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Title: *Dynamic spatial patterns of arctic shrub expansion and hypotheses regarding its landscape-scale drivers*

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Shrub expansion is one of the most recognized components of Arctic vegetation change. Previous work has suggested that three types of shrub expansion are occurring: 1) increasing number of patches, 2) increasing size of patches, and 3) decreasing distance between patches. The precise nature of its development, however, have not yet been quantified. While temperature and nutrient availability have been identified as the primary drivers of expansion, studies have not accounted for landscape and shrub reproductive characteristics. This work addresses these limitations by: 1) mapping and quantifying changes in patterns of development of shrub patches at nine sites on the North Slope of Alaska between the 1950s or 1970s and the present, and 2) developing a basis for hypothesis generation regarding the landscape-scale drivers (i.e., hydrologic characteristics represented by a topographic wetness index (TWI), modes of reproduction) using a spatially-explicit computer simulation model. Shrubs patches were mapped from historic aerial photography and current satellite imagery and categorized by geomorphic unit on which they were situated (floodplain, river terrace, valley slope, intefluve). This resulted in three sets of time series maps of shrub expansion at each of the nine sites. FRAGSTATS was used to quantify changes in patch density, coefficient of variation of patch area, and mean nearest neighbor distance between patches at each site for both the site-scale and within each geomorphic unit. Finally, a C#-based computer simulation model was developed that accepts shrub maps as input, simulates shrub reproduction, and accounts for the local TWI that constrains recruitment to areas where the potential for water accumulation or throughflow is high. At the landscape scale, patch density generally increased, patch size variability generally increased, and mean inter-patch distance generally decreased. This generally confirms results from previous studies utilizing different analysis methods. The patch dynamics within geomorphic units, however, are much more heterogeneous across sites. Preliminary modeling results suggest that patterns of development are driven by a combination of clonal and sexual reproduction, and areas with greater potential for moisture accumulation or throughflow act as constraints on development.