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Ranunculus schmalhausenii (section *Batrachium*, Ranunculaceae), a neglected water crowfoot endemic to Fennoscandia—a case of rapid hybrid speciation in postglacial environment of North Europe

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Abstract

The taxa of *Ranunculus* section *Batrachium* (Ranunculaceae) have been variably and unsatisfactorily treated in North Europe. Since the description of *Ranunculus schmalhausenii* (*Batrachium dichotomum*), probably the most common species in the area, its taxonomic status and identity have been unclear and differently implied. In the majority of treatments, individuals of *R. schmalhausenii* were ascribed to *R. peltatus* but sometimes also to the other morphologically similar, heterophyllous taxa. Based on detailed morphological study combined with geographical, ecological and biological evaluation the separate species status of this taxon was finally evidenced. The additive ITS polymorphism pattern of *R. schmalhausenii* confirmed its hybridogenous origin, however identification of the parental species was impeded by the heterogeneous character of the polymorphism detected. Genetic variation expressed by *R. schmalhausenii* samples may provide evidence of its multiple origin and suggests sexual reproduction of the taxon. Analysis of a sequence variation of two noncoding *cp*DNA regions, namely *psb*E-*pet*L and *rpl*32-*trn*L, showed that individuals of *R. schmalhausenii* inherited *cp*DNA from two lineages of *Batrachium*, indicating that this taxon was created at least in two separate hybridization events. *Ranunculus schmalhausenii* may have originated from sexual ancestral species as multiple created hybrids which have been stabilized by polyploidisation. Genetic structure of *R. schmalhausenii* is somehow similar to also hybridogenous *R. penicillatus*. In this study, a detailed morphological, geographical, ecological, and biological description of *R. schmalhausenii* was presented and the differences between this species and similar taxa were outlined. The name was lectotypified and its synonymy was provided. In contrast to many other heterophyllous species of *Ranunculus* section *Batrachium*, *R. schmalhausenii* occurs mainly in young, postglacial landscapes of Fennoscandia, prefering deep and clear waters with current or wave action and a hard bottom, which perfectly corresponds with a relict, postglacial nature of the species. The species probably presents an example of rapid hybrid speciation (less than 10 000 years) in postglacial environment of North Europe and may be considered as endemic to Fennoscandia. Moreover, *R. schmalhausenii*, as a weak competitor and pollution sensitive taxon, can be regarded as an indicator of clean waters. Phylogenetic relations within section *Batrachium* indicates convergent evolution of some species and two cases of possible *cp*DNA capture.

Key words: distribution range, ecology, hybridization, molecular identification, taxonomy

Introduction

Batrachium (water crowfoots, Ranunculaceae Jussieu (1789: 231)) taxonomically is one of the most complex group within aquatic plants (Preston & Croft 2001, Lansdown 2009). Since the worldwide monograph of *Batrachium* (Cook 1966) some supplemental studies appeared (Holmes 1979, Wiegleb & Herr 1983, Wiegleb 1988, Hong 1991, Webster 1991, Pizarro 1995, Dahlgren 1995, Dahlgren & Cronberg 1996, Tzvelev 1998, Dahlgren & Jonsell 2001, Lansdown 2009 etc.), however still many taxonomic problems remain unsolved. Until recently, even taxonomic rank of *Batrachium* was controversial and varied from a section of *Ranunculus* Linnaeus (1753: 548) to a separate genus. Recently published evolutionary studies on *Ranunculus* and Ranunculaceae showed that the *Batrachium* group is monophyletic and nested within the core clade of *Ranunculus* (Johansson 1998, Hörandl *et al*. 2005, Paun *et al*. 2005,

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