ABSTRACT

The present thesis, having the title „*The Carpathians as a major biogenetic reserve of aquatic insects in Europe*" is a compilation of my most important scientific results in a period between 2001 and 2016, after I finished my PhD. Main issues in my last 15 years of research were focused aroud 3 main topics: (1) assessing alfa and beta taxonomy in some aquatic insect groups using an integrative approach; (2) investigate the role of the Carpathians to develop an autochtonous aquatic diversity in cold stenoterm watersourses using a phylogeography approach; (3) revaluation our taxonomy and phylogeography data to increase the resolution in biological control of water quality management practice.

A well established taxonomical knowledge is the necesarry of any biodiversity research. From this respect the first issue in our research were to diminuate the Linnean shortfall, outlined in the case of some highly neglected aquatic insects groups, like Trichoptera or Diptera. Here we aplied a combination of molecular and genetic data to assess alfa and beta taxonomy in a case of some insect groups with an important endemic diversity concentrated to the mounatinous region of the Carpathians or Balkans and test taxonomic hypotheses using an integrative approach. In a series of our recent studies we investigate the relationship between morphology and genetic differentiation, ending in phylogenetic reconstructions in the case of the *Rhyachopyla tristis* species groups, the subfamily of Drusninae belogs to Trichoptera or the *Idiocera jucunda* complex, *Pedicia occulta* or *P. stary* complex, or *Ptychopterea albimana* complex belongs to Diptera. As a result we were able to descover and describe an important number of caddis flies or crane flies new to the science. Our integrative research has some important edifications. It is now clear that the rate of morphological changes can be very rapid in insular-like fragmented habitats (ecological islands), which is not always followed by a corresponding molecular divergences. A case study in *Ptychoptera albimana/incognita* complex shawed that conspecific populations have the potential to adapt to local habitats over a timeframe that is short enough to not be reflected in patterns of neutral genetic differentiation accumulated by drift. At the same time, populations not under strong selection for morphological characters, and geographycally isolated, may be expected to show greater correspondence between morphological and genetic differentiation, as it was demonstrated in our case studies involved caddislies from the genus *Rhyacophila* or *Drusus* and craneflies from the genus *Pedicia*, subgenus *Amalopis* and *Crunobia*.

In the second part of the thesis we investigate phylogeography patterns of some range resticted aquatic insects in the Carpathians or Balkan Ranges to identify the most important refugia with a high level of concentrations of endemics or relic-like taxa. The level of endemism are generally corelated with geological age of the refugia where relic-like taxa have been evolved an/or could survive. The Carpathians and Balkans are both recognized as one of the most important hotspots for aquatic diversity in Europe, with a number of range restricted cold tolerant aquatic elements, that are often related to Pleistocene glaciations. However, our studies on a series of deeply diverged genetic lineages in caddis flies or crane flies suggests long evolutionary histories and continuous presence dating back to several cooling cicles in the Pleistocene, but even to Pliocene or Miocene major environmental changes. Such deeply divergent morphological and genetic units identified by us in some aquatic groups are important arguments in support the idea that these areas should not simply be viewed as glacial refugia but rather as „long term" or „cumulative refugia". Thus the Pleistocene climate change only influenced populations divergences and induced further diversifications of the already existed genetic structures in important number of aquatic insects from these areas. The geographical projection of these range restricted elements show a cumulative pattern in some well definied mountains units, like Czarnohora, Maramures, Rodnei, Haghimas, Bucegi, Retezat, Apuseni Mts. in the Carpathians or Stara Planina, Pirin, Rila, Rhodope in eastern Balkans or the Dinaric Mountains in vestern Balkan area. Therefore, the cold stenoterm aquatic ecosystems from here has high conservation values and are of important national responsability.

In the third part our main effort is concentrated to assess the potential of larvae taxonomy in water quality management and improve the biological control protocols with serious gaps in taxonomy. Larval stages of Trichoptera or Diptera are crucial quality elements for contemporary biological water quality monitoring approaches. Particularly the differential sensitivity of caddis flies and crane flies to minute environmental changes renders them ideal to monitor the ecological integrity of some freshwaters, particularly at species level. As a number of craneflies or caddisflies are used already as bio-indicators and senzitive species in biological monitoring, larval keys to these highly diversified groups are crucial. From this respect our recent papers which contains an important number of newly described larvae in caddisflies or craneflies will improve the resolution of ecological assessment procedures.

Ant the end of the theses we present our major ideas to develop our scientific carier and plans to integrate our future plans in concordance with the main scientific directions of the Integrative Biology Doctorial School.