

Estuaries: Dynamics, Mixing, Sedimentation and Morphology

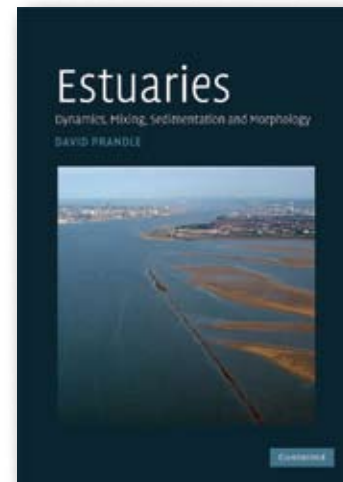
By David Prandle, Cambridge University Press, 2009, 236 pages, ISBN 978-0-521-88886-8, Hardcover, \$130 US

REVIEWED BY ALEXANDER YANKOVSKY

For instructors or students of physical oceanography at the graduate level, choosing a textbook is a pleasant exercise and often a matter of taste rather than necessity when it comes to open-ocean processes. Choices become somewhat limited or even problematic regarding books on estuarine dynamics, and the arrival of *Estuaries: Dynamics, Mixing, Sedimentation, and Morphology* by David Prandle has been met with high expectations. The author's contribution to the field is substantial by any standard, which warrants an interest in this volume by students and experienced researchers alike, as well as by engineers, managers, and other practitioners dealing with the estuarine environment. Prandle compiles and revisits many of his previous results, and includes complementary discussions of other relevant studies. Although individual chapters are written in a "stand-alone" style, the same theoretical framework is applied throughout the text so that the reader can navigate among different chapters and subjects relatively easily. The book's title accurately represents its content: a wealth of information on tidal and residual circulation in estuaries, mixing processes between riverine discharge and oceanic water, and how these dynamics affect sediment balance and shape estuarine morphology.

The book consists of eight chapters. Some chapters conclude with a summary and guidelines for applications, or with appendices discussing relevant theoretical and modeling issues. Each chapter has an extensive reference list. Chapter 1 introduces the essentials of tidal dynamics, saline intrusions, and sedimentation in estuaries, and outlines challenges along with research approaches to address them. Chapter 2 recognizes tidal dynamics as a principal driving mechanism of estuarine circulation. The author introduces well-known shallow-water equations and proceeds with a linearized solution for tidal wave propagation in the converging estuary where the principal balance is between inertia, the pressure gradient, and bed friction terms. Sections addressing the linearization of the quadratic friction term and the generation of higher harmonics and residuals are very well written and exceptionally insightful. Unfortunately, only a cursory description of nonlinear tidal dynamics is included; the chapter would benefit from a more detailed discussion of nonlinear tides in the estuary, perhaps in the framework of the Korteweg-de Vries equation.

Chapter 3 describes the vertical structure of tidal currents using a wide range of parameters. First, Prandle formulates a two-dimensional analytical model for time-dependant estuarine currents driven by the axial barotropic pressure gradient and vertical turbulent friction. He then extends the model to three dimensions by including the Coriolis force. Although useful, the section



dealing with three-dimensional structure of tidal currents is more relevant to shelf dynamics (rather than estuarine); the development of tidal ellipses in the estuarine channel is inhibited by the presence of lateral boundaries and only a very few estuaries in the world are wider than the barotropic Rossby radius. At the same time, the author omits a much-needed discussion of the transverse structure of estuarine residual currents.

Chapter 4 is a true masterpiece. It introduces a classification scheme for estuarine circulation based on the intensity of mixing processes, presents analytical solutions for each distinctive type of longitudinal circulation, and provides a scaling analysis of the governing processes. The net effect of tidally induced mixing and the resulting saline intrusion are parameterized in terms of readily available characteristics such as a riverine discharge (or a mean velocity), tidal amplitude, and channel geometry. The robustness of the analytical results and scaling analysis is demonstrated with numerical experiments. This chapter is written with great clarity and physical intuition, and alone can easily propel this book to the list of bestsellers in this field.

Chapter 5 presents basic concepts of sediment transport, deposition, and erosion in estuaries, focusing on the effects of tidal currents but neglecting the contribution of wind waves. Chapter 6 summarizes material from Chapter 2 through Chapter 4 and revisits the essentials of synchronous estuary dynamics, now focusing on their effect on estuarine morphology. Scaling arguments derived in the previous chapters are applied to determine the major characteristics of estuarine bathymetry (e.g., depth at the mouth, estuarine length, rate of funneling) as a function of riverine discharge, tidal amplitude, and the bed friction coefficient. Also, a bathymetric zone of estuaries is demarcated in terms of tidal amplitude and depth. These theoretical considerations are then applied to a variety of real-life estuaries (mostly from the UK). Other useful topics discussed in this chapter include

minimum depths and flows required for estuarine functioning, as well as spacing between estuaries. The principles of tidal and residual circulation are used to quantify estuarine sediment balance in Chapter 7. Sediment flux is partitioned into river flow, saline intrusion, and tidal current constituents; the simplifying assumption of a synchronous estuary yields the conditions for zero net flux (that is, bathymetric stability) as a function of tidal amplitude and depth. Again, simple analytical expressions derived in this chapter are applied to quantify sediment regimes of several European estuaries. The concluding Chapter 8 discusses strategies for sustainability and challenges under rapidly changing environmental conditions, including rising sea level and severe storms caused by global warming.

As good and timely a contribution as it is, this book has the potential to

evolve into a truly outstanding text if it extends to areas where the author has not contributed himself. The derivations are often elegant and, in most cases, straightforward, but not always seamless between sections or chapters. The book is likely to be used by teaching faculty although it falls short as a textbook because some important topics are missing. Nevertheless, the author's distinctive style of distilling complicated dynamics into simple analytical expressions and governing parameters with a wide range of applicability will find many enthusiastic readers and followers in the years to come.

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Oceanology: The True Account of the Voyage of the Nautilus

By "Zoticus de Lesseps," Templar Company Ltd., Candlewick Press, 2009, 34 pages, ISBN: 978-0-7636-4290-7, Hardcover, \$19.95 US.

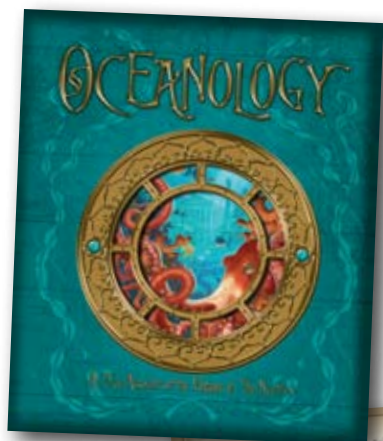
REVIEWED BY CLARICE M. AND CHARLES S. YENTSCH

Oceanology: The True Account of the Voyage of the Nautilus is whimsical and fun, yet treats oceanography with the respect and evidence-driven conclusions of *The Oceans* by Sverdrup, Johnson, and Fleming (1942). This "ologyworld" book (see <http://www.ologyworld.com/>

for additional "ology" books) mentions on the back cover that it is suitable "for ages 6 and up." We saw this statement and purchased the book at the History of Diving Museum as a gift for a child's sixth birthday. We were so taken by the book that we returned to the museum the following day to get a copy for ourselves. It is now on our bookshelf next to Jules Verne's classic *20,000 Leagues Under the Sea* and Matthew Maury's *Physical Geography of the Sea* (1855) and *Manual of Geography* (1870).

The book, beautifully illustrated with many action pullouts and booklets (tiny

books within the book), starts with the publisher's note: "A sea-stained notebook documenting an extraordinary undersea journey, purportedly written by one Zoticus de Lesseps, was recently lent to the publisher. The book appears to be the account of a real voyage, which is surprising, considering the year that the journey apparently took place. Until now, it has been understood that undersea exploration of this nature was not possible in 1863. Despite this volume having every appearance of authenticity, the publisher has been unable to verify the existence of a Zoticus de Lesseps



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Candlewick Press, Somerville, MA.



living in Paris at this time, and the only record of the mysterious Captain Nemo appears in what was always thought to be a work of fiction—a novel from 1870 entitled *Twenty Thousand Leagues Under the Sea* by Jules Verne (1828–1905). Because new advancements have been made in ocean exploration and science since this volume was written, explanatory notes have been added by the publisher throughout this facsimile for the benefit of today's readers."

"Author" Zoticus is the sixteen-year-old assistant of Professor Aronnax ("natural historian specializing in aquatic species"), and through his diary the reader learns about the sea with him. (The real authors of this masterpiece are Emily Hawkins and A.J. Wood along with illustrators Wayne Anderson, Ian Andrew, Gary Blythe, and David Wyatt.) Early on, readers are introduced to the "Life and Works of Matthew Maury." This booklet discusses this oceanographer's

early life, how he charted winds and currents, and how he can be considered the Father of Oceanology because of his book *The Physical Geography of the Sea* published in 1855. Maury's theory of the Northwest Passage is also mentioned along with evidence that it must exist: harpoons from ships in the Pacific have been found in whales in the Atlantic, and vice versa, suggesting that because these whales are mammals they must surface to breathe, and therefore these creatures must have a quicker route between the oceans than round Cape Horn. A publisher's footnote states that Matthew Maury died in 1873, long before verification of his theory by Norwegian explorer Roald Amundsen, who traversed the Northwest Passage by sea in 1906.

There is a good treatment of early navigation and instrumentation and the laying of the transatlantic telegraph cable in 1858. The booklet "History of Diving" describes Leonardo da Vinci's 1400s design for a diving helmet fitted with a breathing tube held at the surface with a cork float, the 1531 first diving bell used in Italy by Guglielmo de Lorena to help divers explore sunken Roman galleys, the 1690 Edmund Halley diving bell that could stay submerged for extended periods, the 1797 diving suit designed by Karl Heinrich Klingert, and the 1829 first air-pumped diving helmet invented by the brothers John and Charles Deane. The map of "our route below the waves" has foldouts that provide impressive drawings of the seabed and of ocean life. A booklet reproduces some beautiful Ernst Haeckel radiolaria plates, and several other wonderful booklets include: "Giants of the Deep," "Kings of Camouflage," "Creatures of the Reef," and "Mystical Beasts of the Deep."

Zoticus's travels also include the Antarctic ice shelf, the Great Barrier Reef, and the shipwreck *Atrilabe*, which is accompanied by a world map of important shipwrecks and estimated dates of sinking: Viking ships (1080), *Mary Rose* (1545), *Santa Margarita* & *Nuestra Senora de Atocha* (1622), *Merchant Royal* (1641), *HMS Pandora* (1791), and S.S. *Central America* (1857). The publisher carefully yet inconspicuously notes that there are several notable shipwrecks missing from this map as they occurred after the date of this journal. It notes *Titanic's* sinking in 1912 and its discovery in 1985, and *Lusitania*, sunk as a victim of World War I and discovered in 1935.

Topics covered also include an underwater volcano and plate boundaries

described by the voyage's marine geologist, Professor Maurice Ewing. The publisher notes: "The theory that the Earth's surface is made up of moving plates was not properly developed until the 1960s. The fact that Ewing describes the idea here is truly remarkable. We must conclude that he was able to develop theories that were startlingly ahead of their time as a result of his exposure to undersea wonders that had never before been witnessed by scientists of his time."

There is a "Web of Life" drawing and a booklet on "Charles Darwin and the Origin of the Species" with a drawing of *HMS Beagle* (1831–1836) and notes on "Darwin in the Galápagos," and "Evolution and Natural Selection." The importance and intrigue of biological

and geological collections and reference samples are honored throughout the book. The voyage ends with a visit to "the vast sunken city" Atlantis—and Poseidon's curse.

This book is a tribute both to Jules Verne, the pioneer of the science fiction genre, and to what we know today about our ocean.

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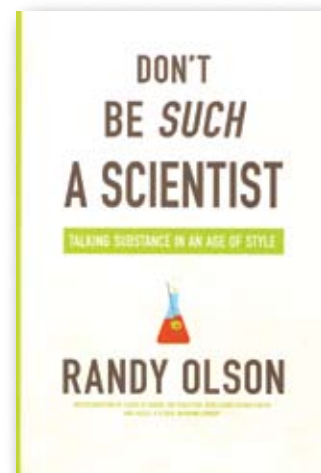
Don't Be Such a Scientist: Talking Substance In An Age of Style

By Randy Olson, Island Press, 2009,
206 pages, ISBN 978-159726-563-8,
Softcover, \$19.95 US

REVIEWED BY JONATHAN H. SHARP

The number of Americans who believe [sic] that our climate is changing has dropped 20 percentage points to 57% in the past two years. This figure should be a clarion call that we, as environmental scientists, are not effectively communicating with the public. Here is a book that addresses the problem with excellent suggestions on how to improve our communication skills. The book might be viewed by some established ocean

scientists as overly critical of them and supportive of our students becoming inaccurate emotional environmental advocates. This should not be the case. Over the past two decades, I have seen increasing numbers of prospective graduate students who were passionate about environmental problems and wanted to "save the world." In our traditional academic training, we tend to squelch this passion in favor of developing quiet, objective, incremental researchers. In the end, our trainees become like us; if they speak out in public at all, it is with guarded, qualified statements. They appear to the more cynical public to be boring "talking heads."



The author of *Don't Be Such a Scientist*, Randy Olson, is a scientist who abandoned an academic career to pursue a new one in professional filmmaking. After earning his PhD in evolutionary biology at Harvard, he advanced to a tenured marine biology faculty position at the University of New Hampshire.

He left that position in his late thirties to enter film school at the University of Southern California. Since then, he has been struggling as an independent filmmaker, making short and feature-length films about evolutionary and environmental sciences for broad public consumption. His neat, short documentary videos in the Shifting Baselines Ocean Media Project are concise, factually accurate vignettes about abuse and overexploitation of the ocean. His feature film *Flock of Dodos*, aptly subtitled *The Evolution-Intelligent Design Circus*, pokes fun at the lack of science in the intelligent design approach, but also at staid, pompous evolutionary scientists. He describes his recent feature film *Sizzle* as a mockumentary about making a documentary film about climate change. I found both films to be entertaining and informative. His short videos and feature films use humor and popular appeal to present solid scientific information.

A major theme of this book is that while scientists speaking in public must, of course, maintain accuracy and objectivity, they fail to communicate to the larger audience that needs to hear them unless they quit being boring. A quote that I like from the introductory chapter is:

The time has come, in our new media environment, which is so cluttered with information that it is at times hard to tell fact from fiction, for new attention to be paid to this second type of error. The powerful and effective communication of science has to be a much higher priority than ever or the science community will lose its voice, drowned out by either the new anti-science movement or just the cacophony of society's noise.

That “second error” is boredom. Olson refers to a traditional scientist’s response to a tedious, boring presentation by a colleague as shrugging it off with the claim that at least the speaker got the facts right and hence no harm was done. He claims that great harm *is* done: it is a total failure to communicate. Throughout the book, he also indicates that this error of boredom helps create an image of scientists that makes the public dismiss and ignore them.

So, what does Randy Olson want us to do? His objective is not to convert a few passionate, articulate young scientists to quit research and go to Hollywood. He suggests that a large portion of our profession make a concerted effort to communicate more effectively with the public, and then gives some valuable pointers on how to do it. He constantly stresses that we do not want to “dumb down” the science and that we must be meticulous in keeping accuracy in our messages. In fact, his “first error” in presenting to the public is inaccuracy. However, we can learn how to make our messages more interesting, more entertaining, and thus, more compelling while still being accurate.

The book has five chapters, the first four with titles starting “Don’t be..”: 1. So Cerebral, 2. So Literal Minded, 3. Such a Poor Storyteller, and 4. So Unlikable. The fifth chapter title instructs what to be: Be the Voice of Science. Throughout, Olson analyzes what he views as common poor communication activities with positive suggestions on how to improve. As a central point, he describes the “objective/subjective divide”: science has the objective side of doing and the subjective side of communicating, with the further division of communicating having the objective

side of substance and the subjective side of style. Even if one’s presentation has great substance, style is needed to get the audience to grasp the substance.

In discussing scientists competing with naysayers to inform the public, he points out that scientists carefully deliver facts. On the other hand, by using emotion and “facts” that are not accurate, the other side succeeds in undermining the scientists’ messages. Many of us have observed this phenomenon. Unfortunately, too often our response is one of disgust for the “charlatans,” as opposed to recognition of our own failure. The message of his last chapter, and a theme throughout the book, is that most scientists should make the effort to become better storytellers. You do not need abandon or water down the substance, rather you need to add style to the substance and be concerned with the story line in public presentations.

Olson relays what he learned from his acting classes about the dichotomy of “arouse and fulfill” (motivate and educate). An actor must first capture the attention of those in an audience, and then fulfill them with the performance. In a similar fashion, a science communicator must motivate the members of an audience and then educate them. In our typical academic presentation format, we generally assume that we are dealing with a pre-aroused audience and can go directly to the fulfill mode. In public presentations, we must first be concerned with motivation: “Why should the public be interested in our message?” He states that scientists usually fail to motivate, but he also points out that well-intentioned Hollywood environmentalists who do motivate often fail to educate. With interesting anecdotes, he suggests that

we need to both motivate *and* educate.

With the modern technological world of Facebook and blogs, Olson suggests that the younger generation of scientists is, and should be, familiar with videos. Probably more and more scientists are beginning to make short videos and post them on their Web pages. This is a potential avenue of expanded communication, both in the mode and in the type of short, interesting message required for presentation. He suggests that we need to move on to using blogs and other voluntary avenues to get our messages out. Olson has been developing and conducting workshops for scientists, including a regular one on communication at Scripps Institution of Oceanography.

Throughout the book, Olson uses interesting anecdotes that describe his transition from research scientist to professional entertainer, and also interesting stories about events and approaches in his filmmaking. Some readers might find his autobiographical approach too personal, but it is effective partially because of his humility. He is very critical of the poor communication success of scientists and most often

pokes fun at himself as an example of what is wrong with the typical scientist's approach. The tone of the book is not "what *you* are doing wrong," it is "what *we* are doing wrong." In the end, he acknowledges that he can't completely quit being a scientist and that he loved his former profession (with the exception of writing grant proposals). He writes as a scientist who loves scientific research, but who is more interested now in mass communication.

This book is well written and interesting. More importantly, it has a compelling message for the scientific community. If you, as an environmental scientist, feel that public perception of and interest in the environment are fine and that people generally are getting good, accurate information, then skip this book. I think that most ocean scientists do not think that everything is going fine. To them, I strongly recommend this book.

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UPCOMING REVIEWS

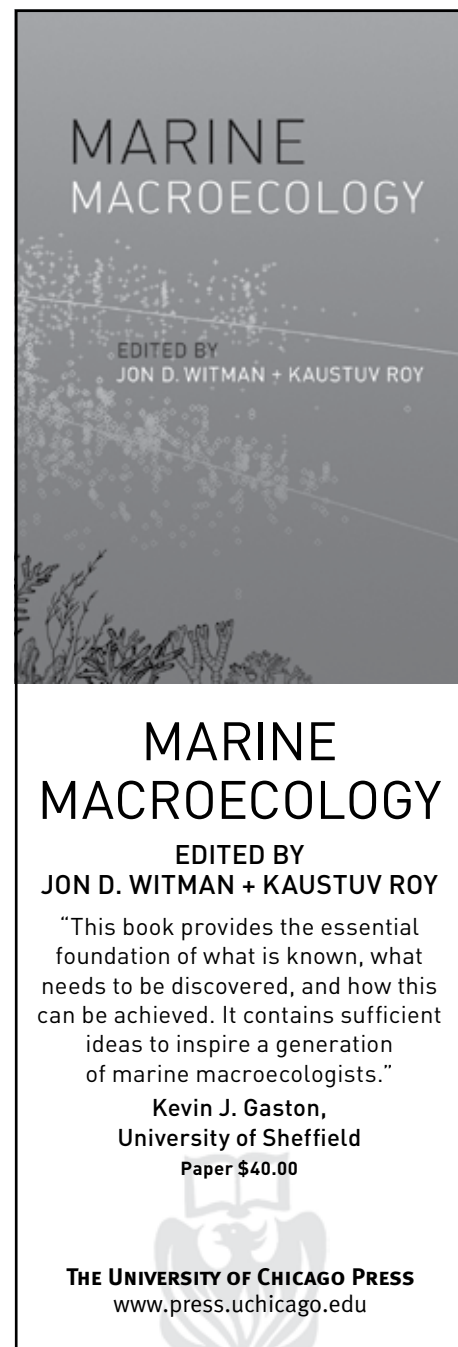
Cold-Water Corals: The Biology and Geology of Deep-Sea Coral Habitats
by J. Murray Roberts, Andrew Wheeler, Andre Freiwald, and Stephen Cairns,
Cambridge University Press, 334 pages

Ecosystem-Based Management for the Oceans
by Heather Leslie and Karen McLeod, Island Press, 368 pages

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by Wolf H. Berger, University of California Press, 519 pages

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by Alanna Mitchell, University of Chicago Press, 176 pages

World Ocean Census: A Global Survey of Marine Life
by Darlene Trew Crist, Gail Scowcroft, and James M. Harding, Jr., Firefly Books, 256 pages



**MARINE
MACROECOLOGY**

EDITED BY
JON D. WITMAN + KAUSTUV ROY

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"This book provides the essential foundation of what is known, what needs to be discovered, and how this can be achieved. It contains sufficient ideas to inspire a generation of marine macroecologists."

Kevin J. Gaston,
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