Preface

Spiders are among the most successful groups of terrestrial organisms. With more than 42,000 species, spiders are the most numerous predacious arthropod group, only seconded by some insect families such as carabids' beetles or ants. This gives spiders, omnipresent in all terrestrial habitats, a key position in ecological networks and ecosystem functioning. During their evolution of more than 300 million years, spiders developed and improved unique features, the combination of which is regarded as entry for their unrivalled success story. Among the key achievements of spiders at least four have to be mentioned.

First, spiders possess up to six different silk gland types that allow them to use silk for a variety of web types not only to catch their prey but also to wrap their victims until they are defenceless. Spiders build silken retreats, sperm webs, cocoons and draglines, thus demonstrating the remarkable material properties of one of the most resistant and elastic biomaterials. Second, spiders are venomous animals and inject defined venom quantities into a prey item to paralyse or kill it. Spider venom is a complex mixture of hundreds of components, consisting of low molecular compounds, peptides and proteins, which target the extracellular matrix, membranes and a variety of receptors, quite often located in the nervous or muscular system. Third, the locomotion of spiders is driven by a combination of muscles and a hydraulic pressure system, since some leg segments only possess flexor muscles. Instead of extensor muscles, the hydraulic pressure of their haemolymph is fine-tuned by a well-balanced system of valves, which provides the necessary back-pressure. This reduces in major parts of the long leg tubes of spiders the muscle system and allows at the same time larger flexors, so that spiders in general are more powerful than comparable insects. Fourth, the distal end of the male pedipalp developed into a complex structure composed of fixed and movable sclerites that are used to transfer sperm to the female seminal receptacles during mating. This key-lock mechanism guarantees safe sperm transfer within the species, largely preventing mating outside the own species, and probably represents a major driver for the fast species radiation we observe in spiders.

Ecophysiology is a bridge from functional and evolutionary aspects of morphology, physiology, biochemistry and molecular biology to ecology. Currently,

cutting-edge science in spiders focuses on the circulatory and respiratory system, locomotion and dispersal abilities, the immune system, endosymbionts and pathogens, chemical communication, gland secretions, venom components, silk structure, structure and perception of colours and colouration and nutritional requirements, to name only a few. Spiders became valuable indicator species in agroecosystems and for conservation biology. Modern transfer and application technologies consider spiders and their products with respect to biomimetics, material sciences and agrochemical and pharmaceutical industries.

It is now 26 years ago that I edited a first comprehensive book on ecophysiology of spiders, published also with Springer [Nentwig W (ed) (1987) Ecophysiology of spiders. Springer, Heidelberg]. Scientific progress since then was remarkable and an evaluation of the topics from that time and relevant publications over the last two decades showed the appearance of many new fascinating subjects. A new book on the old subject, therefore, is definitely not just a revised version but became something completely new. Seven subjects from the old book (on colouration, respiration system, reproductive glands, pheromones, venom, silk and dispersal) can also be found in this new book, most of them now represented by several much more detailed chapters and with a completely new content. Moreover, many additional and intriguing aspects are included. The innovative character of this book and of spider ecophysiology is also underlined by the fact that only two author teams from the old book contributed to this new book (Mark Townley with Ed Tillinghast and me, obviously dinosaurs in arachnology).

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Bern, Switzerland *Wolfgang Nentwig*
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