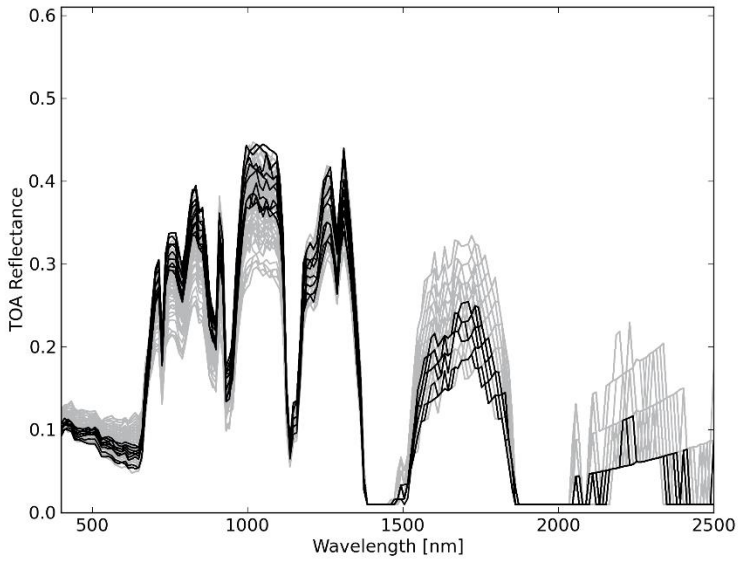
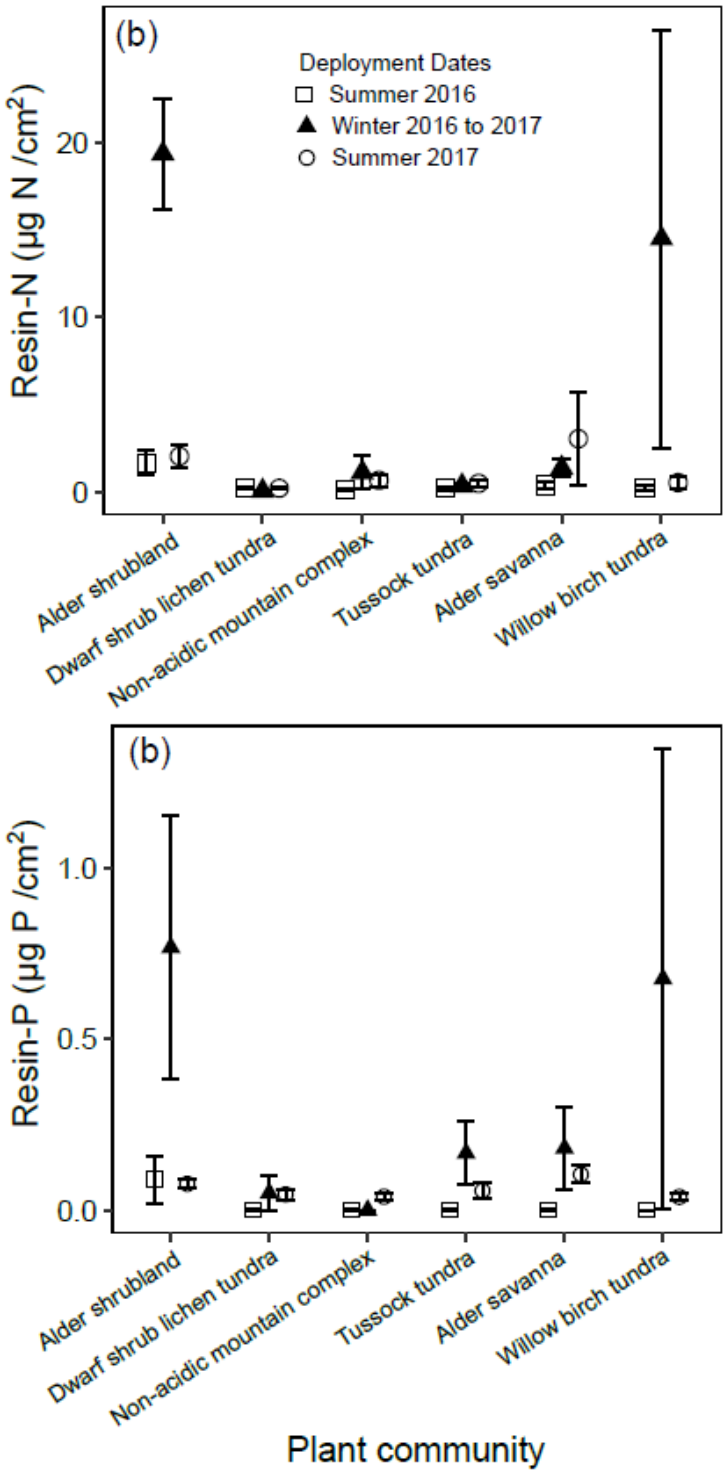
SUPPLEMENTAL MATERIALS

Title: Alder distribution and expansion across a tundra hillslope: implications for local N cycling

Supplementary Figure 1. Spectral properties of Alder shrubland plots, based on EO-1 Hyperion. Back lines represent spectra from alder shrubland plots while grey lines represent spectra from other plant communities present at Kougarok.



Supplementary Figure 2. Resin-N (Total inorganic N extracted from resins, panel a) and Resin-P (panel b) availability. Community type, deployment date, and an interaction between community type and deployment date all had a significant effect on Resin-N ($p < 0.02$). Deployment data had a significant effect on resin-P ($p = 0.02$).



Supplementary Table 1. Spectral and topographic remote sensing data used in the classification of Alder shrubland. (DN: Digital Numbers)

Sensor	Variable	Unit	Collection Date	Resolution	# of bands
SPOT-5	Green, Red, NIR (500-900 nm)	DN	June-September 2009-2012	2.5 m	3
USGS IfSAR DEM	Elevation	m	July 2012	5 m	1
EO-1	198 spectral bands (400-2500 nm)	DN	June 24, 2015	30 m	198
Landsat 8	9 spectral bands (400-2290 nm)	DN	August 17, 2016	30 m	9

Supplementary Table 2. Principal Components analysis of Alder nodule Biomass and aboveground traits. Asterisk (*) and bold type denote variable had a significant impact on Principal component. Significance was determined by bootstrapping of eigenvectors ($p < 0.05$).

Eigenvectors

	PC1	PC2	PC3	PC4	PC5	PC6
Nodule Biomass (g/m^2)	-0.41	0.28	-0.5	-0.5	0.5	-0.2
Height (cm)	**-0.37 ***	0.53	0.3	0.6	0.2	-0.2
Sun Leaf SLA (cm^2/g)	**-0.45 ***	-0.08	0.5	-0.4	-0.5	-0.4
Sun Leaf %N	**-0.26 ***	-0.76	0.2	0.2	0.5	-0.1
Sun Leaf $\delta^{15}N$	**0.37 ***	0.23	0.7	-0.4	0.5	0.1
Sun Leaf %P	**-0.54 ***	0.02	0.1	-0.1	-0.1	0.8

Importance of Components

	PC1	PC2	PC3	PC4	PC5	PC6
Standard deviation	1.80	1.07	0.9	0.6	0.6	0.2
Proportion of Variance	0.54	0.19	0.1	0.1	0.1	0
Cumulative Proportion	0.54	0.73	0.9	0.9	1	1

Supplementary Table 3. Principal Components analysis of Alder N fixation and aboveground traits. Asterisk (*) and bold type denote variable had a significant impact on Principal component. Significance was determined by bootstrapping of eigenvectors ($p < 0.05$).

Eigenvectors

	PC1	PC2	PC3	PC4	PC5	PC6
N fixation (µmole N/g nodule/ hour)	0.21	**-0.73 ***	0.3	-0.1	-0.6	-0.1
Height (cm)	**-0.53 ***	-0.20	0.3	0	0.4	**0.68 ***
Sun Leaf SLA (cm^2/g)	**-0.34 ***	**0.50 ***	0.4	0.4	-0.6	-0.1
Sun Leaf %N	**-0.42 ***	0.09	-0.4	-0.7	-0.4	0
Sun Leaf $\delta^{15}N$	**0.33 ***	0.32	0.6	-0.6	0.2	0
Sun Leaf %P	**-0.52 ***	-0.28	0.30	0	0.20	0.7

Importance of Components

	PC1	PC2	PC3	PC4	PC5	PC6
Standard deviation	1.68	1.10	0.9	0.8	0.7	0.3
Proportion of Variance	0.47	0.20	0.2	0.1	0.1	0
Cumulative Proportion	0.47	0.67	0.8	0.9	1	1