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Arachnophilia

Spiders get a bad press – but they are among the most interesting organisms on the planet

Review by
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Ricardo Pinto-da-Rocha, Glauco Machado and Gonzalo Giribet, editors

HARVESTMEN
The biology of Opiliones
608pp. Harvard University Press. £80.95.
978 0 674 02343 7

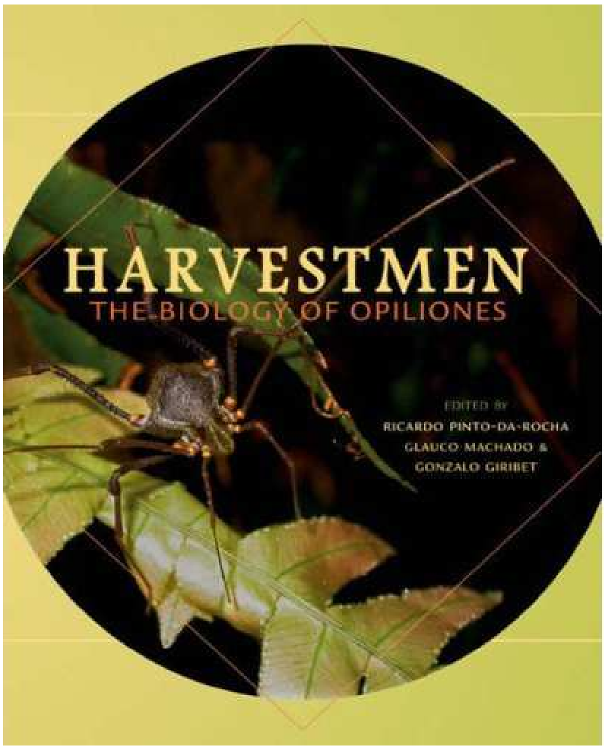
Douglass H. Morse

PREDATOR UPON A FLOWER
Life history and fitness in a crab spider
392pp. Harvard University Press. £32.95.
978 0 674 02480 9

Spiders generally get a bad press. People are scared of them and their long-legged otherness, which, together with their predatory habits, tends to rank them high in lists of least favourite animals. This is unfortunate, as they are some of the most interesting organisms on the planet, as shown by these two excellent, if very different books. Predator upon a Flower is the result of half a lifetime's devotion to the behaviour of crab spiders – vicious predators that lurk on flowers and jump out at their prey. Harvestmen, on the other hand, deals with a huge group of arachnid species that have been studied far more intensively by a substantial number of people.

In their typical form, harvestmen have blob-like bodies suspended from eight incredibly thin legs, a bit like the Martian tripods in The War of the Worlds. In many species, the second pair of legs are primarily used as sensors, which are waved about in front of the animal as it walks. This has given rise to their Japanese name – Zatomushi, or "blind bug". It also means that many harvestmen effectively walk like an insect, on six legs, with three legs touching the ground. Not all harvestmen look like this, however – some are short and squat, and others have powerful forelegs for seizing prey. Although they are part of the class Arachnida (together with spiders, mites and ticks), harvestmen are not spiders – they have fewer eyes (generally only two), none of them produces silk, and the two main body regions generally appear to be fused into a single structure, lacking the "waists" of spiders. Since the nineteenth century they have been classified in the order Opiliones, after the Latin opilio ("shepherd"). The editors of Harvestmen suggest that this derived from a comparison between the long, slender legs of the most obvious species of harvestman and the implausible (but real) tendency for nineteenth-century European shepherds to walk on stilts. However, older names such as the seventeenth-century English "shepherd spider" suggest there was a link with ovines and their keepers long before the recorded use of stilts. In the United States, harvestmen are often called "daddy- long-legs", which British people once used solely for the long-legged crane fly. Many modern common names, however, suggest something to do with harvesting – Kosec ("reaper") in Slovakian, Hooiwagen ("haywagon") in Dutch, or Pedro in Spanish, allegedly after St Peter's Day, which falls during harvest. The Finns avoid all speculation and have adopted a name – Lukki – which apparently has no other meaning.

Harvestmen, like spiders and scorpions, are members of the sub-phylum Chelicerata – a group that includes horseshoe crabs, sea spiders and the thankfully extinct giant water scorpions, which could grow up to three metres long. This watery ancestry suggests that something quite closely related to modern harvestmen crawled out of the sea at the beginning of the Silurian period. This scenario is indicated by the fact that the earliest known harvestmen have been found in the Rhynie chert, near Aberdeen, and date from around 400 million years ago, shortly after terrestrial life began. A spectacular photo of one of these fossils shows sections of male and female harvestmen, complete with genitalia. Scotland has also provided a remarkably modern-looking harvestman, in a 340-million-year-old rock from East Kirkton, near Edinburgh. Part of the mystery of harvestmen is that many of them appear to have traversed some of the most stormy periods of the planet's history – rampaging dinosaurs, oscillating sea levels, plummeting asteroids – with barely any changes to their external morphology. The vital changes that enabled this astonishing survival may of course have been internal, or simply not have left a trace in the sparse fossil record.



Harvestmen have penetrative sex (unlike spiders), and, in a stroke of evolutionary economy, the male and female sexual organs are basically identical – the eversible structure that the male uses as a penis, the female employs as an ovipositor. Around 6,000 species of harvestman are currently known, and they are found on every continent with the exception of Antarctica. However, although they can survive in high latitudes and at high altitude (up to 4,000 m), virtually nothing is known about African, tropical Asian or Amazonian species. The editors suggest that the final number of extant species may be around 10,000, but the scale of our ignorance indicates this is probably a very rough estimate.

Unlike spiders, which are all carnivorous, harvestmen appear to eat a wide range of food (fungi, lichens and hickory nuts), though most species clearly prefer meat (snails, beetles, spiders, etc). If you want to keep them, a final chapter on practical aspects describes how to build a suitable cage, and states that they will consume chopped-up worms, banana or even cappuccino mousse. Amazingly, harvestmen masticate their food rather than sucking it up, like spiders or flies.

Harvestmen covers virtually every aspect of harvestman biology – from palaeontology to cytogenetics (they generally have XY sex determination, like humans), and from social behaviour (some species are highly gregarious, but sadly lack a collective noun) to defence mechanisms (as well as deterrent spines, some species produce a strong smell). Inevitably, the longest chapter is on taxonomy, dealing with the distinguishing features of the families and subfamilies in the four major Opiliones suborders. This is the first major revision of the order in over fifty years, and it is a tour de force. However, though there is an overall key, it is not for the faint-hearted – my attempt to identify a harvestman to one of the subfamilies failed on the first criterion, for which the figure reference appears to be mistaken. The chapter concludes with a mixture of a sigh and a call to arms, in terms that are depressingly familiar to anyone who has struggled with arthropod taxonomy: "Meanwhile, hundreds of obscure species with tiny, complex, and hard-to-interpret male genitalia are waiting for study". Unusually for a collective work, the chapters are remarkably well written and of similar weight and approach. The illustrations are superb. This is a book that will be prized by many naturalists, both amateur and professional. For anyone with even a passing interest in harvestmen, it will be required reading for decades to come.

Despite the remarkable range of information presented, there are inevitable omissions. It is disappointing that the editors could not find space for Robert Hooke's stunning drawings from his 1665 masterpiece Micrographia, which depict the body of a "Shepherd spider" in exquisite detail. More intriguingly, the book reveals that there is a huge gap in the substantial literature on Opiliones. In a great many other arthropods, hydrocarbons – waxes – on the cuticle are used for protection from desiccation, and above all for inter- and intra-specific chemical communication, containing information about species, sex and reproductive status. It would be astonishing if this were not the case for Opiliones, but no one yet seems to have tried dropping a harvestman, spindly legs and all, into some solvent, and then injecting some of the resultant mixture into a gas chromatograph. Major new insights into the behaviour, ecology and taxonomy of harvestmen could probably be provided by this relatively simple technique.

Chemical communication is also largely absent from Predator upon a Flower, Douglass H. Morse's summary of nearly thirty years' work on the behaviour of the crab spider, *Misumena vatia*. Morse's work suggests that volatile pheromones are not involved in crab spider mating, but as with harvestmen, the role of cuticular hydrocarbons ought to be investigated. A more surprising absence is any study of the role of scent in flower choice by these predators – which Morse shows to be a vital point in the spider's life history. As their name suggests, crab spiders have a squat appearance and tend to scuttle sideways when alarmed. They have two large limbs at the front end, with which they catch their prey and, unlike harvestmen, have a massive sexual dimorphism – one of the largest in the animal kingdom, with females weighing up to 100 times more than males.

Morse is interested in how the environment shapes an animal's behaviour, in particular how it forages for food (in this case, through predation). His primary focus is on crab spider life history, often seen through "fitness payoffs", whereby the consequences of a given behavioural, ecological or life-history "choice" are measured in terms of the production and survival of offspring – the ultimate measure of fitness. Twelve summers' worth of observations by Morse and his students are summarized in a striking diagram showing how the mother's choice of predation patch has a major effect on the size of her egg mass and thence on the number of spiderlings. The size of the egg mass also affects the probability that the mother will guard her offspring against predation, before and after hatching, which in turn has an evident consequence for offspring survival.

But as is generally the case in science, answering one question merely raises another. If the impact of predation patch is so important, why do females not always choose the flowers that will be most often visited by potential prey? There does not seem to be any limit to the number of these high-quality sites, relative to the frequency of the spiders, yet both adults and spiderlings seem not to make optimum choices. Intriguingly, the two stages in the animal's life cycle use different stimuli in making this choice: spiderlings respond to flower cues, while adult females – which are much more flexible in their choices – respond directly to cues from prey. The lack of optimality in the choice of flower may be due to the spider's being more likely to be a victim of predation as it searches for a new patch and is no longer camouflaged. In this case, the spider's genes may tell it to stay put as long as it can. Morse has also focused his attention on the tiny male crab spiders. Extreme sexual dimorphism means that each sex adopts different foraging and predator-avoidance strategies, though, like females, males understandably prefer flowers that attract large numbers of potential prey – and potential mates. The way that life-history choices made by males affect their offspring remains an intriguing subject for future research.

Although Predator upon a Flower lacks the rich illustration and humour of Harvestmen, it will also become a classic of its kind, summarizing a distinctive approach to the biology of an intriguing organism. But despite the sexy title and the superb cover picture (*Misumena vatia* eating a bee fly), this is above all a book for serious students of behavioural ecology. In a way, that is sad, as spiders need all the good coverage they can get; this would have been an excellent opportunity to bring both arachnid biology and behavioural ecology to a broader public.

Matthew Cobb is Senior Lecturer in Animal Behaviour at the University of Manchester. His book The Egg and Sperm Race: The seventeenth-century scientists who unravelled the secrets of sex, life and growth was published in paperback earlier this year. His translation of The Misunderstood Gene by Michel Morange appeared in 2001.