example, management options to reduce predation on young vs. managing for increased adult survival can have non-intuitive implications and is an important lesson for young conservation biologists. Similarly non-intuitive for students is the interface between demography and genetics (Chapter 9). The potential impacts of slow growth rate and rapid population decline on genetic factors (e.g., the maintenance of heterozygosity) and the relative impact of inbreeding depression on various vital rates, and how to weight the importance of genetic verses demographic factors is introduced. Rounding out the section is the incorporation of multiple populations and issues related to connectivity, estimation of dispersal, and metapopulation dynamics.

Having introduced these population processes, Part 3 focuses on the application to small and declining and harvestable populations. Here Mills ties human population growth to synergistic effects linked to declines in wildlife populations (Chapter 11). At this point readers are aware of the need for understanding the genetics, age- and sex-specific vital rates, and environmental impacts on small populations. This leads into a discussion of methods for assessing viability of populations, including population viability analysis and listing approaches and their rules of thumb (Chapter 12). A brief chapter on focal species concepts (Chapter 13) and the population biology of harvesting populations completes the applied section. The text is well illustrated with figures and over 50 boxes.

A highlight of the book occurs early (Chapter 2) with an anecdote from Mills' professional life during his tenure with the national lynx survey. Mills tells us of his experience with certain wildlife biologists who purposefully mislabeled lynx hair samples (they were lynx, but were from a trophy) and sent them to Mills for identification. This story leaked, resulting in claims of rampant fraud and led to a congressional hearing and a black eye for wildlife conservation biology. Mills uses this personal experience as a didactic tool to infuse his overall message of ethics above all. With such an experience it is not surprising that ethics has a large and upfront place in this book.

The best scientists and decision makers can separate irrelevant and unreliable knowledge from reliable knowledge. Unfortunately management practice is too often reliant on the opinions of respected authorities, based on uncontrolled experiments, or from descriptive studies. Such "experience-based" evidence is rarely effective and stems from poorly developed scientific skills and weak ethical standards. As emphasized in Mills' text, science is but one factor that contributes to the management and conservation of wildlife and Mills' plea is for biologists to produce the most reliable knowledge possible by embracing uncertainty and the "esoteric pieces of math and invisible DNA molecules" that are critical tools for applied population biologists. This is a message that is critical to ingrain in young biologists before they become tainted by "business-as-usual" management. The rules are simple but often hard to follow.

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Sinks, Sinks, and More Sinks

Reay, David S., C. Nick Hewitt, Keith A. Smith, and John Grace, editors. 2007. **Greenhouse gas sinks.** CABI, Cambridge, Massachusetts. xv + 290 p. $160.00, ISBN: 978-1-84593-189-6.

Key words: carbon dioxide; methane; nitrous oxide; greenhouse gas; sinks.

Carbon sinks were catapulted into public awareness in the late 1990s as climate negotiators became aware that removing carbon from the atmosphere might achieve the same objective (stabilization of greenhouse gas concentrations) as reducing emissions of carbon. Not a great deal of progress has been made in stabilizing the atmospheric concentration of CO_2 (in 2005 it was 28% higher than it was in 1990), but research on the topic of carbon sequestration continues. Furthermore, it is now widely recognized that other greenhouse gases also have sinks, although for gases other than carbon dioxide these sinks are processes that breakdown the gas rather than reservoirs that sequester it.

The book by Reay et al. is an attempt to bring the discussion of greenhouse gas sinks into a single volume—three of the major greenhouse gases, anyway: carbon dioxide, methane, and nitrous oxide. As stated in the preface, "The aim of this book is to provide readers with in-depth, authoritative information on these sinks. We will explore how the sinks may respond to increased GHG emissions and global temperatures, and whether we can protect and even enhance them to help mitigate climate change."

The book contains 17 chapters organized into four sections. The first three sections address carbon dioxide (Chapters 1–8), methane (Chapters 9–12), and nitrous oxide (Chapter 13–15). Two final chapters consider cross-cutting issues and new directions (Chapter 16) and the effects of nitrogen deposition on the fluxes of all three greenhouse gases in European forests (Chapter 17). Each of the three sections has a lead chapter that provides an overview of the sources and sinks for that gas and its importance globally.

Sinks for greenhouse gases are clearly as important as sources in affecting the Earth's climate through radiative forcing, and the design of this book was to assemble the relevant aspects of natural and human-influenced sinks under one cover. The topic is multi-disciplinary, and the chapters cover a range of disciplines, including terrestrial ecology and biogeochemistry, oceanography, geology, atmospheric chemistry, chemical synthesis, and the politics of climate change. It is unlikely that anyone will be interested in the details of each chapter, but the information is here.

Surprisingly, the reader has to wait until Chapter 5 (the effects of no-till agriculture on both the sources and sinks of the three greenhouse gases) to learn the relative radiative importance (global warming potential) of carbon dioxide, methane, and nitrous oxide. The issue is taken up again in Chapters 6 and 15, but there is no chapter that provides an overview comparing these three greenhouse gases with each other and with other

greenhouse gases and other factors important in the Earth's radiative balance.

Individual chapters vary widely in length, comprehensiveness, and quality. The first two chapters are an unfortunate beginning to the book and are not indicative of the writing in subsequent chapters. Chapter 1 is particularly careless: 2010 instead of 2100 and today's emissions of carbon variously reported as 6.5 Pg C/yr, 6.3 Pg C/yr, and 6 Pg C/yr. The units throughout the chapter are generally Pg C/yr, but million tonnes CO_2/year appears once. There are also misleading statements with regard to measurement and inference. One example is "About 88 Pg C/year is released from the surface of the world's oceans, with an annual uptake by the oceans of 90 Pg C. Consequently, the net uptake by oceans is estimated to be ~2 Pg C/year."

Chapter 2 is also disappointing in that it chooses to emphasize differences in definitions and uncertainties rather than characteristics generally agreed upon. "These complications need to be borne in mind as we make both general and specific references to productivity throughout this chapter." This is the easy way out. It excuses the authors from having to decide whether any of the measurements are more reliable than others. Rather, all published estimates are considered equally accurate. This uncritical review leads to the conclusion, not surprisingly, that there is much to learn and many experiments needed—no doubt true, but not for the reasons given here. Furthermore, definitions of NEE, GEP, and NBP do not add much (except unnecessary complexity) to the more commonly accepted definitions for productivity. As in Chapter 1, the units are not consistent throughout.

Despite the slow start, the book has a number of excellent chapters. The chapter on geological carbon sinks, for example, is a particularly good primer. The last chapter by Wim de Vries et al., "The impact of atmospheric nitrogen deposition on the exchange of carbon dioxide, nitrous oxide and methane from European forests," is particularly comprehensive and represents an original contribution. With the exception of the last chapter, most chapters serve as reviews and do not present new material. On the other hand, the breadth of material covered in the book is likely to provide most readers with information that is "new."

There is much here of interest to ecologists. The effects of soils as both sources and sinks of carbon, methane, and/or nitrous oxide are explicitly reviewed in at least four chapters, and, again, the chapter on the effects of nitrogen deposition on European forests is an excellent analysis.

The political discussion in Chapter 4 of the Kyoto Protocol and the Marrakesh accords seems out of place. A much longer history of the politics of climate change agreements and an in-depth review of the issues of carbon trading appears in Chapter 8. Although based on examples from terrestrial ecosystems, the discussion is largely on policy—another example of the book's broad coverage.

With the possible exception of Chapter 4, most of the chapters are on topics one would expect in such a book: terrestrial, oceanic, geological, and atmospheric sinks for carbon, methane, and nitrous oxide. Two other chapters, however, were unexpected, to this reader, at least: a chapter entitled "Artificial carbon sinks: utilization of carbon dioxide for the synthesis of chemicals and technological applications" and a chapter entitled "Artificial methane sinks," exploring the factors that influence methane oxidation in soils covering landfills. While encouraging methanotrophs is consistent with enhancing sinks, recovering methane for fuel would seem a wiser application of technology than ensuring the oxidation of methane in situ.

Although the chapters vary in consistency, the book is generally well edited, with the possible exceptions of the figures, which are sometimes not what they're meant to be, sometimes missing letters, sometimes out of date, and sometimes difficult to interpret from the key.

Nevertheless, the book largely achieves the purpose the editors defined: "to provide readers with in-depth, authoritative information." The major limitation of the book is not what it includes, but what it doesn't include: it does not provide a complete accounting of sinks *and sources*. And the future of greenhouse gas concentrations is not predictable from a discussion of sinks, alone, but rather, from changes that affect the balance of sources and sinks.

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Is Yellowstone on the Brink?

Wagner, Frederic H. 2006. **Yellowstone's destabilized ecosystem: elk effects, science, and policy conflict.** Oxford University Press, New York. xiv +371p. $64.50 ISBN: 978-0-19-514821-3 (acid-free paper).

Key words: elk; natural-regulation policy; northern range; Yellowstone.

As the world's first national park and one of the most extraordinary natural areas in North America, Yellowstone has attracted tremendous attention from visitors, scientists, and managers for the past 135 years. Issues in Yellowstone raise intense controversy, and in many cases polarize the interested parties. Consider issues of bison migration and brucellosis transmission to livestock on private lands adjacent to Yellowstone, ownership of thermal pool bacteria genes, expansive wildfires, the reintroduction of gray wolves, non-native lake trout introduction into Yellowstone Lake, and, of course, elk populations and the condition of vegetation on Yellowstone's northern range. The northern range, encompassing approximately 1/3 of Yellowstone's land area and extending north to include areas of National Forest and private lands, is winter home to of one of North America's largest elk herds, and significant populations of bison, pronghorn, and mule deer. This area has attracted many researchers who have analyzed the dynamics and stability of this region and its ecosystems for decades. While there is a larger body of scientific literature on this area than almost any comparable area in the world, there is no consensus on the "ecological health" of this region. A recent National Academy of Sciences book "Ecological dynamics on Yellowstone's northern range" (Klein, D. R., D. R. McCul-

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