

“p. 00” or “p. 000,” and on p. 161, readers are told to “see p. 161” for details about the green lacewing complex. Such faults are relatively minor and do not detract appreciably from the excellent overall content of the book.

Many researchers and practitioners in the fields of ecology and pest management will find *Invertebrate Conservation and Agricultural Ecosystems* to be worthwhile reading. It may also be useful as a textbook in conservation biology or an advanced ecology course, as assigned reading in a graduate colloquium, and as supplemental reading for a landscape ecology class. With its numerous examples and up-to-date citations, the book makes a useful reference and deserves to be on the bookshelves of applied ecologists who are working to devise, test, and implement agricultural practices that combine sound pest management with the preservation of invertebrate biodiversity.

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Complex Population Dynamics: A Theoretical/Empirical Synthesis

Peter Turchin

Princeton University Press, Princeton, New Jersey,
2003

450 pp., \$39.95

ISBN: 0-691-09021-1

As the title indicates, this textbook presents both theoretical and empirical approaches to the study of population dynamics. Part I, “Theory,” presents an excellent foundation for the understanding of the rationale and process for describing and understanding population dynamics. Part II, “Data,” provides a “how to” manual for developing appropriate models for analyzing data and modeling approaches for the generation of empirically testable hypotheses. Finally, Part III, “Case Studies,” provides real world examples of how theoretical population modeling efforts coupled with experimentation can enhance our understanding of complex population dynamics. In this section, Turchin includes discussions of red grouse, vole, and hare population dynamics. This reviewer was tangentially involved in the early efforts at modeling Southern Pine Beetle population dynamics and was impressed not only at Turchin’s discussion of what is known about the biology of this important forest insect, but by the interesting and well-written description of the process whereby clerid predators are posited as a major factor in modifying the population cycles of this important forest pest species.

This textbook is well written, logically organized, abundantly cross-referenced, and a pleasure to read, even if dense mathematics are not one’s strength. It will be very useful for graduate/advanced undergraduate course work and a valuable reference book for the professional educator/researcher. Turchin’s writ-

ing style is outstanding. One of the greatest impediments to teaching theoretical modeling is to overcome the reticence of many students to be bold in their exploration of meaningful mechanisms and hypotheses. Turchin’s prose and problem-solving approach encourage the reader to take intellectual risks. He makes the subject matter not only understandable, but also enjoyable.

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Environmental Risk Assessment of Genetically Modified Organisms: Volume 1. A Case Study of Bt Maize in Kenya

A. Hilbeck and D. A. Andow

CAB International, Wallingford, UK, 2004

304 pp., \$110.00

ISBN: 0-85199-861-5

Maize is without question a tremendously important and popular crop in Africa, a continent too often in the media, and so in our psyches, associated with food shortages. Portuguese explorers introduced maize to the African continent early in the 16th century, and the first documentary evidence of its cultivation dates to 1540 (McCann 2005). Today, maize is the single most planted cereal on the African continent and the second most important food crop, behind cassava. It is grown in a wide range of environments: from the dry Sahel and southern Africa to the eastern highlands to the lowland tropics. Maize is extremely popular, and not solely because of its palatability, but also because of its high productivity and low labor demands, particularly relative to sorghum and millet. It is easy to see why improving maize productivity in Africa through biotechnology is a needed, although often contentious, enterprise.

The Kenya *Bt*-maize risk assessment case study—prepared by a formidable group of >50 scientists under the editorship of Andow and Hilbeck—is thorough, rigorous, objective, and transparent. It was organized by the Transgenic Organisms in Integrated Pest Management and Biological Control working group of the International Organization for Biological Control (IOBC), with funding from the Swiss Agency for Development and Cooperation and assistance from the Scientific and Technical Advisory Panel of the Global Environment Facility. The book is divided into eight chapters: the first two giving context to the case study, the next five addressing specific aspects of the risk assessment exercise, and the final chapter offering a synthesis of the study’s findings and a series of recommendations.

In the opening chapter, Andow and Hilbeck unveil the goal of the exercise, which was to “develop components of a scientific risk assessment process, which (*sic*) are consistent with that called for by the (Cartagena) Protocol (on Biosafety) . . .” (p. 1). Also in this

chapter, they briefly address a number of concepts relevant to risk assessment (e.g., transgenesis, risk assessment, valuation) and offer a concise overview of the book's content. Information concerning maize production in Kenya in general, and *Bt*-maize in particular, is presented in the chapter by Muhammad and Underwood.

The third chapter, by Nelson et al., is a Problem formulation and options assessment (PFOA) for Kenya *Bt*-maize. This is a very informative chapter, particularly for those not familiar with risk assessment procedures. While PFOA is undoubtedly a useful tool for risk assessment in most natural resource contexts, its use in the case of *Bt*-maize may be problematic. An important characteristic of PFOA is that it can be applied iteratively so that changes in public attitudes and advances in scientific knowledge over time can be incorporated in its application: Once released into the environment, however, *Bt*-maize transgenes cannot be returned to laboratory confinement. Although a "trial run" (p. 62), one significant caveat particular to the Kenya *Bt*-maize PFOA is its narrow stakeholder representation consisting of eight Kenyan and international scientists.

The fourth chapter, concerning *Bt*-maize transgene locus structure and expression, by Andow et al., is excellent. It provides a good and candid discussion, relevant to Kenya, of transgene design, locus structure, expression, and transmission and lists a number of important—including problematic—findings (e.g., available *Bt*-maize events are likely ineffective against *Busseola fusca*, one of the two most important stemborers in Kenya).

The fifth chapter, by Birch et al., is a thorough analysis of potential effects and their likely pathways on nontarget organisms. Particularly noteworthy of this chapter is a series of testable hypotheses (and questions) that are presented related to the potential hazards of *Bt*-maize identified by the authors. In a subsequent section, the authors provide detailed methodologies for testing most of the hypotheses. Some of the hypotheses and methodologies are more fully dealt with than others (e.g., those relative to stemborers and their parasitoids), which reflects corresponding states of knowledge.

The likelihood of and risks associated with *Bt*-maize (trans) gene flow is addressed by Johnston et al. Particularly notable of this chapter are an extended list of questions guiding this component of the risk assessment exercise and a section identifying important knowledge gaps. One such gap, which is particularly troubling—and was noted in passing by Muhammad and Underwood—is that the amount of unique genetic

diversity contained within the Kenyan landraces is unknown.

The final component of the risk assessment exercise was prepared by Fitt et al. and is composed of a detailed analysis of species at risk, potential exposure routes, monitoring methods, possibilities for resistance management, and other issues. A number of important problems were identified that must be resolved before commercial release of *Bt*-maize (e.g., none of the available *Bt*-maize events is a high-dose event against the key stemborers in Kenya and a number of farmer customs and attitudes), and the authors suggest how these problems can be surmounted. In the final section of this chapter, the authors present the components of a resistance management strategy for *Bt*-maize in Kenya. The major themes of the book are tied together in the final chapter, and the book concludes with a short section offering a number of author reflections, case study criticism, and questions for future case studies.

A number of observations scattered among the book's chapters left a sensation reminiscent of a childhood adage: *every object is a nail in the eyes of a child holding a hammer* (a poor translation from Spanish). To wit, the most important constraints to maize production in Kenya, as ranked by farmers, are unrelated to pests (e.g., lack of cash, drought, poor seed quality), and the most important pest problems to farmers are *Striga*, maize streak virus, fungal pathogens, and stemborers (chapter 2). Of these pests, the available *Bt*-maize events show "good efficacy" (p. 106) only against one of the two key stemborer species, and none of these events is high dose against Kenyan stemborers (chapter 7). Furthermore, a substantial amount of past and still ongoing research gives optimism that stemborers can be managed through biological control and crop management strategies such as the "push-pull" system (reference is made to both in chapter 2). Therefore, after reading this book, at least two questions are left to ponder: is low Kenyan maize productivity a true nail to our *Bt*-maize hammer? And, more specifically, is *Bt*-maize, as currently available, a real priority for reducing losses caused by maize stemborers in Kenya?

Reference Cited

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Benefits aside, genetically modified organisms (GMOs) have always been considered a threat to environment and human health. In view of this, it has been considered necessary by biosafety regulations of individual countries to test the feasibility of GMOs in contained and controlled environments for any potential risks they may pose. This paper describes the various aspects of risk, its assessment, and management which are imperative in decision making regarding the safe use of GMOs. Efficient efforts are necessary for implementation of regulations.Â This document recommended that environmental risk assessments can be performed on a case-by-case basis. Since then, the case-by-case approaches of risk assessment for GMO have been widely accepted.