

## **Bioeconomics of Invasive Species: Integrating Ecology, Economics, Policy, and Management**

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such patterns truly constitute culture. And the book did make me think, consider, and want to read more as it brought alive the “cultural” behavior patterns of a range of different animals.

The main task of *The Question of Animal Culture* is to bring together the best minds to provide their research and perspectives on animal culture, to provide the data they feel addresses the question of culture in animals, and to consider the ways in which animal and human cultures are similar or different. The book accomplishes this task both credibly and elegantly. Indeed, it assembles some of the most noted scientists in this field, including Frans DeWaal, Michael Tomasello, Kim Sterelny, and Kim Hill. The chapters cover a wide range of topics, including the social side of primate culture, chimpanzee culture, wild great apes, and bottlenose dolphins, among others. To be sure, opinions are varied and contradictory, and it is up to the reader to decide the final answer, given our current state of knowledge, which *The Question of Animal Culture* sums up. I happened to find all of the arguments about the definitions of culture and the evidence for culture both persuasive and intriguing.

The introduction to the book, as well as the final three chapters (by Susan Perry, Kim Hill, and Kim Sterelny), give the broadest overview of the topic, the controversies, the evidence, and the remaining questions. It is clear from their work, and that of others throughout the book, that this research topic will continue to be stimulating and important for primatologists, psychologists, behavioral ecologists, and anthropologists, as well as ethics and religious scholars. It will also appeal to a lay audience.

Central to the book and to the question of animal culture is the definition of culture. To some extent, how one defines culture surely influences whether the social behavior of animals is understood to represent culture or not. Factors that make up demonstrations of culture include such things as the spread through social learning of behavioral innovations (such as macaques’ hand washing or birds’ development of distinct dialects), traditions of aberrant be-

havior (population-specific behaviors), and information passed across generations as learned traditions (site-specific social behaviors that remain constant over generations). Culture is also defined as the transfer of information by behavioral means. Some scholars, such as Bennett Galef and Michael Tomasello, argue that culture demands a clear demonstration that traditions are a consequence of social learning, and that both imitation and teaching are required.



Evidence that traditions and behavioral aberrations occur among widely dispersed populations of a given species is incontrovertible, and the evidence that such behavior is learned and transmitted is strong. What remains controversial is the implied homologies with human behavior. William McGrew clearly describes variations in chimpanzee behavior across different populations of chimpanzees; Carel van Schaik describes interpopulation and group-specific behavioral repertoires in orangutans; and Hal Whitehead examines these patterns in whales and dolphins. It is these issues that are strongly woven throughout the book in an elegant and stimulating manner. I would have enjoyed more discussion of the role of culture in birds, as the emphasis in the book is on primates and cetaceans, yet some of the classic examples come from bird dialects and tool use.

To some extent, the issues of whether animals have culture or not reminds me of the nature-nurture arguments of the last century. In the end, it was not a matter of what was nature and what was nurture, but rather what was the genetic basis for learning and how much of any given behavior pattern was learned versus innate (and how did these interact).

Perhaps the arguments about whether animals have culture or only humans do are similar. Perhaps there is a false dichotomy between the two positions. It may not be a matter of whether animals have culture, but of how much and to what degree their culture is similar to or different from human culture; and to what extent do the processes vary between animal culture and human culture. Although animals clearly teach one another and their offspring (or at least offspring learn from parents and one another), the elaborate teaching and learning infrastructure so highly developed in humans is absent. Culture in humans may be a quantum leap from that of other animals, and thus understanding culture in animals may not in itself tell us a lot about the development of human culture. This question remains open in the book and in the current scientific dialogue.

*The Question of Animal Culture* is well written and well organized, the authors are the giants in the field, the research is rigorous, the issues and topics are discussed and argued convincingly, and the book is fun and interesting to read. This landmark compendium of current thought describes well the serious debate about culture in animals. I recommend it highly.

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## KNOW YOUR ENEMY

**Bioeconomics of Invasive Species: Integrating Ecology, Economics, Policy, and Management.** Reuben P. Keller, David M. Lodge, Mark A. Lewis, and Jason F. Shogren, eds. Oxford University Press, New York, 2009. 320 pp. \$49.95 (ISBN 9780195367973 paper).

More than 50,000 species of plants, animals, and microbes that have

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been introduced into the United States are estimated to have become invasive. They have caused widespread and hugely expensive damage, particularly to agriculture but also to power generation systems, waterways, and infrastructure generally. Yet reliable information about their effects is not just of interest to environmentalists, economists, and the public. Ecologists are well aware of the impacts that invasive species have on biodiversity: Many invaders have reduced native species' numbers and ranges by outcompeting them, by feeding on them, or by parasitizing them. Some invaders have caused extinctions of native species.

In assessing these impacts, economists attempt to consider both the costs of controlling the invasive species and the damages they cause to agriculture and the environment broadly. The authors of *Bioeconomics of Invasive Species* provide an in-depth perspective on numerous attempts to understand and manage the consequences of invasive species. They concentrate particularly on those that are a hazard to the environment or are costly in terms of the harm they cause and the price of control. The book provides valuable insights for combating the threat that nonindigenous species pose for the environmental and economic well-being of society.

The scientific issues involved in both these considerations are highly complex and difficult to understand and assess. Interestingly, more than 99 percent of all US crops, including corn, wheat, soybeans, and others, were introduced into the United States. But this fact does not diminish the serious ecological and economic problems associated with invasive species. The increasing movement of people and goods throughout the world makes it likely that invasive species will continue to be a serious problem.

The diversity of behaviors and activities of invasive species makes it more difficult to find solutions to control them. In addition, the effects of invasives on agriculture, fisheries, public health, and other aspects of the economy are widespread. Ecologists and economists have occasionally worked with one another to understand the complex issues

that invasive species raise for each discipline independently and jointly. Each discipline has a distinctive perspective and is itself an obstacle to comprehension. When they attempt to merge their techniques and focus on one approach to the problem, the situation becomes highly complicated.

Ecologists tend to rely on the estimates of economic consequences of invasive species provided by managers and specialists in agriculture, fisheries, and energy production activities. Such estimates of costs and benefits may lack the sophistication of assessments provided by some economists. Yet ecologists sometimes question the approach typically employed by economists, which is based on the concept of measuring "willingness to pay."

Measuring willingness to pay can be a highly valuable measure for some problems, including some caused by invasive species. For example, the technique is sound when determining the public's willingness to pay for a specific program of mosquito control to limit the spread of West Nile disease, because the public can be made aware of the risks of the disease and of control measures. However, use of the willingness-to-pay approach in surveys of public attitudes to the use of pesticides generally can be misleading as a way of assessing their public health impacts. Few members of the public have adequate knowledge of the extent of pesticide use and the damage it causes to beneficial native organisms in forests, grasslands, lakes, rivers, and other ecosystems. In addition, the public often does not understand the effects pesticide use may have on human health. These limitations compromise the value of attempts to use the willingness-to-pay approach to assess many of the economic impacts of pesticide use.

In *Bioeconomics of Invasive Species*, the authors attempt to investigate and untangle the complexity of the ecology of many notable invasives and identify their economic interrelationships in various environmental situations. Two chapters examine approaches to modeling of the spread of invasives. The book's major strength may be its integrated analyses of fisheries and various other societal

institutions that are adversely affected by invasive species. The authors warn against relying on oversimplified investigations.

In short, the book is valuable as a source of reliable information related to the management of invasive species ranging from plants to animals to microbes. Its messages are well worth studying for readers interested in biology, ecology, economics, geography, and related applied disciplines.

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## SEEDLINGS FINALLY GET THEIR DUE

### **Seedling Ecology and Evolution.**

Mary Allesio Leck, V. Thomas Parker, and Robert L. Simpson, eds. Cambridge University Press, 2008. 536 pp., illus. \$63.00 (ISBN 9780521694667 paper).

**A**t some point, many plant demographers find themselves staring at a data set full of detailed information on seeds or juvenile and adult plants, but lacking any meaningful information on the seedling stage. Adult plants are usually easily located and either marked for field study or collected for lab study. Even seeds, mysterious little black boxes in their own right, can be collected and brought into the lab and made to jump through experimental hoops. But seedlings lack the attributes that make other life-history stages relatively easy to study; in many systems, seedlings are episodic and ephemeral, difficult to find, and tricky to identify. My personal experience indicates that studying them can cause permanent knee damage.

For these reasons, seedlings have been understudied by most subspecialties of plant science. This lack of information has been reflected in the absence of any comprehensive volume reviewing

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