

Mountains vs. Spain). An extended analysis of 347 individuals out of 42 populations covering the entire range of distribution of *P. alpina* will be conducted with microsatellite markers and RAPDs to get detailed insights in phylogeographic relationships of this species group.

The biogeography and origin of alpine taxa in the montane/alpine European endemic *Soldanella* (Primulaceae) Li-Bing Zhang, Hans Peter Comes and Joachim W. Kadereit

Soldanella is well-characterised by its lacinate petal lobes. The 16 species of this genus are distributed across all major European high mountain ranges.

Based on morphological evidence, the genus can be subdivided into two sections: Sect. *Soldanella* contains 14 species and except for *S. villosa* from the Cordillera Cantabrica and the W Pyrenees is centred in SE Europe. In contrast to this the two species of sect. *Tubiflores* are found mainly in the Alps. The morphological subdivision of the genus is paralleled by the ecology of the two sections. Whereas most species of sect. *Soldanella* inhabit montane forest floor habitats, the species of sect. *Tubiflores* have an alpine ecology. The major exception to this is *S. alpina* which as a member of sect. *Soldanella* grows at alpine altitudes.

The phylogeny of *Soldanella* was analysed using ITS and AFLP variation. This analysis could not recover the two sections as monophyletic groups. Instead, *S. villosa* (sect. *Soldanella*) from the Cordillera Cantabrica and the W Pyrenees is sister to two major clades. The first of these contains *S. minima*, *S. pusilla* (both sect. *Tubiflores*) and *S. alpina* (sect. *Soldanella*), and the second the remaining 12 species of sect. *Soldanella*. This topology implies that (1) sect. *Soldanella* is paraphyletic in relation to the species of sect. *Tubiflores*, and (2) sect. *Tubiflores* is not monophyletic. Excluding *S. alpina* as a possible hybrid taxon from the phylogenetic analysis results in a weakly supported monophyletic sect. *Tubiflores* nested within a paraphyletic sect. *Soldanella*.

A phylogenetic analysis of Primulaceae by Källersjö et al. (2000) had identified *Omphalogramma* as the closest relatives of *Soldanella*, and the application of a molecular clock shows that *Soldanella* is < 1 mill. years old.

On this background it seems likely that *Soldanella* colonised Europe from Central Asia only in Quaternary times. The presence of *S. villosa* as the sister to the remainder of the genus at the western edge of the present range of *Soldanella* suggests that the genus expanded rapidly after its arrival. The alpine species of sect. *Tubiflores* originated from montane ancestors only in the Quaternary.

This hypothesis fully confirms the assumption of many authors that European alpine species originated from lowland ancestors, but in *Soldanella* this apparently happened more recently than generally believed.

The different amount of genetic differentiation among the alpine and montane species is believed to result from the differential effect of glacial periods on these two ecological groups.

Molecular phylogeny and biogeography of the European high mountain endemic *Primula* sect. *Auricula* (Primulaceae) Li-Bing Zhang and Joachim W. Kadereit

Primula sect. *Auricula* contains seven subsections and 24 species distributed from the Pyrenees to the Carpathians. It is one of only few endemics of the European Alpine system with a comparatively large number of species.

In the present study ITS sequence variation of 44 samples representing all 24 species of *Primula* sect. *Auricula* was investigated. This analysis was rooted with representatives of all six sections of *Primula* from Europe and America, two sections of *Primula* from Asia, and two species of *Douglasia*. The strict consensus tree of this analysis shows that sect. *Auricula* is a monophyletic group with 100% bootstrap support. Furthermore, the monophyly of subgen. *Auricula* containing sect. *Auricula*, sect. *Parryi* and sect. *Cuneifolia* is also supported with 100% bootstrap support. The distribution of sect. *Cuneifolia* in East Asia

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Foto B. Hangerer

Abb. 13: *Soldanella alpina*

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and western North America, and of sect. *Parryi* in western North America only suggests an East Asian origin of sect. *Auricula*.

Within sect. *Auricula*, species fall into two well-supported clades distributed in Central to Southeast Europe (Southeast clade), and Central, South and West Europe (West/Central clade), respectively. Most species of the Southeast clade, belonging to subsects. *Cyanopsis*, *Chamaecallis*, *Arthritica* and *Rhopsidium* p.p. have $2n = 66$ or 64 chromosomes. $2n = 66$ is considered to be the chromosome base number in the section. Interspecific relationships are mostly well-resolved in this clade. In contrast to this, the species of the West/Central clade, belonging to subsects. *Erythrodosum*, *Auricula*, *Brevibracteata* and *Rhopsidium* p.p. are karyologically derived (mostly $2n = 62, 64$) and form a polytomy in the phylogenetic tree. These observations imply that the differentiation of the Southeast clade preceded that of the West/Central clade, and that migration in Europe may have taken place from East to West. This seems plausible in view of the postulated immigration of sect. *Auricula* from East Asia into Europe.

Quite remarkably, the geographical differentiation of the entire section is also observed within *Primula auricula*. According to our data, *P. auricula* is diphyletic and can be divided into a south-eastern and a northern taxon.

The species groups resolved in our ITS phylogeny partly do not correspond well with the taxonomic subdivision of the section. One possible explanation for this finding is frequent hybridisation in the section. To further illuminate this point chloroplast DNA sequences will be analysed.