

## *The Ecology and Evolution of Heliconius Butterflies,* by Chris D. Jiggins (2016)

Oxford, Oxford University Press. ix + 277 pp., figs., maps, and 30 color plates.

I delved into this book with some anticipation, mixed with a tinge of chagrin - I myself, as well as a number of other *Heliconius* biologists before me, had earlier intended to write such a book. I know Chris Jiggins very well, as he first came to *Heliconius* as part of my own team studying the *Heliconius erato* and *H. himera* hybrid zones in Ecuador in the early 1990s. From this start, Chris has become the leading expert on the biology and genetics of *Heliconius*, and now heads a large group of international *Heliconius* biologists at Cambridge University and the Smithsonian Tropical Research Institute in Panama. After working with me at UCL, and carrying out seminal fieldwork in Ecuador and Colombia, Chris Jiggins and Owen McMillan brought the biology of *Heliconius* to an advanced molecular level by founding the *Heliconius* Genome Consortium, and carrying out one of the first successful community genome projects in a non-model organism (Dasmahapatra *et al.*, 2012). How Chris found the time to do all this, have a fulfilling family life, as well as write such an excellent book fills me with awe. And this book is a *really* good read, as well as providing an excellent source for every aspect of *Heliconius* biology from basic taxonomy, to behavior and ecology, and genetics and speciation.

I don't want to give the impression that *Heliconius* research is only carried out by lab-coated nerds in high-tech labs. *Heliconius* have a fascinating and well-studied natural history, and are extraordinarily attractive in life. Chris describes swashbuckling fieldwork in sometimes dangerous areas of the new world tropics, where different workers have fallen foul of vehicle breakdowns on muddy roads miles from the nearest mechanics, kidnappings, guerillas, and work in coca-growing regions. He does not describe how he, Russ Naisbit, and Mathieu Joron survived being tied up and held at gunpoint by robbers in the Magdalena Valley of Colombia. The reason *Heliconius* workers go to such lengths is their enthusiasm for the biology of these extraordinary creatures.

When I first saw the rayed Amazonian *Heliconius erato* in the wild, I was amazed by the three-dimensional aspect of their orange, yellow and black color patterns in motion as they hovered near their roosting sites in the early evening. Jiggins describes how since the 19<sup>th</sup> Century work of Henry Walter Bates, Alfred Russel Wallace and Fritz Müller, we have known that their garish colors are under natural selection for warning and mimicry. Their bodies carry cyanogenic glycosides and maybe other compounds that predators find unpalatable. Their caterpillars also attack some of the most beautiful plants in the Neotropics, the Passifloraceae, with their diverse leaf shapes likely molded by a coevolutionary arms race with *Heliconius*. The adults are big enough to observe with the naked eye, and they have extraordinarily sophisticated behavior, developing learned host ranges which include larval and adult host plants, as well as gregarious roosting sites to which they return each night. Recent neurobiological work with the genus shows how parts of the mid-brain appear to grow with experience, suggesting that memory might involve the growth of additional nerve tissue. The adults are long-lived and this is

enabled in part by their unique ability to feed on pollen from coevolved adult host plants from among the cucurbits. When I first became fascinated with the biology of this genus during my own student years, work with *Heliconius* was viewed by other evolutionary biologists as a rather low-tech natural history field, and it was possible to keep up with all of the literature, both amateur and professional, from the handful of enthusiasts active at that time. Reading this book, I realize how much has now changed: among the 750 or so references cited, there are many papers on chemical ecology, coevolution with larval and adult host plants, neurobiology, behavior, and genetics that I'd not read before. Even a highly specialized paper reviewing the topic of coevolution between heliconiine butterflies and their *Passiflora* hosts, a topic first broached in a handful of papers by Larry Gilbert in the early 1970s, cited around 150 references (de Castro *et al.*, 2017). Today, because of the work of Chris and his co-workers, as well as a growing international body of researchers, *Heliconius* has become a textbook example for mimicry, coevolution, evolutionary genetics, and especially speciation.

Perhaps the most surprising findings from the latest genomic studies have been in the field of speciation and hybridization between species, and Chris describes the work very well, unsurprisingly as his group has very much led the way in this research. Unlike the situation in birds, sister species tend to have overlapping distributions, which suggests that speciation may often occur without an interruption to gene flow, i.e. in sympatry or parapatry (Rosser *et al.*, 2015). Hybridization still occurs between species after speciation, so that large fractions of the genome may sometimes be more closely related to those of other species in areas of overlap, than they are to distant populations of their own species. Recent work shows that useful mimicry genes are swapped promiscuously among species, even non-sister species, via rare hybridization. With a light, often humorous style, Chris vividly describes how research in *Heliconius* butterflies is upsetting many old apple-carts of "reproductively isolated species", and is helping to lead to a fresh new view of ecology, evolution, and adaptive radiation in the tropics.

### LITERATURE CITED

- Dasmahapatra, K. *et al.* 2012. Butterfly genome reveals promiscuous exchange of mimicry adaptations among species. *Nature* 487: 94-98.
- de Castro, E. C. P., Zagrobelny, M., Cardoso, M. Z., Bak, S. 2017. The arms race between heliconiine butterflies and *Passiflora* plants – new insights on an ancient subject. *Biological Review* early view, 19 pp., DOI: 10.1111/brv.12357.
- Rosser, N., Kozak, K. M., Phillimore, A. B., Mallet, J. 2015. Extensive range overlap between heliconiine sister species: evidence for sympatric speciation in butterflies? *BMC Evolutionary Biology* 15: 125, 13 pp.

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