

Virtual Water in the Real World

Globalization of Water: Sharing the Planet's Water Resources.

Hoekstra, A. Y., and A. K. Chapagain. 2008. Blackwell Publishing, Malden, MA. 220 (xii + 208) pp. \$65.00 (hardcover). ISBN978-1-4051-6335-4.

Arjen Hoekstra, Ashok Chapagain, and others in their research team have, since 2001, made very important contributions to the development of the science associated with the concepts of “virtual water use” and “virtual water trade” and in the related concept of “water footprints.” Their modeling of these concepts and the national and global processes associated with them have been even more important. They first worked together at the UN Educational Scientific and Cultural Organization-IHE (UNESCO-IHE) Institute for Water Education in Delft in the Netherlands. Arjen Hoekstra now leads an internationally recognized research group working on water footprints at the University of Twente in the Netherlands. Ashok Chapagain is making an extremely important contribution at World Wildlife Fund-UK, where he is underpinning the water science of this influential international organization. The authors have marshaled an immense knowledge of water resources management and the essential capacities to model the complex synergies of water, food, and other commodity trade. Their work has contributed fundamentally to the development of the concepts of virtual water and virtual water trade. They have also promoted and widely disseminated the idea of the water footprint.

The purpose of the book is first to identify and quantify the volumes of water needed to produce food and industrial commodities. Second, it pro-

vides estimates of the impact of the degradation of the quality of water put back into the water environment after crop production and industrial manufacturing have taken place. By calculating the water footprints of the agricultural and industrial activities of the national economies of the world, the authors have highlighted the small number of economies that have water surpluses and the vast majority of economies that are dependent on imports of virtual water in food and industrial commodities.

The authors expertly introduce newcomers to the history of the concepts and the associated and sometimes controversial economic theory. They make understandable complex issues such as defining the water content on the basis of how much water is used to produce commodities at the place of production. They also emphasize the different volumes of water associated with the production of the same commodities in importing economies. The assumptions and methods are clearly stated.

Another important contribution of the book is that it provides a way of gaining a more comprehensive and realistic definition of water resource use. By including green water or soil water among the contributing water sources in rain-fed agricultural activities the authors also have advanced our grasp of the water budgets of nations. They achieve this mode of analysis by estimating water use in agriculture on the basis of evapotranspiration. Another important methodological contribution is their attempt to estimate the impact of water use on stores of surface and groundwater and on flows to which water is returned after use. These impacts are shown to be particularly high for manufacturing industries.

The book is well illustrated with diagrams and maps that will help

readers new to the field grasp the theory and especially the national-level and global processes being analyzed. A number of case studies are used to highlight the insights and understanding provided by the methods and analysis. Very useful tables also allow the reader to see, for example, that there are less than 10 economies worldwide that have a significant water surplus, but that these economies have successfully met, or have the potential to meet, the water deficits of the other 190 economies. Another chapter shows that an unintended, but very useful, outcome of virtual water trade in the crop and livestock sector has been very significant water savings at the global scale. The authors estimate that 1250 billion m³ of water—calculated on the basis of conditions in producing economies—is associated annually with international crop and livestock trade. If these commodities were to be produced in the importing countries, the volume of water needed would be 1600 billion m³. This means that the water, food, and trade nexus has enabled 350 billion m³ of water to be “saved.” That is enough water to provide for the needs of about 300 million people with the average water global footprint of 1250 m³/year. The population of the Middle East and North Africa is about 300 million, as is that of the United States although, as the study shows, the water footprint of an American is almost exactly twice the world average. Three hundred million is equivalent to half the population of Africa.

Another chapter highlights the capacity of virtual water and water footprints to reveal the questionable economics of existing and planned policies to achieve water security. Their analysis shows that in China, the water-scarce region of northern

China is a net exporter of virtual water to the water-surplus region of southern China. The current policy remedy is to move water from the south to the north. The very useful capacity of the virtual-water and water-footprint concepts to highlight underlying economic and hydrological fundamentals does not, however, mean that societies and political processes welcome the revelations. The most powerful features of virtual water trade are its economic invisibility and political silence. Consumers enjoy the delusion of food and water security provided by virtual water trade. Neither consumers nor politicians have willingly adopted the new virtual water and water footprint mindset that would require them to recognize their water and food insecurities. These issues are politically toxic and best kept off the agenda.

The science of this book is sound. It introduces new ideas and a very innovative analysis accessibly and persuasively. The concepts of virtual water and water footprints have taken some time to gain acceptance. This study will accelerate their adoption in the worlds of water science, water resource planning and allocation, and in places where the uses of water resources are highly politicized. It provides an inspired introduction for newcomers to the subject.

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Systematic Conservation Planning Comes of Age

Systematic Conservation Planning. Margules, C., and S. Sarkar. 2007. Cambridge University Press, New York, NY. Ecology, Biodiversity and Conservation Series. 277 (vii + 270) pp. \$65.00 (paperback). ISBN 978-0-521-70344-4.

Ecologists have always been in the business of trying to solve practical conservation problems. Fasci-

nated by progress in physics, mid-20th century ecologists would have rejoiced with the discovery of a formula that unequivocally expressed the universal value of nature. Such a formula was never found and despite attempts to develop a synthetic theory of biodiversity value, it was pragmatism that prevailed when conservation planning algorithms were first proposed. In contrast to previous conservation-evaluation procedures, these algorithms were not about giving high value to areas that contained many species, many rare species, or any kind of value obtained by summation or multiplication of indicators of biodiversity. Instead, the value of an area was seen as a relative concept: the contribution of an area to a pre-defined goal. As noted by Adams and Rose (1978), quoting M. D. Hooper, the "ultimate criterion" of conservation planning would amount to buying areas that added "most new species to an existing reserve system." It was not until 1983 that the idea was formalized and properly implemented with an algorithm (Kirkpatrick 1983), and the concept of "complementarity," itself, was only coined in 1991 (Vane-Wright et al. 1991). The suggestion that conservation areas should complement each other in terms of the features they contain now underpins a growing number of real-world conservation plans. It also constitutes the key principle of the emerging science of systematic conservation planning (Margules & Pressey 2000).

Surprisingly, systematic conservation planning is still poorly represented in textbooks and university curriculum. Might a modest presence in teaching be due to the young age of the discipline? Young age might be a factor indeed. But the breadth of the discipline, the complexity of some of its applications, and the rate with which new studies are being published makes it difficult for pedagogues, students, and practitioners to keep track of progress in the field. This does not come to the advantage of the field. The development

of any discipline requires the subject be taught to students and that it be useful to potential users. Comprehensive and accessible textbooks in systematic conservation planning are thus needed if the field is to grow and mature.

Senior researcher Chris Margules, who recently became a conservation practitioner at Conservation International, and professor Sahotra Sarkar at Texas University have addressed this need. They have published the first attempt to synthesize systematic conservation planning concepts and methods to the nonfamiliar reader. Their book covers a range of topical issues, including a discussion of the strengths and limitations of biodiversity surrogates (chapter 2), the need for more data and for data collected more systematically (chapter 3), and the opportunities for making the best of available data through data mining procedures (chapter 4). Chapters 3 and 4 are not part of what might be loosely termed the science of systematic conservation planning, although they include themes that conservation planners and students need to be aware of. Conceptual issues relevant for the selection of conservation-area networks are highlighted in the introduction and developed in chapter 5, whereas chapters 6 and 7 provide extensions and further details on how planners might account for persistence and complex socioeconomic trade-offs in conservation decisions. These chapters are the spine of the book. Of particular importance is the 11-stage protocol for conservation planning outlined in the introduction. This is an extension of the original six-stage protocol proposed by Margules and Pressey (2000). I remain unconvinced that adding five stages to the original protocol is an improvement. The new stage 1—identification of stakeholders for the planning region—is a useful addition, but the additional stages are not mandatory (e.g., stage 9—examine the feasibility of using multicriteria analysis) or could be a step within a previous stages (e.g., stage 7—assess

prognosis [of persistence] for biodiversity within each newly selected area). Indeed, persistence is best handled as a key component of the prioritization process (e.g., Williams & Araújo 2002). Thus, it should ideally be part of stage 6—prioritize new areas for potential conservation action. Finally, chapter 8 provides examples of five case studies in which concepts and methods characterizing systematic conservation planning, as described in the book, have been implemented in practice. This is a very useful section; in that it demonstrates that concepts and methods in systematic conservation planning can and are being applied in practice. It also helps the reader understand some of the challenges of applying conservation planning in real-world situations.

Overall, the book is well written, accessible, and reasonably comprehensive. The key topics and concepts are introduced and consistently integrated in the chapters, making it a coherent narrative rather than a loose compilation. Obviously, the price of breadth is lack of depth. For example, by choosing to write chapters on data collection and data mining, the authors have sacrificed a more detailed coverage of the field, for example by including a discussion of the environmental-change challenges to systematic conservation planning, to enable a discussion of topics that, although important (no decisions are made without data), are not key aspects of the field. Moreover, data collection and data mining are complex topics for which excellent textbooks already exist. Nevertheless, I am confident that the synthesis provided by Margules and Sarkar will prove a valuable resource, particularly for conservation practitioners. It will also be useful to students, although the book is so heavily based on the authors' own work that it can hardly stand alone as a scholarly resource for teaching systematic conservation planning. For the more engaged reader, an independent search of the primary sources, complementing those provided in the book, is still compulsory.

This is the first textbook that attempts to synthesize the broad and fast-growing field of systematic conservation planning. It certainly will not be the last of such books, but it shows that the field is at last coming of age.

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Literature Cited

- Adams, W. M., and C. I. Rose. 1978. The selection of nature reserves for nature conservation. Discussion paperbacks for conservation, no. 20. University College London, London.
- Kirkpatrick, J. B. 1983. An iterative method for establishing priorities for the selection of nature reserves: an example from Tasmania. *Biological Conservation* 25:127-134.
- Margules, C. R., and R. L. Pressey. 2000. Systematic conservation planning. *Nature* 405:243-253.
- Vane-Wright, R. I., C. J. Humphries, and P. H. Williams. 1991. What to protect? Systematics and the agony of choice. *Biological Conservation* 55:235-254.
- Williams, P. H., and M. B. Araújo. 2002. Apples, oranges and probabilities: integrating multiple factors into biodiversity conservation with consistency. *Environmental Modeling and Assessment* 7:139-151.

Salvaging What, Exactly?

Salvage Logging and Its Ecological Consequences. Lindenmayer, D. B., P. J. Burton, and J. F. Franklin. 2008. Island Press, Washington, D.C. 243 (xvi + 227) pp. \$65.00 (hardcover). ISBN 978-1-59726-403-7.

"This place is sure due for a wildfire," was a recurring thought I had during the summers I spent clearing trail through dense, century-old lodgepole pine. At the time, I was an aspiring land manager just beginning to learn the ecological role of disturbance. A decade later, after a lot more academic training concerning the central role of fire in forest

ecosystems, I returned to that Montana wilderness to find that it had indeed burned, and pretty severely, too. I was surprised by my reaction. It was visceral and irrational. Although I certainly knew better, all I saw was death and loss, a skeleton forest. Considering that I was only a fair-weather friend to the area, I expect my feelings were trivial compared with those who live and work in this landscape full time. So it seems perfectly understandable to me that the knee-jerk reaction to a severe wildfire is often to seek some benefit from within the loss—to salvage something.

Emotional reactions, like mine, are what the authors of *Salvage Logging and Its Ecological Consequences* are up against as they lay out an argument against indiscriminate postdisturbance timber harvest. With few exceptions, logging dead trees has always been the management response to disturbance, whether it comes as fire, ice, insects, or wind. Often salvage has been justified on ecological grounds: to expedite recovery, to ensure regeneration, and to reduce fire risk. So, when the authors assert that harvesting live, "green trees" typically has less ecological impact than harvesting dead trees, they are bucking some seriously entrenched conventional wisdom. I think this book can help managers and policy makers move past the conventional wisdom, the rhetoric, and the emotion to see that there is no ecological justification for salvage logging. Whether there are economic or other justifications is another matter entirely and is a topic outside the purview of this book.

In organizing their book, the authors made two decisions that will ensure that it is read and referenced widely. First, they kept it short. The real meat of the book is just over 150 pages, and is chock full of photos and figures. With more than a century of combined experience in forestry research, Lindenmayer, Burton and Franklin could have easily produced a tome, so I commend them for choosing brevity. Second, they chose not to

create an edited volume, but instead wrote one cohesive argument, where each chapter builds on the chapter before, eventually culminating in a series of evidence-based management and policy recommendations.

They begin with a primer on forest ecology, emphasizing the critical role of disturbance and natural recovery in providing landscape-scale diversity. This is not, nor does it claim to be, a thorough treatment of the topic—instead it is a requisite foundation in their case. Next, they review the published evidence documenting the ways in which salvage logging has ecological impacts distinct from logging of green trees. As they point out, some distinctions arise from a postdisturbance crisis mindset, which is frequently more permissive than during calmer times. Examples include permitting larger cut blocks, removing more volume, and harvesting in areas that would otherwise be unavailable to logging (i.e., roadless areas). Other distinctions relate to the loss of unique post-disturbance biological legacies and the related impacts of these losses on a range of organisms. Finally, there are the distinctions that relate to ecological function and the sensitive condition of the postdisturbance environment, such as increased vulnerability to soil erosion and compaction. After the general overview of potential ecological consequences, the authors introduce a series of case studies in postdisturbance management, broken down by disturbance type: fire, insect, wind, and volcanoes. In this chapter, and throughout the book, the authors lean heavily on large, infrequent disturbances like the massive and ongoing bark beetle outbreak in British Columbia and the 2002 Biscuit fire. Although I am sure that this simply reflects the fact that large events have garnered relatively more research dollars, I would have liked to have seen more emphasis on the smaller, more common disturbance events that managers are more likely to be faced with. Nonetheless, the case studies offer a fascinating trip to

large forest disturbances around the globe and are a reminder that some of the largest salvage operations have come in the wake of very rare events such as the 1938 Hurricane in New England, and the 1988 eruption of Mount St. Helens in the Pacific Northwest.

The last two chapters—“Reducing the ecological impacts of salvage logging” and “Toward Better Management of Naturally Disturbed Forests”—are the book’s most valuable. By this point, the authors have built a mountain of empirical evidence, which lends authority to their recommendations. They urge against reactionary management, “where action is a substitute for thought.” Instead, they suggest that preemptive forest planning should determine the response to disturbance. They acknowledge that economic considerations may alter management timelines—expediting harvest schedules so that the timber retains its value—but they suggest that salvage operations be restricted to areas previously slated for green-tree harvesting. In addition, they emphasize that environment safeguards—such as riparian buffers, snag retention, landscape connectivity, and soil protection—are fundamental considerations for responsible harvest operations, salvage or otherwise. Finally, after the obligatory plea for more research funding, they conclude with a call for new language. The word salvage, they note, has connotations that belie its effects.

There must be dozens of books describing the ecological consequences of green-tree logging, but never before has postdisturbance “salvage” logging been subject to an exhaustive review. Given the emotional reactions to disturbance, the persistent controversy, and misconceptions surrounding the practice, this book is long overdue.

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Keeping Up with Climate-Change Policies

Climate Change and Forests: Emerging Policies and Market Opportunities. Streck, C., R. O’Sullivan, T. Janson-Smith, and R. Tarasofsky, editors. 2008. Brookings Institute Press, Washington, D.C. 360 pp. \$69.95 (hardcover). ISBN 978-0-8157-8192-9,

The Little REDD Book. Parker, C., A. Mitchell, M. Trivedi, and N. Mardas. 2008. The Global Canopy Program, Oxford, United Kingdom. 114 pp. Available at www.globalcanopy.org/ (free download).

The Little REDD+ Book. Parker, C., A. Mitchell, M. Trivedi, and N. Mardas. 2009. The Global Canopy Program, Oxford, United Kingdom. 71 pp. Available at www.globalcanopy.org/ (free download).

One of the risks in writing books (and book reviews) on the topic of global climate change is that the ideas presented are obsolete before the paper publications appear. That danger notwithstanding, it is also important to recognize the antecedents of current global-change policy decisions. These volumes, one a traditional print-version hardcover book and the other a free, downloadable handbook (now translated into French), together serve to equip readers for this rapidly evolving field. The 68 authors from 19 countries that contributed 17 chapters and four case studies to *Climate Change and Forests (CCF)* provide background on the Kyoto Protocol (KP), which will be replaced in 2012 by the new agreement. Foundation for the agreement is outlined in *The Little REDD Book (LRB)* by representatives of a consortium of 37 scientific institutions in 19 countries that focus on forest canopy research. The new instrument known as REDD (Reduced Emissions from Deforestation and Degradation) apparently will address the failure of the KP to consider the climate change mitigation

benefits derived from conserving standing forests. It is hoped that it will also circumvent some of the other limitations of the KP, which are described very clearly in the first half of *CCF*. The second half of the volume may help rescue tropical forests from where the KP left them with its discussion of the REDD option.

Climate Change and Forests provides an overview of the general principles on which the KP replacement mechanism should be constructed. The authors describe the challenges of harmonizing these principles for the diversity of countries where the forests in jeopardy are located. Throughout the book, the architecture of a market-based incentive for forest carbon-emission credits (i.e., baseline definition, monitoring, additionality, permanence, and leakage) is discussed with different levels of detail and in reference to a variety of settings. The chapters are sparsely but nicely illustrated and enriched by helpful footnotes; well-synthesized case studies prepared by on-the-ground experts further enhance the text.

The first chapters in *CCF* set the stage by introducing the policies that connect forestry and related land uses to climate-change mitigation, with emphasis on using market incentives to influence the fates of forests. Several public policy instruments and market incentives are discussed, with emphasis on the clean development mechanism (CDM) and joint implementation (JI), the only components of the KP that specifically deal with trees and carbon through plantations. The succinct analysis by Portela et al. of the conditions that need to be in place for a market-based initiative to succeed in promoting forest conservation (clarity in property rights and legal and regulatory frameworks, credible monitoring and enforcement, and equity) was particularly enlightening.

The second part of *CCF* focuses on the international arena starting with a historical overview on land-use change policies. The other three chapters cover the potential links and

conflicts between measures taken to mitigate global climate change and ongoing efforts to protect biodiversity while respecting national sovereignty. After explaining why CDM and JI have delivered so little, ways to avoid their problems are presented (Ebeling). The importance of learning from the KP experience was, for me, an important overall message of the book; if we do not know the history, we are condemned to repeat it. The relevance of the chapter by Scholz and Jung stems precisely from the idea of learning from KP. These authors examine in detail the admittedly limited impacts of CDM and JI in a discussion of their major attributes, advances, and some of the components that could serve as templates during the next commitment period (2012–2022). The section ends with a comparison of the carbon benefits of avoiding deforestation versus biomass energy derived from planting new forests, with due attention to the issues of transparency and leakage. The implications of these analyses for land-use policy making are enormous because they can affect prices of agricultural commodities and promote more forest conversion.

The third part of *CCF* covers the implementation of CDM with particular attention to clarifying its legal and market structures. Locatelli et al. begin by walking readers through a portfolio of CDM afforestation–reforestation projects. They examine the design of CDM projects emphasizing the importance of addressing the architecture of an intervention (i.e., baseline definition, additionality, etc.) before the onset of a project. With regards to the equally important consideration of permanence, Lecocq and Couture discuss the virtues of permanent versus temporary credits from the perspective of the market, particularly the benefits of portfolio diversity. Similarly, who owns the carbon needs to be clarified upfront. Overall, the lack of clear and enforced systems of property rights in developing countries is a hurdle for CDM that will remain for

REDD. This barrier rises when one considers the high transaction costs of dealing with multitudes of stakeholders with low institutional and financial capacities in countries with weak governance. These legal complexities are illustrated in a chapter devoted to carbon sequestration options in Chile, which failed to consider the enormous environmental costs of converting a large proportion of native forests into plantations.

In addition to these institutional issues, the inherent difficulty but fundamental importance of carbon measuring and monitoring forest carbon stocks and fluxes is addressed in *CCF*. After all, the credibility of any lasting forest-carbon market mechanism lies in the ability of buyers to discern between true and sustained emissions avoiders and “hot air” producers. The chapter by Pearson et al. clarifies this issue by addressing the trade-offs between accuracy and precision and the importance of being able to estimate changes in emissions attributable to the project. The discussion of carbon stocks and fluxes measurements in reference to additionality and leakage will help readers understand how the attributes of the CDM interact.

The chapters in the fourth part of *CCF* introduce the principles of the avoiding deforestation initiative (RED—note the absence of the *D* for degradation). Sullivan sets the stage by analyzing the implications of project scales (regional vs. national), policies, and markets on the design of RED. More hands-on information is provided by Mollicone et al., who propose an accounting approach to establish emissions from reduced forest conversion. Their system, which garnered international support and is addressed in *LRB*, captures the wide range among tropical countries in forest cover and deforestation rates. The chapters by Estrada and Garcia-Guerrero and by Schwartzman and Moutinho describe the details of the deforestation avoidance mechanism in a Latin American scenario. They provide a historical account of the role Latin American

countries play in international negotiations, analyze the factors causing unabated rates of forest loss, and explore the important connections between forests and the rural poor. The topic of reducing forest degradation is brought up, but nowhere in the volume does it receive the attention it deserves perhaps because of the perceived monitoring difficulties. But even if degradation is disregarded, the lack of technical capacity and appropriate governance and institutional structures in many developing countries will make implementation of forest-based climate mitigation programs difficult. Streck et al. suggest that some of these impediments can be overcome by using a phased system that integrates goals at several scales (regional and national) and that has the advantage of involving participation of several sectors.

The final part of *CCF* covers voluntary carbon markets. The authors use models from Australia and New Zealand and the experience of several U.S. states to highlight the virtues of the voluntary versus regulatory markets and the prominent role of consumer choices. Until the KP is replaced, voluntary markets will be the only outlet for credits coming from standing forests. Several schemes are analyzed (Hamilton et al.), which differ in coverage and focus (e.g., agriculture, community-based agroforestry). The innovative role of voluntary markets and the potential synergisms with regulated markets under the future convention cannot be ignored. Bottom-line challenges remaining are credit transparency, credibility, and legitimacy. And finally, after being pretty much disregarded throughout the volume, Meizlich and Brand present a clear argument for considering the potential carbon contributions of improved forest management.

Among the drawbacks of *CCF* is a lack of discussion about what is meant by *forest*, particularly whether natural forests can legitimately be converted into plantations for the cause of carbon. The near-complete disregard of forest degradation and

forest management is also disconcerting, given the prominent roles many of the authors are playing in informing, if not directly participating in, international climate-change policy making debates.

Given the multitude of authors of *CCF* (over 60) some repetition was unavoidable, but it never annoyed me. What emerges from reading the entire volume is a cohesive picture of what KP achieved in terms of forest, and how the forthcoming instrument can more effectively connect tropical forest fates with climate change.

The foundation provided by *CCF* is built on quite effectively in *LRB*. Its structural approach to summarizing a range of governmental and nongovernmental proposals submitted to the United Nations Framework Convention on Climate Change provides an efficient way of conveying information and making useful comparisons of the key elements of REDD proposals (i.e., scope, reference level, benefit distribution, and financing). The format highlights each initiative's strengths and weaknesses and is maintained in the recently updated version (*The Little REDD+ Book; LRB+*). The *REDD+* alludes to a renewed emphasis on conservation and enhancement of carbon stocks. The *LRB+* clarifies the issue of leakage and introduces to the debate new insights about equity and fairness. Refreshing for stakeholders in developing countries and elsewhere is the mention of the need for Annex I countries to control emissions. The inclusion of new proposals (of which mention should be made of China as a big player in climate negotiations), the reshaping of old ones, and the clarification of other actors' actions (e.g., The Prince's Rainforests Project) reinforce the value of the *LRB+*.

Together, *LRB+* and *CCF* provide many insights into the ongoing climate-change policy negotiations and clarify for researchers, policy makers, and the educated public the bottlenecks that need to be cleared if climate-change mitigation is to help maintain forest cover while protect-

ing biodiversity and helping to alleviate poverty. That similarly structured initiatives, such as payments for environmental services (PES), have already had positive impacts on livelihoods makes us cautiously optimistic about REDD. At best, REDD will provide opportunities for institutional renewal, strengthened social institutions, and increased human welfare in developing countries. But no mechanism will be successful unless structural measures are taken to address the causes of forest loss, which vary among regions and countries. After all, no fund or global project can do for tropical forests what the host countries are not willing to do.

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Advances in Noninvasive Sampling through a Better Understanding of Target-Species Ecology

Noninvasive Survey Methods for Carnivores. Long, R. A., P. MacKay, W. J. Zielinski, and J. C. Ray, editors. 2008. Island Press, Washington, D.C. 385 pp. \$45.00 (paperback). ISBN 978-1-59726-120-3.

The release of *Noninvasive Survey Methods for Carnivores* coincided with the February 2008 discovery of a wolverine (*Gulo gulo*) in Tahoe National Forest, near Truckee, California. Without current advances in noninvasive survey methodology, as *Noninvasive Survey Methods* examines, it is likely that the detection of the wolverine would not have occurred. Wolverines had not been confirmed in the state since the 1920s (Grinnell et al. 1937) and were presumed extirpated. Since this recent discovery, a concerted effort has been made to search for more wolverines in the area with a variety of noninvasive survey methods, such as detection dogs, hair snares, and camera

stations—all methods examined in detail within this comprehensive volume. As noninvasive survey methods become more refined, cost-efficient, and easier to deploy, monitoring rare and elusive species on the landscape level can only get more interesting and exciting. *Noninvasive Survey Methods* summarizes several decades of research by dedicated investigators who saw the need to survey for carnivores noninvasively and provides information on hundreds of scientific papers that fine tune and improve on many noninvasive survey methods.

What does *noninvasive methods* mean and why are they important? The editors define *noninvasive* as “not requiring target animals to be directly observed or handled by the surveyor” (p. 1). Animals may be observed on camera, their tracks can be imprinted, or samples of their hair can be obtained—there are numerous noninvasive methods, all of which are described in detail. Although *invasive* methods (live trapping and radiotelemetry) can provide high-resolution data with just a few individuals, noninvasive survey methods can be deployed over large areas and are capable of monitoring entire populations. Although not mentioned in the book, noninvasive methods do not necessarily require the “take” permits from federal and state agencies that live trapping does, which allows researchers to avoid a lengthy permitting process and to complete surveys quickly during the appropriate season.

Why carnivores? Carnivores are “frequently evaluated as potential focal species for regional conservation efforts and ecosystem management” (p. 227). Carnivores with large landscape needs, such as the grizzly bear (*Ursus arctos*), are often considered umbrella species because it is thought that the area of habitat required to support viable and sustainable populations of these species will protect habitat for other species with smaller area requirements, thus advancing the agenda of wildlife conservation (Carroll et al. 2001). *Nonin-*

vasive Survey Methods provides researchers with the tools to ensure that future research involving carnivore conservation remains feasible and possible with the use of noninvasive survey methods.

Noninvasive Survey Methods for Carnivores is divided into 12 chapters, covering noninvasive survey methods, statistical analyses, genetic analysis methods, and survey design. The chapters are arranged chronologically according to the appearance of the particular method in the field: natural sign (tracks and scats), track stations, remote cameras, hair-snag devices and collection, and scat-detection dogs. At the end of most chapters, the editors include interesting case studies of practical applications of the methods discussed in the chapter. Other chapters include useful glossaries to expand on method-specific terms that may have otherwise been unclear to the reader; appendices of complex data sets; examples of field-data forms; and tables, graphs, and figures to enhance clarity and readability.

The editors emphasize that the book is a comprehensive guidebook—guiding researchers along practical routes to accomplish their research goals. Much of the volume focuses on four important research objectives: assessing occurrence and distribution, assessing relative abundance, estimating abundance, and monitoring. As always, the most suitable study design depends on the survey objectives, ecology and population status of the target carnivore, where the survey will take place, and logistical constraints.

Designing a study is as much an art as a science. Theoretical and simulation results provide useful guidance about the expected outcome of a study given certain assumptions, analytic techniques and designs. But these results must be tempered with common sense, expert knowledge of the system under study, and occasionally, lateral thinking. (MacKenzie & Royle 2005:40)

The beauty of this book is that the editors and authors have done a lot of legwork for researchers interested in using noninvasive survey methods. They have evaluated each method, provided the pros and cons of each method and its effectiveness in detecting target species, and recommended which method should be used for certain research objectives. The authors remind us that the lack of clear objectives will often lead to endless debate about design issues as there has been no specification for how the collected data will be used in relation to science and/or management; hence, judgments about the ‘right’ data to be collected cannot be made (pp. 39–40; MacKenzie & Royle 2005:1107).

Noninvasive Survey Methods for Carnivores encourages creativity and the use of one noninvasive survey method either in conjunction with or prior to another method for better survey results, provided the methods do not interfere with one another. Running detection dogs through a study site to determine the species baseline inventory before setting up camera or track stations is a good idea because these stations typically use scent lure that “unnaturally” attract target species from outside of the study site. Some noninvasive methods can also be used to record the effectiveness of another noninvasive method, such as using a remote still or video camera to record carnivore behaviors around hair snags.

Although this book offers much information on various noninvasive survey methods, there are still research gaps that need to be filled. The use of digital remote cameras is fairly new and the advantages and effectiveness over older technology (film cameras) appear to be obvious; however, more side-by-side comparisons are required, including comparing one digital camera design over another (Clark & Orland 2008). Other research to scientifically test different scent and long-distance calling lures that are on the market is needed. For example, a wide variety of carnivores are attracted to skunk-based

scent lures, but ironically, little effort has gone into evaluating methods to detect skunks themselves (pp. 281 and 317).

As with any book written by several authors, unique writing styles are evident. For example, chapter 4 is a rather difficult chapter to read, even though the subject matter is straightforward and should be easy to understand. I had to reread several sections in order to identify the main point. In contrast, chapter 5 was a pleasure to read; it is very well written and has excellent flow. This book is a very useful guide in the field of noninvasive survey methods, and any researcher interested in using one or more of the methods discussed should take advantage of this book. A book summarizing noninvasive survey methods was overdue, and the editors and authors have outdone themselves in advancing the field. I hope, as a researcher, this book will become an important cornerstone in carnivore conservation biology.

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Literature Cited

- Carroll, C., R. F. Noss, and P. C. Paquet. 2001. Carnivores as focal species for conservation planning in the Rocky Mountain Region. *Ecological Applications* 11:961-980.
- Clark, H. O. Jr., and M. C. Orland. 2008. Comparison of two camera trap systems for detection of American marten on a winter landscape. *California Fish and Game* 94:53-59.
- Grinnell, J., J. S. Dixon, and J. M. Linsdale. 1937. *Fur-bearing mammals of California*. Volume 2. University of California Press, Berkeley, California.
- MacKenzie, D. I., and J. A. Royle. 2005. Designing efficient occupancy studies: general advice and tips on allocation of survey effort. *Journal of Applied Ecology* 42:1105-1114.

Zoos Dream of Becoming Conservation NGOs

Zoos in the 21st Century: Catalysts for Conservation? Zimmerman, A., M. Hatchwell, L. Dickie, and

C. West, editors. 2007. Cambridge University Press, New York. 373 pp. \$65.00 (paperback). ISBN 978-0-521-61858-8.

The relevance of zoos, not just to conservation but to society, is an issue that looms large on the horizon. Are zoos asleep at the wheel, about to crash into the oblivion of obsolescence, as society leaves them behind in the junk heap of time? Or are they engineers of their own bright new future, at the helm of a new and improved conservation movement?

Part of the Cambridge University Press series on conservation biology, *Zoos in the 21st Century: Catalysts for Conservation* tackles the diverse issues facing zoos attempting to reinvent themselves as conservation organizations. Where are zoos, collectively, on this path toward conversion? Once menageries managed for the entertainment business, are zoos now born-again conservationists? Undoubtedly, institutions vary in their progress along this trajectory, but this volume attests to the earnestness with which zoos are tackling these issues.

This edited volume stems from a symposium, *Catalysts for Conservation*, held in London in 2004. The symposium drew an esteemed and experienced group—no shortage in intellectual heavy lifting here. As typical of the conference proceedings genre, however, there is variability in quality and gaps in coverage that might be closed with a more strategic and comprehensive volume, not limited by the ability or interest in attending a conference held in a particular place at a particular time. But there is much here to digest and think about. It is a timely volume. Not since 1994's *Creative Conservation* (Olney et al. 1994) has a book attempted to take the pulse of the conservation movement in zoos, although in 2008, the journal *Zoo Biology* devoted an issue to similar soul searching. Much has changed since 1994, when zoos were first beginning to make serious efforts to deal with conservation more comprehen-

sively. Whereas the volume edited by Olney and colleagues devoted a great deal of space to the nuts and bolts of how to conduct conservation science in zoo settings, *Catalysts* takes a broader, more sweeping view of the larger role zoos can play in conservation and measuring the success of conservation ventures.

Readers from inside the zoo community will find little that is particularly new, but no doubt the messages delivered will resonate with their own experiences and they may, as did I, come away feeling more motivated to become an agent of change. And they may have acquired a few more handy tools for their toolbox for effecting change. Outsiders to the zoo community may be a bit daunted by the level of abstraction prevalent in many of the chapters and may wonder, justifiably, where is the beef? The beef—the concrete and innovative examples of exactly how zoos are practicing conservation science—was better addressed in *Creative Conservation* and in more recent taxonomic-specific volumes such as *Wild Mammals in Captivity* (Kleiman et al. 2009).

Several themes are addressed in *Catalysts*, but none so often as the notion that zoos *are* reinventing themselves. If one were to use the “search inside” function of online bookstores, the word “reinvent” would occur significantly more frequently than expected by chance. Tied to this theme is the concept of “USP” or unique selling point, a term coined by Dickie et al. in chapter 15. Zoos, unlike other conservation organizations, have the distinct advantage of having a physical site that people can visit—and connect with wildlife. Much is made by several authors on the need for zoos to leverage this USP to connect people to nature and use this connection to raise awareness, inspiration, and funding for conservation.

For the uninitiated in the role of zoos in conservation, Conway's pithy and passionate appeal in Chapter 2, both hopeful and critical, makes a

good starting point. He throws down the gauntlet for zoos to pick up and run with it. Many of the issues raised here get longer play in other chapters and, in particular, the introductory and concluding chapters will round out the need-to-know issues for many readers. In chapter 10, Baker perhaps articulates best and most comprehensively the multipronged and unique role of zoos in conservation, including genetic reservoirs as hedges against extinction, reintroduction, basic research, technology development for in situ conservation, conservation education, animals as fundraising ambassadors, conservation training and capacity-building, and in situ research and conservation. Mining a similar line of thought, Dickie et al. (chapter 15) lead the reader through many of the same concepts, including some critical analysis of when captive breeding does and does not make a meaningful contribution to conservation (yes for arresting the amphibian extinction crisis, no for breeding elephants. . . unless it presents an opportunity to catalyze support for field conservation).

From all of this one thing seems clear: there has been a sea change in how zoos view themselves and their roles in conservation. Several authors rightly question the commitment of zoos to conservation and claims of success, which may be premature, but they are also justified in pointing out the potential—and growing reality—of zoos' meaningful contributions. A measure of this movement—the World Zoo and Aquarium Conservation Strategy—now calls upon all zoos to develop an in situ component to their conservation mission.

But what I find most interesting in this volume is the possibility of completely redefining the role of (some) zoos in conservation. Can we envision a day when the zoo becomes a conservation NGO that just happens to hold some animals in captivity as part of its mission to connect people to nature? A handful of zoos are almost there (Zimmerman and Wilkinson, chapter 20).

Nearly a quarter of the world's zoos employ at least one staff member devoted to in situ conservation activities, according to survey data reported by Zimmerman and Wilkinson. Clearly, zoos cannot yet classify themselves as conservation NGOs, but let's be fair—most of the world's zoos have not attempted this transformation as of yet. Zoos in developed countries are much further down this path, though these data are not shown. My organization, the San Diego Zoo, fields a staff of nearly 150 people devoted to conservation research, with a growing proportion of conservation effort applied in situ.

Of course, reality has not yet caught up with our imaginations, and zoos often hand-wave about their conservation portfolio without substantiating the impacts of their activities. Perhaps one of the most important contributions of this book is the due diligence given to the need for better assessment tools to measure the efficacy of zoo-based conservation activities. To assess zoos' conservation education mission, Balmford et al. (chapter 9) conducted before and after surveys with zoo visitors to determine the zoo's impact on conservation knowledge and attitudes. The findings were discouraging, but can we really expect a single zoo visit to have an impact? Imagine a similar survey on the front steps of a church. Would people espouse a stronger belief in God after the service? Would the lack of effect indicate religious beliefs were not important to society? These surveys and attempts at quantification are an admirable first step, but it is unclear how much we can read into them.

Mace et al. (chapter 21) attempt a more comprehensive evaluation of zoos' conservation impact, ranging from education to research. They address, for example, the question of how zoos should best allocate limited resources among conservation education, a local recovery project, or donating funds toward a larger project in a biodiversity hotspot. Although I admire such attempts at quantification, I wonder whether

such a question can ever be answered satisfactorily, for a zoo or any organization. Nonetheless, they successfully developed a methodology and metrics for measuring conservation impact. Unsurprisingly, they encountered many difficulties in implementing the system in a pilot study, but we are better off from their having tried.

The end goal of these attempts at quantifying conservation impact is to implement an adaptive-management paradigm in which data are used to alter practices away from those that do not work or are not cost-effective. This effort (it is hoped) will help put zoos on more solid footing for their claims to conservation relevance.

Having embarked on this new mission, zoos have much work to do to reduce the gap between aspirations and reality. One necessary step, which found many advocates in *Catalysts*, is that zoos need to move beyond the captive breeding-reintroduction paradigm (Stanley-Price and Fa, chapter 11; Dickie et al., chapter 15). Although it is true that such species as the California Condor and the golden lion tamarin have zoos to thank for their existence, zoos place too much reliance on these roles when, in fact, reintroductions of captive-bred animals have made only rather limited contributions to larger conservation efforts. It is usually cheaper and easier to prevent the decline of a species in the wild than it is to reintroduce it. An over-reliance on single-species conservation programs can also divert attention away from ecosystem conservation.

Zoos will remain the champions of individual, often charismatic, species, but they need to become more involved in confronting the threats to habitat that often precipitate species decline. As several authors point out, perhaps the most relevant role zoos can play is in the development of the nascent field of translocation biology, which plays to the zoos' strengths of working with individual animals, but also pulls zoos into new directions, such as

habitat restoration and management (see review in Swaisgood 2009). Zoos should continue to specialize in what they do best—organismal biology, management of small populations, lab-field synergy—and expand their domain to include larger spatial scales and higher levels of biological organization. Much of this will be accomplished through multiorganizational collaborations, something zoos can help catalyze (Field and Dickie, chapter 19).

Because of the role animal exhibits play in zoos, captive breeding will always remain a bread-and-butter activity, but this too is something zoos need to do better. As Conway (chapter 2) points out, zoos know how to breed animals; that's not the problem. Even giant pandas, once believed to be hopelessly inept at doing what is supposed to come naturally, now breed routinely in captivity and numbers are soaring. The problem lies in the critical need for zoos to act collectively to reallocate space and resources to develop regional collection plans aimed at sustainability and maintenance of genetic diversity. Collection plans need to be made more strategically to ensure enough spaces on the ark for those species that will benefit most from a stint in captivity, but this is playing out against a backdrop of a shrinking number of spaces on the ark. Why? Because zoos are justifiably increasing the size of their animal spaces to accommodate welfare concerns and provide better visitor experiences (Baker, chapter 10).

This brings us to yet another important point made repeatedly in *Catalysts*: zoos need to walk the talk or risk condemnation for hypocrisy. How can a zoo leverage a conservation message while keeping animals in substandard conditions (e.g., Hutchins, chapter 7; Hatchwell et al., chapter 22)? Showcasing animals in

less naturalistic environments inadvertently *disconnects* people from nature. Similarly, zoos need to implement best practices for resource consumption, that is, become green zoos. A zoo cannot cultivate a conservation ethic in its visitors while wastefully using water in a desert landscape.

Returning to the concept of USP, if zoos are indeed to become catalysts for conservation, they must find a way to maximally leverage their USP. Animal welfare organizations are better fundraisers than conservation organizations because they tap into the appeal of individual animals (Hatchwell et al., chapter 22). Zoos can capitalize on this immediacy, this opportunity to connect to another form of life that few will ever be able to experience in the wild, particularly those located in urban center where most zoos are found.

About 1 in 10 of the world's population will visit a zoo this year. What other conservation organization has this kind of opportunity? Our society has been drifting away from nature, but many long to stop the tide before it is too late, a phenomenon best represented in the movement to reconnect children to nature, spurred on by Richard Louv's *Last Child in the Woods* (2005). Can zoos help avert this crisis? For zoos to exceed in the endeavor, they must inspire people to get out into nature, not just return to the zoo. Zoos, if they do it right, can connect people to the nature beyond their fences. Where will the next generation of conservationists come from if kids stay inside and wired (or wireless)? Zoos can and have made a formative difference in the lives of many conservation professionals. As someone who had my come-to-nature experience in the neighborhood creek, not a zoo, I have been surprised at the number of conservationists who can trace their

love affair with nature back to childhood visits to the zoo. I have no supporting data, but I imagine this role will be more important in the rapidly urbanizing world in which we live.

Zoos are relatively free of political alignments that malign some conservation organizations in the public's eye and are among the most trusted source of information about nature (Reading and Miller, chapter 6). Zoos need to build on this trust they have cultivated in the public. They need to move beyond the feel-good approach too often espoused, but also cannot afford to fall into the gloom-and-doom niche (which has its followers but is not capable of motivating change in the masses). Zoos will need to deal straightforwardly and honestly with real conservation problems, but they must also conclude with a message of hope (Gwynne, chapter 5). Zoos can become conservation NGOs, and good ones. Zoos are not asleep. They are awake. . . and dreaming.

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Literature Cited

- Kleiman, D. G., K. V. Thompson, and C. K. Baer, editors. 2009. *Wild mammals in captivity*. 2nd edition. University of Chicago Press, Chicago, Illinois (in press).
- Louv, R. 2005. *Last child in the woods: saving our children from nature-deficit disorder*. Algonquin Books of Chapel Hill, Chapel Hill, North Carolina.
- Olney, P. J. S., G. M. Mace, and A. T. C. Feistner, editors. 1994. *Creative conservation: interactive management of wild and captive animals*. Chapman and Hall, London.
- Swaisgood, R. R. 2009. The conservation-welfare nexus in reintroduction programs: a role for sensory ecology. *Animal Welfare* in press.

Recently Received Books (April 2009–June 2009)

Animal Behavior. 9th edition. Alcock, J. 2009. Sinauer Associates, Sunderland, MA. 620 (xiv + 606) pp. \$84.95 (paperback). ISBN 978-0-87893-225-2.

Assessing the Conservation Value of Fresh Waters. An International Perspective. Boon, P. J., and C. M. Pringle, editors. 2009. Cambridge University Press, New York, NY. 303 (x + 293) pp. \$70.00 (paperback). ISBN 978-0-521-61322-4.

The Biology of Caves and Other Subterranean Habitats. Culver, D. C., and T. Pipan. 2009. Oxford University Press, New York, NY. 270 (xvi + 254) pp. \$60.00 (paperback). ISBN 978-0-19-921993-3.

Ecology of Fragmented Landscapes. Collinge, S. K. 2009. The Johns Hopkins University Press, Baltimore, MD. 353 (xiii + 340) pp. \$70.00 (hardcover). ISBN 978-0-8018-9138-0.

Ecosystem-Based Management for the Oceans. McLeod, K., and H. Leslie, editors. 2009. Island Press, Washington, D.C. 368 pp. \$45.00 (paperback). ISBN 978-1-59726-155-5.

Eel. Schweid, R. 2009. The University of Chicago Press, Chicago, IL. 224 pp., 40 color plates, 60 halftones. \$19.95 (paperback). ISBN 978-1-86189-423-6.

Evolution. 2nd edition. Futuyama, D. J. 2009. Sinauer Associates, Sunderland, MA. 649 (xvi + 633) pp.

Large-Scale Landscape Experiments. Lessons from Tumut. Lindenmayer, D. B. 2009. Cambridge University Press, New York, NY. 303 (xvi + 287) pp. \$69.00 (paperback). ISBN 978-0-521-70778-7.

Nested Ecology. The Place of Humans in the Ecological Hierarchy. Wimberley, E. T. 2009. The Johns Hopkins University Press, Baltimore, MD. 256 (xi + 245) pp. \$30.00 (paperback). ISBN 978-0-8018-9289-9.

A Student Handbook for Writing in Biology 3rd edition. Knisely, K. 2009. Sinauer Associates, Sunderland, MA. 312 (xvi + 296) pp. \$18.95 (paperback). ISBN 978-1-4292-3491-7.

