Current topics in clonal plants research: editorial

Současné trendy ve výzkumu klonálních rostlin

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Introduction: From model organisms to comparative studies on clonal plants

Clonal plants have been receiving increasing research attention in the last 25 years since the collection of reviews "Population biology and evolution of clonal organisms" was published (Jackson et al 1985). Regular international "clonal meetings" held since 1988 have inspired researchers to consider clonal growth not only when examining plant demography but also when proposing the testing of hypotheses concerning specific clonal plant functions (foraging, division of labour, signalling; van Groenendael & de Kroon 1990, Callaghan et al. 1992, Herben et al. 1994, Oborny & Bartha 1995, de Kroon & van Groenendael 1997, Marshall & Price 1999, Stuefer et al. 2001, Tolvanen et al. 2004, Sammul et al. 2008, Honnay & Jacquemyn 2010).

From the very beginning, however, it was clear that focusing research on model organisms only could not elucidate all questions concerning the evolution of clonality (Eckert 1999) and the role of clonal plants in natural ecosystems; model organisms did not cover the entire diversity of clonal growth forms and plants were usually studied in simplified conditions of pot experiments. As a consequence, our colleague, an ecologist from the Institute of Botany, Academy of Sciences of the Czech Republic, Leoš Klimeš encouraged the first author of this editorial to assess clonal diversity of whole ecosystems, to show that any generalization based on studies of several selected taxa must be necessarily limited. The first version of the database of clonal plants of Central Europe (CLO-PLA) was presented at the Clonal Meeting in Visegrad (Hungary) in 1995. The talk entitled "Modes of clonal growth in different habitats" was the foundation for a review article "Clonal plant architecture: a comparative analysis of form and function" (Klimeš et al. 1997) which is now one of the best-cited works on clonal plants. The collection of data on clonality of plants continued and the second version of CLO-PLA database was launched three years later (Klimeš & Klimešová 1999, 2000), followed by the third version in 2006 (Klimešová & Klimeš 2006, 2008, Klimešová & de Bello 2009).

The CLO-PLA database enabled comparative studies and evaluation of clonal traits for a whole plant community and paved the way for a new route in clonal plant research. This was a major achievement of the late Leoš Klimeš who never returned from field work in the Himalayas in 2007. He initiated the building of CLO-PLA database, executed early analyses, and designed its structure and web application. The present issue of Preslia demonstrates the variety of approaches to studies on clonal plants and the diversity of topics, from demography, population ecology and genetics, to the exploration of the functional importance of this trait, the mechanisms of coexistence with other species, and the role that clonal plants play in plant communities. The topics of papers included here centre around the research interests of Leoš Klimeš. Besides his involvement in the CLO-PLA database, Leoš contributed to research on clonal plants through numerous studies. Of outstanding importance are his analyses of the mobility of plants in species-rich grassland (Klimeš 1999) and his analysis of clonal traits in harsh environment of the West Himalayas (Klimeš 2003, 2008). The papers assembled here to commemorate his major contributions relate to his research activities in one way or another, in terms of topics, environment, geography or methods.

Trade-off between clonal and generative reproduction

A classical question of clonal plant research relates to the existence of a trade-off between clonal and generative reproduction on different levels from biomass investments at individual level to population dynamics. Reassessment of the existing framework presented in this issue by Eriksson (2011) relates to the seedling recruitment patterns of clonal forest plants. This author suggests that the four-category typology should be replaced by a scheme based on two continuously varying factors, the degree of niche overlap between juvenile and adult life cycle stages, and seed limitation during recruitment. This creates a hypothetical continuous space within which all recruitment patterns are placed. This calls for research to focus on identifying mechanisms determining the variation in the recruitment of clonal plants (Eriksson 2011). Experimentally, the question of investment and life history trade-off between vegetative and generative regeneration is examined by Koutecká & Lepš (2011). The performance of tree *Myosotis* species in pot experiment manipulating soil conditions and competition corresponded well to expectation based on their known habitat preferences.

Completely overlooked in the line of clonal research devoted to the relationship between vegetative and generative regeneration is the production of apomictic seed by a plant, i.e. seed genetically identical with the maternal organism but facing the same uncertainties in establishment as any other seed (Kirschner & Štěpánek 2011, Krahulec et al. 2011). Krahulec and coworkers evaluate, experimentally and in field populations, the chances for the emergence of a new genotype in apomictic *Pilosella* species. Although the probability was found to be small it might happen, especially in disturbed habitats (Krahulec et al. 2011).

Survival of clonal plants in extreme environment

Several papers explore the role of clonal plants in extreme environments, represented here by high altitudes of the Himalayas (de Bello et al. 2011), the Alps (de Witte et al. 2011, Erschbammer et al. 2011) and the Arctic (Jónsdóttir 2011). The common opinion on reduced diversity of life-history strategies is revisited by Jónsdóttir (2011). It appears that the diversity of plant life histories in the Arctic is greater than previously thought and that unique combinations of life-history traits are selected among arctic plants (Jónsdóttir

2011). Erschbammer et al. (2011) present results of a 7-year study from four peaks in the Southern Alps which are a part of the worldwide network GLORIA, assessing potential upward migration of plants due to climate warming. Their results indicate that the number of species increased during the evaluated period, with the greatest gains recorded on the two highest peaks. Further reassessments will show whether those changes are mere fluctuations or general trends.

The longevity and life span of plant individual has attracted the attention of researchers for many years, since they are hard to determine due to clonality. Here, de Witte et al. (2011) demonstrate the potential immortality of a clonal plant *Geum reptans* on a glacier foreland, based on approach combining field measurements and matrix modelling; an important consequence of such immortality is the practically unlimited persistence of once established population of a clonal plant, if not destroyed by extrinsic factors.

Response to management

The role of clonal traits in a plant's response to changes in management of semi-natural grasslands is poorly known and the few studies examining their importance have yielded contradictory results. Several papers in this issue address the role of various types of management, including e.g. grazing, mowing, burning or abandonment, on clonal plants (Klimešová et al. 2011, Poschlod et al. 2011, Veeneklaas et al. 2011). In their study aimed at better understanding of the role plant functional traits play in determining competitive ability and clonal growth in response to early changes in management of wet meadows, Klimešová et al. (2011) addressed a methodological issue; they show that the method used to assess abundance significantly affects the output of analyses of the response of functional traits. From the methodological viewpoint, it is generally difficult to assess how changes in management affect basic demography of individual clonal species; two papers in this issue present possible ways of addressing this problem. By using molecular tools to analyse clonal structure of populations of *Elytrigia atherica* subjected to different management regimes in salt marshes, Veeneklaas et al. (2011) provide an evidence that seedling recruitment, rarely observed in clonal populations in the field, does occur in this species. The study is an example of how molecular tools can increase our understanding of vegetation dynamics and processes within populations growing under different conditions. Herbchronology is used as a tool for similar goal in another study. Poschlod et al. (2011) determined the age structure of populations in two species under different management treatments in calcareous grassland by counting annual rings on plant perennial organs. Their results indicate that although some less extensive management types could mimic traditional management, if the effects are assessed from the viewpoint of vegetation patterns, but fail to do so when one has information on the demography of particular species.

Role of clonal plants in plant communities

Several papers deal with traditional issues of community ecology, i.e. how community assembly is affected by environmental conditions and plant traits (Schleicher et al. 2011, Schamp et al. 2011, de Bello et al. 2011). The beginning of the whole process of community assembly during primary succession in urban area was evaluated by Schleicher et al.

(2011). Although some plant traits like seed-bank longevity and lateral spread play some role in succession, overall the community assembly during the first 40 years of succession was driven by trait-neutral mechanisms. Contrasting results were found by Schamp et al. (2011) who studied gradients of biomass production and moisture in species-rich grassland and found several traits non-randomly distributed over gradients and scales examined. However, only one trait, branching type, fits the expectation that limiting similarity among trait characteristics could enhance species coexistence. Even more pronounced support for niche differentiation through different clonal traits was found in the study by de Bello et al. (2011) who examined functional richness in plant communities of East Ladakh, NW Himalayas. While across all analyzed communities trait filtering and hence trait convergence played prominent role, inside sampling plots functional divergence was found to drive community assembly.

To conclude, we believe that this special issue represents a substantial contribution to clonal plant research, notably by revisiting some classical questions, promoting the issue of apomictic reproduction, and assessing the role of clonal traits for community assembly.

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