

A CONCISE HISTORY OF THE RESEARCH OF MAYFLIES (EPHEMEROPTERA)  
IN CZECHOSLOVAKIA

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**Abstract.** History of mayfly research in Czechoslovakia begins in the first third of the last century with faunistic treatment of West Bohemia /Dalla-Torre, Glückselig/. There are several distinct periods of this research, from basic faunistic inventarisation of selected localities /Frič, Pongrácz, Mocsáry and others/ to intensive study of larval stages, taxonomy, life cycles, distribution and ecology /Klapálek, Komárek, Šamal/. After World War II and in the 1950's mayfly research is directed to two principal complexes of questions. In Praha /Landa, Novák, Soldán/ mainly the problems of life cycles, population dynamics and comparative anatomy were studied while in Brno /Zelinka, Marvan, Kubiček/ the attention was paid mainly to problems of ecology, production and saprobiology. In the Danube basin in Slovakia, mayflies have been investigated mainly with respect to saprobiology and general hydrobiological problems.

Elbe, Danube basins, faunistics, taxonomy, ecology, saprobiology

The first distinguished figure among those who noticed and examined water insects in this country was jesuit Bohuslav Balbín (1621-1688) who noticed "scorpion-like" organisms in Bohemian rivers. Well-known engraver Václav Hollar (1607-1677) executed engravings of imagines of several orders of insects, e.g. that of a dragonfly depicting wing venation in the minutest detail.

The first data on the occurrence of mayflies in Bohemia and Moravia began to appear only in the middle of the last century, although enormous swarms of then common river species Palingenia longicauda, Ephoron virgo, and Oligoneuriella rhenana had long before been attracting the attention of naturalists. The very

first faunistical data for this country were finds of about 10 common species in the vicinity of Locket and the Ohře basin in west Bohemia (Glückselig, Dalla-Torre). Kolenati (1860) described Rhithrogena iridina (as Baetis) from the Jeseníky. It was the very first description of a new taxon of mayflies in this country.

Some hydrobiologists (Frič, Vávra and Kafka) who studied water organisms in ponds, lakes of the Bohemian Forest, and backwaters of the Elbe near Brandýs at the turn of the century, also brought forward valuable information, recording the occurrence of about 5 most abundant species of mayflies living in stagnant water (Cloeon, Caenis, Leptophlebia).

The faunistics of Ephemeroptera in Slovakia was studied at that time largely by Hungarian entomologists. However, only a few places in the relatively large and mountainous country attracted their attention, in particular the Danube and its branches (Petricskő, Ortvay), the Bodrog basin and the vicinity of Zemplín, Michalovce and Humenné, the region of Liptov and the High Tatra (Mocsáry, Pongrácz), and the environs of Slavnicca near Trenčín (Pacziczki, Fekete). Pongrácz (1936) using mayflies collected by Fekete near Slavnicca described Centroptilum hungaricum, a species controversial to this day. Basic faunistical lists compiled by these authors have been their most valuable contribution to the work of entomologists of the following generations. These lists included over 25 Slovakian species. Especially stimulating was the compendium "Fauna regni hungariae" (Mocsáry 1918).

That period, approximately the beginning of this century, closed the first phase of faunistical investigations on aquatic insects of Central Europe. A basic inventory of species occurring at more or less randomly chosen localities was the primary object of the researches. In the period that followed, Eaton's monograph (1883-1888) summarizing all the scattered knowledge and introducing the first consistent system into the taxonomy of mayflies became widely known. The leading personality among Czech naturalists at that time was František Klapálek who concentrated, besides faunistics, on the taxonomy, systematics, and study of larvae that had been ignored in the past. In a series of 6 papers he described a number of new species from this country, e.g. Ecdyonurus subalpinus, Torleya major, and Rhithrogena gorganica from the then Carpathian Ukraine. Some of his other descriptions remain controversial, namely Ecdyonurus flavimanus and Rhithrogena henschi. The former is probably identical with E. venosus, the latter may be a case of mistaken location of the type series (he might have confused it with material from the Balkan). Klapálek mostly collected in the environs of Prague and Třeboň where he was a schoolteacher, and in the Giant Mountains and Šumava (Bohemian Forest) which he frequently visited. The best of his work is his very modern treatment of the taxonomy and identification of the order in the series "Süsswasserfauna Deutschlands" (Klapálek 1909) which includes, besides morphological data, the treatment of more than 50 species of Central European mayflies based on adults and larvae

known at the time. A part of Klapálek's collection has been preserved in the National Museum in Prague, but, unfortunately, it is seriously damaged.

The most distinguished among the Czech zoologists of the first third of this century was Julius Komárek, a man of a wide range of interests and a more comprehensive approach to zoology than his predecessors. He described many previously unknown larvae, and made the remarkable discovery of Prosopistoma foliaceum in the Vltava in Prague (Komárek 1916). He also published valuable treatments of the mayfly fauna of the Doupovské Hills and the High Tatra. Šámal and Šámalová probed deeper into the questions outlined by Komárek, describing larvae of other species and dealing with their taxonomical and morphological aspects as well as with faunistics of some regions, e.g. the Bohemian Forest, but their finds were never published in a comprehensive form. Šámal (1930) revised and described Klapálek's collection. In the Čerchovské Mts. near Bardejov, Šámalová (1931) discovered a species described only four decades later in Poland (Ecdyonurus carpathicus Sowa). The collections of Komárek and Šámal have not been preserved.

The basic regional faunistical research of aquatic insects naturally continued also in the third phase which could be characterized as focusing on the study of developmental stages and bionomy. Finds from the Elbe basin, especially from the Sudeten and the region of the Kralický Sněžník were mostly published by the German authors (Kohn, Pawlik, and others), while other authors examined the role of aquatic insects in the nutrition of fish (Štěpán, Dyk, Schäfferna). Mayer (1939) published the first finding of the later much discussed Baetis melanonyx in the environs of Rajec in Slovakia.

Studies important from the hydrobiological point of view, examining the effects of organic pollution on the composition of benthic fauna, appeared in that period. Holly found 8 species, among them Palingenia longicauda, in the lower Nitra polluted by waste from sugar refineries. Nowak investigated the impact of pollution on some species living in the lower Oslava and its tributaries, and in the upper Vltava before Týn nad Vltavou. The first paper on the commensals and parasites was a study by Šulc and Zavřel (1924) including a discovery of the parasitic chironomid Symbiocladius rhithrogenae.

Most of the faunistical research of the Danube basin in Slovakia was done in that period by V. Balthasar who wrote several studies on the basin of the lower Morava and the Danube near Bratislava. He discovered Arthroplea congener at Jur pri Bratislave, and elucidated the position of the genus Arthroplea within Heptageniidae. Other authors (e.g. Zavřel) gave most attention to the conspicuous river species Palingenia longicauda.

Several authors studied water biotopes of the High Tatra, rhithral (Schoenemund 1930) as well as tarns (Kalmus, Hrabě). They found over 25 species in these mountains.

The fourth period which began after World War II has been

influenced by the rapid progress in hydrobiology focused on production, purity of water and biology of fish, as well as by entomology, in particular the developmental morphology and physiology of insects. Faunistical data on the distribution of mayflies in the Elbe basin in Bohemia and Danube basin in Moravia have been published by many authors: Landa and Řiha made detailed investigations of water biotopes in the environs of Prague, Winkler studied ponds in the Lnáře district, the vicinity of Horská Kvilda and the Vltava basin in the area which now is the Lipno impoundment. The fauna of the Giant Mts. has been receiving much attention (Černý, Obenberger, Doskočil, Winkler), Winkler has pointed out the present paucity of mayfly species in the Krkonoše Mts. and Ore Mts. (we call them Krušné). Landa (1954) studied the distribution of northern species (Siphonurus alternatus, Arthroplea congener and Caenis lactea) and of Habrophlebia and Brachycercus species in the Elbe and Danube basins. Zelinka, Kubiček, Brabec, Kubičková and others published reports on the distribution of mayflies in the Morava basin. These authors who found many species new for the Morava basin (e.g. Centroptilum pennulatum, Arthroplea congener, Baetis lutheri, etc.) concentrated on the region of the Jeseníky and Moravian-Silesian Beskids as well as on the basin of the lower Dyje, and on the environs of Brno.

However, the development of two main lines of research in the fifties had a decisive influence on the study of aquatic insects in Czechoslovakia: on one hand, it was the Prague group concerned with the faunistics of the Elbe basin in Bohemia and with population dynamics, taxonomy, higher classification and comparative anatomy (V. Landa, K. Novák and others), on the other hand it was the Brno group primarily interested in problems of hydrobiology and hydrology (production, drift, fish food, impoundments, saprobionts, etc.) (Zelinka, Marvan, Kubiček and others).

An extensive program concerning the faunistics and seasonal dynamics of aquatic insects that was carried out by the Institute of Entomology of the Czechoslovak Academy of Sciences from 1955 to 1962 included a systematic investigation of several hundred localities evenly covering the entire basin of the Elbe and comprising all kinds of biotopes at all altitudes; the localities were examined in all their seasonal aspects (Landa 1964). The results of this research from the taxonomical, bionomical and distributional points of view are summarized in identification keys and in one volume of the series Fauna of Czechoslovakia (Landa 1969a). The total of 78 species were found in the basins of the Elbe and Danube, including three newly described species of the family Heptageniidae (Ecdyonurus quadrilineatus, E. submontanus, Rhithrogena hercynia). The seasonal dynamics and larval stages of all species found in Czechoslovakia have been described. The originally faunistical program gradually developed into a study of comparative anatomy based on material from all over the world. In particular the tracheal system, malpighian tubules, ventral nerve cord, and later the digestive tract and reproductive system were studied in detail. Data on

more than 120 genera of mayflies from all zoogeographic regions were gathered (Landa 1969b, Soldán 1981, etc.). The information was also used for studying the phylogeny and higher classification of Ephemeroptera (Landa 1973).

Our knowledge of the distribution of individual species in the Morava basin is quite extensive at the present time thanks to tens of existing hydrobiological papers, although of necessity they largely concern model areas where the experimental parts of those studies were carried out. As concerns bioindication, the most important studies are the ones contributing to creation of a system of assessing saprobionts, which is widely used not only in Czechoslovakia but also in the other COMECON countries, although it is subjected to certain criticism. Zelinka and Marvan (1961, 1976) did most for establishing the system. The other hydrobiological papers which also bring forward information on mayflies deal with production (Helan, Kubiček, Zelinka), quantitative and qualitative state of zoobenthos, its changes due to a changed quality of water or to the building of impoundments (Tenora, Kubiček, Losos, Marvan, Straškraba, Sukop, Štěrba, Peňáz, Obrdlík, Zelinka, and others), with zoobenthos as the food of fish, especially the trout (Tuša, Sedlák), the bullhead (Orság, Zelinka), the barbel, roach and other cyprinids (Hochman, Hruška, Lellák, Adámek, Obrdlík, and others). Some of these papers deal with mayflies in much detail, e.g. Zelinka's (1977, 1979, etc.) studies on the production of mountain and submontane species in streams of the Moravian-Silesian Beskids. Sukop (1973) studied seasonal cycles of individual species in the Křtiny river, and Tuša (1974) the species composition and habitats of two streams in the Jeseníky. Most of these studies were made in the basins of the Morava, Bečva and Svatka. Zelinka (1977) discovered a species new for Czechoslovakia (Baetis tracheatus).

The faunistical exploration of the Danubian and Visla basins in Slovakia has developed similarly as in Moravia. Faunistical papers have been rarer, e.g. Lichardová studied mayflies in branches and backwaters in the flooded area along the Danube, Husárová-Dudíková investigated the fauna of the Bystrica brook in the Lesser Carpathians, and Rothschein recorded the occurrence of Palingenia species in the east Slovakian lowlands after a gap of almost 50 years. Zelinka and Rothschein (1967) compiled a prodomus of Slovakian mayflies comprising about 70 species. Other papers are more of hydrobiological character, dealing e.g. with benthos in the Danube and Hron (Dudich, Brtek, Rothschein), benthos of the Orava and its tributaries, with particular attention given to changes that have occurred since the completion of the Orava impoundment (Obr), purity of water in the Hnilec and Hornád (Bílý, Hanuška, Winkler) and in the Tisza basin in East Slovakian lowlands (Rothschein, Kokorďák).

Several species, very rare in this country (Acentrella sinaica, Ecdyonurus macani, Rhithrogena ferruginea, R. iridina and Caenis beskidensis), have recently been found as new for Czechoslovakia, for Slovakia, or rediscovered during hydrobio-

logical research (abundance, dominance, seasonality and zonation of benthos) of the basins of the small rivers Revúca, Lupčianka and Belá (Krno, Deván). The area of the Great Vihorlat Lake and its tributaries near Remetské Hámre has been thoroughly investigated (Winkler, Gajdůšek, Kubíček, Obrdlík, Terek).

Last but not least, internationally recognized data ensuing from studies on the pathogens and parasites of mayflies should also be mentioned. Weiser (1964) described many new pathogenic microorganisms (especially microsporidia) from the environs of Chotěboř and the river Chrudimka. Distribution of the parasitic chironomid Symbiocladius rhithrogenae and of the protozoan Spiriopsis adipophila in Czechoslovakia has also been investigated.

In the near future we should concentrate on finishing the studies on distribution and its changes due to changes in the quality of water with regard to bioindication (over 100 mayfly species have been recorded in Czechoslovakia to the present time), and continue research of the biosystematics, physiology and genetics of the mayflies.

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