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Species Delimitation and Phylogenetic Relationships

A study of *Silene* sections *Atocion* and *Cryptoneuræ*

The thesis will be defended in public Friday September 19th at 13:00, in the lecture hall (Hörsalen), Department of Biological and Environmental Sciences, at Carl Skottsbergs Gata 22 B, Gothenburg.

Faculty opponent: Docent Johannes Bergsten, Swedish Museum of Natural History, Department of Entomology, Stockholm.

Examiner: Prof. Mari Kallersjö, Department of Biological and Environmental Sciences, University of Gothenburg

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ABSTRACT: The existence of conflicting genealogies of different genes through the evolution of species complicates the inference of phylogenetic relationships. The Multispecies Coalescent (MSC) model provides a theoretical background that account for the stochasticity in the genealogical process, thus providing systematists with a potentially objective way of testing alternative hypotheses of putative species.

This thesis focus on species delimitation under the MSC model with particular reference to *Silene* L. (Caryophyllaceae) sect. *Cryptoneuræ* Aydin & Oxelman and sect. *Atocion* Otth. A phylogenetic overview of both sections including several taxonomic conclusions are presented. Based on extensive sampling of nuclear *ITS* and chloroplast *rps16* markers across the tribe Sileneae, sect. *Atocion* and sect. *Cryptoneuræ* are shown to be distantly related, despite strong morphological similarities. Section *Cryptoneuræ* is formally described and a key to the included species is provided. Species limits within sect. *Cryptoneuræ* are evaluated with the Bayesian methods BP&P and marginal likelihood estimation (MLE) with *BEAST using data from six putatively independent loci. MLE score comparison is found to be an efficient way to evaluate alternative hypotheses of species delimitations. The recognition of a new species, *S. ertekinii* Aydin & Oxelman is strongly supported by both approaches.

Species limits in sect. *Atocion* are investigated with the DISSECT method without conditioning on any classification defined *a priori*. MLE scores of morphological classifications estimated with *BEAST are found to be inferior to classifications recognising strongly supported minimal clades from the DISSECT results, which reveal strong support for the recognition of several new species in the section. Two lineages which belong morphologically to *S. assyriaca* Hausskn. & Bornmüller ex Lazkov are found to be distantly related, thus being cryptic species, as no morphological and geographical differentiation can be detected. Two major, geographically structured clades are found in the section. One of the two western lineages should be named *S. atocioides* Boiss., whereas *S. aegyptiaca* (L.) L. belong to the eastern clade. *Silene delicatula subsp. pisidica* Boiss. is shown to be synonymous to *S. atocioides*. *Silene fraudatrix* Meikle, considered by current taxonomy as an endemic species on Northern Cyprus, is not clearly distinct from some mainland populations of *S. aegyptiaca* and those on Cyprus. From one of the studied loci, an ancient recombination event resulting from a hybridization event between the eastern and western clades is detected. This study is one of the first that applies the MSC model for species delimitation in plants. The strengths and weaknesses of the approach are discussed, as well as the possible consequences to taxonomy and, in the long run, biodiversity estimation.

Keywords: Caryophyllaceae, *Silene*, Section *Atocion*, *Silene ertekinii*, *Silene cryptoneura*, *Silene aegyptiaca*, Systematics, Phylogenetics, Species delimitation, Multispecies coalescent, Marginal likelihood, Species tree, DISSECT