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Survival of the Thickest? Peat Depth as a Control of Peatland Ecohydrological Resilience to Drought

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Northern peatlands provide important ecosystem services (e.g. carbon storage, water storage, species at risk habitat). While these ecosystems are facing large increases in the areal extent and frequency of climate-mediated disturbances (e.g. wildfire, drought), they are generally resilient to these disturbances. Numerous autogenic ecohydrological feedbacks operate within peatlands that regulate their response to changes in seasonal water deficit. However, the foundational research upon which this peatland resilience framework understanding was based were undertaken in deep and large peatlands where a water table (WT) is ever-present. In contrast, little research has been undertaken on shallow and small scale peat-accumulating systems and as such their vulnerability to disturbance remains unknown. To address this research gap this study examines the ecohydrological processes that control water storage dynamics and moss water availability in 18 peat-filled depressions (sites) of Canadian Shield rock barrens in central Ontario. Sites with intermediate peat depths (30-50 cm) had a WT variability two to three times greater than sites with deep peat depths (> 70 cm) at WT depths > 20-25 cm. Relative to deep peat sites, shallow sites (<15 cm) and intermediate sites had greater rates of WT decline during drying intervals, deeper average WT depths when a WT was present, and extended periods of WT absence during the summer months. As such, moss growing in shallow and intermediate sites generally had lower near-surface water availability as compared to deep sites. WT dynamics and moss water availability were generally weakly correlated to site catchment size. The results of this study suggest that peat depth is important in controlling the strength and sign of autogenic ecohydrological feedbacks and in determining peatland vulnerability to drought. Moreover, this study provides insight into both the evolution of the optimality of peatland ecosystems and potential adaptation strategies to minimize the vulnerability of shallow and/or recently restored peatlands to drought.