

## **Shrub encroachment in North American grasslands: shifts in growth form dominance rapidly alters control of ecosystem carbon inputs**

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### **Abstract**

Shrub encroachment into grass-dominated biomes is occurring globally due to a variety of anthropogenic activities, but the consequences for carbon (C) inputs, storage and cycling remain unclear. We studied eight North American graminoid-dominated ecosystems invaded by shrubs, from arctic tundra to Atlantic coastal dunes, to quantify patterns and controls of C inputs via aboveground net primary production (ANPP). Across a fourfold range in mean annual precipitation (MAP), a key regulator of ecosystem C input at the continental scale, shrub invasion decreased ANPP in xeric sites, but dramatically increased ANPP (41000 g m<sup>2</sup>) at high MAP, where shrub patches maintained extraordinarily high leaf area. Concurrently, the relationship between MAP and ANPP shifted from being nonlinear in grasslands to linear in shrublands. Thus, relatively abrupt (50 years) shifts in growth form dominance, without changes in resource quantity, can fundamentally alter continental-scale pattern of C inputs and their control by MAP in ways that exceed the direct effects of climate change alone.

Keywords: aboveground net primary production, carbon, climate change, grasslands, growth form, LAI, MAP, shrublands