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What are the patterns of carbon allocation in Arctic shrub tundra: do species differ?

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Arctic "greening" is now a well-accepted phenomenon; multiple lines of evidence suggest that plant productivity has increased, driven by increases in shrub abundance. There is very little understanding, however, of how this "shrubification" will impact biogeochemical cycling, including the allocation and turnover of carbon. Recent research has shown, for example, that greater plant productivity is not necessary associated with greater ecosystem C storage. Proliferation of a number of shrub species has been observed in different regions; for example increased willow growth in Arctic Russia, as opposed to primarily alder expansion in NW Canada, where stem density increased 68 % between 1968 and 2004. The degree to which shrub type will determine the impacts of shrub expansion on the carbon cycle is unknown.

We use ^{13}C pulse-labelling to trace the fate of recently photosynthesised carbon in vegetation dominated by two common Arctic shrubs, *Betula nana* (dwarf birch) and *Alnus viridis* (green alder) just above the Arctic treeline in NW Canada. We quantify the amount of ^{13}C assimilated, and the proportion of assimilate returned to the atmosphere via respiration *versus* that allocated to plant tissues. This enables an analysis of the contrasting carbon-use-efficiencies and aboveground *versus* belowground allocation patterns in the two vegetation types. We use these novel field data to address the hypothesis that belowground C allocation in *A. viridis* (a symbiotic nitrogen fixing species) is a smaller proportion of total C assimilation, as this species supports less extensive ectomycorrhizal networks compared to *B. nana*. This is the first tracer study of carbon allocation in N-fixing and non-N-fixing vegetation types in a natural system and provides crucial data for predictive modelling of the Arctic carbon cycle.