

THE AGROECOLOGY OF CARABID BEETLES

J. M. HOLLAND [ed.] 2002.

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This volume arose out of a session on polyphagous predators, held at the Entomological Society of America meeting at Atlanta in 1999. At first sight, the book is similar to compilations of the proceedings of the triennial European carabidologists' meetings. For example, the authorship is decidedly European in emphasis with only four of 17 authors having institutional affiliations outside Europe. However, an important difference is that the carabidologists' conferences feature new research results, whereas — with a few exceptions — the chapters in this volume are quite thorough literature reviews. The compilation therefore provides a comprehensive overview of the topic as it was in 1999.

The first chapter, "Carabid beetles: their ecology, survival and use in agroecosystems", is by the editor. This chapter is the most Eurocentric in the book. A tabulation of "the most common species found in arable land" relies solely on European sources and omits several species of importance in the Nearctic. Laroche's lists of natural enemies of carabids are used extensively, but most other North American work is ignored. The "ecology" portion of the chapter is a quite brief and selective update of Thiele (1977). The "survival" component is dealt with in a section detailing biotic and abiotic influences on populations with the heading "Population regulation". Many of the factors discussed in this section are not regulatory in the strict sense of population dynamics. The "uses" of carabids identified are as agents of pest control, as food for vertebrates, and as bioindicators; of these, the first and third receive attention in subsequent chapters.

The second chapter is by M.L. Luff and considers the attributes of carabid assemblages in agroecosystems. The chapter analyses major data sets including SCARAB, an experimental assessment of effects of intensive pesticide use carried out in 108 half-fields in Britain, and Luff's own compilation of 119 published species lists from Europe, North America and Japan. The analysis reaffirms — and broadens to new regions — Thiele's (1977) finding that carabid assemblages in crops typically have about 30 species. Luff identifies and characterizes the ecology of six genera that dominate in terrestrial cropping systems. He also demonstrates that variation in carabid assemblages in crops is largely attributable to site, year and crop plant, and that pesticides or other agronomic management practices are of subsidiary importance.

The next five chapters, occupying over 40% of the book, review literature on carabids as natural enemies of crop pests. Three chapters address aspects of carabid diets, and the following two assess evidence for control of invertebrate pests and weeds respectively. Toft and Bilde separate dietary items on the basis of food value, as judged by the diet's effect on carabid fitness; they conclude that cereal aphids, although frequently considered to be controlled by carabids, are a low quality diet. This and other examples demonstrate that we know little about carabid prey choice and so lack a basis for quantitative assessments of pest consumption in agroecosystems. Ingerson-Mahar reviews carabid morphology in relation to diet, and gut dissection as a method of dietary assessment. This is the only chapter in which entomological terminology might deter the non-specialist agroecologist: this problem could have been alleviated by clearer, more effectively labelled, figures. Symondson's chapter provides a summary of the rapidly developing fields of immunological and molecular methods of dietary assessment, and is made more useful by its inclusion of references up to 2002. Those familiar with the work by Hagley and colleagues on carabids as predators of apple pests may be dismayed to note that Ingerson-Mahar refers to Hagley as "Hagely", and that Symondson alleges that Allen and Hagley's publications on predation of tortricids and tephritids deal with *Heliothis zea*!

Sunderland presents a comprehensive worldwide review (to 2002) of evidence that cropland carabids consume invertebrate pests (by scavenging or predation), that they kill invertebrate pests, and that they, alone or as part of a larger natural enemy complex, affect invertebrate pest populations. Presentation of the information in tables makes it very accessible, although by now many of the best examples are familiar as they were also used in the chapters on carabid diet. Sunderland concludes that, with some exceptions, “there is little evidence that trophic generalist carabids can, by themselves, make a significant impact on pest populations” (p. 201) but “There is more evidence that, when carabids form part of an assemblage of generalist predators, the assemblage as a whole can often reduce pests to a significant degree”. Tooley and Brust’s chapter on weed seed predation, although parallel in apparent niche to the chapter by Sunderland, adopts a very different approach. It provides a general review of the topic of post seed-shed weed seed predation by carabid beetles. Although it is concluded that weed seeds are consumed by carabids, lack of information on prey selection by carabids and on implications of seed mortality for weed population biology make conclusions parallel to those of Sunderland impossible.

The remaining four chapters deal with various aspects of carabid ecology in the context of the agricultural landscape. Hance briefly reviews the influence on carabids of crop management practices, including crop selection and arrangement, cultivation, agricultural chemicals, and natural enemy refuges. This is followed by Holland et al., who address the same topics from the opposite viewpoint: “Are carabids indicators of the environmental impacts of crop management practices?” This chapter presents carabid-related results from the SCARAB project on pesticide effects (referred to above), and from the LINK integrated farming systems study, in which conventional and low agrochemical input farming systems were compared. This chapter is not the epitome of reader-friendly communication: in addition to SCARAB and LINK, the reader must grapple with several more acronyms, some of inconstant meaning, must deduce the meaning of a table (9.2) that lacks adequate explanations and, if interested in important methodological details, must seek them in project reports to various UK government agencies. It is difficult for the reader to reach a balanced evaluation of the outcomes of the LINK and SCARAB projects: for each of them, the data presented are selected because they show the greatest responses by carabids and so are by no means typical. The authors conclude that, with the exception of the fields they choose to highlight, neither project shows evidence of effects of pesticides on carabids.

Lee and Landis review the management of non-crop refuges for carabid beetles, including “beetle banks” which are raised grassy strips within crop fields. While such refuges contain high densities of carabid beetles that are often in better physiological condition than those in crops, it is not clear whether the refuges operate as sources or sinks for carabids, and to what distance their influence extends into the crop. While the authors do address the issue of how to manage refuges, they admit that a major limitation of adoption is the absence of clear evidence that they improve pest control.

The final chapter, by Thomas et al., considers the spatial distribution of carabid beetles in agricultural landscapes. There is a discussion of methodology and results of studies of distribution of carabids in and around agricultural fields, and within individual fields. At the latter scale, the authors demonstrate from their use of SADIE (Perry 1995) to describe spatial patterns and measure their association with potential causative factors. They contend that SADIE provides a tool for learning how to manage habitats for biodiversity, conservation or pest control.

Overall, the literature reviews are by far the most valuable components of the book, as most of them provide comprehensive summaries of the state of knowledge. Most figures and tables are well presented and provide useful information in support of the text. Further editing would have removed some of the typographic and spelling errors, and helped the non-anglophones to present their knowledge more effectively. The editor might also have negotiated with authors to reduce the

degree of overlap between chapters: in addition to the repetition in the section on diet, “beetle banks” were described in three chapters. Such repetition may not affect the average user of this book: only reviewers and editors are likely to read it from end to end. The average user of the book is likely to fall into one of three categories: the carabid specialist, the crop entomologist with an interest in pest management with natural enemies, and the agroecologist interested in how production practices affect non-target organisms. For the non-entomological agroecologist, it is sufficiently free of entomological terminology to be quite approachable. Carabids are probably the best-studied non-pestiferous insects of agroecosystems, and the book provides a valuable summary of our knowledge about them and, salutarily, reveals how much remains to be discovered.

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