

Eocene, some 90 million years later. The implication is that the highly sophisticated social system of present-day insect species was not enough in itself to result in the success we see in these groups. Without the fossil evidence, we could easily and erroneously assume social complexity was the single causal factor.

One of the great benefits of the way that this book is written is that it follows a path like that of a good class in insect systematics. First it leads the reader through sections on basic and broad concepts that underlie scientists' understanding of insect evolution. Grimaldi and Engel briefly lay out their ideas on important issues such as homology, species, and phylogeny reconstruction. These areas of systematics remain steeped in debate, so the authors' particular take on such topics will not please everyone, but this is not the intent of the book.

For those of us less familiar with fossils, the book provides a good primer on fossil formation and different types of insect fossils. Fossils and fossilization of insects are extremely well treated, with a particularly fascinating overview of amber inclusions. One cannot help but be captivated by the remarkable quality of amber preservation, which makes it possible to view mitochondria in some fossils and recalls controversy over the amplification of ancient DNA.

The bulk of the book begins with a systematic treatment of arthropods that are near relatives of insects, and then details each of the major insect groups. The incorporation of fossils in the book is its most innovative aspect, but there is a very competent treatment of every insect order, providing a salient and mercifully brief historical overview of the taxonomic work in each group, tabular lists of significant characters in the included taxa, and overviews of both fossil and extant taxa. Clearly drawn phylogenetic trees are provided for all major groups. The trees that include fossil taxa, however, are by necessity composite compromise diagrams derived from several disparate sources, rather than actual cladograms based on an inclusive analysis of all data and taxa. But the authors are clear about the source of the trees, so the reader has



reasonable warning of their limitations. Current DNA evidence is discussed, and important morphological data are presented in many easily comprehensible figures.

Although the text is clearly geared to a relatively sophisticated readership, it is the most accessible treatment of fossil insects available. The organization of information follows historical and phylogenetic lines and so maximizes connectivity and information content. The book is beautifully illustrated with close to 1000 photographs and figures (most in full color), including adult, immature, fossil, and extant insects. Attention to detail and quality in the figures sets this work apart from other entomology texts. The book is up to date in its information and will be an invaluable resource for anyone teaching a course in insect systematics. I have already used it as background reading for class preparation.

This is a rich work and an excellent contribution to the study and teaching of insect and arthropod science. Anyone with an interest in insects—and just about any organismal biologist—will want to have access to this fine reference, either through an institutional library or on the bookshelf at home. Grimaldi and Engel have breathed life into old cuticle (or at least the traces of old cuticle) and have reinforced the idea that a broad and integrative view of any group is essential for understanding its evolution, and indeed for a full understanding of life on Earth.

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SEXUAL CONFLICT: A NEW PARADIGM?

Sexual Conflict. Göran Arnqvist and Locke Rowe. Princeton University Press, Princeton, NJ, 2005. 360 pp., illus. \$39.50 (ISBN 0691122180 paper).

I'm watching a breeding colony of southern elephant seals on a remote island in the Falklands. The harem master is an impressive behemoth, and as he makes his way through his courtiers to clash with rival males, some of his females and their pups are inevitably crushed. This does not seem to bother the master, since his main *raison d'être* is to sire the pups that will be born a year later. Females, which have only about a fifth of his mass, are powerless to fight him off to save themselves and the pups. A short distance away, southern giant petrels breed on the same beach. Giant petrels pair for life, and they raise their single offspring by sharing the incubation, brooding, and feeding of their young for a staggering 6 months.

So why and how did nature produce some species in which males and females have severe conflicts over reproduction, such as elephant seals, whereas in others, such as giant petrels, cooperation prevails? In *Sexual Conflict*, Göran Arnqvist and Locke Rowe offer some illumination, and in so doing they make a major contribution to the field of sexual selection. This is a wonderful book, packed with exciting natural history, distilled interpretation of recent experimental studies, and straightforward explanations of complicated mathematical models. If you want to learn how male bedbugs rape females (and fellow males), examine the tactics of penis fencing in marine flatworms, or discover the tricks a promiscuous penduline tit uses to cheat its mate, this is the source to turn to. These and other intricate examples illustrate that nature produces many bizarre examples of sexual conflict in which the interests of males and females are strikingly divergent.

Reproduction is an uneasy alliance between the sexes, a game of tug of war. For a viable embryo, both a male and a female gamete are needed, though to achieve fertilization the sexes (and indeed hermaphrodites) use different means. For males, often the best strategy is to pursue matings persistently, whereas for females selective resistance may be the winning card. It is important, however, to realize that males and females are tied together in more than an allegorical way: If males harm females—for instance, by developing brutal intromittent organs—not only will the female's reproductive success in a population be reduced, but so will that of an average male.

Sexual conflict is becoming a major concept in evolutionary biology for two main reasons. First, teasing apart the male and female perspectives is genuinely fascinating. Unlike some other relationships involving conflict, such as predator-prey and host-parasite interactions, sexual conflict has fighting teams (labeled “males” and “females”) that share the vast majority of their genes. Second, sexual conflict can be studied at several levels using a variety of research tools and model organisms, from genes through individuals to macroevolution. Thus researchers use advanced techniques borrowed from molecular genetics, population genetics, behavioral ecology, and comparative phylogenetics. Indeed, as Arnqvist and Rowe argue, a single type of methodology is unlikely to be successful for revealing the details, directions, and intensity of sexual conflict.

The concept of sexual conflict goes back to seminal papers by Robert Trivers and Geoffrey Parker in the early 1970s, but present-day students can draw on recent rapid advances in genetics, behavioral biology, and phylogenetics. For instance, clever genetic techniques allow researchers to speed up sperm competition in fruit flies and pit the resulting supercompetitive males against unaltered populations of females. The unlucky females are likely to die, an unfortunate side effect of the enhanced seminal fluids produced by supercompetitive males. These achievements warrant a full-fledged new paradigm that cuts

through the boundaries of traditional biological disciplines, although only time will tell how far we can push the Trivers-Parker paradigm. It seems certain, however, that Arnqvist and Rowe's well-balanced and carefully worded book is a landmark, and it is likely to recruit new fans to the sexual conflict camp.

Two major challenges, in my view, remain to be tackled. First, we need a full understanding of the costs and benefits of mating, for both sexes. There are convincing demonstrations that mating is costly for females. However, gaining access to the females and achieving copulation may be exceedingly costly for males as well; for example, bull elephant seals can rarely sustain their bloody fights with rivals beyond a single breeding season. Second, we need to find out why life histories, physiology, and ecology appear to make some species more prone to conflicting interests than others, so that many exhibit overt sexual conflicts, like the elephant seals, whereas others, like petrels, become cooperative. Are the effects of ecology and life history unidirectional, leading to the presence or absence of sexual conflict? Or does strife between the sexes feed back to ecology and life history, amplifying or dampening their effects? The balance between conflict and cooperation may lie at the heart of success (or failure) of alleles, individuals, and populations.

Although I enjoyed this book from cover to cover, some explanatory notes or boxes on the details of the major research techniques would have been a welcome addition. Researchers on sexual conflict use vastly different techniques, so brief descriptions of the principal ones would be especially valuable for postgraduates and for those whose research background is in just one field.

Nevertheless, I expect that *Sexual Conflict* will be popular among postgraduates, evolutionary biologists, and behavioral ecologists. I have already found it excellent material for my final-year undergraduate course on sexual conflict. And though the book is aimed primarily at professional biologists, I hope and expect the fascinating examples on the behavior and natural history of various

beasts will appeal also to the general public.

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AN INSTRUCTION MANUAL FOR THE ENDANGERED SPECIES ACT

Species at Risk: Using Economic Incentives to Shelter Endangered Species on Private Lands. Jason F. Shogren, ed. University of Texas Press, Austin, 2005. 283 pp. \$21.95 (ISBN 0292705972 paper).

Many biodiversity conservation efforts can be described by the proverb, “If all you have is a hammer, every problem looks like a nail.” While we conservationists have developed a vast array of different tools, we have not been very good about developing the instruction manuals that help our practitioners figure out the conditions under which to use or not use any specific one. *Species at Risk: Using Economic Incentives to Shelter Endangered Species on Private Lands* attempts to meet this need by providing a guide to using one family of conservation tools—the various incentives for conservation of endangered species on private lands, particularly in relation to the US Endangered Species Act (ESA).

The introduction to the book, by editor Jason Shogren, quotes Jim Berger, the former president of the Wyoming Stock Growers Association, as saying that “the best wildlife management we can have is a local game warden, a rancher, and a cup of coffee.” Shogren goes on to point out, however, that “many others might add that a fat checkbook would be helpful too. This book addresses whether this ESA checkbook makes sense from several vantage points” (pp. 18–19). In effect, the problem is how to keep the owners of habitat that could be used by an endangered species from destroying that