CHAPTER 1. INTRODUCTION

PREDICTING HOST RANGES OF PARASITOIDS AND PREDACIOUS INSECTS—WHAT ARE THE ISSUES?

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GOALS FOR HOST RANGE TESTING

Estimating the likely nontarget impacts of agents released to suppress invasive plants has been legally required, to one degree or another, for many decades. Similar predictions were not formally required for introductions of parasitoids or predators of pest arthropods. That is now beginning to change. This book has as its goal an exploration of how such estimates can best be made. This requires overcoming a series of problems, some logistical, some technical, some tied to an unclear theoretical framework for the activity. In this book, the editors and authors have tried to address many of these needs, in some chapters as essays on important tasks that need to be achieved, in other chapters as case history explorations of how the tasks were done in particular cases. This book will not be the final answer, but we hope it might propel the search for such an answer along.

LEGAL REQUIREMENTS

Whether or not predicting the host ranges of parasitoids and predators is legally required varies among countries. There is an absolute requirement for such predictions in New Zealand and Australia, but not in most other countries. In the EU, there is a developing consensus that such information will be required, but in the United States legal authority is lacking to impose such a requirement. Rather, the degree of such an assessment currently depends on the agency of employment of the person importing the natural enemy, with more stringent requirements for federal employees.

Regardless of the current legal status quo in any particular country, there is a trend to impose such requirements. The role of this book is in part to shape how such requirements are written, by revealing some of the complexities in the process of making such estimates and highlighting the risks of making overly sweeping assumptions about the utility of laboratory test data.

PRACTICAL PROBLEMS

Some of the problems posed by estimating the host ranges of candidate entomophagous biocontrol agents relative to the fauna of the receiving country are purely practical, rather than theoretical. Compared to plants, the number of species in a native biota of insects can be overwhelmingly large, with hundreds, thousands, even tens of thousands of native species in the target pest's family in the receiving biogeographic region. Many of these are likely to have little or no information associated with museum specimens about such important matters as their biology, habitat, host plants, and so on. This double edged problem, too many species and too little information, can cripple efforts to rationally consider the impact of a new parasitoid or predator on such a group. Many species that would be desirable members of a host range test list may be impossible to find or, if found, information on how to rear them will be unavailable. Rearing difficulty is further compounded by the necessity of holding insects as reproducing colonies at great cost in labor, rather than as seeds or long-lived individuals as can be done for plants. Finally, the large numbers of species of many groups means that many other species exist that are unknown, especially if importations are being considered for tropical continental areas, and that modern molecular phylogenies of the relevant insect groups are less likely to be available than for plant groups.

ISSUES OF THEORY

Issues of theory also complicate the study of host ranges of entomophagous arthropods. For specialized herbivorous arthropods, host ranges seem to track plant taxonomy because that itself is often highly correlated to secondary plant chemistry, compounds often used by specialists for host plant recognition. No such simple framework exists shaping the host ranges of insect parasitoids – or at least work to date has not shown this to clearly be the case. Rather, parasitoids themselves are of two potentially different sorts – idiobionts and koinobionts – each of which may be tracking different things in selecting hosts. Idiobionts being outside of their hosts need not have the high level of physiological adaptation to manipulate living hosts' immune systems that koinobionts require. Rather, idiobionts may be freer to use a wider range of hosts and may be more shaped in their host choices by the habitats or host plants or type of plant structure (leafmine, gall, etc) in which they find hosts. Koinobionts, in contrast employ venoms, viruses and other devices to master their hosts' immune systems and as such may find it more feasible to learn to find taxonomically related host insects on novel plants than to dominate novel immune systems of less related hosts on familiar plants. Sorting this framework out is the big theoretical issue in predicting host ranges of entomophagous insects. Such information is needed to make sense of actual host range test designs and test lists.

TECHNICAL ISSUES

Many technical issues exist about which sorts of host range tests are most useful in predicting what entomophagous insects are likely to do after their release in a new region. How much weight should be placed on host finding versus host suitability? Should preference be considered a factor likely to protect nonpreferred species from attack or will the biological control agents find themselves accepting or rejecting hosts without other immediately available choices? Should data from small cage studies be viewed as a reliable indicators of host choice or should tests use large cages? If so, how large? Should biological control agents used in tests be naïve (no contacts with the target pest) or experienced? Hungry or satiated? Mated or unmated? Young or old? While much has been learned in the past 40 years about how parasitoids and predacious insects are influenced in their host foraging by such factors, synthesis of this information into an approach for host testing is just beginning.

PROCESS OF RESOLUTION

Present in this book are essay-style chapters that try to address a number of the above mentioned issues (Chapters 3-7). Other Chapters (8-16) present case histories in the belief that the particular stories they tell will cast light on methods, details, logical approaches that will have applications in other systems. Debate on many details of theory and practice will be needed to develop a consensus and a mature body of techniques for use in estimating host ranges of entomophagous arthropods. A new forum for such debate was begun in 2002 with the First International Symposium on Biological Control of Arthropods in Honolulu, Hawaii (USA). This series continues with the 2nd ISBCA scheduled to take place in Davos, Switzerland in September of 2005. Among the symposia to be held will be one debating issues affecting host range testing.

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