Phylogeography, taxonomy, and systematics of chosen members of family *Bosminidae*

Abstract of Ph.D. Thesis

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For their life cycles, phenotypic plasticity, presence of sibling species and worldwide distribution, cladocerans are useful organisms for evolutionary studies with the aim to understand mechanisms of speciation, adaptive radiation, and polymorphism. While members of the genus *Daphnia* (family Daphniidae) became an iconic model in such studies, members of the family Bosminidae posses comparably interesting set of characteristics that could help to elucidate speciation mechanisms. In particular, members of the genus *Eubosmina* are known for extreme levels of phenotypic plasticity, especially in the Circumbaltic region, which puzzled the taxonomy and confused relationships of all described morphotypes since the first *Eubosmina* was described in 1857. The presented thesis explores genetic and morphometrical relationships with the aim to clarify how closely related all the described morphospecies are, to find out if there are some reproductive barriers and how strong these barriers are, how is the present-day structure of morphotypes reflected in paleolimnological record with the possible implications for origin of such plasticity, and what can be learned from the mitochondrial genome of eubosminas compared to other cladocerans.

Presented thesis is a summary of following manuscripts:

I. Coexisting Cyclic Parthenogens Comprise a Holocene Species Flock in *Eubosmina*

II. Radiation of the European Eubosmina (Cladocera) from Eubosmina longispina – a concordance of multipopulation molecular data with paleolimnology

III. The comparison of mitochondrial genomes of three cladoceran species; *Bosmina* (*E.*) *coregoni*, *Bosmina* (*E.*) *tanakai*, and *Chydorus brevilabris* (Branchiopoda; Crustacea)

The major conclusions of the thesis can be summarized as follows:

1. The hypothesis that morphotypes (morphospecies) of *Eubosmina* lack morphological and genetical discreteness under sympatry is rejected. Instead, the results are consistent with the establishment of Holocene reproductive barriers as predicted by the paleolimnological record.
2. Studied *Eubosmina* morphotypes represent a group of young species undergoing speciation with apparent reproductive barriers despite coexistence in the relatively homogenous freshwater pelagic zone.

3. Even if mixed breeding system that are considered to impede the formation of discrete evolutionary clusters, *Eubosmina* group is associated with some of the most rapid radiations known in animals.
4. European morphotypes radiated from *longispina* morphotype as suggested by the results and are supported by the paleolimnological record and biogeographical pattern. Thus *longispina* spread most likely from one main refugia at the end of late Pleistocene.
5. Some morphotypes (morphospecies) have apparently evolved in a parallel fashion, thus they consist of several cryptic lineages.
6. The incomplete lineage sorting is expected in young radiations and together with multiple origins of the morphospecies cause difficulties in species delimitation in *Eubosmina*.
7. The *Eubosmina* group presents a case where morphology and haplotype sharing are more informative for species boundaries than mtDNA sequence divergences. Nevertheless, there is intense demand for 1) more sensitive tools and different approaches to detect young radiations species flocks and 2) species definition and delimitation in case of species with polyphyletic origin and incomplete lineage sorting as suggested for *Eubosmina*.
8. *Eubosmina* taxonomical systems based on morphology should be treated with awareness of presented genetic results and subspecies and species should be regarded as morphospecies/morphotypes. Subsequent analyzes are necessary to test if biological species concept or related concepts can be safely applied on *Eubosmina* morphotypes (morphospecies).