Summary

This thesis aimed to test specific hypothesis concerning habitat differentiation, local adaptation and outbreeding depression of the rare herb of dry calcareous grasslands, *Aster amellus*.

Chapter 1 examined habitat requirements of diploid and hexaploid *A. amellus* and their role in segregation of the two cytotypes in the Czech Republic. I chose three diploid and six hexaploid populations belonging to two habitat types (with low and high productivity). To test for differences in fundamental niche between the two cytotypes, I analysed habitat characteristics of sites occupied by each cytotype and used reciprocal transplant experiments. Then, I tested the effects of habitat type, ploidy level and population of origin on plant performance in the experiments.

Sites of diploid and hexaploid populations differed significantly in vegetation and soil properties but much overlap existed in habitat characteristics of the two cytotypes. Diploids had overall higher flowering percentage than hexaploids, suggesting differences between the two cytotypes. However, plants from sites with low productivity also flowered more than plants from sites with high productivity. Moreover, the largest differences in survival, leaf length and flowering were found among plants from different populations. This suggests that overall performance of *A. amellus* differs more among individual populations than between the two cytotypes.

Seedling survival was higher and transplanted plants had longer leaves at sites of the home ploidy level, suggesting niche differentiation between the two cytotypes. Nevertheless, both seedlings and adult plants were able to grow at sites of the foreign cytotype. Furthermore, seedling survival, survival of adult plants and flowering percentage were higher at sites of home population than at foreign ones, indicating local adaptation. Because the two cytotypes of *A. amellus* have a patchy distribution the divergence between two cytotypes due to local adaptation could evolve. Subsequent adaptive evolution with the environment could therefore contribute to habitat differentiation of the two cytotypes. I conclude that niche differentiation alone cannot explain spatial segregation of the two cytotypes of *A. amellus*.

Chapter 2 aimed to explore local adaptations of diploid *A. amellus* at the small spatial scale. I conducted reciprocal transplant experiments in the field with six populations using seeds and adult plants. To determine the differences between populations, I used geographic, genetic and ecological distances. I used isozyme markers to estimate genetic distance between populations. I analysed vegetation composition, soil properties and potential direct solar irradiation to obtain ecological distances between each pair of sites. Then, I tested which differences explain the degree of local adaptation.

I found evidence of local adaptation in terms of higher seedling survival at home sites than at foreign sites. This result suggests that adaptive population differentiation may arise already at a small spatial scale among isolated habitats with relatively little ecological differentiation. However, not all populations of *A. amellus* adapted to their local conditions. This could be due to two reasons: i) only some populations may be able to adapt to local conditions or ii) local adaptation may be limited to the most extreme sites. Nevertheless, more populations should be examined to reliably assess why only some populations of *A. amellus* adapted to local conditions.

Differences in local climate and in vegetation composition particularly affected local adaptation. This result is plausible because genetic distance based on neutral markers reflects past gene flow and genetic drift and does not necessarily indicate adaptive divergence between populations. Only sowing seeds provided overall evidence of local adaptation. Therefore, transfer of seeds is a more appropriate technique than transfer of adult plants in conservation practice because it more likely prevents non-adapted genotypes from establishing.

In **Chapter 3** I examined consequences of between-population crosses in *A. amellus*. Crosses between populations may lead either to higher offspring fitness (heterosis) or to reduced offspring fitness (outbreeding depression). The spatial scale, over which these effects may arise, is little investigated. I conducted three types of crosses: within populations, between populations within regions and between populations from different regions. Then, I investigated fitness of F1-hybrids in the common garden and in the field.

Crosses between different populations led to contrasting results depending on the distance between populations. Crosses between populations from different regions resulted in higher seed set, while crosses between populations within regions resulted in lower seed set than within-population crosses. However, the effects of within-population crosses did not significantly differ from the effect of between-population crosses in seed set, not indicating outbreeding depression. Moreover, between-population crosses led to higher number of flower heads in common garden than within-population crosses, indicating heterosis. Plant performance in the field was not affected by the cross-type. I conclude that outcrossing between populations of *A. amellus* did not lead to immediate outbreeding depression.

Implications for conservation

I found only small differences between diploid and hexaploid *A. amellus*. Plants of both cytotypes exhibit large genetic differentiation within and between populations. Habitats of isolated populations of both cytotypes differed in soil properties, vegetation composition and local climate. Such little ecological differentiation together with restricted gene flow led to evolution of locally adapted types. However, local adaptation was apparent mainly at the stage of seedling establishment and differed between populations. In contrast, transplanted adult plants were able to grow in all populations in the studied area and to flower in most of them. Crosses between different populations did not lead to immediate outbreeding depression. Therefore, translocations of individuals between populations over the distance of 70 km aiming at increasing genetic variation within populations appear as valid management option. I conclude that material for the translocations should come, not necessarily from the closest population, but rather from ecologically similar habitats.