

# **Sperm Competition**

and Its Evolutionary  
Consequences in  
the Insects

**LEIGH W. SIMMONS**



MONOGRAPHS IN BEHAVIOR AND ECOLOGY

# Sperm Competition And Its Evolutionary Consequences In The Insects

**Robert L. Smith**



## **Sperm Competition And Its Evolutionary Consequences In The Insects:**

*Sperm Competition and Its Evolutionary Consequences in the Insects* Leigh W. Simmons, 2019-12-31 One hundred years after Darwin considered how sexual selection shapes the behavioral and morphological characteristics of males for acquiring mates Parker realized that sexual selection continues after mating through sperm competition Because females often mate with multiple males before producing offspring selection favors adaptations that allow males to preempt sperm from previous males and to prevent their own sperm from preemption by future males Since the 1970s this area of research has seen exponential growth and biologists now recognize sperm competition as an evolutionary force that drives such adaptations as mate guarding genital morphology and ejaculate chemistry across all animal taxa The insects have been critical to this research and they still offer the greatest potential to reveal fully the evolutionary consequences of sperm competition This book analyzes and extends thirty years of theoretical and empirical work on insect sperm competition It considers both male and female interests in sperm utilization and the sexual conflict that can arise when these differ It covers the mechanics of sperm transfer and utilization morphology physiology and behavior Sperm competition is shown to have dramatic effects on adaptation in the context of reproduction as well as far reaching ramifications on life history evolution and speciation Written by a top researcher in the field this comprehensive up to date review of the evolutionary causes and consequences of sperm competition in the insects will prove an invaluable reference for students and established researchers in behavioral ecology and evolutionary biology

**Sperm Competition in Butterflies** Mamoru Watanabe, 2016-01-06 This book describes about 30 years of theoretical empirical and experimental work on butterfly sperm competition It considers the reproductive morphology and sperm utilisation interests of males and females which shape the mating tactics of each sex Females of most butterfly species mate multiple times throughout their lives The reasons are explored as well as the numerous adaptations males have developed to prevent future mating and fertilisation by the sperm of other males In particular this volume focuses on the role of apyrene sperm Eupyrene and apyrene sperm dimorphism is most likely a key factor in sperm competition and the study in butterflies promotes understanding of sexual selection across animal species with sperm polymorphism This book describing the evolutionary causes and consequences of the sperm competition in butterflies is a recommended read for students of behavioural ecology

*Reproductive Strategies in Insects* Omkar, Geetanjali Mishra, 2022-02-15 Reproduction is one of the most inherent tasks that all living organisms are actively involved in It forms the backbone of their existence with all evolutionary energies directed over billion years of creation into maximizing reproductive effort For so simple and directed a need such as maximizing reproduction it is interesting to see how much diversity and complexity exists in this task Each organism despite having the same end goal employs different strategies The complexities intricacies and strategies of successful reproduction while being extremely fascinating are equally befuddling *Reproductive Strategies in Insects* provides an expansive critical look at the reproductive strategies of the most diverse group of animals the insects Insects which

inhabit myriad niches in all ecosystems except the oceans show the most diverse reproductive strategies ranging from simplest to most complex Reproductive strategies viz search for mates number of mates display of mate quality assessment of mate quality acceptance of mate rejection of mates forced copulations the fight for paternity pre during and post copula the modulation of paternity ovipositional strategies and parental care are described in detail in this book Also each strategy is analyzed in relation to its morphological physiological ethological ecological and evolutionary aspects Features Covers a wide variety of reproductive strategies A detailed step by step description of reproductive strategies Discusses morphological physiological ethological ecological and evolutionary aspects Modulation of these strategies and responsible modulatory factors are also discussed Well illustrated Recent research results and probable future research directions This is a niche reference book for ethologists biologists studying behavioural evolution and entomologists It may also be used as a textbook for a graduate level course in behaviour

**Sperm Competition in Humans** Todd K. Shackelford, Nicholas

Pound, 2006-11-22 In species with internal fertilization sperm competition occurs when the sperm of two or more males simultaneously occupy the reproductive tract of a female and compete to fertilize an egg Parker 1970 A large body of empirical research has demonstrated that as predicted by sperm competition theory males and females in many species possess anatomical behavioral and physiological adaptations that have evolved to deal with the adaptive challenges associated with sperm competition Moreover in recent years evolutionary biologists and psychologists have begun to examine the extent to which sperm competition may have been an important selective pressure during human evolution Some research has suggested that male humans like males of many bird insect and rodent species might be able to adjust the number of sperm they inseminate according to the risk of sperm competition Other research has examined whether such responses might be accompanied by psychological changes that motivate human males to pursue copulations when the risk of sperm competition is high Furthermore there is research suggesting that aspects of human penile anatomy might function to enhance success in sperm competition Much of this work has been controversial some of the findings have been disputed and others have been greeted with skepticism However the idea that some aspects of human psychology and behavior might best be understood as adaptations to sperm competition remains intriguing and in certain cases very persuasive

Encyclopedia of Evolutionary Biology , 2016-04-14 Encyclopedia of Evolutionary Biology Four Volume Set is the definitive go to reference in the field of evolutionary biology It provides a fully comprehensive review of the field in an easy to search structure Under the collective leadership of fifteen distinguished section editors it is comprised of articles written by leading experts in the field providing a full review of the current status of each topic The articles are up to date and fully illustrated with in text references that allow readers to easily access primary literature While all entries are authoritative and valuable to those with advanced understanding of evolutionary biology they are also intended to be accessible to both advanced undergraduate and graduate students Broad topics include the history of evolutionary biology population genetics

quantitative genetics speciation life history evolution evolution of sex and mating systems evolutionary biogeography evolutionary developmental biology molecular and genome evolution coevolution phylogenetic methods microbial evolution diversification of plants and fungi diversification of animals and applied evolution Presents fully comprehensive content allowing easy access to fundamental information and links to primary research Contains concise articles by leading experts in the field that ensures current coverage of each topic Provides ancillary learning tools like tables illustrations and multimedia features to assist with the comprehension process

*Sexual Selection and Reproductive Competition in Insects* Murray Blum, 2012-12-02 Sexual Selection and Reproductive Competition in Insects explores the biological mechanisms underlying intrasexual reproductive competition as a driving force in sexual selection in insects The book contains papers presented at a symposium on reproductive behavior in insects held at the 15th International Congress of Entomology in Washington D C in 1976 Organized into 13 chapters this volume begins with a historical background on sexual selection theory and some of the principal conceptual advances that have been made since Charles Darwin 1871 posited that a sexual character was a characteristic possessed by only one sex and not the other It then introduces the reader to differences in patterns of sexual selection and how they affect the reproductive success of individuals male female mating relationships and mate choice by females The book also discusses the evolution of mating strategies in insects touching on concepts such as parental investment female choice and sexual conflict Later chapters focus on winglessness fighting and dimorphism in male fig wasps and other insects along with agonistic behavior among males of *Achias australis* the function of horns in beetles and the evolution of alternative male reproductive strategies in field crickets The book also looks into the courtship and mating behavior of insects and then concludes with an analysis of insect life histories in order to elucidate the biological aspects of the male female phenomenon This book is an essential reading for biologists and chemists

**Sperm Competition and Sexual Selection** Tim R. Birkhead, Anders Pape Møller, 1998-08-12 Sperm Competition and Sexual Selection presents the intricate ways in which sperm compete to fertilize eggs and how this has prompted reinterpretations of breeding behavior This book provides a theoretical framework for the study of sperm competition which is a central part of sexual selection It also discusses the roles of females and the relationships between paternal care in sperm competition The chapters focusing on taxonomic development are diverse and cover all the major animal groups both vertebrate and invertebrate and plants The final chapter provides an overview discussing the relationship between sperm competition and sexual selection in terms of both function and mechanism and how these translate into species fitness This book will be of prime interest to behaviorists ecologists and evolutionary biologists suggesting new avenues of research and new ways of approaching old problems The only up to date summary of a central and popular subject Well known editors and authors Provides a theoretical framework for the study of sperm competition Covers all major animal groups Includes a chapter on plants

**The Evolutionary Biology of Human Female Sexuality** Randy Thornhill, Steven W. Gangestad, 2008 This title

introduces a theoretical framework for understanding women's sexuality based on comparative female sexuality across all vertebrate animals. It shows that estrus is present in human females contrary to earlier research. Conceptual Breakthroughs in Ethology and Animal Behavior Michael D. Breed, 2017-01-25. Conceptual Breakthroughs in Ethology and Animal Behavior highlights through concise summaries the most important discoveries and scientific revolutions in animal behavior. These are assessed for their relative impact on the field and their significance to the forward motion of the science of animal behavior. Eighty short essays capture the moment when a new concept emerged or a publication signaled a paradigm shift. How the new understanding came about is explained and any continuing controversy or scientific conversation on the issue is highlighted. Behavior is a rich and varied field drawing on genetics, evolution, physiology, and ecology to inform its principles, and this book embraces the wealth of knowledge that comes from the unification of these fields around the study of animals in motion. The chronological organization of the essays makes this an excellent overview of the history of animal behavior, ethology, and behavioral ecology. The work includes such topics as Darwin's role in shaping the study of animal behavior, the logic of animal contests, cognition, empathy in animals, and animal personalities. Succinct accounts of new revelations about behavior through scientific investigation and scrutiny reveal the fascinating story of this field. Similar to Dr. John Avise's Contemporary Breakthroughs in Evolutionary Genetics, the work is structured into vignettes that describe the conceptual revolution and assess the impact of the conceptual change with a score which ranges from 1 to 10, providing an assessment of the impact of the new findings on contemporary science. Features a lively, brisk writing style and brief entries to enable easy, enjoyable access to this essential information. Includes topics that cover the range of behavioral biology from mechanism to behavioral ecology. Can also be used as supplemental material for an undergraduate animal behavior course or as the foundational text for an upper level or graduate discussion course in advanced animal behavior.

Sperm Competition and the Evolution of Animal Mating Systems Robert L. Smith, 2012-12-02. Sperm Competition and the Evolution of Animal Mating Systems describes the role of sperm competition in selection on a range of attributes from gamete morphology to species mating systems. This book is organized into 19 chapters and begins with the conceptualization of sperm competition as a subset of sexual selection and its implications for the insects. The following chapter describes the relationship between multiple mating and female fitness with an emphasis on determining the conditions under which selection on females is likely to counteract selection on males for avoiding sperm competition. Other chapters consider the female perspective on sperm competition, the evolutionary causation at the level of the individual male gamete, and the correlation of high paternal investment and sperm precedence in the insects. The remaining chapters are arranged phylogenetically and explore sperm competition in diverse animal taxa such as the *Drosophila*, *Lepidoptera*, spiders, amphibians, and reptiles. These chapters also cover the evolution of direct versus indirect sperm transfer among the arachnids or the problem for kinship theory presented by multiple mating and sperm competition in the *Hymenoptera*. This book further

discusses the remarkable potential for sperm competition among certain temperate bat species whose females store sperm through winter hibernation and the mixed strategies and male caused female genital trauma as possible sperm competition adaptations in poeciliid fishes The concluding chapter examines the predictions concerning testes size and mating systems in the primates and the possible role of sperm competition in human selection This book is of great value to reproductive biologists and researchers

Insect Evolutionary Ecology Royal Entomological Society of London. Symposium, 2005 Insects provide excellent model systems for understanding evolutionary ecology They are abundant small and relatively easy to rear and these traits facilitate both field and laboratory experiments This book has been developed from the Royal Entomological Society's 22nd international symposium held in Reading in 2003 Topics include speciation and adaptation life history phenotype plasticity and genetics sexual selection and reproductive biology insect plant interactions insect natural enemy interactions and social insects

The Evolution of Primary Sexual Characters in Animals Janet Leonard, Alex Cordoba-Aguilar, 2010-07-19 Primary sexual traits those structures and processes directly involved in reproduction are some of the most diverse specialized and bizarre in the animal kingdom Moreover reproductive traits are often species specific suggesting that they evolved very rapidly This diversity long the province of taxonomists has recently attracted broader interest from evolutionary biologists especially those interested in sexual selection and the evolution of reproductive strategies Primary sexual characters were long assumed to be the product of natural selection exclusively A recent alternative suggests that sexual selection explains much of the diversity of primary sexual characters A third approach to the evolution of reproductive interactions after copulation or insemination has been to consider the process one of sexual conflict That is the reproductive processes of a species may reflect as does the mating system evolution acting on males and on females but in different directions In this volume authors explore a wide variety of primary sexual characters and selective pressures that have shaped them from natural selection for offspring survival to species isolating mechanisms sperm competition cryptic female choice and sexual arms races Exploring diverse reproductive adaptations from a theoretical and practical perspective The Evolution of Primary Sexual Characters will provide an unparalleled overview of sexual diversity in many taxa and an introduction to the issues in sexual selection that are changing our view of sexual processes

**Insect Ecology** Peter W. Price, 1997-08-12 Insect Ecology is the world's foremost reference to the never ending and crucial interactions of the richest taxon of organisms on this earth with perhaps some 8 million extant species Now in its Third Edition and twentieth year of publication Insect Ecology has endured as an unparalleled classic Taking the reader from an explanation of the science to its significance as a discipline Insect Ecology is a meticulous systematic examination of the underlying dynamics of plant insect interactions predation parasites and hosts and mutualistic relationships including pollination ecology that are central to understanding the insects role in nature Viewing the largely invisible drama of natural protagonists and antagonists hidden in the lush foliage of a tropical rain forest or temperate woody vegetation Peter Price

details the unique traits behaviors and functions of insects while placing them in the broader contexts of their places in food webs ecosystem function population dynamics and community interactions The author also describes the various levels of insect interaction from trophic relationships Part II populations Part III and communities Part IV while unfolding the infinite variety of insect species and their visible legacy in the fossil record Full of fascinating details Ants are everywhere but only occasionally noticed They run much of the terrestrial world as the premier soil turners Insect galls provide tanning acids and the basis for inks Insect Ecology offers detail and breadth while providing timely discussion on the conservation of biodiversity the existence and study of vacant ecological niches latitudinal gradients in species richness and evolutionary perspectives on population dynamics The book also examines the development of theory in insect ecology and how it is advanced Novel features in the Third Edition include four new chapters covering the importance of insect ecology the development of theory in the science hypotheses on plant and herbivore interactions and a synthesis chapter on population dynamics Subheadings within chapters provide easier subject access and many new figures contribute to the book s aesthetic appeal Clearly organized and with a bibliography of 2 000 references to up to date and classic literature the Third Edition of Insect Ecology is a practical well formatted resource Also copiously illustrated with over 350 figures many new to this edition Insect Ecology is a lush graphic tour of the minute often startling universe of insects in their native habitat With a history in geologic time much older than the terrestrial vertebrates insects speak to us the scarab beetle encased in amber or New Zealand s endangered large Wellington speargrass weevil of a resilience and ingenuity oddly reflective of our own Insect Ecology has let generations of agriculturalists ecologists entomologists environmental scientists foresters professionals and students understand the insects world and ours With unerring detail and breadth Insect Ecology has described for generations of professionals the interactions and dynamics of the world s richest group of species the insects whose wildly various 8 million forms have been the source of endless fascination and study From caterpillars to the goliath beetle from the adult copper butterfly to the agromyzid fly the insect universe is at once ordinary and exotic capturing in microcosm nature s complexity and beauty

**Insect Defenses** David L. Evans, Justin O. Schmidt, 1990-01-01 This work takes a fresh modern approach to investigate and explain the predator and prey relationships of insects and spiders the major terrestrial fauna on earth Devoted to broad and in depth analysis of arthropod defenses against predators the book s approach is both experimentally and theoretically based with major emphasis on evolution predator strategies and tactics and prey defensive adaptations and behaviors The authors explain such topics as cryptic and aposematic coloration the conflict between sexual and survival needs web spider prey choice and evolution of prey counter defenses predator prey interactions and the origins of intelligence bird predatory tactics and caterpillar defense strategies Also examined is the use of timing for fitness and survival evolutionary gamesmanship in the predatory bat moth relationship colony defense by paper wasps startle as a defense by moths aggregation as a defense chemicals as defenses plant chemicals as defenses and venoms as defenses The authors



illustrate each topic with numerous specific well documented examples presented in a clear readable style

**The Evolution of Anisogamy** Tatsuya Togashi, Paul Alan Cox, 2011-04-14 Darwin identified the existence of separate male and female gametes as one of the central mysteries of evolutionary biology 150 years later the question of why male gametes exist remains an intriguing puzzle In this the first book solely devoted to the evolution of anisogamy top theorists in the field explore why gamete dimorphism characterizes nearly all plants and animals Did separate male and female gametes evolve as a result of competition or does anisogamy instead represent selection for cooperation If disruptive selection drove the evolution of anisogamy with male gametes focused on search and fusion and female gametes provisioning the new zygote why do some algal species continue to produce gametes of a single size Does sperm limitation or escape from infection better explain the need for extremely small highly mobile sperm Written by leaders in the field this volume offers an authoritative and cutting edge overview of evolutionary theory

**Female Infidelity and Paternal Uncertainty** Steven M. Platek, Todd K. Shackelford, 2006-08-03 Although commonly believed that males are more promiscuous than females new research has revealed that female infidelity is a common occurrence throughout the animal kingdom Female Infidelity and Paternal Uncertainty is the first book to address how males deal with the consequences of female infidelity and the strategies they have evolved to try to avoid the possibility of raising an offspring they unknowingly did not sire Each chapter deals with a specific evolved strategy developed to aid males in either limiting opportunities for their mate to be unfaithful or to correct the by products of infidelity should it occur With sections including mate guarding intra vaginal tactics and paternity assessment this book will appeal to researchers and graduate students in behavioral biology evolutionary psychology human sexuality anthropology sociology reproductive health and medicine

**Jervis's Insects as Natural Enemies: Practical Perspectives** Ian C.W. Hardy, Eric Wajnberg, 2023-11-09 There has been a dramatic increase in theoretical and practical studies on insect natural enemies over the last decades The appeal of insect predators and in particular parasitoids as research animals derives from the relative ease with which many species may be cultured and experimented on in the laboratory the simple life cycles of most parasitoid species and the increasing demand for biological pest control as a key component of the integrated pest management approach There is now a very substantial literature on insect natural enemies and thus a great need for a general text that enquiring students or research workers can use in deciding on approaches and techniques that are appropriate to the study and evaluation of such insects This book fulfils that demand It is a considerably updated and expanded version of a previous best seller and provides an account of major aspects of the biology of predators and parasitoids punctuated with information and advice on which experiments or observations to conduct and importantly how to carry them out Guidance is provided where necessary on the most recent further literature that may need to be consulted on given topics While researchers can now refer to several books on parasitoids and predators Jervis's Insects as Natural Enemies is unique in emphasising practicalities It is aimed at students and professionals working in universities and

both government and commercial institutes in the fields of integrated pest management agriculture horticulture and forestry as well as those interested in fundamentals of behavioural population community and evolutionary ecology     **Sexual Conflict** Göran Arnqvist, Locke Rowe, 2013-11-28 The past decade has seen a profound change in the scientific understanding of reproduction The traditional view of reproduction as a joint venture undertaken by two individuals aimed at replicating their common genome is being challenged by a growing body of evidence showing that the evolutionary interests of interacting males and females diverge This book demonstrates that despite a shared genome conflicts between interacting males and females are ubiquitous and that selection in the two sexes is continuously pulling this genome in opposite directions These conflicts drive the evolution of a great variety of those traits that distinguish the sexes and also contribute to the diversification of lineages G ran Arnqvist and Locke Rowe present an array of evidence for sexual conflict throughout nature and they set these conflicts into the well established theoretical framework of sexual selection The recognition of conflict between the sexes is transforming our theories for the evolution of mating systems and the sexes themselves Written by two top researchers in the field Sexual Conflict is the first book to describe this transformation It is a must read for all scholars and students interested in the evolutionary biology of reproduction     **Physiological Systems in Insects** Marc J. Klowden, Subba Reddy Palli, 2022-09-24 Physiological Systems in Insects Fourth Edition explores why insects have become the dominant animals on the planet Sections describe the historical investigations that have led us to our current understanding of insect systems Integrated within a basic physiological framework are modern molecular approaches that provide a glimpse of the genetic and evolutionary frameworks that testify to the unity of life on earth This updated edition describes advances that have occurred in our understanding of hormone action metamorphosis and reproduction along with new sections on the role of microbiomes insecticide action and its metabolism and a chapter on genetics genomics and epigenetic systems The book represents a collaborative effort by two internationally known insect physiologists who have instructed graduate courses in insect physiology As such it is the ideal resource for entomologists and those in other fields who may require knowledge of insect systems Presents updated information on key physiological principles Covers detailed and instructive figures for visual enhancement Provides flowing text without the interruption of citations Includes evolutionary considerations throughout also providing a discussion on the implications of molecular techniques and discoveries Encourages further reading with a complete bibliography at end of each chapter     **Cryptic Female Choice in Arthropods** Alfredo V. Peretti, Anita Aisenberg, 2015-05-25 This timely book revisits cryptic female choice in arthropods gathering detailed contributions from around the world to address key behavioral ecological and evolutionary questions The reader will find a critical summary of major breakthroughs in taxon oriented chapters that offer many new perspectives and cases to explore and in many cases unpublished data Many groups of arthropods such as spiders harvestmen flies moths crickets earwigs beetles eusocial insects shrimp and crabs are discussed Sexual selection is currently the focus of numerous

and controversial theoretical and experimental studies Selection in mating and post mating patterns can be shaped by several different mechanisms including sperm competition extreme sexual conflict and cryptic female choice Discrimination among males during or after copulation is called cryptic female choice because it occurs after intromission the event that was formerly used as the definitive criterion of male reproductive success and is therefore usually difficult to detect and confirm Because it sequentially follows intra and intersexual interactions that occur before copulation cryptic female choice has the power to alter or negate precopulatory sexual selection However though female roles in biasing male paternity after copulation have been proposed for a number of species distributed in many animal groups cryptic female choice continues to be often underestimated Furthermore in recent years the concept of sexual conflict has been frequently misused linking sexual selection by female choice irrevocably and exclusively with sexually antagonistic co evolution without exploring other alternatives The book offers an essential source of information on how two fields selective cooperation and individual sex interests work together in the context of cryptic female choice in nature using arthropods as model organisms It is bound to spark valuable discussions among scientists working in evolutionary biology across the world motivating new generations to unveil the astonishing secrets of sexual biology throughout the animal kingdom

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