Soil Microbial Activity Provides Insight to Carbon Cycling in Shrub Ecotones of Sub-Arctic Sweden

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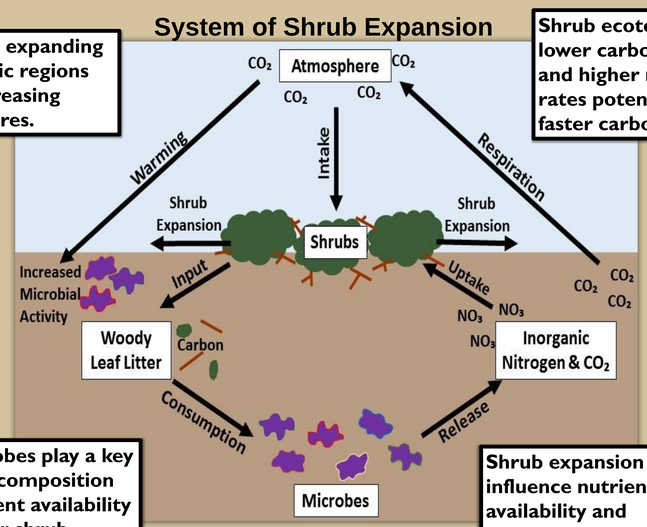
Introduction

Shrubs are expanding in sub-arctic regions due to increasing temperatures.

Shrub ecotones have lower carbon stocks and higher respiration rates potentially due to faster carbon cycling.[2-3]



Soil microbes play a key role in decomposition and nutrient availability needed for shrub expansion.[1]

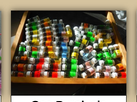
Shrub expansion may influence nutrient availability and decomposition by soil microbes.

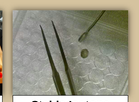
How does increased shrub cover influence microbial activity and decomposition by soil microbes?

Methodology

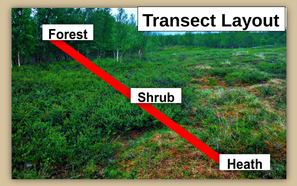

Microplate Enzyme Assays


Chloroform Fumigation


Gas Pyrolysis Chromatography


Stable Isotope Analysis

- Soil samples collected from organic horizon along six transects at two sites
- Vegetation survey of representative species completed along transects
- Each soil sample was processed and analyzed for:
  - Microbial abundance
  - Soil extracellular enzyme activity
  - Percent carbon and nitrogen
  - Soil percent carbon composition



Representative Species of Ecotones

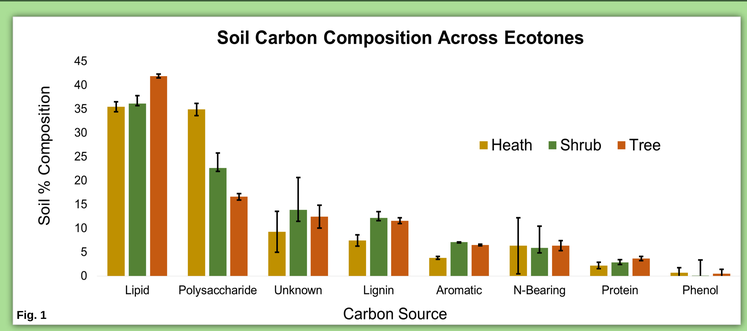


Fig. 1

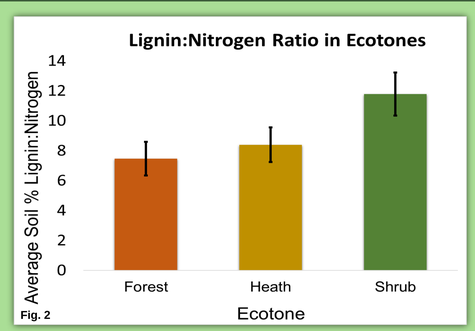


Fig. 2

Results

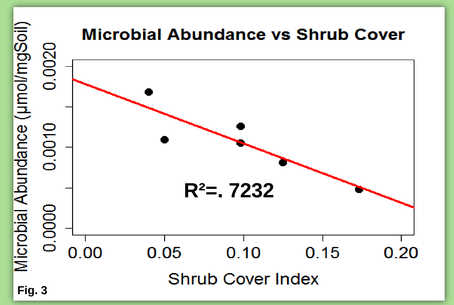


Fig. 3

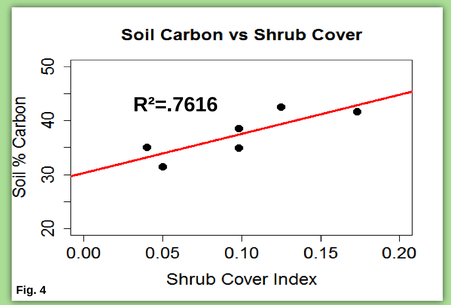


Fig. 4

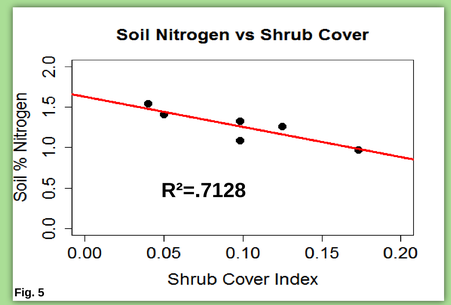


Fig. 5

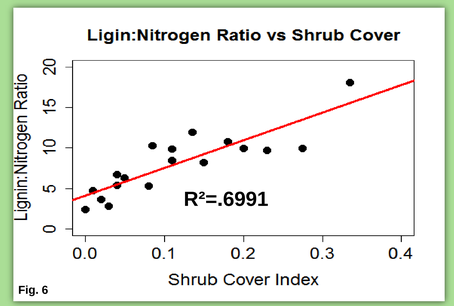


Fig. 6

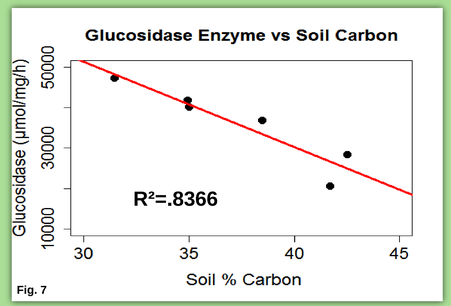


Fig. 7

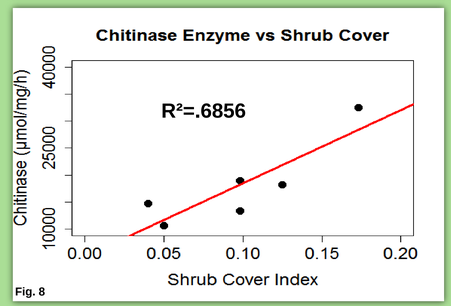


Fig. 8

- Fig. 3-8 have significant correlations (p-value<0.05).
- Shrub cover index is based on the average % shrub cover over an entire transect.
- Microbial abundance in Fig. 3 is calculated from the total microbial carbon per mg of soil.
- Lignin : Nitrogen ratios in Fig. 6 is a proxy for decomposition rate.
- Glucosidase enzyme in Fig. 7 is a proxy for microbial breakdown of labile carbon.
- Chitinase enzyme in Fig. 8 is a proxy for microbial breakdown of organic nitrogen.

Conclusions

Low levels of nitrogen and high levels of chitinase enzyme in Fig. 5 & 8 suggest nitrogen limitation in shrub-covered soil.

Decreased microbial abundance under shrubs in Fig. 3 supports the assessment of shrubs becoming a net carbon sink.

Changes to Our Understanding of Shrub Expansion

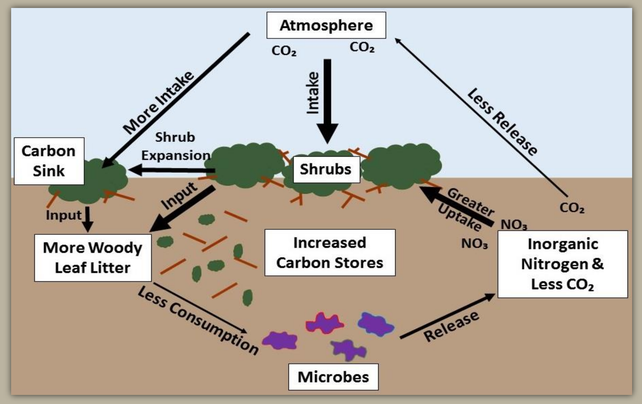


Fig. 4 & 7 suggest soil microbes decompose carbon less readily than carbon is added by shrubs which may cause shrub-covered areas to become net carbon sinks.

Increased Lignin : Nitrogen ratios in Fig. 2 & 6 supports the conclusion of faster decomposition rates under shrubs.

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