



## Obituary

## Natalia Aleksandrovna Filippova (1930–2018)—A tribute to an outstanding acarologist



The field of Acarology has lost a leading tick taxonomist. Dr. Natalia A. Filippova passed away on January 7, 2018 after a severe and prolonged disease. For more than 50 years she was the main authority on the taxonomy of the Ixodoidea in the USSR and later in Russia as well as one of the most reputable specialists in the world.

Natalia Filippova was born in Moscow on February 15, 1930. A part of her school years coincided with WWII when her parents had to leave Moscow for the Moscow District for two years. She entered the State University of Moscow in 1947 where she chose the Department of Entomology for further education. Her first teachers were the prominent acarologist Prof. Aleksei A. Zachvatkin (the head of the Department until his early death in 1950), Prof. Evgenii S. Smirnov, the head of the Department after 1950, as well as Prof. Vladimir N. Beklemishev, the famous specialist in Medical Entomology, who lectured in the Department at that time. During her studies, she gained an interest in ixodid ticks and their taxonomy. Her Diploma work (M.Sc. dissertation), under the supervision of Aleksander B. Lange, a former graduate student of Prof. Zachvatkin, was dedicated to the identification of the immature stages of *Ixodes* ticks. At that time, she wrote her first scientific papers, which were soon published in “Zoologicheskii Zhurnal” (Zoological Journal), the main Russian academic journal in Zoology. In 1952 she graduated *cum laude* from the University and continued her graduate studies in the Department of Entomology under the supervision of Prof. Smirnov.

Her Ph.D. work was a continuation of her student research. Natalia Filippova was the first who used comparative ontogenetic methodology for getting a better understanding of the systematic relationships among ixodid tick species. During her work she interacted with famous parasitologists and taxonomists such as Maria V. Pospelova-Shtrom, Vsevolod B. Dubinin and Aleksander S. Monchadsky. She also participated in summer expeditions to collect ticks in the field and cultivate them under laboratory conditions to be able to study morphological

characteristics of all parasitic stages of a given species. She continued doing field works until the 1990s, and she collected ticks in nearly all regions of the former Soviet Union. With her excellent basic University education in Zoology and Botany as well as being in close contacts with specialists in these fields, she was able to form a realistic outline of various aspects of tick life histories (for example, their hosts, habitats and behavior). One outstanding result of her research was a revised subdivision of the Palearctic *Ixodes* ticks into different subgenera. In 1955 she presented her Ph.D. thesis on the morphology and taxonomy of the Ixodinae. (According to Russian taxonomists, the family Ixodidae is divided into 2 subfamilies, the Ixodinae and the Amblyomminae, which exactly correspond to the Prostriata and Metastriata lines, respectively).

The Academician Eugene N. Pavlovsky, the Director of the Zoological Institute of the Academy of Sciences of the USSR in Leningrad and the head of the Russian School of Parasitologists, invited Natalia to work in his Institute and proposed that she should study the species composition of argasid ticks with epidemiological and epizootiological importance in the southern regions of the former Soviet Union, and to revise their taxonomy. In 1955, Natalia left Moscow for Leningrad (now Saint-Petersburg) and for more than 60 years her life and scientific activities were tied to that Zoological Institute, one of the leading academic institutions in the country. She was included in the staff of the Department of Parasitology, where another young acarologist, Yuri S. Balashov, already worked (see Filippova, 2013). Going forward, the personalities of these two outstanding scientists greatly increased the amount and the quality of acarological research, and attracted young talented biologists to the field of Acarology.

The principal goal of her research was the preparation of a monograph in the authoritative “Fauna of the USSR” academic series. Such a monograph required a standard format including a comprehensive description of morphology and anatomy of all life stages of a particular group, data on the biology and geographic distribution of the representatives of the group, a discussion on its taxonomy and its importance, as well as suitable methods of collection and identification of its representatives. This task required a deep knowledge of the group under study. During the following 10 years Natalia collected a huge amount of argasid ticks from different regions of the southern part of the country. She used the same approach already successfully applied in her work with *Ixodes* ticks – laboratory cultivation of field-collected adults and subsequent description of the resultant immature specimens. This allowed her not only to produce detailed descriptions of the larval and nymphal stages of several tick species but also to add new data on

their biological characteristics. Special attention was paid to *Argas reflexus* ticks from different regions. As a result, four new species were described forming the *reflexus* group (the name of the group and its transcription in accordance with Filippova, 2008a). Interestingly, *A. latus* sp. nov., with only a few adults detected by Natalia at a single location in Turkmenistan, was found extensively parasitizing pigeons in several Israeli cities 30 years later (Filippova et al., 1999; Wilamowski et al., 1999). Her monograph on argasid ticks was published (Filippova, 1966), and is considered an important work by tick specialists. Up to now, this is the most authoritative source of information concerning argasid ticks of the Palearctic region. This monograph was presented by Natalia Filippova as her Dr. Sci. thesis.

After completing the decade-long studies of argasids, Natalia Filippova resumed her work with Ixodinae ticks, and the first step was a thorough study of *Ixodes* ticks closely related to the taiga tick *Ixodes persulcatus*, which resulted in the formation of the *persulcatus* group (Filippova and Ushakova, 1967). Particular attention was drawn to *Ixodes pavlovskiyi*, a tick that had been described from a single female specimen collected in the Russian Far East in the 1940s. This species was later found in the Altai Mountains and in eastern Kazakhstan and appears to be a common species in these and some other regions now. The work included detailed descriptions of all parasitic stages of *I. pavlovskiyi*, and extensive data on its biology and ecology were presented in several papers (together with Galina V. Ushakova). Other Palearctic representatives of the *persulcatus* group (*I. ricinus*, *I. nipponensis*, *I. kashmiricus*, and *I. kazakstani*) were analyzed on the basis of comparative ontogenetic data. These studies were presented by Filippova at the 3<sup>rd</sup> International Congress of Acarology in Prague in 1971 (Filippova, 1973b).

The number of species belonging to the *persulcatus* group increased when Indomalayan and Nearctic ticks were included (Filippova, 1969, 1973a, 1990). The close relationship of the distribution, ecology and evolution of *Borrelia burgdorferi*, the first described Lyme disease/borreliosis pathogen, with the *persulcatus* group tick species was postulated, and vector competence for *B. burgdorferi* was predicted for poorly studied species of this group, such as *I. pavlovskiyi* (Filippova, 1990, 1991). The results of her studies and her hypothesis were presented at the 8<sup>th</sup> and 9<sup>th</sup> International Congresses of Acarology in 1990 and 1994 (Filippova, 1991, 1999).

Natalia Filippova's efforts laid the groundwork for a number of later studies of *I. pavlovskiyi*, including to define its distribution (Livanova et al., 2011), to isolate and identify *B. burgdorferi* sensu lato from this species (Gorelova et al., 2001; Korenberg et al., 2010) and to document its prevalence in urban areas (Romanenko and Leonovich, 2015; Uspensky, 2017).

Revision of other species of *Ixodes* from the collection of the Zoological Institute or collected by Filippova and colleagues during their numerous field expeditions to various regions made it possible to compile a new monograph of the "Fauna of the USSR" series concerning ixodid ticks of the subfamily Ixodinae (Filippova, 1977).

At that time Natalia Filippova received an offer to become the Editor-in-Chief of the collective monograph on the taiga tick *Ixodes persulcatus*, prepared in the framework of the UNESCO Program "Man and Biosphere". She outlined the concept of the book, chose the most authoritative authors and edited all the text. She herself wrote about 30% of the whole text including chapters and subchapters concerning systematics and evolution of the species (with identification keys for the Palearctic species of the *persulcatus* group), individual and geographic variability of specimens of different life stages, the geographic ranges of the species of the group, the ecological relationships of the taiga tick with closely related species in the zones of sympatry, as well as Preface and Conclusion. Especially innovative was her attempt to reconstruct the evolution of the *persulcatus* group (Filippova, 1985). At the time of the preparation of the book, the taiga tick was known only as the main vector of the tick-borne encephalitis virus. The subsequent discovery of its role in the transmission of the Lyme disease/borreliosis pathogens

and other agents of human diseases has greatly increased the importance of this book.

The resumption of the work on the Amblyomminae was a logical continuation in Filippova's comprehensive research of the Ixodoidea. She studied species of the genera *Haemaphysalis*, *Dermacentor* and *Rhipicephalus* (including *Boophilus*, whose incorporation into the genus *Rhipicephalus* she considered insufficiently justified (Filippova, 2008a)) of the former USSR as well as species of the genus *Anomalohimalaya*, the latter of which were unknown in the country before her work. As before, she used her comparative ontogenetic methodology but also applied a new technique (scanning electron microscopy), involved new morphological characters (the shape of the Haller's organ and the apron) for tick identification and tried to utilize a novel statistical approach to process morphometric characters. At that time, she already was the leading figure in tick taxonomy consulted by specialists from the whole country as well as from abroad with their taxonomic problems. In 1993, Dr. Natalia Filippova was awarded the E.N. Pavlovsky Gold Medal from the Russian Academy of Sciences for her outstanding contribution to the study of the Ixodoidea. This was the highest award for outstanding achievements in the field of Parasitology issued by the Presidium of the USSR and later Russian Academy of Sciences.

As a result of her work, the third monograph in the series (now named "The Fauna of Russia and Neighboring Countries") was published (Filippova, 1997). Unfortunately, the genus *Hyalomma* was not included in this monograph (because of various reasons) but she continued to work with ticks of that genus. Her visit to the Berlin Museum für Naturkunde was very fruitful in this respect (Filippova et al., 1995). Later she passed this subject on to her graduate student Dmitry A. Apanaskevich who did his M.Sc. and Ph.D. works on the systematics of the immature stages of *Hyalomma* species under her supervision.

Summarizing the importance of all three monographs on the Ixodoidea by Natalia Filippova (which all are now a bibliographic rarity) it is necessary to note the very efficient keys for identification of all parasitic stages of ticks, the detailed descriptions of morphological characters, and, especially, the unique pictures of the most important details of tick morphology. These books have become handbooks for several generations of acarologists in Russia. Although the monographs were published in Russian, they are highly regarded worldwide (Estrada-Peña et al., 2017).

Having her own vast collections of ticks from many regions of the former USSR, and receiving specimens of different tick species from other specialists of the country and from abroad, she greatly widened the tick collection of the Zoological Institute including to revise old materials in the collection. She published a valuable description of all the type specimens in that collection (Filippova, 2008b). During her scientific career Filippova described 11 new tick species and found several species new for the territory of the former Soviet Union including representatives of the genus *Anomalohimalaya*.

She returned to the study of *Ixodes* ticks after publishing her monograph on the Amblyomminae. She analyzed problems of the identification of closely related species in the *persulcatus* group with emphasis on characters that complicate the precise identification, among them intraspecific geographic variability, especially in the immature stages, and morphological inversions in the ontogeny of ticks. She paid special attention to the differentiation of ixodid ticks in genera, subgenera, and species on the basis of their morphological characters. She was attracted to the category of "group of species" ("species complex"), which she considered having a great importance in the relationships of ticks with tick-borne pathogens. She analyzed morphological characters in closely related species, which might provide reproductive isolation between these species in the zones of their sympatry (Filippova, 1999, 2002, 2007, 2008a). In her last papers, Natalia Filippova tried to synthesize her enormous materials to reveal some patterns in the formation of the intraspecific biodiversity of ticks and to reconstruct the history of their ranges (Filippova, 2017). She continued to work up to her last days.

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