

Commemoration of Dr. Barnabás Nagy, a Research Entomologist on a Mission to Serve Biodiversity and Agrozoology

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Dr. Barnabás Nagy (1921–2020), a naturalist, orthopterologist, agrozoologist and forward-looking ecologist covered a rich scientific career. In commemoration of his significant contribution to entomology, we attempt to shed some light on a selection of his achievements. While devoted to his chosen insect order, Orthoptera, he was sensitive also to problems coming from everyday's practice in controlling pests in agriculture. Consequently, he dealt with various pest species, belonging to a variety of insect taxa (Coleoptera, Lepidoptera, Hymenoptera). He always put the actual problem in ecological context. This may have helped him to recognize the need for an ecological approach in plant protection and to develop the pioneering concept of biological / ecological pest management, published in Hungarian, as early as in 1957. When arguing for his concept, he criticized the surplus usages of toxic pesticides and provided guidelines for facilitating the beneficial activity of the natural enemies of pests. This way he prepared the way for integrated pest management (IPM), preceding the international mainstream of his age. He held an active part in the International Organization for Biological Control (IOBC), as a founder of the International Working Group of Ostrinia (IWGO), and was the Head of the Department of Zoology of the Plant Protection Institute, Budapest, Hungary. He held several positions in the Hungarian Entomological Society (President, vice-President, Secretary, committee member), to that society he was engaged for 80 years. Here we cite only some of his most important, original entomological papers. He regularly published also in journals for popular science and gave lectures for the young generations of entomologists.

Curriculum vitae in a nutshell

Barnabás Nagy was born at Szamoskér (Eastern-Hungary), in 1921. He completed his advanced studies at the Grammar School of the Calvinistic College at Debrecen. He continued with his studies first at the University of Debrecen (1939–1942), then at the

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University of Kolozsvár (recently: Babeş-Bolyai University, Cluj-Napoca, Romania) (1943–1944), where he obtained his diploma, and university doctorate (zoology). He started his career at the Institute of Zoology, University of Debrecen. He spent the most significant part of his career at the Department of Zoology, Plant Protection Institute (Budapest), as research entomologist, scientific adviser, and later as retired scientific adviser (1950–2013). He held the position of the Head of the Department (1970–1978). In his last period, he joined the Collection of Smaller Insect Orders, Department of Zoology, Hungarian Natural History Museum (Budapest), as associate research fellow.

From early motivation to an outstanding scientific career

Motivated by famous professors, such as Rezső Soó (botany), Béla Hankó (ornithology), Pál Örósi (entomology, apiary) and Sándor Pongrácz (entomology, orthopterozoology), **Barnabás Nagy** developed a holistic view of biology and, especially on the influence of Prof. Pongrácz, the director of the Hungarian Natural History Museum in that time, specialized himself on Orthoptera. He published his first paper on the Orthoptera fauna of the Hungarian Lowland, East from the river Tisza (Nagy, 1943), when he was still a student. With his early, but very comprehensive publication on the locust and grasshopper fauna of Hortobágy (a steppic area in Eastern-Hungary, recently a national park) he established his reputation. When he joined the Plant Protection Institute, he studied invasive pests, and devoted his attention to solving pest management problems. From this time, his career was in dual attraction of orthopterozoology and agrozoology.

DR. BARNABÁS NAGY'S SELECTED CONTRIBUTIONS TO ORTHOPTEROLOGY

Working mainly on agroentomology at his workplace in the Plant Protection Institute, Dr. Barnabás Nagy always focused on orthopterans (such as outbreaks) as well. Beyond this, he took every opportunity to study other aspects of his favorite insects, especially in his spare time, mostly on the field. He studied several aspects of orthopterozoology and published more than a hundred papers and book chapters in Orthoptera related topics.

Locust plagues

Dr. Barnabás Nagy studied the locust plagues of his time in Hungary, with special attention to the ecology of the local locust species (Nagy, 1964; 1993a). Moreover, he overviewed the history and analyzed the time series of the known locust outbreaks in the Pannonian Basin (Nagy, 1988; 1995).

Faunistics and zoocoenology

The research of **Dr. Barnabás Nagy** on Orthoptera faunistics covered most parts of Hungary (e.g. Bátorliget: Nagy, 1953a; 1991a; Hortobágy: Nagy, 1944; 1947; Tihany Peninsula: Nagy, 1948; 1950a; Kenyeres et al. 2004; Mecsek Mountain: Szövényi et al., 2007), the neighbouring countries (e.g. Serbia: Nagy, 2009; Croatia: Puskás et al., 2018),

and oversea territories as well (British Columbia: Vickery and Nagy, 1973). In these studies, he always applied a zoocoenological approach since his very earliest works, which may be considered some of the earliest publications elaborating this concept. As a former eminent student of the renowned phytocoenologist Rezső Soó (whom the Professor wanted to raise to a botanist), **Barnabás Nagy** investigated not only the Orthoptera fauna occurring in a habitat, but clearly recognized the relationships between the structure and composition of the vegetation and the composition of inhabiting grasshopper assemblages. His early works inspired the elaboration of the zoocoenological concept of Balogh (1953; 1958).

Nutritional biology and etology

Dr. Barnabás Nagy conducted detailed studies on nutritional biology (e.g. Nagy, 1950b; 1952a) and etology (e.g. Nagy, 1959; Orci et al., 2010a) of several grasshopper species in the laboratory and on the field as well.

Nature conservation

Dr. Barnabás Nagy participated in the exploration of the Orthoptera fauna and assemblages of several national parks and other protected areas in Hungary, the Hortobágy National Park (Nagy, 1983), Bükk National Park (Nagy and Rácz, 1996), Órség Protected Landscape (Nagy and Szövényi, 1997), Körös-Maros National Park (Nagy and Szövényi, 1998), Aggtelek National Park (Nagy et al., 1999) and the Fertő-Hanság National Park (Nagy and Sziráki, 2002) among them. At the same time he analyzed the background of the decline of populations of certain grasshopper species, drawing attention to the importance of their protection in practice (e.g. Nagy, 1974a; 1981; Nagy and Szövényi, 1999a). His scientific results in this field are still inspiring the nature conservation of grasshoppers in Hungary.

Biogeography

Dr. Barnabás Nagy discussed the faunistical data usually in a biogeographical frame (e.g. Nagy and Szövényi, 1999b). Apart from this general approach, he paid eminent attention to some special topics, like area dynamics (Nagy, 1974b), and role of activity and mobility pattern in colonization (Nagy, 1987; 1992).

Urban ecology

Dr. Barnabás Nagy was interested also in the faunistics and ecological traits of habitats transformed to varied degrees by the human activity, like city parks, cemeteries or motorway edges. He compared grasshopper assemblages of the main habitat types of the Budapest city area and analyzed the effects of different types of human impacts (Nagy, 1991b; 1997). Orthopterans of Sas Hill (Sas-hegy), a highly isolated protected area inside Budapest, were studied by him in details (Nagy, 2012).

Taxonomy

Although **Dr Barnabás Nagy** recognized taxonomic problems in Orthoptera with good sense, he dealt with such issues only tangentially. He participated in the description of a new species, endemic to the Eastern Carpathians in Romania, the Harghita Plump Bush-cricket (*Isophya sicula* Orci, Szövényi and Nagy, 2010) (Orci et al., 2010b).

DR. BARNABÁS NAGY'S SELECTED CONTRIBUTIONS TO AGROZOOLOGY

Acting as an advocate of a new paradigm of his time in the 1950s, **Dr. Barnabás Nagy** focused on studying the life of insects, on revealing the life cycle, host plants, behavior and natural enemies of the species, sometimes in contrast to the prevailing practice of pure descriptive approach of that time. He always investigated the problems in ecological context. At the same time, he well-balanced between experimental and descriptive entomology in the course of his entire career. He had also a special sense of bridging theory and practice. He was sensitive to new problems of practical pest management, grasped the essence of each problem, placed it in the context of basic science, and usually came up with novel solutions and recommendations for the plant protection practice.

Case studies of searching for new approaches in controlling upcoming invasive and local pests

Apart from Orthoptera, which remained his beloved group in his entire life, **Dr. Barnabás Nagy**, as an agrozoologist, had a problem-orientated (and not a taxon-orientated) approach. This helped him to study great varieties of insect taxa. With the sharp eyes he had, he focused on the Achilles heel of the pest. As a consequence, he often came up with ecological solutions, based either on facilitating the role of natural enemies, or on exploiting control possibilities offered by secondary natural host plants (reservoirs for re-infestation of crops), or by the life cycles, or by the migratory habits of the pests.

When the spread of the accidentally introduced fall webworm, *Hyphantria cunea* Drury (Lepidoptera: Arctiidae) speeded up in Hungary, he studied the beneficial parasitoids of this pest (Nagy, 1952b; 1953b; 1953c). What is more, he came up with a simple method for saving parasitoids. Briefly, decoy straw (wisp) should be fastened on the trunk of trees (apple, plum) and when lots of *H. cunea* pupated in them, these wisps are transferred into barrels. Instead of fire-eliminating the *H. cunea* pupae, however, the barrels should be covered by a net with appropriate hole-size, which allows the emerging adults of parasitoids to leave, while preventing the moths from escaping. Counting *H. cunea* pupae in wisps and assuming an average level of parasitism in these years, it was calculated that ca. 40 thousand adults of *Psychophagus omnivorus* Wlk. (Hymenoptera: Pteromalidae) could be re-cycled from a single barrel (Nagy, 1953c). This is an example of how **Dr. Barnabás Nagy** combined his fresh ideas with the development of a practical guideline for pest management.

Without going into details, we just list some related studies in this line of research, conducted by **Dr. Barnabás Nagy**. Apropos of a gradation, he studied the natural and cultivated host plants of the shoulder-striped clover moth, *Heliothis maritima* Grasl. (synonym: *Chloridea maritima* Grasl., Lepidoptera: Noctuidae), as well as the distributions

of subspecies, in comparison to its sibling species, the marbled clover, *H. viriplaca* Hufn. (syn: *Ch. dipsacea* L.) (Nagy, 1954–56). He reported the appearance of the Eurasian hemp moth, *Grapholitha delineana* Wlk. (syn: *G. sinana* Feld., Lepidoptera: Tortricidae) in Hungary (Nagy, 1967). He published a monograph of the sawflies, *Hoplocampa* (Hymenoptera: Tenthredinidae), with a key of adults for the dominant pest species in orchards (the apple sawfly, *Hoplocampa testudinea* KL., the yellow- and black plum sawfly, *H. flava* L. and *H. minuta* Christ., and the pear sawfly, *H. brevis* Kl., etc.) and with detailed description of immature stages, distributions, symptoms on fruits, life cycles, prognoses and control measures (Nagy, 1960).

The concept of biological / ecological pest management

Studying the role of natural enemies in controlling the populations of some pests, e.g. that of the fall webworm, *H. cunea*, an invasive pest in the 1950s in Hungary, **Dr. Barnabás Nagy** came to the conclusion that plant protection measurements should facilitate the potential of parasitoids, instead of unintentionally eliminating these beneficial organisms by surplus applications of toxic pesticides. Supported by detailed arguments and examples, he published the concept of ecological pest management, as early as in 1957 (Nagy, 1957). Looking back on it, he was clearly one of the earliest pioneers of environmental-sound plant protection, leading to integrated pest management (IPM), as pointed by Sáringer (2008) in his historical review. In his prologue to the 50 years' jubilee of the appearance, **Dr. Barnabás Nagy** put the importance and actuality of the concept of ecological pest management in focus, while left unstressed his own personal contribution (Nagy, 2008).

Trials of radiobiological methods in pest control

In the early 1960s, a new research line appeared in the palette of plant protection methods, an attempt to exploit radiobiological techniques. **Dr. Barnabás Nagy** joined this new line. He wrote with co-authors a comprehensive monograph on the state-of-the-art knowledge and literature of this field, which was published by the Hungarian National Atomic Energy Agency – Institute for Radiobiology (Nagy et al., 1965). In this monograph not only direct controlling of pests by ionizing radiations was discussed, but also the sterile male technique.

Dr. Barnabás Nagy himself participated in such trials in Hungary, as documented in a publication reporting efforts against the common European cockchafer, *Melolontha melolontha* L. (Coleoptera: Scarabeidae) (Jermy and Nagy, 1967). Although these types of methods have not reached the point of applicability in practice for various reasons, research directed in this line resulted in revealing many useful details of the behavior of pests.

European corn borer: host plants, flight periods and voltinism, pheromone-strains

Dr. Barnabás Nagy studied the European corn borer (ECB), *Ostrinia nubilalis* Hbn. (Lepidoptera: Crambidae, Pyraustinae) from various aspects in details, over a long period of his career. His most important results include revelation of different life-cycles

of various geographical populations within Hungary. He proved the presence of bivoltine populations in South-Hungary (Nagy, 1958; 1961), which was a sensational finding at that time (populations are bivoltine almost in the whole area of Hungary, by now – cf. Keszthelyi, 2010). He argued that the second flight does not contribute to next year's populations, because there is no food available for the larvae so late in the vegetation season. He regarded millet (*Panicum*), hemp (*Cannabis*) and hop (*Humulus*) as the original main host plants of ECB (Nagy, 1985), and ranked host plants into categories “first class”, “secondary” and “third-rate” (Nagy, 1993b). For maintaining laboratory rearing of ECB, he developed a simplified semi-synthetic diet (Nagy, 1970), which is still in use for rearing some polyphagous species of Lepidoptera, in our laboratories. He participated in an international network of clarifying the European distribution of the pheromone strains of ECB, organized by researchers of INRA (Bordeaux, France) (Anglade et al., 1984).

Popular science

Being in close contact not only with the academic compeers, but also with a wide spectrum of the agricultural experts and the young generation of devoted entomologists, **Dr. Barnabás Nagy** published many papers in popular science journals. These are not referred here, except the one reporting on the passion of the world-famous Hungarian composer, Béla Bartók, loving and collecting insects (Nagy, 1962).

Engagement in national- and international plant protection organizations

Dr. Barnabás Nagy was the Head of the Department of Zoology of the Plant Protection Institute, Budapest, Hungary (1970–1978). He was a member of the Hungarian Entomological Society for 80(!) years. During that time he held many leading positions in the Society (President, vice-President, Secretary, committee member). He acted as an Editor-in-Chief of the Newsletter of the Society.

Dr. Barnabás Nagy was one of the founder members of the International Working Group of Ostrinia (IWGO) (today: Ostrinia and Other Maize Pests) of the International Organization for Biological Control (IOBC). He was the President of the Working Group of Biological Control and the Standing Committee of Genetic Methods.

Decorations

To our knowledge, the most prestigious decorations of **Dr. Barnabás Nagy** are as follows: Excellence in Agriculture (1963, 1986), Frivaldszky Imre Medal (silver: 1971, gold: 1990), Horváth Géza Medal (1991), Szelényi Gusztáv Medal (1994), Herman Ottó Medal (1999), „Életfa” (life-career) Merit, gold (2012), Hungarian Order of Merit (Civilian), Knight's Cross (2019).

Taxa named in the honor of Dr. Barnabás Nagy

In recognition of his entomological career, his colleagues named insect species in his honor. A grasshopper (Nagy's Mountain Grasshopper – *Pseudopodisma nagy*i Galvagni and Fontana, 1996), a bush-cricket (Nagy's Plump Bush-cricket – *Isophya nagy*i,

Szövényi, Puskás and Orci, 2012) and a scale insect species (*Mirococcopsis nagy* Kozár, 1981) are named after him.

In separate papers of the present issue of ACTA PHYTOPATHOLOGICA ET ENTOMOLOGICA HUNGARICA the following taxa are named in honor of **Dr. Barnabás Nagy**: *Rotundabaloghia nagy* Kontschán and Neményi, 2020; *Leipothrix nagy* Ripka and Kiss, 2020 (both mites); *Isoperla nagy* Murányi, Kovács and Graf, 2020 (stonefly) and the genus, *Nagyelma* Páll-Gergely and Hunyadi, 2020 (snail).

Epilogue

Dr. Barnabás Nagy completed an eminent, internationally highly significant scientific career. Some of his views preceded the prevailing main stream of biological-ecological thinking of his time. Looking back from decades to his findings and recommendations in pest control, they are valid also today and serve for guidelines in environmental-sound pest management. He put distinguished efforts on passing his knowledge to younger generations. His scientific legacy stimulates us to proceed in the direction appointed by him.

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