Phylogeny and Evolution of Angiosperms

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Source: BioScience, 57(6) : 537-538

Published By: American Institute of Biological Sciences

URL: https://doi.org/10.1641/B570612

HOW TO SAVE OCEANIC LIFE

Marine Conservation Biology: The Science of Maintaining the Sea's Biodiversity. Elliott A. Norse and Larry B. Crowder, eds. Island Press, Washington, DC, 2005. 470 pp., illus. $49.95 (ISBN 9781559636629 paper).

Conservation biology—that combination of biology, economics, and policy trying to stem the loss of biodiversity—has focused mainly on terrestrial problems and issues. Perhaps this is inevitable, since we are a terrestrial species, and perhaps even appropriate, since the impact of humans has been greater on the land than in the sea. But the sea covers 70 percent of our planet's area, and 95 percent of the volume where life occurs, so a treatment from a marine perspective is overdue. *Marine Conservation Biology: The Science of Maintaining the Sea's Biodiversity*, edited by Elliott Norse and Larry Crowder, delivers. The 25 chapters by 43 authors, with a foreword by conservation biology pioneer Michael Soulé, cover a wide range of topics: population biology, species invasions, fisheries management, habitat destruction, pollution, marine reserves, restoration efforts, and legal and ethical issues.

Why a separate book on marine *conservation biology?... Conservation challenges in the sea differ in fundamental ways from those on the land. The ranges, fecundity, and vagility of organisms are different. Legal and management structures are different. Economic incentives are different. And, most fundamentally, the attitudes of people are different.*

Why a separate book on *marine* conservation biology? In the first two chapters, editors Norse and Crowder point out that conservation challenges in the sea differ in fundamental ways from those on the land. The ranges, fecundity, and vagility of organisms are different. Legal and management structures are different. Economic incentives are different. And, most fundamentally, the attitudes of people are different.

Part 1, "Marine Populations: The Basics," covers topics that set the stage for the rest of the book. Stephen Palumbi and Dennis Hedgecock note that high fecundity and wide larval dispersal have implications for the design of marine reserves, and also for the probability and speed of recovery after population reductions. Don Levitan and Tamara McGovern review the Allee effect in the sea, the tipping point that makes recovery from small population sizes especially difficult. Ransom Myers and Andrea Ottensmeyer discuss extinction risk. Because species in the sea are harder to observe and monitor, it is likely that many marine species extinctions are unrecorded "silent extinctions." Julia Parrish illustrates how knowledge of behavior can contribute to effective conservation actions. This introductory section could have been strengthened by a chapter on changes in the sea from a long-term perspective. Marine conservation efforts are handicapped by the difficulty of conceiving what pristine ecosystems really were like. Worse, each generation of marine biologists takes an increasingly degraded state as the goal for restoration (the "sliding baselines" syndrome).

Part 2 is entitled "Threats to Marine Biological Diversity." The editors introduce this section by listing five main threats to marine diversity: overexploitation, physical alteration, pollution, alien species, and climate change. Pollution and alien species are covered in chapters by Nancy Rabalais (nutrient overenrichment), James Carlton and Gregory Ruiz (invasions), Kiho Kim and colleagues (diseases), and Denise Breitburg and Gerhardt Riedel (multiple stressors). Overexploitation and physical alteration are covered in part 3. Curiously, however, there is no chapter on the fifth threat, climate change. Global warming is mentioned only briefly as an extinction threat, mainly in relation to coral reef bleaching.

In part 3, "The Greatest Threat: Fisheries," we get to the heart of the matter. The problem is not simply that we catch too many fish. Richard Law and Kevin Stokes document how fishing alters the size, age, and genetic structure of exploited populations, usually selecting for greater rates of reproduction at the expense of growth and survival. Les Watling compares bottom trawling to forest clearcutting and oil exploration: Although the destructive effects of trawling are often more widespread and longer lasting, the general public is far less aware of them. Fisheries also catch animals that are not the target of the fishery (bycatch). This incidental catch is often the main threat to long-lived marine animals such as turtles, seabirds, dolphins, and whales. Selina Heppell and colleagues discuss how the life histories of long-lived species, including targeted species such as sharks, make them highly vulnerable to the effects of fishing.

The title of the chapter by Dave Preikshot and Daniel Pauly poses the central question: "Global Fisheries and Marine Conservation: Is Coexistence Possible?" They contend that fisheries management fails to meet broader conservation goals because of two "pathologies": a focus on single species instead of whole ecosystems, and the traditional view that the fishing industry is the sole legitimate user, in effect the owner, of marine living resources. The final chapter of part 3 seems to illustrate the point. Ray Hilborn refers to unharvested fish as "surplus," is sanguine about ecosystem changes as a result of fishing, and defends the single-stock approach to fisheries management. As I read the chapter, the core philosophical issue became clear. By current standards, well-managed fisheries, such as the ones Hilborn describes, reduce the target species (often a top predator) to about 30 percent of its natural (unfished) abundance. The target species is in no danger of extinction, and let us assume that bycatch of other species is not an issue. Under these conditions, is the 70 percent reduction of a top predator acceptable? If not, what level *is* compatible

with maintaining a healthy ecosystem? Calling for a sustainable level of fishing is not sufficient because, as Hilborn points out, fishing can be sustainable at different levels. Sustainable overfishing is not an oxymoron.

Part 4, "Place-based Management of Marine Ecosystems," has four chapters on how marine reserves contribute to conservation goals. Reserves are defined as areas with the highest level of protection. (The term "sanctuary" seems to have been captured by the US Marine Sanctuary Program, which, paradoxically, allows fishing). Marine reserves hold great promise as effective tools for fisheries management (Joshua Sladek Nowlis and Alan Friedlander) and as a means of restoring habitats and populations already damaged by fishing (Callum Roberts). Because many (but, importantly, not all) marine organisms have a planktonic larval dispersal stage, metapopulation aspects of marine reserves are important (Romuald Lipcius et al.). In the open sea, the concept of "place" is literally more fluid, so reserves might be defined on the basis of oceanographic features, such as fronts or isotherms, rather than fixed coordinates (Elliott Norse et al.).

The book appropriately concludes with part 5, "Human Dimensions." James Acheson provides an illuminating cross-cultural perspective on the circumstances that lead to successful fisheries management. Alison Rieser and colleagues discuss the legal framework for marine conservation, but limit their excellent discussion mainly to US laws—so many marine conservation problems are inter- and extranational that a broader coverage of legal issues would have been useful. Robert Richmond offers a measured review of the benefits and limits of marine restoration efforts, and cautions against the hubris of assuming that we can restore whole ecosystems. He emphasizes that restoration efforts, while valuable, should not be used as an excuse for further degradation. Dorinda Dallmeyer's chapter on the development of a sea ethic is reflective. Louis Botsford and Ana Parma, in a chapter on uncertainty, describe how the ratchet effect leads to overfishing: Because of constant economic and social pressure for higher catches, fishing rates increase during times of high abundance but do not decrease during times of low abundance. Botsford and Parma make the important point that decisions under multispecies or ecosystem management will have greater uncertainty than under single-species management. The corollary (not developed in the book—unfortunately, given current enthusiasm for ecosystem management) is that unless we change how we deal with uncertainty and associated burden-of-proof concepts, ecosystem approaches to management could work against marine biodiversity and conservation goals, rather than support them. The final chapter by Norse eloquently argues that we can no longer afford a frontier mentality toward the sea. The sea should be zoned according to its uses, just as on land. There is a thoughtful discussion of the pros and cons of individual fishing quotas, comanagement, and marine reserves, and how these could fit into a larger system of ocean zoning.

Overall, the tone of *Marine Conservation Biology* is hopeful; many chapters either suggest solutions or give positive examples of overcoming problems. As in many multiauthored books, chapters vary in style, coverage, and assumed background. All chapters are well referenced, however, and there is both a subject index and a species index. Either for reference or teaching, this book will be valuable to anyone interested in marine conservation biology.

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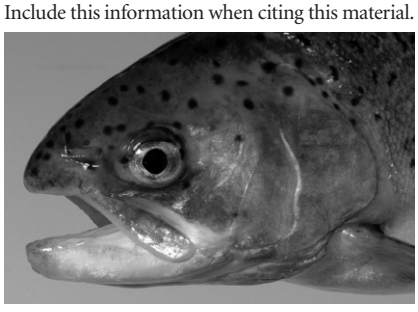
doi:10.1641/B570611
Include this information when citing this material.



DARWIN'S "ABOMINABLE MYSTERY" DEMYSTIFIED

Phylogeny and Evolution of Angiosperms. Douglas E. Soltis, Pamela S. Soltis, Peter K. Endress, and Mark W. Chase. Sinauer, Sunderland, MA, 2005. 370 pp., illus. $62.95 (ISBN 9780878938176 paper).

Phylogeny and Evolution of Angiosperms is intended as a summary and review of the many advances made in plant phylogeny in recent years. It brings together the evidence from many disparate sources in a literature that has grown too big for any one scientist to keep abreast of any more, and elaborates the basis for recent changes in the classification of flowering plants. The same literature from which the picture of angiosperm phylogeny can be pieced together also provides insight into evolutionary trends in the biology of flowering plants. The book takes the opportunity to integrate this information with the phylogenetic evidence to examine evolutionary trends in, for example, floral diversification and genome size and structure.

The past two decades have seen tremendous advances in understanding plant phylogeny, including Darwin's "abominable mystery," the origin of angiosperms. Most of this has come from molecular systematic studies. The pace of advances in angiosperm systematics has been remarkable, the envy of systematists working on many other groups of organisms. That this has been so is due largely to the cooperative nature of the many plant systematists, molecular and otherwise, who have contributed to collaborations around the world, as exemplified by the "Deep Green" Research Coordination Network (RCN) and its subsequent spin-offs "Deep Gene" and "Deep Time."

The best-known cooperative effort in this regard was Chase and colleagues' (1993) publication on seed plant phylogeny, coordinated in large part by Mark Chase and Doug Soltis. These two, along with their coauthors here, Pamela Soltis

and Peter Endress, have continued to encourage a collaborative atmosphere among plant systematists. A logical outcome of the cooperative efforts at phylogenetic research was the publication of a new classification of flowering plants based on this work, which itself resulted from the participation of many systematists (APG 1999, 2003). Although some may disagree with details of the decisions on ranking in this classification system (e.g., expansion of the Caryophyllales), virtually all plant systematists acknowledge that it is a vast improvement over the traditional "authority-based" classifications that had come before. Although the book under review uses the Angiosperm Phylogeny Group (APG) classification as a basis for its organization, it devotes several pages to a discussion of alternate, rank-free methods of classification based explicitly on phylogeny.

In several respects, this book is the companion volume to the APG classifications. The authors, who are among the principal contributors to those classifications, accept the APG system as the basis for taxonomic units discussed in the book. While the APG has provided a taxonomy for plant systematics for nearly a decade, the publications containing the classifications have been brief in the extreme, in terms of providing the underlying scientific evidence for the classifications in them. This book goes a long way toward supplying that basis, reviewing the literature and providing summary trees at the family level for the major lineages of angiosperms.

Angiosperms contain more than a quarter million recognized species, so it is useful to break the group down into large chunks for discussion. Orders and subclasses in traditional classifications have not held up well in molecular phylogenies, so newly recognized clades, some with names inherited from traditional systems, form the basis for chapters in the discussion of phylogeny here. Unfortunately, two significant portions of the angiosperm tree do not fit nicely into clearly defined lineages, so two chapters are devoted to paraphyletic grades, basal angiosperms and early-diverging eudicots (tricolpates). Each chapter includes a discussion of evolutionary trends in the group, as well as information on where the remaining problems lie.

Through detailed study of many plant species chosen carefully to represent critical lineages, Endress has been able to decipher the broad trends in floral evolution in angiosperms in a phylogenetic context.

For those systematists who have followed the phylogenetic literature and already have a good understanding of the phylogenetic picture, the input from Endress in the chapter on floral evolution may be the most significant contribution in this book. This chapter is written with the clarity and economy that characterize Endress's writings on floral evolution. Through detailed study of many plant species chosen carefully to represent critical lineages, Endress has been able to decipher the broad trends in floral evolution in angiosperms in a phylogenetic context.

With this book and the textbook *Plant Systematics: A Phylogenetic Approach* (Judd et al. 2002), Sinauer has now published the two most significant books on flowering plant phylogeny and systematics to come out in recent years. The two books overlap in some respects, but complement each other in many others. Both present a classification for flowering plants based on recent phylogenetic studies, and they summarize the underlying evidence. Both provide information on unifying traits for the major lineages of flowering plants and discuss trends in character evolution. However, the book by Judd and colleagues (2002) is constructed as a textbook for a traditional course in plant systematics, with an emphasis on family recognition, systematic methods, and evidence, whereas the book by Soltis and colleagues is more of a reference source for scientists and students looking for an entrée into the literature. As such, the book might be appropriate for an advanced course or graduate-level class on plant phylogeny, when supplemented with readings from the original literature.

The authors of *Phylogeny and Evolution of Angiosperms* owe a debt of gratitude to the collaborations of many plant systematists. Forty-two coauthors contributed to an earlier publication on phylogenetics (Chase and colleagues 1993), and the two iterations of the APG classification had 29 and 27 contributors, respectively. Many more have participated in Deep Green and subsequent RCNs. The bibliography is extensive, and the acknowledgments show that many of these scientists were consulted directly in the preparation of this volume. This book belongs on the bookshelf of any serious plant systematist—it will be a valuable resource for years to come.

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doi:10.1641/B570612
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