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EDITORIAL ARTICLE

Life and work of Ivo Hodek

Ivo Hodek, who was well-known for his professional work on ladybirds (Coccinellidae) and insect ecophysiology, as well as a teacher or mentor of many entomologists, and the longest serving editor of the *European Journal of Entomology* died on June 11, 2021, shortly after his ninetieth birthday.

Studies and career

Ivo was born on 3 June 1931 in Prague. Since 1950 he studied at the "High School of Agricultural and Forestry Engineering", today the Czech University of Life Sciences in Prague, and then at the Faculty of Science of Charles University, Prague till 1954. During his studies he became interested in ladybird beetles, and this group of insects was the subject of his Master (in 1954) and PhD thesis (in 1957), which were both about the ecology of the seven-spot ladybird, *Coccinella septempunctata*. When Ivo announced his wish to study such a common beetle, his boss, prof. Jan Obenberger, argued that everything was already known about it. However, Ivo published a large number of studies on that species and used it as a model for developing the concept of essential and alternative prey and elucidating various aspects of diapause. In 1957 he began a fruitful career at the Institute of Entomology of the Czechoslovak and later (since 1993) Czech Academy of Science, where he became the leader of a world-famous research group studying the biology of aphidophagous insects. Later he founded a Laboratory of Ecophysiology at the institute.

Exceptionally for the former Czechoslovakia, Ivo was allowed to work at two western European institutions: in 1972–1973 at the University of Wageningen (The Netherlands) and in 1979–1980 at the Rabelais University in Tours (France). After retirement, in 1997 he became an emeritus researcher and spent most time on editorial work for the *European Journal of Entomology* (see below). Ivo's life achievement was honoured by the Jan Evangelista Purkyně Medal awarded him by the Czech Academy of Sciences in 2000. Besides being an influential busy entomologist, Ivo was interested in philosophy, history, classical music, and other human activities. He held an old cottage with fruit orchard, where he did not want to replace old infertile trees by new useful ones. He was married twice and had a son. More details of Ivo's career may be found in his biography published together by his classmate and his first student (Hůrka & Honěk, 2001).

Research interests

An important feature of Ivo's work was the synthesis of rich experimental experience and extensive knowledge of the literature written in various languages. The first of his two main research specializations was ladybird beetles (Coleoptera: Coccinellidae) as part of a predator guild. Among several predatory specializations of ladybirds, Ivo preferred to study the aphidophagous one, making him also interested in syrphids, lacewings and other aphid-eating predators.

The second main specialization was insect ecophysiology, including the role of photoperiodism and temperature in regulating diapause, respiration, flight, migration and cold hardiness, and their underlying hormonal mechanisms. Much of this work was carried out in collaboration with his wife Magda Hodková, a world expert in insect endocrinology. His early studies focused on the development of insect dormancy under natural conditions, diapause development and termination and maintenance of photoperiodic sensitivity during post-diapause development. The model species for these studies were often coccinellids and later phytophagous Heteroptera (Pentatomidae and *Pyrrhocoris*). The temporary switch to bugs

was forced on him by the fact he developed a bad allergy to ladybirds. Fortunately, he was able to return to coccinellids after some years, when he also had students and technicians to handle the beetles.

One of his important discoveries regarding aphidophagous coccinellids was the distinction between essential and alternative food (Hodek, 1962). The essential prey species were defined as those which permitted ovarian development up to egg laying and larval development till pupation. Michaud (2005) later refined the definition of suitability of prey to distinguish between larval and egg development. The alternative food for aphidophagous ladybirds ranges from unsuitable aphid species through pollen to sweet fruits. Ivo also defined accepted and non-accepted prey, and he found that some toxic aphids (*Aphis sambuci* with sequestered glycosides from its hostplant *Sambucus nigra*) are accepted (eaten) by ladybirds that cannot perceive the toxicity in advance (Hodek, 1956).

Ivo discovered conspicuous overwintering clusters of diapausing *Hippodamia undecimnotata* (at that time placed in the genus *Semiadalia*). They spend a prolonged combined estivation and hibernation in massive aggregations on prominent hills in Czechia. Ivo studied these aggregations on the hills in several countries personally; later he sent his students there, including the authors of this article. Particularly notable among his discoveries related to diapause was the finding of the loss and recurrent gain of photoperiodic sensitivity in some insects (Hodek, 1971; Hodek & Hodková, 1992), as well as the presence of multiple physiological pathways of diapause completion, namely horotelic (a slow natural process, including chilling) and tachytelic (an accelerated process by exposure to conditions similar to the summer reproductive season) (Hodek et al., 1977; Hodek & Hodková, 1986).

Supervisor / mentor

Ivo taught ecophysiology courses in foreign (Tours, Wageningen) and Czech universities (Charles University) and supervised MSc and PhD students. In the Institute of Entomology, Ivo had several students and postdocs in the above mentioned fields of research, including Alois Honěk (now in Crop Research Institute, Prague – studying both Coccinellidae and insect ecophysiology), Plamen Kalushkov (Institute of Zoology, Bulgarian Academy of Sciences – studying both Coccinellidae and insect ecophysiology, died 2021), Takashi Okuda (National Institute of Agrobiological Sciences, Japan – studying ecophysiology), Vladimír Košťál (Institute of Entomology, Czech Academy of Science – studying ecophysiology), Piotr Ceryngier (Cardinal Stefan Wyszynski University, Poland – studying Coccinellidae) and Oldřich Nedvěd (University of South Bohemia, Czechia – studying both Coccinellidae and insect ecophysiology). However, his influence was much wider. Years after he became an emeritus researcher, people from various countries were still asking for scientific internships under his supervision. Surprisingly, he never published any study with his son Petr Hodek who became a professor of biochemistry.

Conference organizer

Already in 1965, during a relatively free part of the communist era in Czechoslovakia, Ivo Hodek, with a group of young entomologists in Prague, organized a conference *Ecology of Aphidophagous Insects* in Liblice Castle. Ivo was the group leader and the specialist for Coccinellidae, Jaroslav Holman for aphids, Petr Starý for parasitoids, Jiří Zelený for Chrysopidae, Pavel Štys for Heteroptera. While travelling to western countries was difficult for scientists from the eastern bloc, Czechoslovakia was accessible to both eastern and western scientists. Much later, in 1984, Ivo organized the second conference *Ecology of Aphidophaga*, which began a series of meetings that continue today. *Ecology of Aphidophaga* later became a global working group within the IOBC (International Organization for Biological Control). The meeting in 1987 was held in Poland, and that in 1990 in Hungary, while the following ones could take place in the western countries: 1993 in France, 1996 in Belgium, 1999 in Canada, 2002 in Portugal, 2004 in Czechia, 2007 in Greece, 2010 in Italy, 2013 in Serbia, 2016 in Germany, 2019 in Canada, and 2022 in Spain. For more history of the group, see the web at www.aphidophaga.org that was built for the conference in 2004. Ivo stopped travelling at the beginning of the new millennium, although he organized the 2004 meeting: he only sent and received greetings to and from many friends who organized and participated in the later conferences. Of equal importance was his role in organizing symposia on insect ecophysiology in Prague (1974) and in České Budějovice (1995). These were subsequently followed by various conferences on ecophysiology and cold hardiness organized by colleagues in various countries.

Publications and citations

A full list of publications authored by Ivo Hodek was completed for the article celebrating Ivo's 85th birthday (Honěk & Dixon, 2017). Ivo published two original research articles in Nature, in 1960 and 1965. However, more influential were two review articles in other journals: Bionomics and ecology of predaceous Coccinellidae (104 WoS citations: Hodek, 1967) and Multiple role of temperature during insect diapause – a review written with his wife, Magda Hodková (137 WoS citations: Hodek & Hodková, 1988). The articles ordered according to the number of citations form an ideal mixture of coccinellid and diapause studies. This duality of research interests (and influence) is mirrored in the work of Ivo's students (see above), including both authors of this article. The very last article co-authored by Ivo was published in 2015. Many articles were published in non-indexed conference proceedings, and his books and chapters are his most cited and influential works (see below). Although the most productive two years were 1989 and 1993, the highest number

of citations came as late as 2012. This timing shows the importance of his lifetime work, which is not always recognized immediately during the research activity of a scientist.

Books

Among researchers working on coccinellids, the three books written and edited by Ivo are well-known and appreciated. These books were milestones in coccinellid research, with each being a complete review of the literature and synthesis of the knowledge at the time. The first one, *Biology of Coccinellidae* (Hodek, 1973), was published by the Czech publishing house Academia in 1973. Ivo wrote most of the content himself. His non-authorship of the first two chapters Taxonomy and morphology of adults (by Ivo Kovář) and Morphology and taxonomy of the larvae (by G.I. Savoiskaya, Bernhard Klausnitzer and Ivo Kovář) illustrate well that Ivo was not trained or particularly focused on taxonomy. The third chapter, Variability and genetic studies, also had an external author, Alois Honěk, Ivo's first student. The other chapters represented the interests of Ivo: Life history, Habitats, Food, Dormancy, Enemies, and Utilization, although for the last applied one, he only provided theoretical studies as he was not involved in practical biological control, as is his student Alois Honěk. The huge contribution and service of this book was that it made rich coccinellid literature written in Russian available to English-reading entomologists. This first book gained 533 citations in the database Web of Science, most in 2000, and the number still increases.

The second book, *Ecology of Coccinellidae*, published by Kluwer in 1996, was edited and authored by both Ivo Hodek and Alois Honěk. The book had similar chapters as the first one. Morphology and taxonomy chapters were much shorter and written again by Ivo Kovář, while the chapter on enemies was co-authored by Piotr Ceryngier. The second book gained 769 citations in the database Web of Science, it was most often cited in 2011, shortly before publishing of the third book, and it is still being cited. This may be because the second book remains most widely available to authors especially in developing countries.

The third book published by Wiley-Blackwell in 2012 got a slightly longer title: *Ecology and Behaviour of the Ladybird Beetles* (*Coccinellidae*), and was edited by three editors, Ivo himself, Alois Honěk, and also Helmut van Emden. It somewhat changed structure and had many invited specialist authors producing different chapters. There were a few new chapters reflecting the recent directions of research, such as Intraguild interactions. Ivo wrote only two of the 11 chapters (plus "Future trends"), namely Food and Diapause, which clearly shows his research preferences. This book already has 487 citations in spite of the short time since its publication.

Journal editor

Ivo Hodek was the longest-serving editor of the *European Journal of Entomology*, formerly *Acta Societatis Entomologicae Čechosloveniae* and *Acta Entomologica Bohemoslovaca*, which continues to be independently published by the Institute of Entomology, Biology Centre of the Czech Academy of Sciences, rather than by a large publishing house. Ivo's scientific reputation and close contact with colleagues worldwide were important in acquiring both valuable manuscripts and reviewers for the journal. He also served as an editor of other scientific journals, including *Entomologia Experimentalis et Applicata*, *Entomophaga*, *Biocontrol Science and Technology*, *Ekologia Polska* and *Acta Societatis Zoologicae Bohemicae*. He was a very helpful reviewer and contributed to the scientific content of innumerable papers published in a wide range of periodicals.

Because of his important contribution to the development of *European Journal of Entomology*, the editorial board, led by Petr Švácha, decided to dedicate a special virtual issue of the journal to the memory of Ivo. The intention was to gather both original papers and reviews related to the research areas of interest of Ivo, namely the biology of coccinellids and other aphidophagous organisms, and various aspects of insect life cycles and their regulation, such as diapause and cold hardiness. Thirteen papers were published, with the authors being mostly Ivo's friends, his former students, and students of his students. The published papers represent a variety of topics, and include five reviews (diapause: Denlinger, 2022; photoperiodism: Saunders, 2022; cold injury: Rozsypal, 2022; chemical defence: Sloggett, 2022; parasitoid of coccinellids: Ceryngier et al., 2023) and original studies on coccinellid colouration (Asiri & Foster, 2022), coccinellid reproduction (Osawa, 2022), intraguild predation (Labrie et al., 2023), egg diapause (Goto & Nagata, 2022; Nakamura & Fukushima, 2022), adult diapause (Kutcherov & Lopatina, 2022; Nedvěd et al., 2023), and combined diapause of a coccinellid (Obrycki, 2022).

We are indebted to Ivo for much of our own personal scientific development during which we became, so to speak, imperfect copies of Ivo's personality. Besides our professional relationship, both authors remember Ivo as a friend. We especially value good times with him, his wife Magda and their dog(s) Blackie, in their very small cosy house and in their garden with pear and plum trees.

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