CHARACTERIZING FOREST VEGETATION OF THE TANANA VALLEY: WHAT CAN FOREST INVENTORY AND ANALYSIS DELIVER?

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Abstract—Vegetation profile data were collected as part of a forest inventory project in the Tanana Valley in interior Alaska, providing a means of characterizing the forest vegetation. The black spruce forest type was most common, followed by Alaska paper birch, and white spruce, quaking aspen, and balsam poplar. For individual tree species, black spruce was recorded on 68 percent of all plots, birch was recorded on 67 percent and white spruce on 58 percent. The distribution of growth habits in horizontal layers varied by forest type. There was a higher percentage tree cover in hardwood forest types. Shrubs were prominent in all forest types, dominating in the lowest horizontal layer in black spruce forests and mid layers in other forest types. The most common species recorded include (in descending order) lingonberry, black spruce, Alaska paper birch, bog Labrador tea, white spruce, green alder, bog blueberry, and prickly rose all recorded on at least 35 percent of all plots. A full census of vascular plants on 25 subplots accumulated almost 2.5 times as many species as the Vegetation profile protocol on 101 subplots on the same set of plots.

INTRODUCTION

Understanding the existing distribution and abundance of plant species in ecosystems is important for monitoring the effects of a changing climate on natural ecosystems. In Alaska, changing distribution and composition of vegetation have been observed as shrubs encroach into tundra (Dial and others 2007); hardwoods replace spruce in some areas (Rupp 2011); and white spruce forests are expanding in others (Roland and others 2013). At the same time, new pest outbreaks are being observed that could further influence shifts in vegetation composition (USDA Forest Service 2015). These changes can effect biomass accumulation and greenhouse gas emissions (Rupp 2011). Vegetation data collected on the ground is relatively scarce in Alaska, but is needed to aid the interpretation of the remotely sensed-data that managers depend on with increasing frequency. The Forest Inventory and Analysis (FIA) 2014 project in interior Alaska provides a systematic sample of 98 plots within the Tanana River Valley, in part to estimate biomass. Documenting vegetation characteristics now is essential for monitoring vegetation change over time. Using data generated from FIA's Vegetation Profile (VEG profile) protocol, I characterize the vegetation in the different forested conditions sampled, and demonstrate what can be reported using this new set of measurements.

STUDY AREA

The Tanana Valley is located in Interior Alaska, north of the Alaska Range, following the Tanana River. Systematic samples of 71 plots within the Tanana Valley State Forest and 27 plots on the Tetlin National Wildlife Refuge (TNWR) were collected from June through August, 2014.

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METHODS

The FIA Core-Optional VEG profile, level of detail 3 protocol was implemented on all plots (USDA Forest Service 2014). Both forest and non-forest conditions were sampled if accessible. Data were collected on each subplot and included the distribution of plant growth habit cover by layer. Layer 1 is between the ground and 2 feet, Layer 2 is between 2 and 6 feet, Layer 3 is between 6 and 16 feet, Layer 4 is 16 feet and higher. Up to four of the most abundant species per growth habit, if present with at least 3-percent subplot cover, were also recorded with percentage of subplot cover. In addition, a full census of all vascular plants on subplot 1 was implemented on the plots within the TNWR. These data were summarized by averaging subplot cover measurements to either plot or domain, and determining the percentage of plots where species were recorded for various domains.

RESULTS

Conditions

Of the 98 sampled plots, 73 were intact (100 percent single condition), 11 were fully forested but with multiple conditions, and 14 plots included some non-forest land cover class (Table 1). Black spruce (see Appendix Table 1 for list of common and scientific names) forest type was most the common, with 38 intact plots, and occurring on seven samples with multiples condition and eight edge plots. Alaska paper birch (birch) was the second most common with 20 intact plots; white spruce was third with eight intact plots. All of the non-forest land cover classes sampled were natural vegetation types, with shrubland being most common. Full descriptions of forested conditions sampled are included in Table 1.

Structure

Data from the intact forest condition plots were used to characterize structure overall and by forest type. Total tree cover on 73 intact plots included 23 plots with cover greater than 60 percent, 42 plots with greater than 40, and four with less than 10 percent. There were 27 plots with the highest percent tree cover in Layer 4. Twelve of these plots had average tree cover of 60 percent or more and 14 had cover between 25 and 60 percent. There were 16 plots where the maximum tree cover was in Layer 2 and Layer 3. The maximum tally tree cover was recorded in Layer 1 on 13 plots. Non-tally trees (a growth habit to describe species growing as trees but not included in standard tree measurements) were recorded on10 plots, three plots had an average of more than10 percent subplot cover.

Average shrub cover exceeded tree cover on 40 plots. Overall, average subplot shrub cover exceeded 10 percent in Layer 3 on16 plots and in Layer 4 on 19 plots. Grasses and forbs contributed to cover primarily in Layer 1. The average overall grass cover was 4 percent, recorded on all but two plots, and 22 plots had grass cover of 10 percent or more. Forbs had an average cover 13 percent, cover greater than 10 percent on 24 plots.

Structure was quite different between forest types. Average subplot cover of growth habits by layer for stands of the three main forest types that were at least 35 years old are shown in Figure 1. Shrubs were important in all types but varied by height.

Most abundant species

A total of 105 species were recorded using VEG Profile protocols. Tree and shrub species dominated the most abundant species collected (Table 2) and most forest types had several top species in common. The hardwood types with only a few sample plots had a few unique species. Although forb and grass growth habit cover were recorded on most plots as structure, only a few species exceeded the 3-percent threshold for recording (blue-joint reed grass, field horsetail, and fireweed).

Tree species distributions were examined by size across forest types. Large trees (LT) were 5 inch or greater in diameter, and small trees (SD) were less than 5 inch diameter (USDA Forest Service 2014). Black spruce and birch forest types are tied for number of other tree species found on single condition plots, but white spruce and birch trees are found on more forest types and condition combinations than black spruce trees (Table 1). Non-tally tree species were recorded as either large or small trees on seven plots, and included Bebb willow, green alder, and Scouler's willow.

Table 1—Number of plots by forested condition and percentage of plots with records of large (LT) and small (SD) trees by species

		Tree species										
		Black spruce		Alaska paper birch		White spruce		Quaking aspen		Balsam poplar		Tamarack
Condition and Forest Type Description	Plot Count	LT	SD	LT	SD	LT	SD	LT	SD	LT	SD	SD
Single condition:	*Number*	*Percentage of plots where recorded*										
Black spruce	38	47	100	21	50	21	0	8	8	0	0	8
Paper birch	20	20	45	80	90	55	60	5	25	5	5	0
White spruce	8	0	0	75	50	100	88	25	25	13	0	0
Aspen	3	0	33	33	67	67	67	67	67	0	0	0
Balsam poplar	3	0	0	0	0	33	67	0	0	100	100	0
Non-stocked	1	0	0	0	0	0	0	0	0	0	0	0
Multiple condition:												
Black spruce/ Paper birch	4	75	100	100	100	50	100	0	0	0	0	0
Black spruce / Multi age	3	33	100	0	100	67	100	0	0	0	0	0
White spruce/ Multi age	2	0	0	0	0	100	100	0	0	50	0	0
Paper birch/ Multi age	1	0	0	100	100	100	100	0	0	0	0	0
White spruce / Paper birch	1	0	100	100	100	100	100	0	0	0	0	0
Some non-forest:												
Black spruce/ Shrubland	3	33	100	0	33	0	0	0	0	0	0	33
Black spruce/ Mixed Veg	2	50	100	50	0	50	100	0	50	0	0	0
White spruce/ Shrubland	2	0	0	100	50	100	50	0	0	0	0	0
Black spruce/ Shrubland/Mixed Veg	1	100	100	100	0	100	100	0	0	0	0	0
Black spruce/ Non-vascular	1	100	100	0	100	0	0	0	0	0	0	0
White spruce/ Mixed Veg	1	100	100	0	100	100	100	0	0	0	0	0
Paper birch / Shrubland	1	0	0	0	0	0	0	0	0	0	0	0
Paper birch /Non-vascular	1	0	100	0	100	0	0	0	0	0	0	0
Paper birch / Mixed Veg	1	100	100	0	100	100	0	0	0	0	0	0
White spruce/Non-vascular	1	100	0	0	0	0	100	0	0	0	0	0

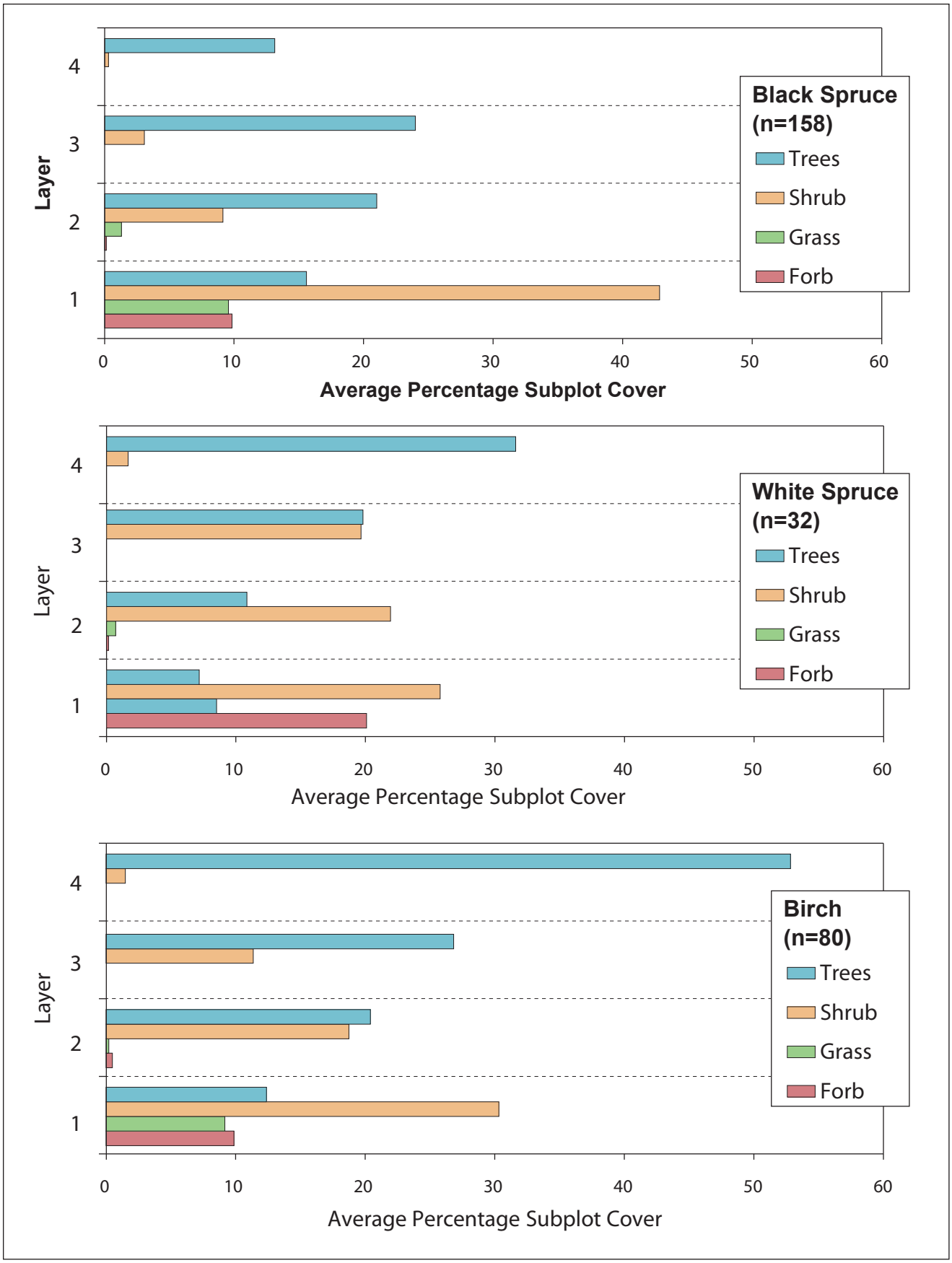

Figure 1—Average subplot percentage of cover by growth habit by layer for three predominant forest types in interior Alaska

Table 2—Most common abundant species and percentage of plots where recorded overall and by forest type; superscripts indicate the rank of the five most common species within each forest type

Species common name	All Plots (n=98)	Forest type					
		Black spruce (n=38)	Paper birch (n=20)	White spruce (n=8)	Balsam poplar (n=3)	Aspen (n=3)	Other (n=25)
		Percentage of plots where recorded					
Lingonberry	72[1]	84[3]	65[4]	38	0	33	88
Black spruce	68[2]	100[1]	45	0	0	33	76
Alaskapaperbirch	67[3]	53[4]	100[1]	88[2]	0	67 [2]	68
Bog Labrador tea	62[4]	87[2]	55[5]	0	0	33	64
White spruce	58[5]	34	70[3]	100[1]	67[2]	67[2]	72
Green alder	53[6]	40	75[2]	63[3]	0	67[2]	60
Bog blueberry	38[7]	53[4]	25	0	0	33	44
Prickly rose	36[8]	8	70[3]	88[2]	67[2]	33	32
Bluejoint	28[9]	13	40	38	67[2]	67[2]	28
Dwarf birch	24[10]	42[5]	5	0	0	0	24
Field horsetail	16	11	20	63[3]	67[2]	33	16
Quaking aspen	16	11	30	25	0	100[1]	4
Fireweed	12	3	25	13	33	67[2]	8
Thinleaf alder	8	0	5	38	100[1]	0	4
Balsam poplar	6	0	5	13	100[1]	0	4
Redosier dogwood	2	0	0	0	67[2]	0	0

n = number of plots

The two most commonly recorded shrub species, lingonberry and bog Labrador tea, made up the majority of shrub cover in Layer 1 in black spruce forest types. Alder and willow species were common and provided cover in the mid layers of most other conditions sampled. An alder species was recorded on 58 of 98 plots, and on 30 of those plots, the average subplot cover was greater than15 percent. There were 54 plots with one to three species of willow, and 32 plots with willow species that may be encountered either as shrubs or trees (USDA NRCS 2015, Viereck and Little 2007).

TNWR full census

A complete census on 25 subplots accumulated 135 species, whereas the VEG Profile method recorded only 55 species on a total of 101 subplots on the same Tetlin plots (some subplots were inaccessible). There were 82 species recorded on the full census that were not captured and only nine species recorded with VEG Profile not in the full census. Of those species present on 50 percent of sampled subplots for each effort, the lists matched except for four species recorded on the full census trial (dwarf scouring rush, field horsetail, red fruit bearberry, and prickly rose).

DISCUSSION

The VEG Profile provides important information about the arrangement of all vascular plants in the forest stands sampled. Structure characterization is important for fire behavior models/maps of vegetation types. Data on the distribution of large and small trees support the observations that black spruce types seem to be increasingly replaced by hardwoods rather than regenerating black spruce (Rupp 2011). Although VEG Profile captures the presence of large shrubs and non-tally trees with cover and height layer, the only allometric equations for calculating biomass of large shrubs are based on stem diameters (Chojnacky and Milton 2008). Stem diameter measures for large woody shrubs and non-tally tree species should be considered in the future for inclusion into biomass estimations.

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LITERATURE CITED

Chojnacky, D.C.; Milton, M. 2008. Measuring carbon in shrubs. In Hoover, (ed.) Field Measurements for Forest Carbon. Springer. NY New York. Pp 45-72.

Dial, R. J.; Berg, E. E.; Timm, K.; McMahon, A.; Geck, J. 2007 Changes in the alpine forest-tundra ecotone commensurate with recent warming in southcentral Alaska: Evidence from orthophotos and field plots, J. Geophys. Res., 112, G04015, doi:10.1029/2007JG000453.

Roland, C.A.; Schmidt, J.H.; Nicklen, E.F. 2013. Landscape-scale patterns in tree occupancy and abundance in subarctic Alaska. Ecological Monographs, 83 (1)pp19-48.

Rupp, Scott. 2011. Rising temperatures trigger ecological changes in the boreal forest in Alaska. Joint Fire Science Program Fire Science Brief. Issue 130. https://akfireconsortium.wordpress.com/2011/10/28/new-jfsp-brief-rising-temps-trigger-ecological-changes-in-the-boreal-forest-of-alaska/ (accessed June 25 2015)

USDA, Forest Service. 2014. Forest Inventory and Analysis National Core Field Guide – Version 6.1. 141-157 . http://www.fia.fs.fed.us/library/field-guides-methods-proc/docs/2014/Core%20FIA%20field%20guide_6-1.pdf . (accessed June 25 2015)

USAD Forest Service. 2015. Forest Health Conditions in Alaska 2014. Anchorage Alaska. U.S. Forest Service, Alaska Region. FS-R10-FHP. Publication R-10-PR-36. 88 p.

USDA NRCS. 2015. The PLANTS Database. National Plant Data Team, Greensboro, NC 27401-4901 USA. http://plants.usda.gov, (accessed June 25 2015).

Viereck, L.A.; Little, E.L. 2007. Alaska Trees and Shrubs, Second Edition. University of Alaska Press. Fairbanks, AK. 359p.

APPENDIX TABLE 1 – COMMON AND SCIENTIFIC NAMES

Common name	Scientific name
Alaska paper birch	*Betula neoalaskana* Sarg.
Balsam poplar	*Populus balsamifera* L.
Black spruce	*Picea mariana* (Mill.) Britton, Sterns & Poggen.
Blue joint	*Calamagrostis canadensis* (Michx.) P. Beauv.
Bog blueberry	*Vaccinium uliginosum* L.
Bog Labrador tea	*Ledum groenlandicum* Oeder
Dwarf birch	*Betula nana* L.
Dwarf scouring rush	*Equisetum scripoides* Michx.
Field horsetail	*Equisetum arvense* L.
Fireweed	*Chamerion angustifolium* (L.) Holub ssp. *angustifolium*
Green alder	*Alnus viridis* (Chaix) DC.
Lingonberry	*Vaccinium vitis-idaea* L.
Prickly rose	*Rosa acicularis* Lindl.
Quaking aspen	*Populus tremuloides* Michx.
Red fruit bearberry	*Arctostaphylos rubra* (Rehder & Wilson) Fernald
Red osier dogwood	*Cornus sericea* ssp. *sericea*
Tamarack	*Larix larcinia* (Du Roi) K.Koch)
Thin leaf alder	*Alnus incana* (L.) Moench ssp. *tenuifolia* (Nutt.) Breitung
White spruce	*Picea glauca* (Moench) Voss