Environmental Impact of Invertebrates for Biological Control of Arthropods: Methods and Risk Assessment
F. Bigler, D. Babendreier, and U. Kuhlmann, eds.
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Since the methodology of classical and augmentative arthropod biocontrol became formally recognized by pest managers at the beginning of the 20th century, concerns about the environmental impacts of natural enemy releases (also termed “nontarget effects”) have persisted. It was not until the late 1990s that these nontarget concerns were extensively debated among biocontrol practitioners, conservation biologists, and other public interest groups. Many studies and reviews addressing nontarget effects of biocontrol programs have since been published (Follett and Duan 2000, and reference therein). However, nontarget impact assessments for biocontrol have proven both technically and practically challenging. To date, there have been no standard methods and procedures to regulate and assess the risk of exotic invertebrate natural enemies (INEs) associated with arthropod biocontrol programs (van Driesche et al. 2001).

This multi-authored book compiles 16 chapters and attempts to address the procedural and methodological issues related to regulation and environmental impact assessment of INEs for arthropod biocontrol programs. Specifically, this book addresses (1) prediction of host specificity of INEs; (2) assessment of indirect effects of INEs on target ecological communities through competition and secondary interactions such as interbreeding with existing natural enemy complexes; (3) determination of the dispersal and establishment potential at both field and regional scales; (4) prevention of unintended release of harmful organisms associated with introduction of natural enemies; and (5) development of harmonized and science-based regulatory frameworks and policies that would not overburden the conduct and practice of arthropod biocontrol, while at the same time effectively preventing unintended introduction of harmful organisms into target ecosystems.

After an introduction that summarizes the history of regulation and science used in the environmental impact assessments of arthropod biocontrol (Babendreier et al.), Kuhlmann et al. and van Lenteren et al. address various aspects of the methodological and procedural challenges in determining the host specificity of introduced arthropod parasitoids and predators and provide useful recommendations for selection of appropriate nontarget species and use ecologically relevant methods for host range testing and data interpretation. One chapter (Albajes et al.) addresses the risk of plant damage caused by certain (facultative) groups of arthropod predators and might have been better placed immediately after the host specificity chapter.

After giving a detailed account of various ecological factors that potentially affect the competition and interbreeding between introduced and native biocontrol species, Messing et al. and Hopper et al. recommend methods for evaluating these risks. However, it is debatable if interbreeding between closely related species of invertebrate natural enemies should be viewed as a hazard inherent to arthropod biocontrol programs, as it is a biological phenomenon, and its impact is often limited by species boundary and natural selection.

The ability of natural enemies to disperse and establish within a broad geographical area occupied by their hosts is traditionally viewed as one of the important attributes influencing the success of classical and augmentative biocontrol programs. However, this same attribute may also pose a risk to nontarget species outside the targeted field or region. After examination of the abiotic and biotic factors that may limit dispersal and establishment, Boivin et al. show how to use temperature tolerances to assess the establishment potential of non-native biocontrol agents in the released field. While Mills et al. show the use of the traditional mark-release-recapture technique and associated mathematical models to monitor the dispersal of natural enemies from point source releases on a within-field scale, Cock et al. examine the usefulness of the ecoregion approach to predicting the potential for dispersal, movement, and establishment of concerned invertebrate biocontrol agents in broader, regional scales.

The unintended release of harmful organisms may come from two sources: contaminants and/or misidentification of the invertebrate biocontrol agents. While Goettel and Inglis recommend detailed guidelines for identifying and assessing the risk of different contaminants associated with biocontrol agents, Stouthamer reveals the usefulness and role of various modern molecular technologies in helping to correctly identify the agents and contaminants.

Barratt et al. show the complexity and value of postrelease studies on introduced natural enemies using experiences in New Zealand with both arthropod and weed pest biocontrol programs. Unfortunately, postrelease monitoring cannot be used, a priori, as a risk analysis tool for regulatory decisions.

In nontarget risk evaluation studies, false-negative (type II) errors are often more serious than false-positive (type I) errors. Thus, it is imperative that the experimental design ensure a high level of statistical power (or low type II error rate). However, study designs attempting to achieve high power levels (e.g., >80%) are often too costly to conduct and may present a higher probability of detecting statistically significant, but biologically unimportant, differences between treatments. Hoffmeister et al. address this statistical dilemma using examples of risk evaluation for genetically modified crops. Although their statistical tool is not new to many ecologists, risk assessment researchers in the field of biocontrol may still find it...