

Verified hypotheses on the ‘nurse’ and ‘burial’ effects on introduced *Quercus rubra* regeneration in the European Scots pine forest

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March 28, 2024

Abstract

1. Recognition of favourable environmental conditions for seed germination and seedling survival in different types of forest sites is crucial both for effective regeneration of introduced tree and for control of its spontaneous spread. Studies on the encroachment of North American northern red oak *Quercus rubra* into European Scots pine forests revealed high abundances of seedlings and saplings under shrubs, with lower abundances in open areas or in clumps of bilberry *Vaccinium myrtillus*. It was unclear, does burying acorns by seed-hoarders in moss or soil in different microhabitats impact survival of red oak seeds and seedlings, and does acorn size matter? 2. Results of previous (observational) studies were verified in a 3-year experimental study: a pool of 900 sown acorns was monitored in natural conditions. 3. Study revealed that ~80% of sown acorns were lost due to pilferage, lack of germination, fungal infection, and death of sprouting acorns and leafed-out seedlings. The fate of acorns and seedlings depended largely on acorn size and differed among microsite types. Viable seedlings were twice as likely to develop from large- and medium-sized, than from small acorns. Surviving seedlings grew mainly from acorns sown under moss cover within bilberry clumps or in open area, confirming a positive ‘burial effect’. Less than 10% of acorns sown under shrubs developed into viable seedlings, contradicting former conclusions on their ‘nurse effect’. 4. The occurrence of extensive bilberry clumps and small clusters of shrubs in pine forests favours *Q. rubra* regeneration, but severe fluctuations of the warming climate limit the viability of red oak seeds and seedlings. Prognosed range shifts of native tree species and expected dramatic loss of *V. myrtillus* climatic optima will impact *Q. rubra* distribution in European forests. Meanwhile, to prevent red oak spread (if necessary), it is recommended to remove shrubs from pine stand.

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