Environmental Flows: Saving Rivers in the Third Millennium.

Author: Freeman, Mary C.

Source: BioScience, 63(6) : 499-500

Published By: American Institute of Biological Sciences

URL: https://doi.org/10.1525/bio.2013.63.6.12

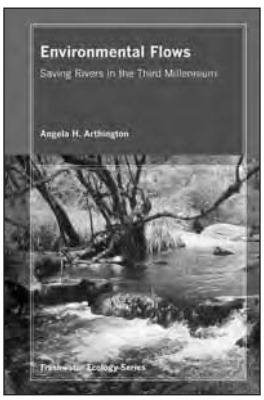
Training the Next Generation of River Warriors

Environmental Flows: Saving Rivers in the Third Millennium. Angela H. Arthington. University of California Press, 2012. 422 pp., illus. $75.00 (ISBN 9780520273696 cloth).

Scientists and natural resource managers concerned with protecting riverine systems have defined *environmental flows* as "the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems" (Brisbane Declaration 2007, p. 1). Environmental flows have emerged as a primary solution to the global problem of river, wetland, and estuary conservation while meeting other human demands for water—for use in irrigation, hydropower, industry, sanitation, and drinking. Despite over 50 years of research and application, however, defining the flow regime needed to sustain a river or estuarine ecosystem remains a difficult problem.

Population growth, with expanding water demands, increasing climate variability, and an extensive loss of aquatic biodiversity, has rendered a balance between ecosystem and human needs for water that is increasingly tenuous. *Environmental Flows: Saving Rivers in the Third Millennium* addresses the key question of how much we can alter river flow (and the associated sediment and water quality) regimes without causing unacceptable ecological change. The book is intended to provide an overview of the relevant ecological concepts, the effects of dams and diversions on flow-dependent ecosystems, and methods for assessing environmental flow requirements.

Author Angela H. Arthington is internationally recognized for her studies in river and fish ecology, particularly in Australia, where she is currently an emeritus professor in the School of Environment and a senior research member of the Australian Rivers Institute at Griffith University, in Queensland. She has pioneered the development of globally applicable, ecology-based approaches to river management intended to shift the focus from minimum flow allocations to the range of flow conditions necessary to sustain biodiversity and key ecological processes. From her many reports and journal publications, one senses that Arthington has long been in the trenches, developing tools to protect and restore river ecosystems.



Environmental Flows is not, however, a how-to manual for developing and implementing ecologically protective flow regimes. Rather, the volume explains how river ecosystems function, how humans have altered riverine systems (and why we should care), and how various environmental flow methods have been (or could be) applied to protect or restore flow regimes. Readers new to the subject are introduced to concepts that underpin many environmental flow methods: for example, natural hydrologic variability in rivers, flow regime classification, and geomorphic variation in drainage networks. The ecological consequences of geomorphic gradients and hydrologic dynamics along river systems are summarized through the lens of alternative (and somewhat complementary) models: the river continuum concept, the flood pulse concept, the process domains concept, and the riverine ecosystem synthesis.

In a chapter specific to river ecology, Arthington highlights the ecological significance of natural flow regime dynamics to processes, from plant growth and nitrogen cycling to biodiversity and life-history evolution (described in 14 example-rich tables). She then focuses on the global scope of human alterations to riverine ecosystems—not only dams but deforestation, urbanization, and irrigation, dating back to early Mesopotamian societies. Arthington thus establishes a context for considering environmental flows: River ecosystems depend on hydrologic variability in complex ways, and we have extensively altered rivers, their catchments, and their flow regimes, which has resulted in a variety of ecological consequences.

Arthington briefly reviews examples of hydrological and hydraulic-rating methods for assessing environmental flows, then offers a more extended discussion of a widely applied habitat-simulation method: the in-stream flow incremental methodology (IFIM; Stalnaker et al. 1995). The IFIM is typically used to simulate habitat for selected, valued species under alternative flow management scenarios and has provided a tool for resource managers worldwide to negotiate water releases downstream from dams. In the past 20 years, however, ecologists have urged the use of more ecosystem-centered approaches. Arthington focuses on these methods, which she conceptualizes as either *bottom-up* (constructing environmental flow regimes from specified ecosystem requirements for baseflows, spates, seasonal floods, and so on) or *top-down* (building environmental flows based on acceptable levels of change in natural flow regimes and ecological functions).

doi:10.1525/bio.2013.63.6.12

In her own work, Arthington has championed *benchmarking*, a top-down approach in which scientists measure change along gradients of flow regime alteration in order to evaluate the ecological risks associated with various water management scenarios. Quantitative benchmarking anchors the recently formulated Ecological Limits of Hydrologic Alteration (ELOHA) framework (Poff et al. 2010), to which Arthington dedicates a chapter that outlines its rationale, methodological steps, and recent applications.

An ongoing tension exists in management between the desire for widely applicable principles (e.g., predictable ecological responses to hydrologic change) and the highly variable nature of rivers. *Environmental Flows* similarly alternates between descriptions of broad concepts and methodological frameworks and specific examples that illustrate the dependence on context of flow alteration effects. Indeed, the text is rich in examples, many from Australia and Europe, which may be particularly informative to North American readers.

Most referenced publications are dated earlier than 2011, but Arthington points the way forward in a short chapter that touches on a range of challenges for developing predictive models of ecological responses to hydrologic change. These include incorporating thermal regimes and water chemistry into ecosystem flow models and linking population and community dynamics to flow alteration. Another major challenge clearly lies in extending concepts of ecological water management to groundwater-dependent ecosystems, which Arthington discusses in detail and with an especially clear description of what *groundwater* is, how it gets there, and why it is ecologically important.

Arthington dedicates her book to "river warriors everywhere," and *Environmental Flows* provides a solid starting point for those entering the fray over water. The book will help students of water management and policy, as well as engineers, educators, and environmentalists, understand why the question "How much flow should we leave in the river?" may not have a short answer.

References cited

Brisbane Declaration 2007. The Brisbane Declaration: Environmental Flows Are Essential for Freshwater Ecosystem Health and Human Well-Being. Declaration of the 10th International River Symposium and International Environmental Flows Conference, 3–6 September 2007, Brisbane, Australia.

Poff NL, et al. 2010. The ecological limits of hydrologic alteration (ELOHA): A new framework for developing regional environmental flow standards. Freshwater Biology 55: 147–170.

Stalnaker CB, Lamb BL, Henriksen J, Bovee K, Bartholow J. 1995. The Instream Flow Incremental Methodology: A Primer for IFIM. US Department of the Interior, National Biological Service. Biological Report no. 29.

MARY C. FREEMAN

Mary C. Freeman (mcfreeman@usgs.gov) is a research ecologist with the US Geological Survey's Patuxent Wildlife Research Center's field station in Athens, Georgia, where she studies the effects of altering flow regimes on biodiversity in rivers of the southeastern United States.

WALLACE IN AMERICA

Alfred Russel Wallace's 1886–1887 Travel Diary: The North American Lecture Tour. Charles H. Smith and Megan Derr, eds. Siri Scientific Press, 2013. 258 pp., illus. $45.00 (ISBN 9780956779588 paper).

The purpose of *Alfred Russel Wallace's 1886–1887 Travel Diary: The North American Lecture Tour* is to document a little-known chapter in the life of this British naturalist and codiscoverer (with Charles Darwin) of evolution by means of natural selection. This publication also marks the 100th anniversary of the death of Wallace (he lived from 8 January 1823 to 7 November 1913), who recorded many of his remarkable experiences in a two-volume autobiography (Wallace 1905). In the first decade of this century alone, four biographers have explored his life (Raby 2001, Shermer 2002, Fichman 2004, Slotten 2004), and the author of one of those (Michael Shermer) also wrote the preface to this volume. The first editor, Charles H. Smith, is a science librarian who runs the Web site *The Alfred Russel Wallace Page* at Western Kentucky University (*http://people.wku.edu/charles.smith/index1.htm*) and is the editor of both an anthology (Smith 1991) and an intellectual history (Smith and Beccaloni 2010) of Wallace.

History has provided Darwin with the lion's share of the credit for the theory of natural selection because of the 20 years of data he presented in *On the Origin of Species* (Darwin 1859). Wallace was fully supportive of Darwin's priority, pleased to be Darwin's colleague in raising the subject, and delighted that it was not his fate to explain evolution to the world. Darwin even wrote to Henry Bates, Wallace's good friend and traveling companion in the Amazon: "What strikes me most about Mr. Wallace is the absence of jealousy towards me: He must have a really good honest and noble disposition, a far higher merit than mere intellect" (Berra 2013). This nonproprietary attitude allowed Wallace to concentrate on biogeography (Wallace 1869, 1876) and eventually on spiritualism—in the form of a bizarre fixation with mediums and séances that began in 1866 and that adversely affected his scientific standing.

Wallace was a pallbearer at Darwin's funeral in 1882, along with James Russell Lowell, an eminent literary figure and the American minister to Britain at that time. The latter invited Wallace, then the world's most famous living naturalist, to lecture at the Lowell Institute, in Boston. Wallace accepted the offer in 1885 and began planning what was to become his North American lecture tour, his lectures eventually forming a substantial part of his major work, entitled *Darwinism* (Wallace 1889). Wallace arrived in