Book Reviews

Biological Confinement of Genetically Engineered Organisms. By the National Research Council of the National Academies. 2004. The National Academies Press, Washington, DC. 255 p. US$42.95 hardcover. ISBN 0-309-52778-3.

In recent years, genetically modified organisms (GMOs), or, as they are referred to in this book, genetically engineered organisms (GEOs), have become the subject of many debates. Two of the questions raised in some debates are, "How much control do we have over genetically engineered organisms escaping into the wild?" and "How easily can genetically engineered organisms crossbreed with native or natural species?" To address these questions, the US Department of Agriculture, in 2001, requested that a committee on biological confinement of GEOs be assembled. This document is the resulting report. The committee's focus was on bioconfinement methods and how they are applied to transgenic plants, grasses, trees, fish, shellfish, and other organisms. The report is written to address these questions:

1. What is the status of scientific understanding about various bioconfinement methods for genetically engineered organisms?
2. What methods are available, and how feasible, effective, and costly are these methods?
3. What do we know about when and why methods fail, and what can be done to mitigate those failures?
4. When these methods are used in large-scale applications, what procedures can be used to detect and cull individuals for which the bioconfinement methods have failed?
5. What is the cost effectiveness of these mitigation, detection, and culling procedures?
6. What are the probable ecological consequences of large-scale use of bioconfinement methods (e.g., deployment of sterile organisms) on wild populations, biological communities, and landscapes?
7. What new data and knowledge are required for addressing any of these important questions?

The report consists of 6 chapters. It begins with a brief summary of the problem and why the committee was formed. It also includes several tables that list GEOs, control methods, etc.

In the introductory first chapter, the report defines the terms *genetically engineered organism* and *bioconfinement*. It also gives a brief history of bioconfinement starting in 1972, with the first GEO, which was a hybrid virus that could be used to deliver genes to bacteria. At the end of the chapter, the authors review the social acceptance of GEOs. One issue raised was: "Is it ethical to create seed crops that, after their first year produce sterile seeds, then sell them to subsistence farmers so they have to come back and buy seed year after year?" While the question was not out and out asked, it was suggested, by example, through a case study in terminator technology.

The second chapter, titled "When and Why to Consider Bioconfinement," examines risk analyses and how transgenes disperse among populations. It gives a large table of GMOs with their applications, among other topics. One of the more interesting parts of this chapter is an insert that contains information on Starlink corn. In this case, bioconfinement had failed and Starlink genetically modified corn had crossbred with corn that was used for human consumption and made its way into the food chain.

The third, fourth, and fifth chapters are on bioconfinement of plants, animals, and viruses, with the majority in the book in the chapter on plants. These chapters describe most of the kinds of confinement known at the time of the report and give their strengths and weaknesses. As the report was being written, new types of confinement were being created, so the report's authors were not able to fully address them. Many of the methods described are related to sterility or an inability to breed with natural or native species so that no gene transfer is possible.

The sixth and final chapter examines "biological and operational considerations for bioconfinement." This chapter lists the conclusions drawn from researching the topic of bioconfinement. It lists the ways that bioconfinement could fail and calls for much more research in the area of bioconfinement of GEOs.

The title of this report sounds technical, but the report is a fairly easy read. The reader doesn't have to be an expert in genetics to understand the book. The material is explained in a way that anyone who has passed a 100-level college biology course can understand.

Most of us hear about the potential for a super weed (basically a genetically modified plant that cross breeds with an already weedy plant, increases its ability to be competitive with other plants, and further reduces native plant populations), a super virus, etc., but we don't really have sufficient depth of understanding of how one of these organisms could arise or of methods for keeping them from entering ecosystems. This report explains the problem of GEOs and bioconfinement and, in doing so, effectively addresses ways to prevent such organisms from threatening ecosystems.—*Brett Larsen,* Washington State University, Pullman, WA.

Against the Grain: How Agriculture Has Hijacked Our Civilization. By Richard Manning, 2004, North Point Press, New York. 232 p. US$13.00 paper. ISBN # 0-86547-713-2.

Richard Manning introduces his book, *Against the Grain: How Agriculture has Hijacked Our Civilization,* with a history of agriculture and its effect on both humans and the natural landscape over the past 10 000 years. Throughout this timeline, Manning tries to give a sense of how and why agriculture has grown, and what effects it has had on both the environment and the people of the world. Also, Manning examines the phenomenon of modern agriculture, including the concept of the Green Revolution and the economics of the agricultural industry. Along with the benefits of increased yield and surplus, Manning discusses the wealth of problems associated with modern farming. Finally, he expresses hope for change with his proposition of organic farming as a partial solution. Although Manning's ideas and assumptions are not mainstream, he raises many important points that are worth consideration.

Manning begins by asserting that humans are essentially hunter-gatherers by nature. Therefore, he suggests, the expansion of agriculture was often violent and almost always led to the displacement or outright murder of the native hunter-gatherers. The early manifestation of social division centered around the establishment of a stationary lifestyle and the subsequent ability of landowners to store crops and accrue wealth. Disparity developed as a result of certain individuals controlling the farmed land itself and, therefore, the products of that land, while the rest of the

population was dependent on those individuals for work and sustenance. The ultimate result of this social stratification was a class of very rich individuals and a massive class of very poor ones.

According to Manning, one consequence of the monoculture approach (the production of a limited number of crop products) in providing sustenance to the population as a whole has been the progressive rise of malnutrition of the poor within societies. As agriculture developed, the poor were no longer reliant only on themselves to provide for their needs and, instead, depended on the wealthier societal members to determine their allotment. This situation, of course, resulted in the poor being provided with what was cheapest (such as potatoes or wheat, rather than meat), which did not usually constitute a well-balanced diet of high-quality fare.

The development of agriculture also translated into a great increase in both population size and density. Unfortunately, these increases led to negative impacts on the population. Increased population density inevitablyleads to an increase in disease incidence, often in naïve populations with no immunity to disease. An unfortunate example of this type of casualty was the decimation of Native Americans by smallpox. Similar consequences occurred as hunter-gatherers made the transition to an agricultural society.

Another factor that the author states has contributed to the development of malnutrition and disease is the prevalence of famine in agricultural societies. As previously stated, the development of agriculture leads to an increase in population. Often, human populations then reach unsustainable levels, where they are impacted by famine in years with decreased amounts of crops. If a society is dependent on only a few crops for sustenance, failure of one of those crops can equal starvation and devastation for the population. Starvation then results in malnutrition, disease, and death.

Environmental impacts of agriculture have far-reaching effects. Nitrogen excess from agricultural fertilization causes biological dead zones in waterways with low oxygen tension and poor nutrient quality. A major current example of a dead zone is a huge area in the Gulf of Mexico that sustains no aquatic life as a direct result of farm nutrients of the Midwestern United States running off the Mississippi watershed. Another major consequence of agriculture is erosion of the land, which was evident in the Dust Bowl of Oklahoma during the 1930s.

Increased population size that results from agricultural development directly correlates to an increased need for space and need for increased resources. Expansion of the population area inevitably occurs until there is no further room to expand. During the 20th Century, the capacity of the land to produce crops, combined with the limited amount of space available, resulted in a situation where something had to give if the population was to be sustained.

In the mid-1960s, the Green Revolution occurred as a response to this demand. Because the area of land could not be expanded, the yield per unit area of land had to increase. The term "Green Revolution" was adopted to refer to the development of methods to increase crop yields. Although the Green Revolution may have solved some problems, it created many of its own. These more modern crops require increased fertilizer, which, along with pesticides, causes increased environmental contamination. Also, the soil is increasingly depleted of its nutrients at a faster, exponential rate, leading to irreparable damage and loss of long-term sustainability of the land.

A more modern social impact of agriculture centers around the high profits enjoyed by the product middlemen, such as food processors, who purchase crops from farmers and sell to consumers. A vast economic inequality between the farmer and agribusiness corporations has developed, such that many farmers struggle to survive from year to year while corporations maintain lucrative enterprises.

Although Manning clearly does not approve of agricultural practices, he does concede the necessity of agriculture in modern society as a compromise between the belief that agriculture causes negative impacts on society and the inevitability that the current population must depend on some form of agriculture to survive. Manning endorses the methods of organic farming. Through organic farming, Manning hopes to eliminate wealthy middlemen and bring profitability back to the farmer. Also, organic farming has less impact on the environment, due to its decreased intensity of farming, its increased diversity of crops, and its reduced use of fertilizer.

The main purpose behind this book is to give us, as a society, insight into the problems with our agriculturally based lives rather than necessarily presenting viable solutions for these problems. Although many of Manning's theories are based on general (and disputable) assumptions, they are still relevant to understanding problems that have hounded us since the birth of agriculture and even more intensely since the development of industrial agriculture. Through discussion of the history and development of agriculture, Manning allows the reader to understand and consider his theories. His concluding suggestion to apply organic farming as a solution for many of the problems that we face is not necessarily feasible on a large scale, but such farming may provide some methods to apply to large-scale farming to decrease the negative impacts of traditional agriculture. In any case, Manning has presented some vital issues concerning agriculture that need to be considered if we plan to sustain ourselves as a society.—*Devon Thrasher,* Washington State University, Pullman, WA.

Stochastic Modeling in Range Management: Selected Essays. By Amitrajeet A. Batabyal, with other text contributors. 2004. NOVA Science Publishers, Inc., Hauppauge, NY. 120 p. US$69.00 hardbound. ISBN 1-59033-844-8.

In 1956, Bloom's taxonomy of cognitive levels was first published. The authors presented 6 levels of cognitive learning. These included knowledge, comprehension, application, analysis, synthesis, and evaluation. Interestingly, each of the natural sciences has had to move through these various cognitive stages to mature as a science. The science of rangeland management is no different. The concept of moving range management beyond the elementary cognitive levels of knowledge, comprehension, and application has been captured by Dr. Amitrajeet A. Batabyal in his book, *Stochastic Modeling in Range Management: Selected Essays.*

This book combines well-defined principles of range management and some elegantly sophisticated mathematics to discuss several current issues in range management. The book is a combination of some new and some reprinted essays. The central claim of this book is developed around three points. First, to a great extent, a theoretical approach has not been applied to range management. Second, most research has treated range management as a purely ecological problem, when it should, in fact, be considered an ecological-economic system. Third, range management is dependent on decision making under uncertainty and very little work has been done to model uncertainty in these systems. To address these three concerns, several essays have been compiled to show how stochastic modeling can be applied to effectively model rangelands.

If one undertakes a rudimentary scan of the book, the mathematics may look somewhat daunting. In addition, the authors tend to use a good deal of mathematical jargon. However, the book is highly readable aside from the mathematics. Several of the issues managers must deal with daily are tackled within the book. For example, the authors provide information for selecting the optimal number of paddocks, determining the proper timing and duration of grazing, evaluating the steady-state distribution of animals, and managing to avoid potential crisis states.