Genetic architecture of traits associated with serpentine adaptation of *Silene vulgaris*

M. Bratteler, C. Lexer & A. Widmer
Habitat Adaptation & Ecological Succession

- Directional Selection is an important driver of speciation
- Habitat subdivision may reduce gene flow
- Thus, habitat divergence plays a role in the evolution of plant ecotypes
• Adaptive changes in life history, behavioral and morphological characters may reflect evolution at many loci

• Use QTL to identify the number of loci contributing to these traits, examine their relative effect sizes, their chromosomal location and interactions
Research Questions

1) What is the number of QTLs and their magnitudes for traits that differentiate ecotypes of *S. vulgaris*?

2) Are QTLs for different traits associated with serpentine adaptation located in the same genomic regions?

3) What is the likelihood that selection for heavy metal tolerance generated the phenotypic differences we observe among *S. vulgaris* ecotypes?
Methods

• 263 F2 plants from a serpentine X nonserpentine cross were tested for Ni tolerance and QTL analysis

• Flower number, plant height, leaf area, and leaf succulence were measured
• **Genotyping**: fragments present in one parent, absent in the other parent, and present in the F1 individual were scored as dominant markers (expected 3:1 in F2)

• **Linkage Map Construction**: maternal and paternal maps were made with AFLPs
Results

- Phenotypic Traits:
  - Morphology – height, leaf area, flower #, succulence
  - Life History - # days to flower, # days to germinate
  - Physiology – Ni tolerance

- Linkage Maps:
  - Maternal – 42 AFLP loci, 12 linkage groups
  - Paternal – 55 AFLP loci, 13 linkage groups

- QTL Analysis:
  - 23 QTLs found, 15 of which were ‘major’
  - Every trait is controlled by at least one major QTL
  - Highest # QTLs for succulence, least for days to germination
  - Of 6 linkage groups with multiple QTLs, 5 show trait overlap
Discussion

• Prevalence of major QTLs is suggestive of a scenario in which the observed phenotypic trait differences have been created or are currently maintained by selection

• Paternal alleles increased Ni tolerance and succulence, supportive of an adaptive history of consistent direction selection forming two different ecotypes
Conclusions

• Linkage may facilitate adaptation and is unlikely to prevent adaptation on the long term

• Pleiotropy may facilitate or constrain adaptation