Book Review

Marsh Flies, Snails, and Blood Flukes: Biology of the Ecologically Connected

Driven by curiosity and determination, scientists often spend their lifetime dedicated to research and writing about their discoveries in a specific scientific area of interest. Through numerous iterations of analyses and revision, this process can yield the synthesis of a hypothesis or natural law, described and published for posterity. This book by Lloyd V. Knutson, an American retired United States federal entomologist, and Jean-Claude Vala, a French professor of biology, does exactly this by unifying the current knowledge and scientific details that link marsh flies, snails, and blood flukes as they relate to humanity. This exemplifies what scientists are all about—connecting often strange and divergent subject areas into an integrated unified understanding of nature.

The flies, Order Diptera, constitute one of the largest groups of insects—highly diverse with over 41,000 species extant on our planet, of which approximately half remain yet to be discovered and described (Danks and Smith, 2009). With a pair of powerful wings and halteres for balance, and distinctive body morphology, the flies are easily recognized as inhabiting diverse habitats in great abundance and being broadly distributed throughout the world. Both the decomposer and predator, as well as being saprophagous or parasitic, many of these species have adapted into blood feeders, like the mosquito. Additionally, many different species of these flies are closely associated with humans as vectors of many important human and animal diseases; examples include many well-known species of flies that have elaborate mouthparts for biting and blood sucking, similar to mosquitoes for malaria (Plasmodia), black flies for river blindness (Onchoerca), and many others. In this book, two dedicated scientists, Knutson and Vala, present a comprehensive treatise about the fascinating marsh flies, Sciomyzidae, that feed on and complete the life cycle of snails and slugs (malacophagy). These mollusks also harbor blood flukes (Schistosoma) that develop into highly mobile cercaria that find human hosts and penetrate into their skin causing human schistosomiasis.

The linkage of marsh fly larvae to snails was first reported by the French scientist E. Perris in 1850 and was proven a century later by Clifford O. Berg (1953), a dedicated young scientist at Cornell University, who years later became a major professor for the graduate degree program of Lloyd Knutson, the senior author of this volume. On the other hand, as schistosomiasis is easily diagnosed by “bloody urine” (hematuria), the linkage of blood flukes and humans was already recorded in ancient time. Blood fluke eggs were found in Egyptian mummies from 1200 BC, and hematuria was commonly found among soldiers reported by surgeons in Napoleon’s army in Egypt (1799–1801). Schistosomes do not require a second intermediate host in their life cycles but mature in the blood vascular system of subject hosts, namely fishes, turtles, birds, and mammals, including humans. The life cycle of human blood flukes starts with the larvae “Cercaria” released in water from snails where they can penetrate the skin of human legs, eventually they land in the liver and transit in the mesenteric veins to the colon where blood fluke larvae will mature. Eventually, embryonated-eggs will pass with the host’s feces and hatch in the water to become freely mobile “miracidium” that then penetrate into snails and develop into cercaria that can once again penetrate into the skin of the human host in water. Here, the life of sciomyzid flies is linked to snails, as these fly larvae must feed on snail tissue (Roberts and Janovy, 2000).

The chapters are organized by important subject areas of biological and ecological factors related to the linkage between sciomyzid flies and mollusks, focused on all aspects of morphological, ecological, and behavioral characteristics of larval development in their hosts. In the Introduction, the authors present the definition of primary terms, such as saprophage, parasite, and parasitoid, along with the anatomy and life history of snails, aquatic/semi-aquatic and terrestrial, the classification of snails and slugs, and a description of their habitats in some detail at a generic level for reference. This chapter is followed by a section describing the unique panorama of the marsh flies-schistosomes-human ecosystem that includes the natural enemies of snails and slugs, the malacophagy of Diptera, and their life cycle. In Chapters 5 through 8, the subject on the feeding behavior and competition of sciomyzid flies are presented in detail followed by Chapter 9 that is concerned with phenology, reproduction, and development of marsh flies. Chapters 10 through 13 then present the core ecological resources related to population dynamics (pp. 161–198).

A large portion of the book (Chapters 14–17, pp. 199–396) is devoted to the taxonomy, phylogeny, and classification of Sciomyzidae and related taxa. Beginning with a comprehensive character analysis pertaining to morphology, physiology, and behavior related to adults, larvae, and eggs, the useful taxonomic keys (adults and puparia) are presented for the genera of different geographic regions, followed by a comprehensive treatment of the higher classification of marsh flies (pp. 199–396). In the concluding remarks, the authors discuss the issues of character selection (Section 17.11), with a focus on adaptive versus non-adaptive characters (Tothova and others, 2012; Chapman and others, 2012). It may be important to visit the statement pertaining to taxonomic characters that states: “The cladistic analyses of Marinoni and Mathis (2000) and Barker and others (2004) based on most of the same characters, plus some other characters, most of which also are adaptive non-adaptive. The value of such non-adaptive characters in determining relationships of species and genera of Sciomyzidae might be questionable.” (Knutson and Vala, 2011)

Logical selection of taxonomic characters for any given taxa for developing phylogenetic trees is still controversial, particularly in front of the challenge by genetic and genomic analyses. In addition, the problem becomes even more complicated for arthropods, specifically most of the insects and diverse mites (Acarina) with complicated life cycles, such as many aquatic insects (e.g., dragonflies with larvae in a water habitat and adults flying in the air). Irrespective of which cladistic technique is used for phylogeny, critical character
analysis based on all acceptable characters is required for the most parsimony and the commonly acceptable classification. As shown in this book, all biological characters should be considered for character evolution including morphological and ecological ones. It is natural to come up with two different phylogenetic trees and thus classifications of a specific taxon if the analysis was based exclusively on adults, larvae, eggs, or even on the composition of all stages. If one wishes to use all potential taxonomic characters from all stages, adults, larvae, and eggs, even behavioral and ecological characters, character selection often becomes arbitrary or illogical, and thus any of the final phylogenetic trees may not represent a parsimonious or commonly acceptable classification.

The last three chapters offer a practical application for biological control of snails and slugs, a research history on marsh flies, the ecology of snail killers and the necessary methods for collecting, collection management and larval rearing, and ecology of snail killers (Chapters 18–21, pp. 397–431), followed by the World Checklist of Sciomyzidae and Phaeomyiidae (pp. 461–486). The book ends with two sets of references (Part A—Sciomyzidae and Phaeomyiidae [pp. 461–486] and Part B—References cited other than Sciomyzidae and Phaeomyiidae [pp. 486–496]), the Equations (p. 497), and four Indices for miscellaneous names that appear in the book.

This book is an interesting professional treatise bringing together massive scientific contributions on the biology of snail-killing sciomyzid flies into a single volume with the synthesis of the current state of our knowledge—the complete work about what you want to know about snail-killing flies related to a severe tropical disease. This volume also represents a meticulously and relentlessly prepared monograph on every aspect of these interesting flies, Sciomyzidae. It is an interesting and well-written publication that is simultaneously highly technical for professionals but also readily accessible to educators and the public, particularly with some penetrating details that may entertain many different readers in diverse sectors of our society.

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