Biological control of pests, diseases and weeds
Sabelis, M.W.

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Amblypygi and Solifugae. Maybe my lot are deprived and there are still places where solid taxonomic zoology is taught. But I suspect that Cambridge is not atypical and that those of us with this sort of background are an endangered species, teetering towards extinction. The young, adapting to a world that has changed, have a better chance of professional survival if they concentrate on other things. They should, by all means, be encouraged to scan this book, to be aware that such bodies of knowledge exist, to note some of the things they are missing. Indeed, it would do no harm to a number of my professional colleagues who have never been exposed to this sort of zoology. If it did no more than enhance their enjoyment and understanding of a walk in the country or of natural history programmes on the television, they would gain something, and some of the more molecular of them might be persuaded that a knowledge of what organisms are adapted to do, and of the evolutionary routes by which they have got there, are relevant to the interpretation of their cell biology. But the idea that a student should learn the vocabulary, let alone the detail, of the arguments and examples presented in this often excellent, if rather patchy, little book is frankly unrealistic. They have too much else to do.

Martin Wells
Dept of Zoology, University of Cambridge, Downing St, Cambridge CB2 3EJ, UK.

Biological Control

Biological Control of Pests, Pathogens and Weeds: Developments and Prospects


In February 1987 the Royal Society of London organized a discussion meeting on developments and prospects of biological control. This meeting brought together workers involved in the biological control of a wide range of agents that damage useful plants, such as insects, mites, nematodes, fungi, bacteria, viruses and weeds. The proceedings are now available and they have much to offer as a review of the state of the art: spectacular success in using a specific parasitoid to control a pest of cassava mealybug accidentally introduced into Africa in 1973 (Naenschwander and Herren), interesting new developments in the control of soil-borne pathogens by non-pathogenic antagonists (Cook, Deacon and Schippers) and a very insightful review of the pros and cons of bracken control in England by using exotic insects (Lawton).

There is also an authoritative review of how simple mathematical models may help to develop release strategies for natural enemies and to unravel the dynamic complexities of predator-prey and parasite-host interactions (May and Hassell), a subject of much recent debate in the literature among entomologists. Moreover, as expected and intended, there are many speculations by plant and insect pathologists on how to implement DNA technology in the development of new biological control methods.

Views on coevolutionary trends in systems involving the target pest and its control agent emerge in many chapters of the book and they appear to have a strong influence on the criteria for selection of biocontrol agents and the development of biocontrol strategies. Much of the discussion on this topic concerns Hokkanen and Pimentel's hypothesis a that good control agents are more likely to be found among those without a close evolutionary history with the pest because coevolution leads to increased resistance of the pest and decreased effectiveness of the biocontrol agent. This so-called 'new association theory' is not generally accepted, however. Waage and Greathead show that the chance for success does not significantly differ between new and old associations of parasitoids and insect pests. Cullen and Hasan argue that highly coevolved and specialized pathogens of weeds (such as the rust Puccinia chondrillina, against the weed Chondrilla juncea) have been very successful in that they caused weed density to decrease to an acceptable level. These examples indicate that Hokkanen and Pimentel's hypothesis is not generally applicable and that there is no reason to give precedence to new associations as a selection criterion. This is not to say that their hypothesis does not hold under any circumstances, but rather that the conditions should be specified. As stressed by Waage and Greathead, it is also important to consider expected evolutionary trends after the release of biological control agents, be it a new or an old association. If the effectiveness of biological control agents will generally decrease with time, this could jeopardize the development of management strategies that induce resistance in their host and decreased effectiveness of the biocontrol agent. This so-called 'new association theory' is not generally accepted, however. Waage and Greathead show that the chance for success does not significantly differ between new and old associations of parasitoids and insect pests. Cullen and Hasan argue that highly coevolved and specialized pathogens of weeds (such as the rust Puccinia chondrillina, against the weed Chondrilla juncea) have been very successful in that they caused weed density to decrease to an acceptable level. These examples indicate that Hokkanen and Pimentel's hypothesis is not generally applicable and that there is no reason to give precedence to new associations as a selection criterion. This is not to say that their hypothesis does not hold under any circumstances, but rather that the conditions should be specified. As stressed by Waage and Greathead, it is also important to consider expected evolutionary trends after the release of biological control agents, be it a new or an old association. If the effectiveness of biological control agents will generally decrease with time, this could jeopardize the development of management strategies. Payne therefore pleads for programmes on the television, they have too much else to do.

So far, theoretical and empirical studies on the coevolution of antagonists have suggested that arms races between species do not always proceed as relentless and progressive bouts of defense and counterdefense and that mutual counteradaptations may be erratic and constrained as some interactions evolve towards commensalism, others cycle through frequency-dependent or density-dependent selection and still others cope with varying selection for mutualism and antagonism. The problem now is to understand the conditions that make some outcomes more probable than others. Such an understanding cannot be gained, however, without consideration of the selective forces operating on organisms at other trophic levels. There are many examples in the book to illustrate this point, such as plants that benefit from luring and feeding nectar to natural enemies of their herbivores (Van Emden, Pickett), parasitic RNA that causes virulent strains of fungi (e.g. chestnut blight) to become hypovirulent (Buck), and hypovirulent pathogens that induce resistance in their host against further attack by virulent pathogens. These examples suggest that one should not focus on the evolution of pest and control agent alone, but rather include other trophic levels as this may reveal conflicts or concert of interest and thus help to elucidate otherwise unexpected evolutionary pathways.

Invasions of pest organisms and releases of antagonists in new environments are, in effect, manipulation experiments on a grand scale. They have contributed to our knowledge of the possible consequences and these results represent much of our experience on which to judge the risks involved in the release of genetically engineered organisms. Unfortunately, almost none of the
successes in biological control have
been studied in the field beyond the
relatively short period when natural
enemies were actually being re-
leased, and then only in a rather
superficial way. As emphasized by
May and Hassell, this is a great op-
portunity being wasted, especially
because it could provide invaluable
information on species invasions,
population dynamics and (co)evolu-
tionary processes. The discussion
meeting in 1987 and its Proceedings
have, no doubt, contributed to elari-
ying this issue.

Maurice W. Sabelis
Dept of Pure and Applied Ecology, University of
Amsterdam, Kruislaan 302, 1098 SM Amsterdam, The
Netherlands.

References
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Books Received

Review copies of the following books have
been received. Books that have been reviewed
in Trends in Ecology and Evolution are not
included. The appearance of a book in the list
does not preclude the possibility of it being
reviewed in the future.

Alan A. Berryman (ed.) Dynamics of Forest
Insect Populations: Patterns, Causes, Impli-
cations Plenum Press, 1988. $117 (xx+603
pages) ISBN 0 306 42745 1

Laura Betsig, Monique Borgerhoff Mulder and
Paul Turke (eds) Human Reproductive Be-
aviour: A Darwinian Perspective Cambridge
University Press, 1988. £40/$75 hbk, £19/$24.95
pbk (vii+363 pages) ISBN 0 521 32738 5

K.A. Browning, B.J. Conway, J-P.A. Muller and
D.J. Stanley (eds) Exploiting Remotely Sensed
imagery Royal Society, 1988. £45 (UK) £48
(elsewhere) (vi+176 pages) ISBN 0 85403 349 1

Richard Calendar (ed.) The Bacteriophages
pages) ISBN 0 306 42863 9

D.C.D. Happold The Mammals of Nigeria
Clarendon Press, 1987. £75-90 (xvii+402 pages)
ISBN 0 19 857555 3

Henry F. Howe and Lynn C. Westley Ecological
Relationships of Plants and Animals Oxford
University Press, 1988. £22.50 (xiii+273 pages)
ISBN 0 19 504431 2

F.C. Hummel, W. Paal and G. Grassi (eds) Biomass Forestry in Europe: A Strategy for the
Future Elsevier Applied Science, 1988. £65.00
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William F. Loomis Four Billion Years: An Essay
pbk (xvii+266 pages) ISBN 0 87893 476 6

James D. Mauseth Plant Anatomy Benjamin/
Cummings, 1988. $18.95 (xiv+560 pages) ISBN
0 8053 4570 1

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ogy: Observations of an Evolutionist Harvard
University Press, 1988. $27.95/$41.95 (xiii+564
pages) ISBN 0 674 89665 3

Ken Rubel Tropical Rain Forest in South-East
Asia: A Pictorial Journey Tropical Press SDN

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mental Information in Vertebrates Springer-
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DM 159 (xvii+446 pages) ISBN 0 387 96647 6

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Anwar and Nazaruddin Hidayat The Ecology of
Sumatra (2nd edn) Gadjah Mada University
Press, 1987. $45 hbk, $22 pbk (xx+583 pages)
ISBN 979 420 061 1

Anthony J. Whitten, Muslim Seed Mustafa and
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$25 pbk (xxi+777 pages) ISBN 979 420 060 3