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Changes in water levels and linkages to wetland shrub growth over time in Central Alberta

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The Boreal Plains region of Western Canada has experienced cyclical drying and wetting trends since measurements began during the early to mid-20th century. Water deficit periods when evapotranspiration exceeds precipitation persist throughout the region with infrequent wet periods approximately every 12 years. When combined with recent expansion of natural resources extraction, the vulnerability of ecosystems and wetland/ponds in particular, may exceed natural vegetation growth and mortality cycles associated with wetting and drying events. This study examines a wetland/forested upland complex of more than 2000 wetlands north of Utikuma Lake in central Alberta, Canada. Water table measurements have been collected multiple times each year along transects traversing the pond-wetland-upland interface at three pond sites. The objectives of this study are to: 1. Quantify shrubification and mortality trends (loss of biomass) over the regional study area using multi-temporal (2002, 2008, 2011, 2015) airborne Light Detection And Ranging (LiDAR) and in situ mensuration data for allometric (biomass) relationships; 2) Determine linkages between ground water availability along water well transects and temporal biomass change at three pond sites during a period of prolonged drying and wetting.

The results of this study indicate average shrub height growth into wetlands 0.54 m yr-1 (0.21 m yr-1 stdev.) in areas of individual shrub succession, while average losses are 0.75 m (0.53 m yr-1 stdev.) and juvenile tree/sapling mortality, found throughout the broader study region. Significant shrubification (where growth exceeds vertical error of the LiDAR data = $\sim$0.2 m) occurs predominantly in areas with relatively deep water tables and within close proximity of forested stagnant ice moraines, during both the dry period of 2002 to 2008 and 2014 to 2016, and the wet period between 2008 and 2012. However, flooding controls shrub encroachment in broad fens with distance from uplands. This indicates that infrequent flooding maintains peatland function by limiting periodic shrub succession. Wetland/pond complexes with increased shrubification are also prone to shrinking water extent (up to $\sim$0.85 m horizontal displacement per year on average), but this does not occur on all ponds and is highly variable when it does occur, indicating complex spatio-temporal hydrological feedbacks associated with each system.