



EATON E.R. 2021: WASPS: THE ASTONISHING DIVERSITY OF A MISUNDERSTOOD INSECT. Princeton University Press, Princeton and Oxford, v+256 pp. ISBN 9780691211428. Hardcover. Price USD 29.95.

Eric R. Eaton is an entomologist, nature photographer, professional writer and author of several successful books such as *Kaufman Field Guide to Insects of North America* (ISBN 9780618153107) and *Insectpedia* (ISBN 9780691210346). *Wasps: The Astonishing Diversity of a Misunderstood Insect* (Fig. 1) is an excellent and attractive insight into the biology of wasps, insects with a very bad reputation, but with a highly interesting evolution and ecology. The book is richly illustrated and complemented by a large number of high quality photographs. It consists of an *Introduction*, eleven chapters, a *Glossary*, *Useful References*, an *Index*, *Picture Credits* and *Acknowledgments*.

The chapters are largely organised thematically, starting with “*Evolution – Origin of Wasps*”, where the author divides the chapter into six subchapters (“*How Wasps Evolved*”, “*Trapped in Amber*”, “*Fossils in Stone*”, “*Are Bees Just Hairy Wasps? Yes!*”,

“*Advent of the Social Lifestyle*”, and “*Classification of Wasps*”) that seamlessly introduce the reader to the systematic classification of wasps, the role and beauty of fossils, and also the evolution of bees and the social behaviour of Aculeata. I must say that this is only the first chapter and I am already enjoying the read and the way the author presents otherwise serious facts. The second chapter is “*Anatomy – Structure and Function*”. It contains eleven subchapters, starting with “*How Wasps Are Built*”, followed by six subchapters, each dealing with a specific body part, its morphology and function, from “*Head: Sensory Input*” to “*Ovipositor*”. The chapter then continues with the subchapters “*Sting and Venom*”, “*Sexual Dimorphism*”, “*Bizarre Variations*” and ends with a short profile of the “*Dryinid Wasps (Family Dryinidae)*”. “*Metamorphosis – Purpose in Transformation*” as a chapter consists of six subchapters (“*The Wasp Life Cycle*”, “*The Egg: Embryogenesis*”, “*The Larva: An Eating Machine*”, “*The Pupa: Epic Reorganization*”, “*The Adult: Mating and Host-finding*”, and “*Alternation of Generations*”). They describe to the reader the life cycle of wasps as holometabolous insects, in addition to providing short profiles of “*Paper Wasps (Polistes spp.)*” and the “*Emerald Cockroach Wasp (Ampulex compressa)*”. The fourth chapter “*Beauty – Purpose Expressed in Structural Design*” deals with the phenomena of “*Iridescence and Aposematism*” and “*Warning Colors*” and provides short profiles for “*Cuckoo Wasps (Family Chrysididae)*”, “*Tarantula Hawks (Genera Pepsis and Hemipepsis)*” (Fig. 2) and “*Velvet Ants (Family Mutillidae)*”, all shining examples of iridescence and warning colouration. The fifth chapter explores “*Ecology – The Place of Wasps in Ecosystems*”. It consists of six subchapters (“*Wasps Make the World Go Round*”, “*Pollinators*”, “*The Food Web*”, “*Mutualistic Relationships*”, “*Agricultural Ecosystems*”, “*Urban and Suburban Ecosystems*”) and is complemented with three short profiles (“*Fig Wasps (Family Agaonidae)*”, “*Miniature Warriors (Trichogramma spp.)*” and “*Ensign Wasps (Family Eparidae)*”). I like the fact that the author emphasises the economic and anthropological importance of wasps, as they are usually seen as pests by the public. The chapter “*Diversity – Success Through Variation*” introduces the reader to the diversity of wasp ‘trophic’ classes in ten subchapters (“*Exploiting Every Opportunity*”, “*The Vegetarians*”, “*The Gall-makers*”, “*The Micro-parasitoids*”, “*The Macro-parasitoids*”, “*The Pollen-eaters*”, “*The Stinging Parasitoids*”, “*The Hyperparasitoids*”, “*Guests, Thieves, and Killers*”, “*The Social Wasps*”). The chapter also contains several spotlights in which, for example, the biology of the so-called “*Cicada Killers*” and “*Nocturnal Wasps*” is briefly described. The book continues with the seventh chapter called “*Behavior – Instinctive Complexity*”. In eight subchapters (“*Intricate adaptations*”, “*Host-seeking Behaviors*”, “*Adult Feeding Behavior*”, “*Acoustic Behavior*”, “*Sleeping*”, “*Male Behaviors*”, “*Courtship and Mating*”, “*Nesting*”) the author presents the most important facts of wasp ethology. The chapter also contains two spotlights (“*Thermoregulation*”, “*Parental Care*”) and a short profile of the “*Warrior Wasps (Synoeca spp.)*”. Once again, I marvel at the perfection of the illustrations used in this chapter and the book in general. The chapter “*Wasp Mimics – Protec-*

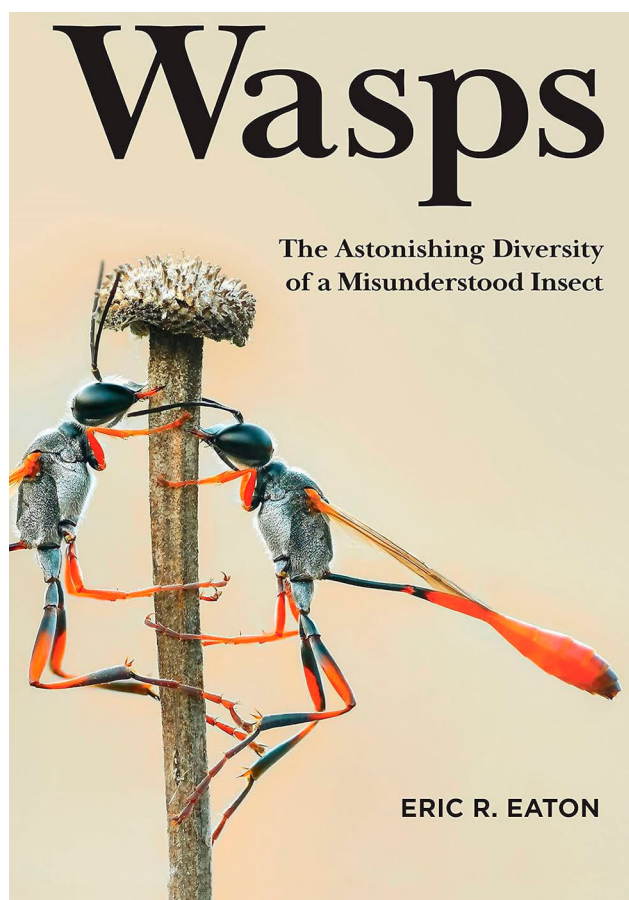
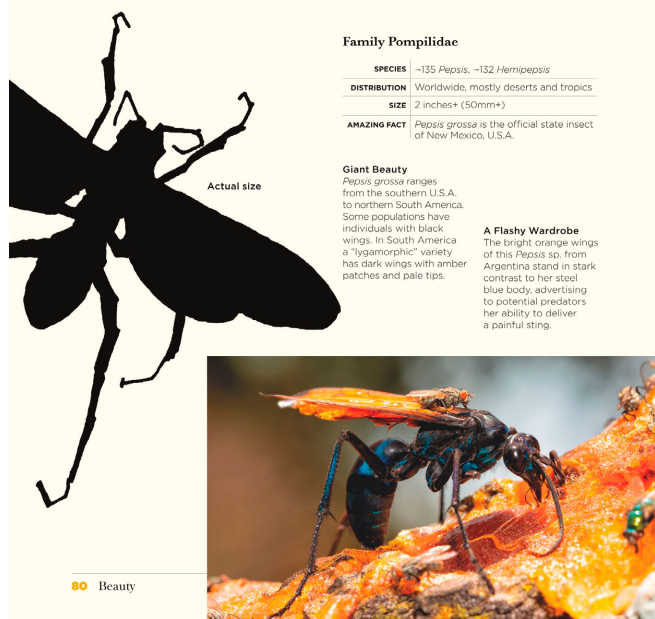


Fig. 1. The book cover (from Eaton, 2021).

## PROFILE

**Tarantula Hawks**Genera *Pepsis* and *Hemipepsis*

A different combination of warning colors is demonstrated by some members of the spider wasp family Pompilidae. The tarantula hawk, *Pepsis heros*, is probably the largest stinging wasp, as shown below at actual size. Found in the northwestern third of South America, it models the iridescent blue body and bright orange or scarlet wings common to many large spider wasps. These colors are structural in origin, restricted to appressed pubescence (fine, densely matted, scale-like hairs) on the wasp's body. The wings are pigmented, but may also be covered in iridescent scales.



At least some tarantula hawk species reinforce their warning colors with aromatic compounds secreted by the mandibular glands near their jaws, and threat posturing with abdomen curled under and forward, and wings splayed. The wasps also have a dense exoskeleton that helps repel attacks from the fangs of their spider prey, the beaks of birds, and jaws of other adversaries.

*Pepsis* species found in scorching desert habitats often assemble in loose, usually active aggregations in the shade provided by the foliage of trees or shrubs to pass the hottest hours of the day. Both sexes are usually present, so the gatherings might also function as the insect equivalent of speed dating. The communal clusters also increase the impact of their warning colors when so many individuals are on display at once.

Ignore the warnings at your peril. The Schmidt Sting Pain Index ranks *Pepsis* stings a whopping four out of four: "Blinding, fierce, shockingly electric. A running hair dryer has just been dropped into your bubble bath." Surprisingly, the effects of a tarantula hawk's self-defense sting begin and end there. A human with a healthy immune system typically experiences immediate, excruciating pain from a *Pepsis* sting, but the agony subsides quickly, in roughly three minutes or so. There is no nerve damage, tissue damage, or any other sub-lethal or chronically debilitating effect of the venom.

The tarantula prey of these wasps does not get off so easily, though, as her venom induces permanent paralysis. The victim is then dragged to a pre-existing cavity, sometimes the spider's own burrow, where the limp arachnid is deposited. Our spider-slaying heroine places a single egg on the still-living host. The larva that hatches will consume the spider.



**An Epic Wasp Versus Tarantula Battle**  
A tarantula hawk from New Mexico, U.S.A., stings a spider into paralysis, then drags it into a burrow. She lays an egg upon it, and the larva that hatches feasts.

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**Fig. 2.** The short profile of Tarantula Hawks (from Eaton, 2021).

*tion by Deception*" concerns not the wasps themselves, but rather groups of arthropods ("Flies: Extraordinary Fakers", "Beetles: Unlikely Imposters", "True Bugs, False Wasps", "Katydids: The Sheep in Wolf's Clothing", "Moths: Surprising Scammers") known for their mimicry, mostly of the aposematic colouration of the wasps. The book continues with "Enemies of Wasps – Subverting the Sting" in which, as the title suggests, the author discusses the various enemies, parasites and pathogens of wasps in five subchapters ("Wasps Are Not Invincible", "Vertebrate Predators", "Invertebrate Predators", "Invertebrate Parasites and Parasitoids", and "Viruses, Fungi, and Other Pathogens"). Short profiles are dedicated to the wasp stalkers "Satellite Flies (Sarcophagidae: Miltogramminae)" and the gregarious ectoparasitoids of wasps "Little Nest Pests (Genus Melittobia)". The tenth chapter, "Wasps and People – A Misunderstood Relationship", describes the role of wasps in our culture, mythology, art and literature in six subchapters ("Allies, Outlaws, or Both?", "Wasps in Religion and Mythology", "Wasps in Folklore and Superstition", "Wasps in History, Tradition, and Pop Culture", "Wasps in Literature, Art, and Entertainment", and "Wasps in Science and Invention"). The subchapter "Wasps as Pests and Invasive Species" opens a discussion about wasps as agricultural pests and biological invasions by wasps such as *Polistes dominula* (Christ,

1791). The chapter ends with a subchapter "Welcoming Wasps into Your Outdoor Space" in which the author attempts to convince readers why it is good to have wasps in their life and how to improve their diversity. The final chapter of the book "A Wasp Family Album – Microcosm of Diversity" is a broad guide to over fifty wasp families (including Parasitica). The chapter ends with "Wasp Watching", where the author briefly explains how to observe and study wasps.

Overall, the book is a brilliant and attractive introduction to wasps and their biology. It covers all the important topics from the evolutionary history of wasps to their role in our culture, history and art. In addition, the book provides an additional guide to over fifty wasp families, which is a very welcome cherry on an already delicious cake. Although this is more of a coffee table book, it is professionally illustrated and full of interesting information that will be appreciated not only by a general reader, but also by hymenopterists. Despite my issue with the terminology used in the evolutionary part of the book, I think this book is a fine piece of knowledge that no library should be without, especially at such a friendly price for the hardcopy.

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