.

Moving up into the amniotes, Michael W. Caldwell gives a review and update of the conflicting hypotheses on the origin of snakes, including some of the amazing complete Cretaceous specimens with vestigial limbs found since 1979. Luis M. Chiappe and Gareth J. Dyke review the controversies about the origin of birds, including the recent discoveries that further amplify and illuminate the “birds are dinosaurs” hypothesis. Naturally, their sympathies lie with the bird-dinosaur school of thought, but they do a good job of rebutting recent arguments by Feduccia, Martin, and others that birds are descended from some other group of archosaurs.

Although *Major Transitions in Vertebrate Evolution* is dedicated to Robert L. Carroll (who was a teacher or mentor to many of the contributors of the volume) and thus focuses mostly on the more primitive groups of amphibians and reptiles that he spent his career studying, there are also two chapters that review evolutionary transitions in mammals. Zhe-Xi Luo gives a broad overview of Mesozoic mammalian evolution, boiling down the much longer volume that he recently coauthored with Zofia Kielan-Jaworowska and Richard L. Cifelli (*Mammals from the Age of Dinosaurs: Origins, Evolution, and Structure*, Columbia University Press, 2004). This is a very valuable contribution, since the number of new specimens and the understanding of Mesozoic mammals has exploded in the past two decades. If you haven't kept up with it, there is much new material to learn (and unlearn). Finally, Mark D. Uhen briefly summarizes the now classic example of the origin of whales from terrestrial mammals. He gives summaries of nearly all the functional and ecological parameters as well, and compares them to primitive artiodactyls rather than to mesonychids. Surprisingly, he doesn't spend much time talking about the molecular evidence for whale-hippo affinities.

Major Transitions in Vertebrate Evolution is beautifully produced, with numerous color plates in the center, and typographical errors or problems in the reproduction of the halftones were very nearly absent. The volume is complete and up-to-date on the transitions within the vertebrates, although it does not give a complete picture because it focuses on the lower vertebrates. In particular, many more well-documented examples exist of transitional fossils in the synapsids, and especially within the placental mammals. These would have been nice to include in a complete volume, but at 422 pages of dense, technical text, it was probably too much to ask that this volume be comprehensive. However, any scientist who wants to get a quick update on the current thinking about the transitions mentioned above would do well to consult the chapters in this book.

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ACCOUNTING FOR NATURE

The Law and Policy of Ecosystem Services. J. B. Ruhl, Steven E. Kraft, and Christopher L. Lant. Island Press, Washington, DC, 2007. 360 pp., illus. \$35.00 (ISBN 9781559630955 paper).

Two publications in 1997—*Nature's Services* (Daily 1997) and *The Value of the World's Ecosystem Services and Natural Capital* (Costanza et al. 1997)—brought significant attention and research focus to assessing the value of ecosystem services. Interest has grown steadily since then, and ecosystem services are now a central feature of discussions about conservation and sustainability. Indeed, ecosystem services were the central organizing theme of the Millennium Ecosystem Assessment (MEA 2005), and the World Bank, the US Environmental Protection Agency, and the Natural Capital Project (a partnership among the Nature Conservancy, World Wildlife Fund, and Stanford University), among others, have ongoing research programs on ecosystem services.

The vast bulk of the research on ecosystem services to date has focused on assessing the provision of ecosystem services, and thus concerns ecology and other natural sciences, and the value of ecosystem services, which brings in economics. Quantifying and valuing ecosystem services offer a clear and compelling way to demonstrate to policymakers and the general public the importance of conserving ecosystems. Before this information can bring about changes in human decisions affecting ecosystems, however, policymakers must recognize these values and institutionalize them in law and policy, and the general public must reflect these values in their every-

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day decisions. As J. B. Ruhl, Steven E. Kraft, and Christopher L. Lant point out in *The Law and Policy of Ecosystem Services*, “The component that is least developed in the literature on ecosystem services is *the law*, particularly as it relates to property rights and governance issues.” The purpose of their book is to address the important legal and policy issues involved in getting ecosystem services into the mainstream of decision-making.

Law and Policy is a result of collaboration between a lawyer (Ruhl), an economist (Kraft), and a geographer (Lant), written in large part to fill the void on the law and policy aspects of ecosystem services. The book is laid out in four sections. Part 1 reviews important concepts from ecology, geography, and economics relevant for understanding ecosystem services; part 2 reviews the status of ecosystem services in law and policy; part 3 contains a series of case studies; and part 4 discusses the design of new laws and policies to more effectively incorporate ecosystem services into societal decisions.

Much of the material in part 1, which covers the existing ecology and economics literature relevant to understanding ecosystem services, has been reviewed elsewhere (e.g., Heal 2001, MEA 2005, NRC 2005); this part covers little new ground. One disappointment is that no ecologist was on the team of authors to add greater depth to our understanding of the ecological basis of ecosystem services. The more novel aspect of part 1 is the inclusion of a chapter on geography, but this material isn't integrated into the flow of ideas in the other chapters. Compared with ecology and economics, which are central to understanding the value of ecosystem services, geography's role in the understanding of ecosystem services is less clear, and the discussion in this chapter does not add substance to the book's focus on law and policy.

The discussion in part 2 of law and policy relevant to ecosystem services, and the discussion of possible new directions in law and policy in part 4, forms the essential core of the book. Part 2 begins with an analysis of prop-

erty law and its potential for protecting natural capital and promoting the provision of ecosystem services. In principle, property law could be a powerful tool for protecting the provision of ecosystem services. Under the nuisance doctrine of common law, a landowner can be prohibited from taking actions that harm the property of others or required to compensate those who are harmed by an action. The question, then, is whether actions that diminish the provision of ecosystem services constitute a nuisance.

Part 4 probes this question with a useful thought experiment: Suppose an apple orchard is located between an industrial facility and a forest. The orchard's productivity declines. Consider three possible scenarios for the cause of the decline: emissions from the industrial facility damaged the bark of the apple trees, emissions from the industrial facility deterred pollinators from visiting the orchard, or the owner of the forest parcel replaced the forest with a shopping mall, thereby removing pollinators from the vicinity of the orchard. In each of these three scenarios, an action taken by either the owner of the industrial facility or the owner of the forest results in economic losses to the owner of the apple orchard. The first scenario is “classic fodder for a nuisance claim.” In the second scenario—and especially in the third—it would be difficult for the owner of the orchard to get relief under current interpretations of the law.

Part 2 of this book makes a strong case that there is an anticonservation bias in current law making it difficult to use property law to protect ecosystem services. The law may eventually evolve, but as the authors point out in chapter 4, property law does not at present provide an adequate basis for protecting natural capital or the provision of ecosystem services.

The standard tack in environmental policy is a regulatory approach grounded in environmental legislation (e.g., Clean Air Act, Clean Water Act, Endangered Species Act) rather than one that relies on property law. Certainly regulatory approaches are important, although, as

pointed out in chapter 5, such approaches do not provide a firm basis for the protection of natural capital and ecosystem services. Examples related to wetlands protection under section 404 of the Clean Water Act, coastal protection under the Coastal Zone Management Act, and forest protection under the National Forest Management Act drive home the point that current laws and regulations do not necessarily protect the vital natural capital underpinning the provision of ecosystem services. An even more direct example might be the Endangered Species Act, which provides protection for listed species but does not protect habitat, unless doing so is deemed critical for the survival of a listed species.

Laws and policies evolve slowly and thus reflect past as well as current views on what is beneficial or desirable. What we now call wetlands and strive to protect for the myriad services they provide (e.g., flood control, nutrient retention, water filtration, habitat provision) were more likely to be viewed by our predecessors 100 or 200 years ago as unproductive, unhealthy swamps that needed to be drained so crops could be planted. The authors of this book make a convincing case that documenting the values of ecosystem services and demonstrating their value to people—the stuff of natural science and economics—may be a necessary condition for their protection, but not a sufficient one. Ruhl, Kraft, and Lant usefully describe the current state of law and policy and explain the lack of a sound footing for protecting natural capital and enhancing ecosystem services. Their book also provides much that is useful for thinking about potential future directions that would allow the evolution of laws and policies that could provide a sound basis for sustaining ecosystem services.

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