Marine Mammal Science

# Books

MARINE MAMMAL SCIENCE, 26(3): 757–760 (July 2010)

DOI: 10.1111/j.1748-7692.2009.00359.x

**Systemic Management: Sustainable Human Interactions with Ecosystems and the Biosphere.** Charles W. Fowler. 2009. ISBN: 978-0-19-954096-9. Oxford University Press, Oxford, U.K. 295 pp. US$99.00 (hardback).

Charles Fowler has thought for a considerable amount of time about how humans fit into the natural world and how our interventions in the natural world should be guided. This book is one long argument (which he sees as more than confined to science) about how we fit in and how our actions should be managed.

The two overarching principles are easy to state: First, we do not manage populations, species, or ecosystems. The only thing that we manage is human intervention with populations, species, and ecosystems. Second, when human intervention occurs, it should not create abnormal situations. He uses the Bering Sea as an example to allow the principles to have a concrete form. For example, we can ask whether the mean abundance of cetaceans, the composition of the fish community, the distribution of species over space, the mean trophic level, or species diversity are normal or abnormal? We can ask whether individual species (*e.g.*, Steller sea lions, bowhead or blue whales) are outside their natural range of variation for population size? In the walleye pollock (*Theragra chalcogramma*) fishery, is human interaction abnormal (*e.g.*, mean size of pollock taken or the functional response relating consumption/harvest and abundance) relative to other predators of pollock?

Most of the first chapter is explaining how conventional management, very often a negotiated political decision, fails to achieve the two principles. Fowler builds his case on tenets that management must (1) be based on understanding humans as part of a complex biological system; (2) recognize that control of other species and ecosystems is impossible; (3) account for the complexities of nature; (4) be consistent in application, especially across different levels of biological organization; (5) strive to avoid the abnormal; (6) be risk averse and strive for sustainability; (7) be based on evidence and information; (8) include scientific methods and principles in research, monitoring, and assessment; and (9) have clearly defined, measurable goals and objectives. In the rest of this chapter, he explains the failure of conventional management, the abnormality of the current situation, and how stakeholders could be involved in a new kind of management. Later in the book (Chapter 4), Fowler returns to why conventional management fails to meet these tenets and identifies the causes of the problems. The causes include that humans are not objectively considered in management (usually given priority); that we manipulate systems and proceed as if we have control, when we do not; that there is little consistency in application at various levels of biological organization; that many of the goals and objectives involve guesswork; and that science is not used for its strengths but we fall prey to its weaknesses. The result is that abnormal situations abound.

An immediate implication of the first overarching principle is that "ecosystem management" should be banned from the lexicon and that authors who use it (*e.g.*, Christensen *et al*. 1995, Walters and Martell 2004) damage the cause. Indeed, Fowler notes that even those

who use this oxymoron lack a common definition for ecosystem management and often lack criteria for evaluating the health of the ecosystem. Most of the book is spent fleshing out the second overarching principle, the core of which is "the objective finding of a sustainable niche for humans that is in dynamic (*i.e.*, limited stochastic) balance with larger systems and their other components" (p. 131). Fowler believes that we do this by having clear questions that lead to scientific work that reveals the patterns on which management must be based. I will come back to "objective," but for now we can focus on the protocol for management to achieve sustainability. Fowler sees this as a four-step process. First, we define a management question. Second, we identify the relevant levels of biological organization and associated characteristics to be measured. Third, we find the range of natural variation of these characteristics. Fourth, we act to avoid human abnormality, *i.e.*, preventing the natural range from being exceeded.

Fowler sees the role of science in the second and third steps and alternately calls his approach systemic-management, reality-based management, or pattern-based management and views it as "transcending hierarchical boundaries between the various levels of biological organization" (p. 203). In addition, he believes that systemic thinking removes from us the process of decision-making and setting goals—it is the natural variation that sets the goals for us. Then, we will approach nature with much more humility, than if we have hubris to think that we "manage ecosystems." The role of scientists in systemic management becomes one of being the specialists who help identify the patterns that are associated with specific management questions.

Thus, most of the book is taken up with a discussion of pattern. In Chapter 2, Fowler focuses on patterns among species (*e.g.*, body size, trophic level, number of consumers, interaction strength, predation or consumption rates, consumption of energy/production of carbon dioxide, geographic range, allocation of consumption over space, population density, population size, the coefficient of variation of population size, the intensity of density dependence, rate of population increase, biomass per unit area, maximum reproductive rate, rate of increase per generation, or lifetime reproductive effort). The pattern of variation across species (*e.g.*, the coefficient of variation [cv] of population size of the sample of marine fishes ranges from about 0.1 to 1.3) leads Fowler to ask the question "How much variation is too much? How do we use abnormal variation to lead to meaningful management questions that conform to the tenets of management laid out in Chapter 1?" (p. 35). The point of understanding such patterns, of course, is that they almost always involve characteristics that have been shaped by natural selection (at the individual level or selection by extinction and speciation; these are "Nature's Monte Carlo experiments in sustainability"). Thus, the patterns about body size, generation time, density, and so forth provide a consistent way to introduce biology into management. And this sorely needs to be done. For example, proponents of marine reserves often act as if all species will respond in the same manner to reserves, even though it is easy to see that this cannot be the case (*e.g.*, Mangel 1998). Describing pattern becomes more difficult, of course, when one has more than a couple of traits or species in the mix; how to do this is still an open question.

The focus of Chapter 3 is selective extinction and speciation, which Fowler sees as a natural complement to natural selection and thus most of the chapter is a compare and contrast essay regarding natural selection on individuals and extinction and speciation creating new variation, including a historical perspective. After explaining in Chapter 4 why conventional management has failed, in Chapter 5 Fowler explains why systemic management works. We avoid the abnormal situation by considering that the human species is part of the natural system and our interactions with the natural system must account for the same laws that govern the rest of the species and we do this through a scientific treatment of the complexities of the material world. He carefully explains how systemic management adheres to the tenets described earlier by being guided by information that is integrative, addresses the diversity of the questions that we need to ask, and accounts for complexity and interconnectedness. Fowler provides some convincing plots (*e.g.*, density [numbers/area], total population size, proportion of walleye pollock consumed) concerning humans in nature—we are always at the

extremes of the distributions. He emphasizes the importance of monitoring and that models that are appropriately used can be tools for research and guidance. He also discusses the limits of systemic management. These include that priorities are not always clearly defined, species frequency distributions are inadequately developed, acquiring information is difficult, and all measures are reference points not an end in themselves.

In Chapter 6, Fowler discusses humans as a species beyond limits and returns to the example of consumption of walleye pollock. There are 21 species that consume pollock, so it is possible to create a meaningful frequency distribution of proportion of standing stock consumed. To move human consumption from the extreme right hand tail of the distribution to the center would require approximately a 100-fold reduction in harvest rates; to move it roughly to one standard deviation above the mean would require about a 10-fold reduction in harvest rates. Similar arguments are made about herring, mackerel, and hake and overall consumption in the Eastern Bering Sea and about overall consumption in the Georges Bank and the Benguela Current ecosystems. To move overall consumption by humans in the Eastern Bering Sea towards the middle of the distribution (based on 20 species of marine mammals) will require a more than 10-fold reduction in total consumption. The examples are not limited to fish: he also includes freshwater and energy use, production of carbon dioxide, geographic range, and population density. In each case (and there are others too) humans are found at the extreme of the distribution. Even our fishery control rules—when viewed as functional responses relating prey abundance and predator consumption—are extreme. But the task is not impossible. Fowler shows that human take of deer, elk, and moose in northwest Montana and southeastern British Columbia is not abnormal. This chapter ends the formal scientific presentations.

The last chapter is a wide-ranging epilogue, going beyond the boundaries of scientific discussion. In it, Fowler discusses the elements of change that are required to move from conventional to systemic management. He discusses belief systems that block the road, the crucial role that education at all levels will play, and the roles of organizations, science itself, politics, and religion in making the transition. I concur with him that we have missed an opportunity to bring science and religion together for solving important environmental problems (Mangel 2007) and if systemic management can help us to make the links, that is good.

In summary, the protocol for systemic management is (1) define the management question, (2) identify the relevant levels of biological organization and the associated characteristics to be measured, (3) find the limits to the normal range of natural variation of the characteristics identified in the preceding step, and (4) take action to avoid human abnormality. Fowler believes that systemic or reality-based management will transcend boundaries between different levels of biological organization and reduce conflicts prevalent in conventional management because the elements of potential conflict are carefully dealt with in the way information consonant with the management question is used.

While, I like these ideas, I have some concerns. Fowler considers that models are indispensable tools for better understanding and discovering and representing pattern and process but "*are not the reality they attempt to represent*" (p. 210, italics added). However, he views the patterns as "objective" statements about the world for which there is thus little room to doubt. But the patterns are described with histograms, so the shape of the pattern depends upon the interval for binning and different results arise with different binning rules or measurement units (*e.g.*, log[mass], mass, or ln[mass]). He points out (p. 91 following) that simulation models are always incomplete, but the same is true of all science (field, laboratory, or theoretical): we always run the risk of missing the important factor and science can never be "realistic" and this includes the patterns shown in the book. Often he writes about "Science" in the third person, as in "Science may be able to partially explain patterns. . ." (p. 26) or "One of the products of science is that of documenting and describing problems so that they can be drawn to everyone's attention" (p. 78) as if science itself is devoid of people, non-controversial, and hegemonic. But that is surely not the case.

## Literature Cited

Christensen, N. L., A. M. Batuska, J. H. Brown, *et al*. 1995. The report of the Ecological Society of America Committee on the scientific basis for ecosystem management. Ecological Applications 6:665–691.

Mangel, M. 1998. No-take areas for sustainability of harvested species and a conservation invariant for marine reserves. Ecology Letters 1:87–90.

Mangel, M. 2007. New views on religion and science. Reviews of E. O. Wilson The Creation, F. S. Collins The Language of God and J. Roughgarden Evolution and Christian Faith. BioScience 57:273–277.

Walters, C. J., and S. J. D. Martell. 2004. Fisheries ecology and management. Princeton University Press, Princeton, NJ.

Marc Mangel, Center for Stock Assessment Research, Department of Applied Mathematics and Statistics, The Jack Baskin School of Engineering, University of California, Santa Cruz, California 95064, U.S.A. E-mail: msmangel@ucsc.edu.