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# The *Melampyrum sylvaticum* group in Central Europe – comparison among variation patterns in the Alps, Carpathians and Hercynian Massif

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We investigated morphological and molecular variation in the *Melampyrum sylvaticum* group in the Alps and Carpathians to capture and compare variation patterns in these regions and reconstruct evolutionary history of the whole complex. Two additional species, *M. saxosum* and *M. herbichii*, have been traditionally delimited from *M. sylvaticum* s. str. in the Eastern Carpathians on the basis of corolla size and anther length. These two species should differ from each other in corolla color which is white in *M. saxosum* or golden yellow in *M. herbichii* (i. e. same color as in *M. sylvaticum* s. str.). Populations occurring in the Alps have been always assigned to *M. sylvaticum* s. str. although certain degree of variation has been reported from this region too.

We collected population samples from the Alps, Eastern and Western Carpathians and the Hercynian Massif. Morphometric analyses of corolla shape (thin plate spline with sliding semilandmarks) and sequencing of ITS region of nuclear DNA and *trn*L-*trn*T region of cpDNA were employed to capture morphological and molecular variation respectively. Beside this, we also recorded variation in corolla color.

We detected a pronounced morphological and molecular differentiation of the Eastern Carpathian populations from the rest. These results indicate that they are not directly interrelated to the Western Carpathian and Hercynian type but are two distant lineages which met and hybridized on the boundary between the Eastern and Western Carpathians. We did not detect any coincidence between differences in corolla color and variation in any of the morphological traits or molecular markers within the North-Eastern Carpathian region. Hence, we suggested *M. saxosum* and *M. herbichii* conspecific (a single species displaying two corolla colors) and the earlier published name *M. saxosum* being correct for the Eastern Carpathian populations of the *M. sylvaticum* group. We observed pale yellow and white flowering populations also in the Alps in the surrounding of Cortina d'Ampezzo in Italy and in the Wallis valley in Switzerland; none-

theless the color tones have never been as contrasting as in the Eastern Carpathians in either of the cases and the actual appearance of the "whitish" corollas is different and does not suggest any relationship to *M. saxosum*.

High molecular variation and its pattern advocate for the Pleistocene origin of *M. saxosum* and its survival in the Eastern Carpathian area during the Weichsel/Würm Ice Age. This hypothesis is supported by several recent phytogeographical and palaeoecological studies. Molecular uniformity of the Western Carpathian and Hercynian populations evokes on the other hand recent (Holocene) migration from perialpine glacial refuges. Pattern of variation in the Alps will be also presented. It is very likely that the Alpine populations of *M. sylvaticum* s. str. are rather variable and those occurring the Western Carpathians and Hercynian Massif display only a fraction of this variation.

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