Long-distance seed dispersal may blur ecotypic divergence in a terrestrial orchid

Long-distance dispersal & adaptive divergence

The family Orchidaceae is well known for its exceptional diversity, with approximately 26,000 species. It is argued that realized long-distance dispersal (LDD) combined with local adaptation to different environments is a possible mechanism underlying this species diversity (e.g., Phillips et al., 2012). However, empirical data about LDD combined with local adaptation are scarce and completely lacking for orchids.

Fen orchid

We studied realized LDD and adaptive divergence in fen orchid (Liparis loeselii (L.) Rich.), a small green-flowered orchid of fens and dune systems. Two varieties are sometimes distinguished: a narrow-leaved variety occurring in fens, and a shorter, broad-leaved variety (var. ovata Ridd. ex Godfrey) occurring in dune slacks (Wheeler et al., 1998). Genetic differentiation may exist between the two habitats to the extent that hybrid offspring suffers from marked outbreeding depression, i.e., isolation-by-adaptation.

Low signals of adaptive divergence

Six (1.3%) ‘outlier’ loci, potentially reflecting local adaptation to habitat-type, were identified with high statistical support. Of these, only one (0.22%) was an outlier in multiple independent dune-fen population comparisons and thus possibly reflecting truly parallel divergence. Signals of adaptation in response to habitat type were most evident at the scale of individual populations.

“Contrasting the expectations, we found remarkably high levels of effective long-distance seed dispersal and low levels of adaptive divergence.

The homogenizing effect of realized long-distance seed dispersal may overwhelm divergent selection associated to habitat type in fen orchids in Northwest Europe.”

Methodology

We analyzed 451 polymorphic AFLP-loci on a total of 422 individuals from 23 dune and 16 fen populations. Assignment tests were performed with AFLPOP within two independent sites in which we are quite certain to have allocated all fen orchid populations: A) Northwest France and B) Belgium and the Netherlands (Fig. 2). Furthermore, we sampled one population in the French Alps in the Marsh of Les Etoiles, five populations in Slovenia located in the pre-alpine hills and north-western Dinaric Mountains, and two populations in Hungary.

Fig. 2. Locations of Liparis loeselii along the coast of the North Sea over a distance of 600 km from Normandy in northern France up to the Dutch Wadden Sea islands in the north of the Netherlands. All known locations, except the ones indicated with a black triangle, are included in this study.

Adaptive divergence was investigated by a genome scan approach at different spatial scales (continental, landscape and regional) with the programs BAYESCAN and MCHEZA.

References


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