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To mix or not to mix – benefits of introducing diverse Sphagnum mixtures in bog restoration

Peter Raabe, Norbert Hölzel, Till Kleinebecker, and Klaus-Holger Knorr

Spontaneous recolonization of hummock peat mosses in rewetted cut-over bogs in north-western Germany can rarely be observed. Whether this is either a result of poor site conditions or dispersal limitation has long been questioned. Slow pace of restoration seems here to be a combination of both – mismatch between high ecological requirements of hummock-forming species and very often at least temporarily unfavorable site conditions, as well as generally low level of viable source populations in a widely altered landscape. Recently, field trials have revealed that on numerous existing restoration sites an establishment of selected mosses can successfully be initiated. However, since diaspores of local origin are scarce and protected, propagation of donor material is needed to provide significant amounts for further reintroduction measures to achieve the full potential for ecosystem recovery. With this approach, several questions are being raised, concerning the appropriate use of available species and water.

Therefore, we conducted a cultivation experiment with mainly three different *Sphagnum* species, which were taken from a small local relic population. In a first phase, mosses were multiplied by setting up four different species mixtures. Subsequently two different watering treatments were applied (constant water supply from below, with or without additional sprinkling, by using collected rain water). After a growing period of 18 month (June 2015 – November 2016) biomass accumulation ranged between 425 and 507 g DW m^{-2}, which corresponds to an increase of 970 ‘% and 1120 % respectively. Measured capitula nitrogen content (ranging between 9.4 and 14.4 mg N g^{-1}) showed a significant negative relationship with biomass accumulation for S. magellanicum. In contrast, significant positive relationships became apparent for *S. papillosum* and *S. rubellum*. This fits well as an explanation that species-specific effects of nitrogen on moss growth can induce shifts in species composition. Nonetheless, within each mixture no significant differences could be detected between the watering treatments with regard to both, the entire yield as well as each species share.

Furthermore, during a second phase (June – October 2017) additionally two alternating wet/dry cycles were applied, by simulating supply disruptions at either one- or two-week intervals. Since species mixtures until this point were clearly cultivated under optimal conditions, this was done to test their establishment ability under unstable field conditions. Preliminary results indicate that almost all multispecies combinations maintain high biomass accumulation rates (up to 317 g/m^2, +68 % in 20 weeks) without significant shifts in species composition, regardless under which watering treatment, while the lowest rates were observed for a mixture containing almost exclusively *S. rubellum* in the treatment with unstable water supply and no additional sprinkling. Thus, species mixtures which contain also *S. magellanicum* and *S. papillosum* possess by far higher potentials to successfully establish at restoration sites with fluctuating water levels. To establish more sensitive species early in the restoration process too, the cultivation of mixtures appears to be the most promising approach.