THE OFFICIAL MAGAZINE OF THE OCEANOGRAPHY SOCIETY

Oceanography

CITATION

Pershing, A.J. 2006. Review of *Dynamics of Marine Ecosystems: Biological-Physical Interactions in the Oceans (Third Edition)*, by K.H. Mann and J.R.N. Lazier. *Oceanography* 19(2):157–159, http://dx.doi.org/10.5670/oceanog.2006.87.

DOI

http://dx.doi.org/10.5670/oceanog.2006.87

place where this idea is communicated in a flat-out erroneous statement. The rest of the book simply tries to never draw a line between luminescence and fluorescence. The first (and as far as I could find, the only) explanation of the difference between them is on page 72—roughly a third into the book, hidden in the middle of the paragraph. I think the main reason for keeping the reader confused was to fully exploit the magic contained in the phrase "glow in the dark," and also to justify putting the actually unrelated stories about bioluminescence as a sort of prologue to the GFP research. Interestingly, the foreword helps the authors by using the word "bioluminescence" to refer to all matters addressed in the book—apparently the authors of the foreword were confused as well.

In short, I would not recommend this book to those looking for comprehensive information about bioluminescence and biofluorescence. Instead, it can be a great source of inspiration for science students and researchers early in their careers, especially for those attracted to biotechnology and/or neuroscience.

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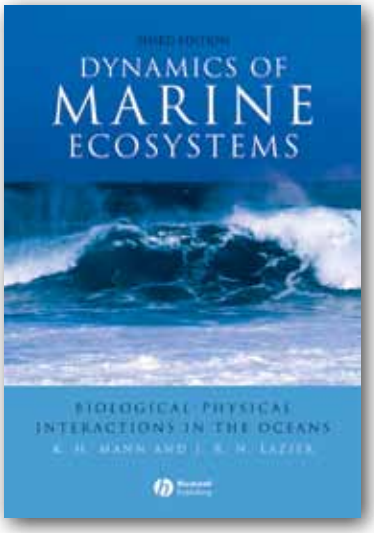
Dynamics of Marine Ecosystems

Biological-Physical Interactions in the Oceans (3rd Edition)



By K.H. Mann and J.R.N. Lazier, Blackwell Publishing, 2006, 496 pages, ISBN 1405111186, Paperback, $74.95 US

REVIEWED BY ANDREW J. PERSHING

In 1991, Kenneth Mann and John Lazier published the first edition of *Dynamics of Marine Ecosystems* (DME). Subtitled "Biological-Physical Interactions in the Oceans," DME was an ambitious attempt to describe how physical processes in the ocean structure biological communities. The newly released third edition contains significant updates to several sections. Although the book has grown somewhat, the additional material makes for a more comprehensive treatment of the field, and perhaps surprisingly, a more cohesive book.

In the interest of full disclosure, I must inform you that I am not an unbiased reviewer. At my Ph.D. institution (where I am currently employed), cows outnumber oceanographers by more than ten to one. In lieu of a formal course on biological oceanography, a small band of us, led by my major professor, worked our way through Mann and Lazier's first edition. As Mann and Lazier state in the preface to the first edition, DME presents the essentials of physical oceanography in the context of how it influences the biology. Biology is presented in more detail, and the authors try to outline areas of current research. DME served me very well in this regard, and my well-worn copy provided a jumping off point for my dissertation research. DME is now required reading for my students, and whichever one has my book, please return it.

Now that the legal stuff is out of the way, let's get to the review. The main theme of the book is that biological processes in the ocean are intimately connected with physical processes. Mostly, this theme is considered from the point of view of how a physical process such as vertical mixing influences a biological process like primary productivity; however, the latest version has expanded its consideration of how biological processes feed back to the physics. This discussion includes carbon cycling and climate changes as well as absorption of heat and light by phytoplankton pigments. The interdisciplinary approach serves two functions. On a pedagogical level, it provides a coherent treatment of two major subdisciplines of oceanography. On a practical level, presenting the physics and

biology together is consistent with how most modern oceanographic research is conducted.

The book is organized by scales, starting from the smallest to the largest. The authors begin by considering life at low Reynolds numbers, focusing on nutrient uptake by single phytoplankton cells and the influence of turbulence on predator-prey interactions. I must admit that, as a graduate student, I found this section rather boring. However, my interest in low-Reynolds-numbers phenomena increased after seeing video footage of copepods feeding. This point brings up perhaps the biggest weakness of this book: the paucity of photographs. While one could argue that a graduate-level text shouldn't need fancy pictures, I think it a shame to devote so much text (and time reading) to the intricacies of flagellar swimming and copepod feeding without actually showing the reader what a dinoflagellate or a copepod looks like.

DME then moves up to scales of 1 km and focuses on mixed-layer dynamics. On the physical end, the authors consider the processes that lead to the shoaling or deepening of the mixed layer. DME does an excellent job synthesizing thermodynamics, including light penetration and heat flux. The level of detail of the physics is sufficient to give the reader a good qualitative and even intuitive understanding of these processes, which sets up their discussion of phytoplankton dynamics. In particular, the section on Sverdrup's critical depth theory is one of the best I've seen. The new edition also contains a good review of iron limitation, a much needed improvement to the book.

The next section considers scales of 1–1000 km, including coastal upwelling and fronts of various kinds. This section begins with a very readable description of the development of Ekman spirals and then moves on to Ekman drift and Rossby deformation scales. Then, the authors discuss the impact of coastal upwelling on ecosystems in the context of five major upwelling regions. The next chapter presents fronts of various kinds and discusses research on why frontal systems are often associated with high concentrations of plankton and fish. Finally, the section concludes with a discussion of tides and internal waves. Their description of equilibrium tidal theory and Kelvin waves is one of the most intuitive I've encountered, as is their description of internal waves.

The third section considers processes on the scale of ocean basins. DME presents a straightforward qualitative description of wind-driven circulation, beginning with global wind systems and ending with western boundary currents and their rings and eddies. When the authors turn to the influence of basin-scale circulation on biology, the chapter really comes alive. Although the physical processes that generate rings and eddies are largely ignored, Mann and Lazier's synthesis of the role that mesoscale eddies play in the primary productivity of the subtropical ocean is quite exciting, and certainly cleared up a lot of my personal confusion on this subject.

The next chapter discusses the impact of changes in ocean circulation on marine ecosystems, notably, on fisheries. My trusty copy of DME was the first place I encountered the ideas of basin-scale variability, notably for me, the North Atlantic Oscillation (NAO). The discussion of this phenomenon serves as a good example of one of the key strengths of DME, and also one of its key weaknesses. Mann and Lazier walk a fine line between presenting established concepts like critical depth theory alongside emerging research ideas that are still under development. The biology sections that conclude most of their chapters are

equivalent to review papers, and the authors should be commended for their attempts to synthesize current results into something fresh and new. This approach makes the text exciting and serves their goal of introducing emerging scientists to emerging ideas. However, it is often hard to distinguish when Mann and Lazier are pushing the envelope. For example, the NAO section in their original edition contained several misstatements, including a summary figure that was patently wrong. Thankfully, the new edition corrects these errors, at least in the NAO section, but I can't help wondering what else is lurking out there. However, if I had to choose between a book that occasionally pushed the boundaries and one that stuck with established fact, I'd take the former. The new ideas in the book make it much more interesting to read and should be excellent fodder for class discussion and, likely, the genesis of a few dissertations. My hope is that future editions will maintain the adventurous spirit but provide some sign posts when they're leading us on a new trail.

In the final chapter, Mann and Lazier discuss four big-picture "questions for the future." It's easy for scientists to get caught in the details of their particular research area, and I found it refreshing to read a consideration of very broad questions. Of the four questions they present, the one that resonates the most (at least with this reviewer), is the issue of whether we can develop models that span the enormous range of scales of time, space, and body size, inherent in marine ecosystems. Essentially, Mann and Lazier are asking whether we can merge the ideas and models developed by some of the major research programs of the 1990s (e.g., JGOFS and GLOBEC). This section does an incredible job tying together many of the ideas presented in the earlier chapters, and the authors clearly had a lot of fun writing it.

In their opening chapter, Mann and Lazier declare that marine ecology "may be said to have come of age." When I first read their declaration that marine ecology has come of age, I found it hard to figure out what Mann and Lazier really meant. I mean, what does it really mean for a field to come of age? Can marine ecology stay out past midnight? Can I buy it a beer? Seriously, though, I've given this some thought. Coming of age implies a sense of self, of definition, of who you are and where you want to go. In this sense, I think Mann and Lazier were right on. Marine ecology has definitely come of age, although perhaps it's still a bit gawky. Similarly, I think that DME could be said to have come of age as well. In the first edition, Mann and Lazier boldly presented the physics along with the biology and emphasized the interdisciplinary nature of marine research. As the field progressed in the intervening years, the value of interdisciplinary research has grown. In their third version, Mann and Lazier have done an incredible job of integrating these new developments into their text. The result is a more coherent and more confident presentation of the field.

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