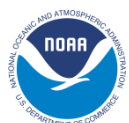
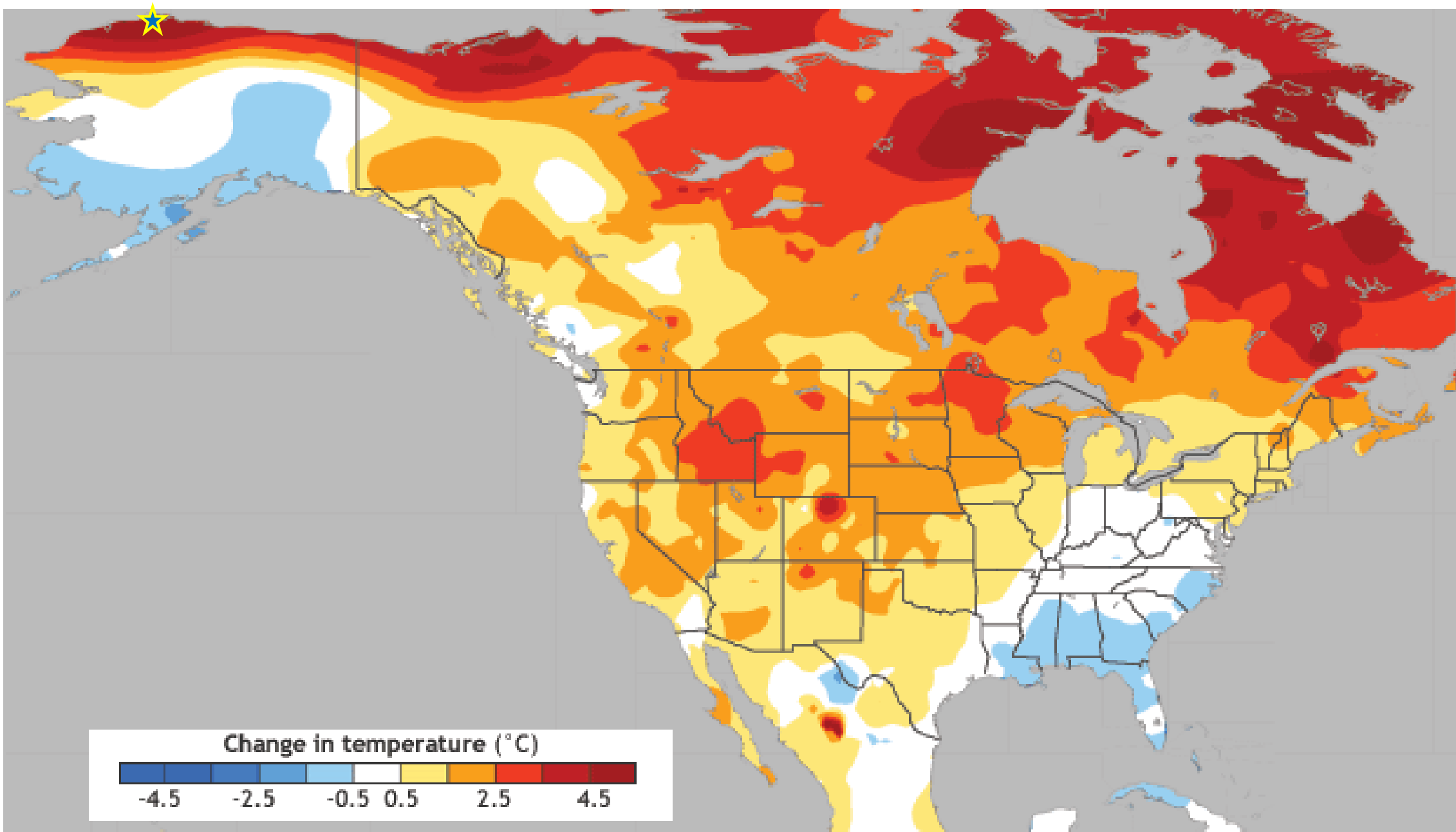


A field of white, fluffy plant heads (likely cottongrass) growing in a grassy area. The plants are in various stages of growth, with some showing more developed, rounded heads and others still in bud. The background is a soft-focus field of similar vegetation under a bright sky.

Exploring Plant Traits as Predictors of Changes in Vegetation Cover

**Katlyn Betway &
Dr. Bob Hollister
Grand Valley State University**



National Oceanic and Atmospheric Administration (NOAA)

Capital Weather Gang

This city in Alaska is warming so fast, algorithms removed the data because it seemed unreal

By Angela Fritz December 12, 2017 Email the author



Change in temperature (°C)



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Capital Weather Gang

This city in Alaska is warming so fast, algorithms

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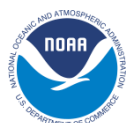
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Alaska's Northernmost Town Warms So Fast, It Fools NOAA Computers

As sea ice grows shockingly low and late, Utqiagvik's record warmth stymies algorithms

By Andrea Thompson on December 20, 2017



In this aerial image, lakes created by melting permafrost are seen on June 15, 2017 in Utqiagvik

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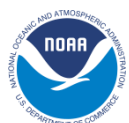
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Alaskan North Slope climate change just outran one of our tools to measure it

Author: Deke Arndt

December 6, 2017



It was bound to happen. In fact, my colleagues have planned for this. More on that later.

On December 4th, the folks in the Climate Monitoring group at the National Centers for Environmental Information (NCEI) did what we do pretty much every 4th of the month: we processed the previous month's data to prepare our initial US climate report. The data from Utqiagvik, Alaska, was missing, which was odd. It was also missing for all of 2017 and the last few months of 2016. This was even weirder, because we knew we'd kinda marveled at how insanely warm the station had been for several weeks and months during 2017.

What happened?

The short version: in an ironic exclamation point to swift regional climate change in and near the Arctic, the average temperature observed at the weather station at Utqiagvik has now changed so rapidly that it triggered an algorithm designed to detect artificial changes in a station's

Beyond the Data

A blog by the nation's official climate record keepers.

Disclaimer:

Beyond the Data is written and edited by Derek Arndt, Jake Crouch, Jessica Blunden (NOAA NCEI), and Rebecca Lindsey (contractor to NOAA CPO). Posts reflect the views of the bloggers or guest contributors themselves, not necessarily

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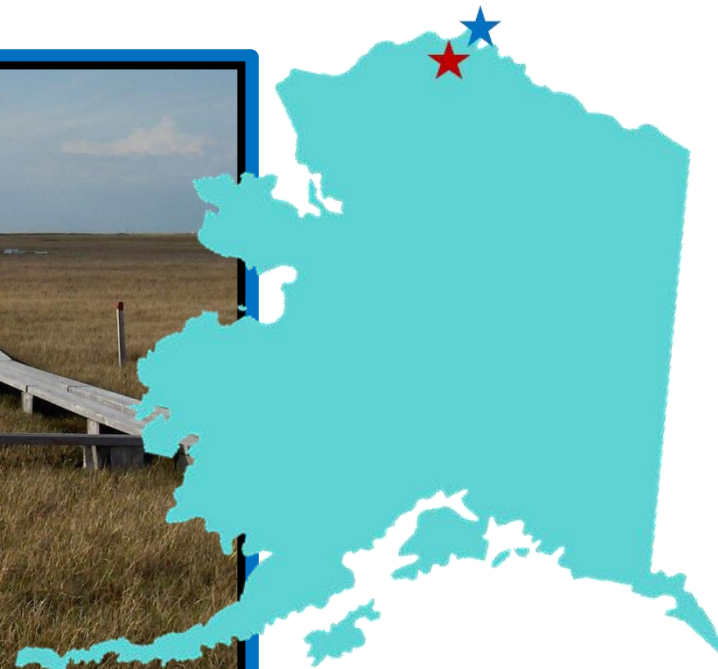
Utqiagvik



Dry



Wet



Atqasuk



Dry



Wet

Warming experiments elucidate the drivers of observed directional changes in tundra vegetation

Robert D. Hollister¹, Jeremy L. May^{1,2}, Kelseyann S. Kremers^{1,3}, Craig E. Tweedie⁴, Steven F. Oberbauer², Jennifer A. Liebig¹, Timothy F. Botting¹, Robert T. Barrett¹ & Jessica L. Gregory¹

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Keywords

Arctic, biodiversity, *Cassiope tetragona*, climate change, community change, ITEX, *Poa arctica*.

Correspondence

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Abstract

Few studies have clearly linked long-term monitoring with in situ experiments to clarify potential drivers of observed change at a given site. This is especially necessary when findings from a site are applied to a much broader geographic area. Here, we document vegetation change at Barrow and Atkasuk, Alaska, occurring naturally and due to experimental warming over nearly two decades. An examination of plant cover, canopy height, and community indices showed more significant differences between years than due to experimental warming. However, changes with warming were more consistent than changes between years and were cumulative in many cases. Most cases of directional change

Graminoids

Alopecurus alpius
Arctagrostis latifolia
Calamagrostis homii
Carex spp.
Dupontia fisheri
Eriophorum spp.
Hierochloa spp.
Juncus biglumis
Luzula spp.
Poa spp.
Trisetum spicatum

Deciduous Shrubs

Salix spp.
Betula nana

Evergreen Shrubs

Cassiope tetragona
Ledum palustre
Diapensia lapponica
Vaccinium vitis-idaea

Forbs

Antennaria friesiana
Artemisia borealis
Cardamine pratensis
Cerastium beeringianum
Chrysosplenium tetrandum
Cochlearia officinalis
Draba lactea
Melandrium apetalum
Minuartia obtusiloba
Oxyria digyna
Papaver hultenii
Pedicularis spp.
Petasites frigidus
Polygonum spp.
Potentilla hyparctica
Ranunculus spp.
Saxifraga spp.
Senecio atropurpureus
Stellaria spp.



Taxa	C1
------	----

Utqiagvik dry (BD) site

Deciduous Shrub	15.0
Evergreen Shrub	11.4
Graminoid	3.0
Forb	4.5
Bryophyte	11.0
Lichen	27.0

Average cover of each growth form



Taxa	C1
Utqiagvik dry (BD) site	
Deciduous Shrub	15.0
Evergreen Shrub	11.4
Graminoid	3.0
Forb	4.5
Bryophyte	11.0
Lichen	27.0

Average cover of each growth form



Taxa	C1
Utqiagvik dry (BD) site	
Deciduous Shrub	15.0
Evergreen Shrub	11.4
Graminoid	3.0
Forb	4.5
Bryophyte	11.0
Lichen	27.0

Average cover of each growth form



Taxa	C1
Utqiagvik dry (BD) site	
Deciduous Shrub	15.0
Evergreen Shrub	11.4
Graminoid	3.0
Forb	4.5
Bryophyte	11.0
Lichen	27.0

Average cover of each growth form



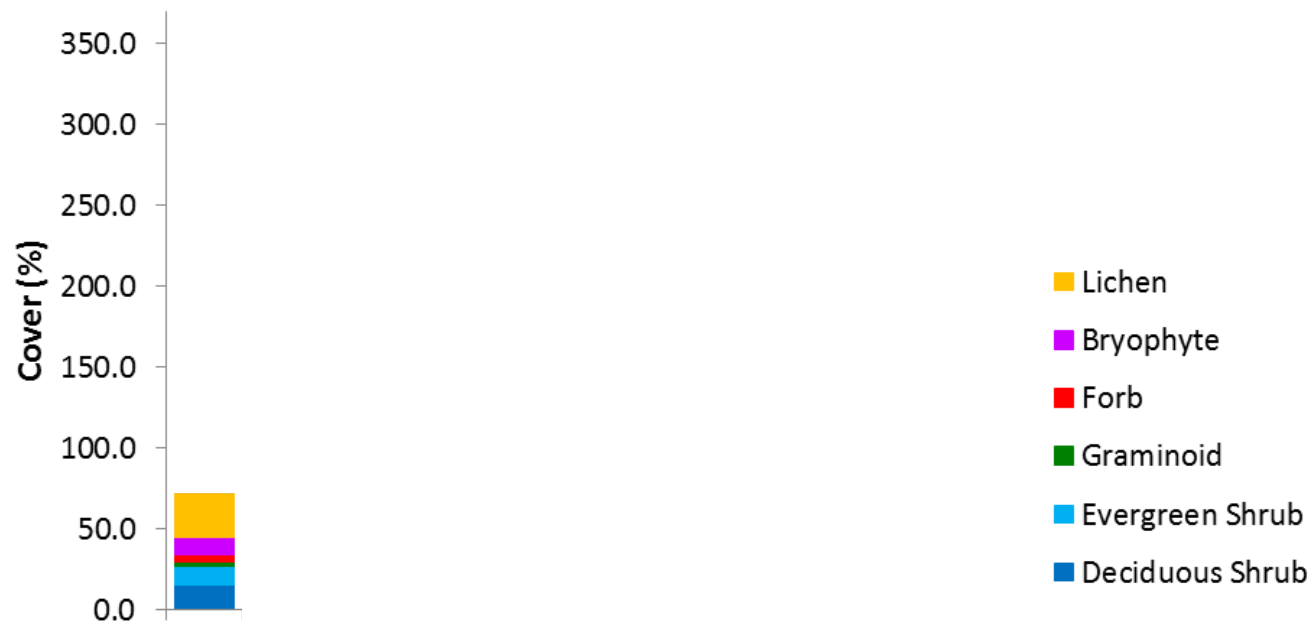
Taxa	C1
Utqiagvik dry (BD) site	
Deciduous Shrub	15.0
Evergreen Shrub	11.4
Graminoid	3.0
Forb	4.5
Bryophyte	11.0
Lichen	27.0

Average cover of each growth form



Taxa	C1
Utqiagvik dry (BD) site	
Deciduous Shrub	15.0
Evergreen Shrub	11.4
Graminoid	3.0
Forb	4.5
Bryophyte	11.0
Lichen	27.0

Average cover of each growth form



Taxa	C1
Utqiagvik dry (BD) site	
Deciduous Shrub	15.0
Evergreen Shrub	11.4
Graminoid	3.0
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Bryophyte	11.0
Lichen	27.0

Average cover of each growth form



Taxa	C1
Utqiagvik dry (BD) site	
Deciduous Shrub	15.0
Evergreen Shrub	11.4
Graminoid	3.0
Forb	4.5
Bryophyte	11.0
Lichen	27.0

Average cover of each growth form



Taxa	C1
Utqiagvik dry (BD) site	
Deciduous Shrub	15.0
Evergreen Shrub	11.4
Graminoid	3.0
Forb	4.5
Bryophyte	11.0
Lichen	27.0

each year sampled



Taxa	C1	C2
Utqiagvik dry (BD) site		
Deciduous Shrub	15.0	28.5
Evergreen Shrub	11.4	20.4
Graminoid	3.0	7.3
Forb	4.5	7.7
Bryophyte	11.0	19.8
Lichen	27.0	37.9

each year sampled



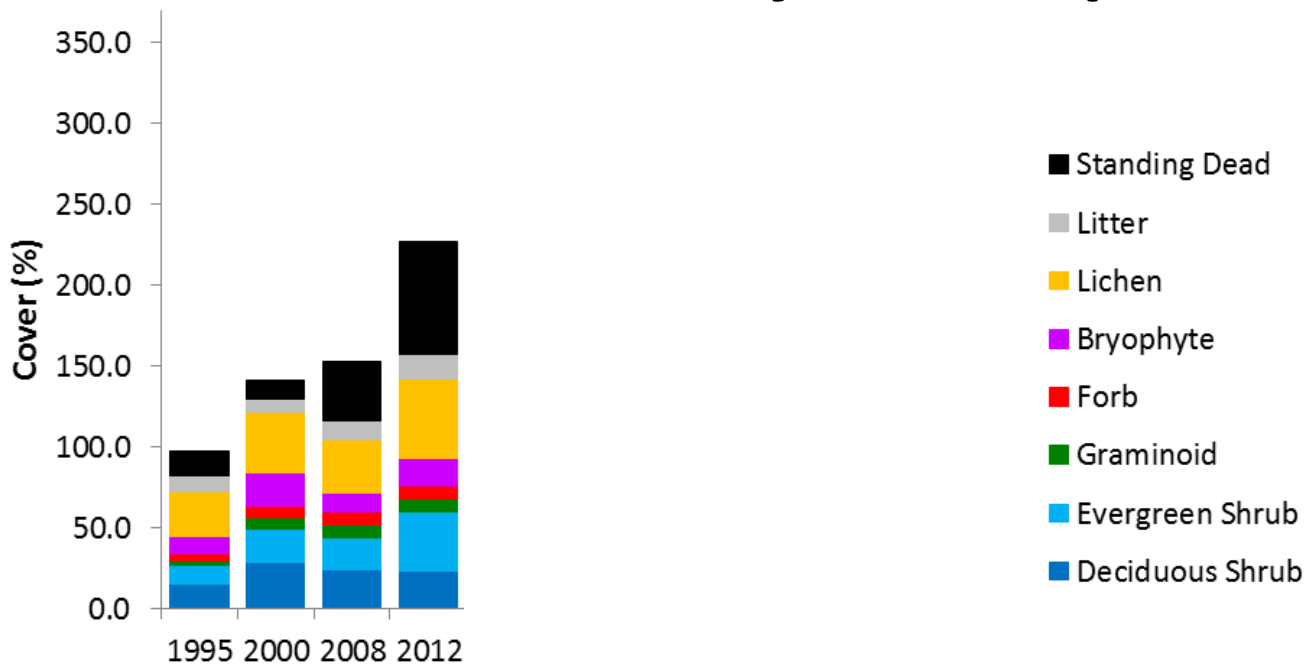
Taxa	C1	C2	C3
Utqiagvik dry (BD) site			
Deciduous Shrub	15.0	28.5	24.5
Evergreen Shrub	11.4	20.4	19.5
Graminoid	3.0	7.3	8.2
Forb	4.5	7.7	7.7
Bryophyte	11.0	19.8	11.8
Lichen	27.0	37.9	32.5

each year sampled



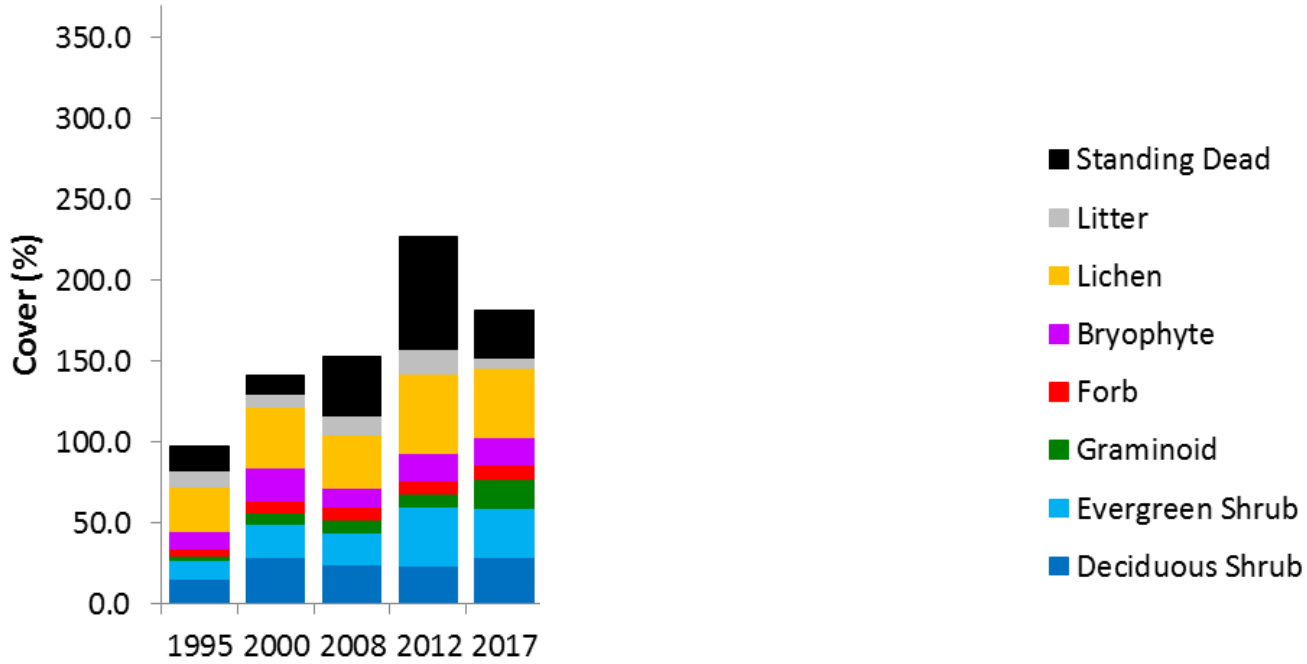
Taxa	C1	C2	C3	C4
Utqiagvik dry (BD) site				
Deciduous Shrub	15.0	28.5	24.5	23.0
Evergreen Shrub	11.4	20.4	19.5	37.1
Graminoid	3.0	7.3	8.2	8.0
Forb	4.5	7.7	7.7	7.6
Bryophyte	11.0	19.8	11.8	17.5
Lichen	27.0	37.9	32.5	48.4

each year sampled



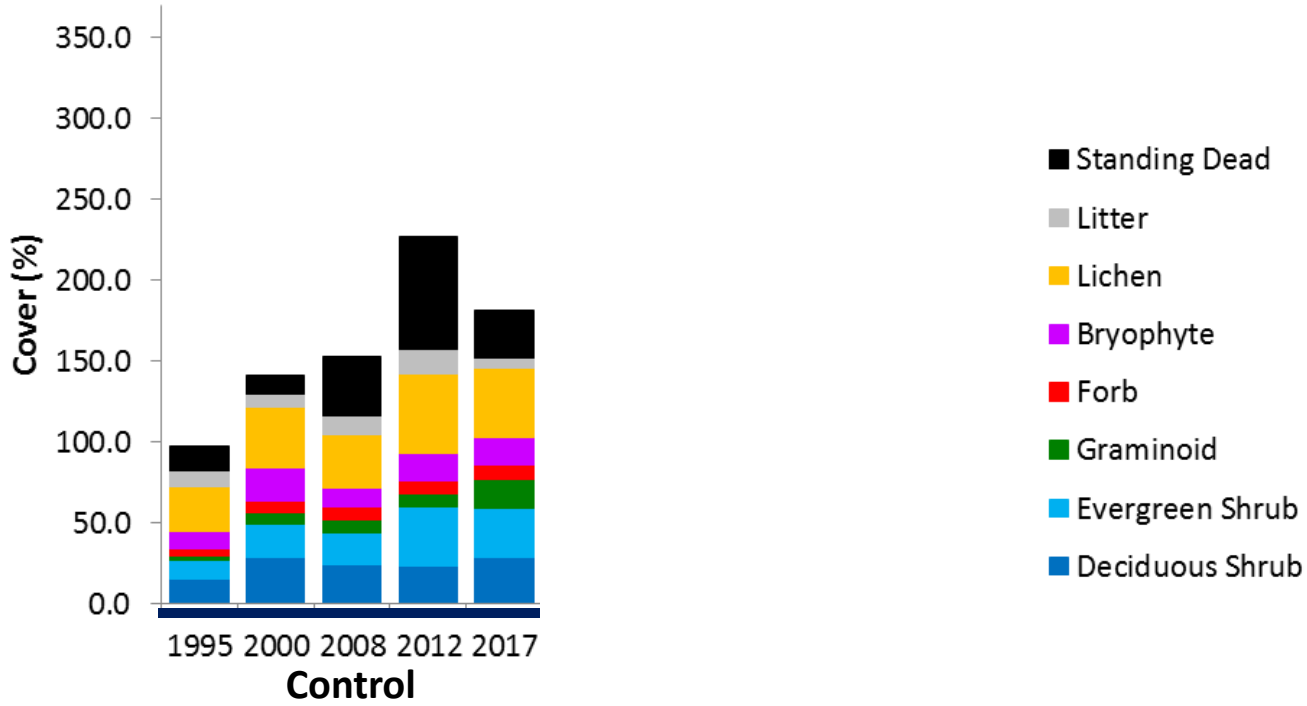
Taxa	C1	C2	C3	C4	C5
Utqiagvik dry (BD) site					
Deciduous Shrub	15.0	28.5	24.5	23.0	28.3
Evergreen Shrub	11.4	20.4	19.5	37.1	30.3
Graminoid	3.0	7.3	8.2	8.0	18.0
Forb	4.5	7.7	7.7	7.6	9.2
Bryophyte	11.0	19.8	11.8	17.5	16.8
Lichen	27.0	37.9	32.5	48.4	42.7

each year sampled



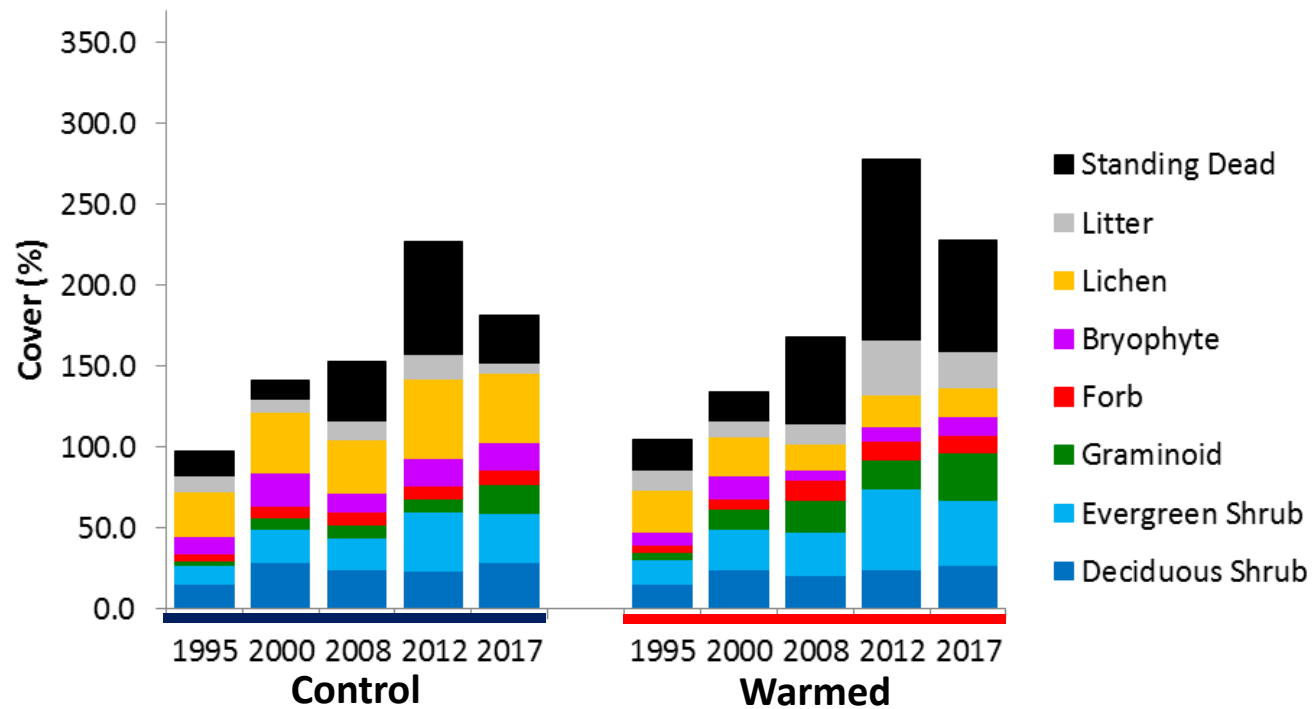
Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Utqiagvik dry (BD) site																	
Deciduous Shrub	15.0	28.5	24.5	23.0	28.3	I	14.9	24.3	20.0	24.1	27.2	.	-0.1	-4.2	-4.4	1.1	-1.2
Evergreen Shrub	11.4	20.4	19.5	37.1	30.3	D ⁺	15.2	24.8	27.7	50.2	40.2	C ⁺	3.8	4.4	8.2	13.0	9.9
Graminoid	3.0	7.3	8.2	8.0	18.0	D ⁺	4.5	12.3	19.6	17.7	29.4	D ⁺	1.4	5.0	11.4	9.7	11.4
Forb	4.5	7.7	7.7	7.6	9.2	D ⁺	4.3	6.6	12.3	11.3	10.6	.	-0.3	-1.0	4.6	3.7	1.5
Bryophyte	11.0	19.8	11.8	17.5	16.8	I	8.4	13.8	6.3	9.6	11.5	C ⁻	-2.6	-6.0	-5.5	-7.9	-5.3
Lichen	27.0	37.9	32.5	48.4	42.7	I	25.8	24.7	15.9	19.6	18.0	I	-1.3	-13.2	-16.6	-28.8	-24.7

each treatment



Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5	
Utqiagvik dry (BD) site																		
Deciduous Shrub	15.0	28.5	24.5	23.0	28.3	I	14.9	24.3	20.0	24.1	27.2	.	-0.1	-4.2	-4.4	1.1	-1.2	
Evergreen Shrub	11.4	20.4	19.5	37.1	30.3	D ⁺	15.2	24.8	27.7	50.2	40.2	C ⁺	3.8	4.4	8.2	13.0	9.9	
Graminoid	3.0	7.3	8.2	8.0	18.0	D ⁺	4.5	12.3	19.6	17.7	29.4	D ⁺	1.4	5.0	11.4	9.7	11.4	
Forb	4.5	7.7	7.7	7.6	9.2	D ⁺	4.3	6.6	12.3	11.3	10.6	.	-0.3	-1.0	4.6	3.7	1.5	
Bryophyte	11.0	19.8	11.8	17.5	16.8	I	8.4	13.8	6.3	9.6	11.5	C ⁻	-2.6	-6.0	-5.5	-7.9	-5.3	
Lichen	27.0	37.9	32.5	48.4	42.7	I	25.8	24.7	15.9	19.6	18.0	I	-1.3	-13.2	-16.6	-28.8	-24.7	

each treatment



Utqiagvik Dry



Utqiagvik Dry



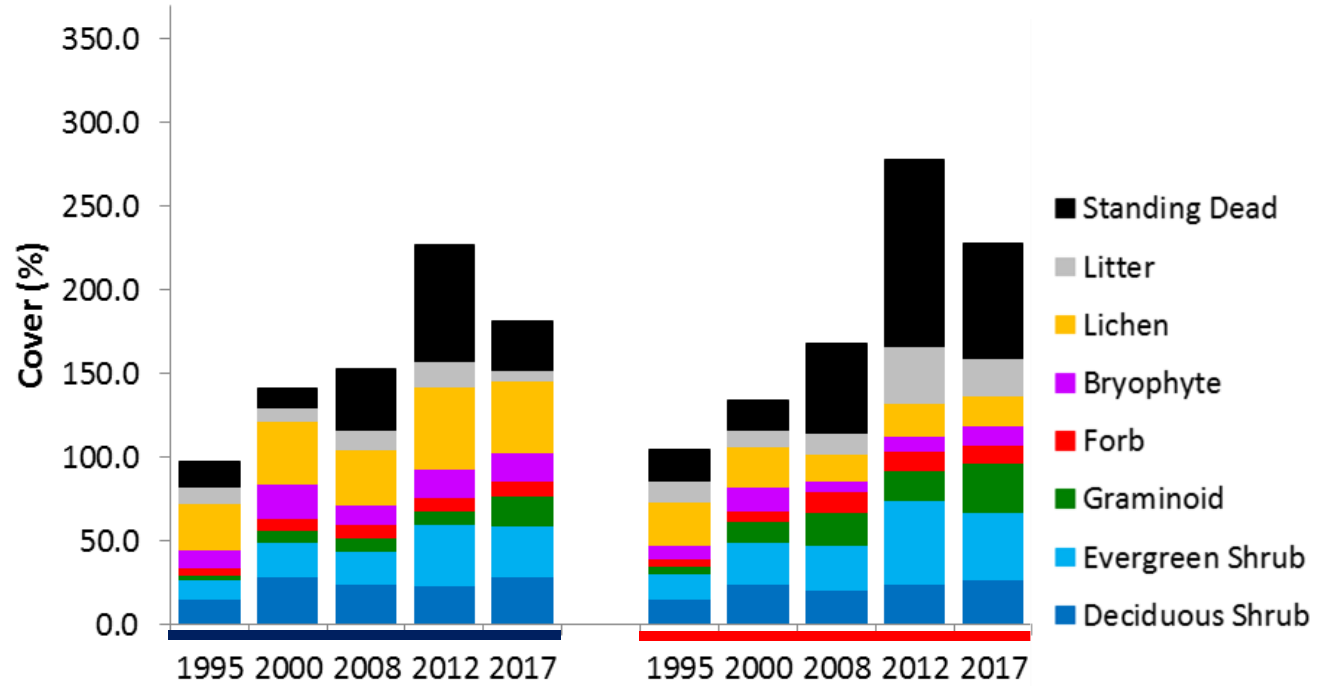
Utqiagvik Dry

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Utqiagvik dry (BD) site																	
■ Deciduous Shrub	15.0	28.5	24.5	23.0	28.3	I	14.9	24.3	20.0	24.1	27.2	.	-0.1	-4.2	-4.4	1.1	-1.2
■ Evergreen Shrub	11.4	20.4	19.5	37.1	30.3	D ⁺	15.2	24.8	27.7	50.2	40.2	C ⁺	3.8	4.4	8.2	13.0	9.9
■ Graminoid	3.0	7.3	8.2	8.0	18.0	D ⁺	4.5	12.3	19.6	17.7	29.4	D ⁺	1.4	5.0	11.4	9.7	11.4
■ Forb	4.5	7.7	7.7	7.6	9.2	D ⁺	4.3	6.6	12.3	11.3	10.6	.	-0.3	-1.0	4.6	3.7	1.5
■ Bryophyte	11.0	19.8	11.8	17.5	16.8	I	8.4	13.8	6.3	9.6	11.5	C ⁻	-2.6	-6.0	-5.5	-7.9	-5.3
■ Lichen	27.0	37.9	32.5	48.4	42.7	I	25.8	24.7	15.9	19.6	18.0	I	-1.3	-13.2	-16.6	-28.8	-24.7



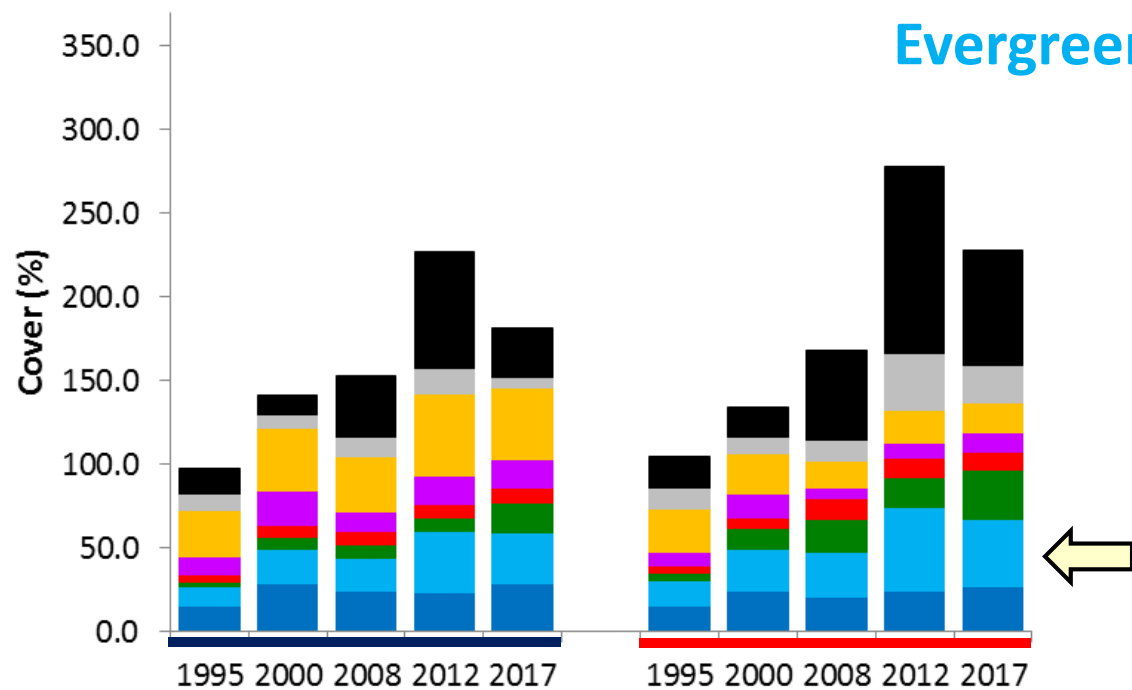
Utqiagvik Dry

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Utqiagvik dry (BD) site																	
Deciduous Shrub	15.0	28.5	24.5	23.0	28.3	I	14.9	24.3	20.0	24.1	27.2	.	-0.1	-4.2	-4.4	1.1	-1.2
Evergreen Shrub	11.4	20.4	19.5	37.1	30.3	D ⁺	15.2	24.8	27.7	50.2	40.2	C ⁺	3.8	4.4	8.2	13.0	9.9
Graminoid	3.0	7.3	8.2	8.0	18.0	D ⁺	4.5	12.3	19.6	17.7	29.4	D ⁺	1.4	5.0	11.4	9.7	11.4
Forb	4.5	7.7	7.7	7.6	9.2	D ⁺	4.3	6.6	12.3	11.3	10.6	.	-0.3	-1.0	4.6	3.7	1.5
Bryophyte	11.0	19.8	11.8	17.5	16.8	I	8.4	13.8	6.3	9.6	11.5	C ⁻	-2.6	-6.0	-5.5	-7.9	-5.3
Lichen	27.0	37.9	32.5	48.4	42.7	I	25.8	24.7	15.9	19.6	18.0	I	-1.3	-13.2	-16.6	-28.8	-24.7



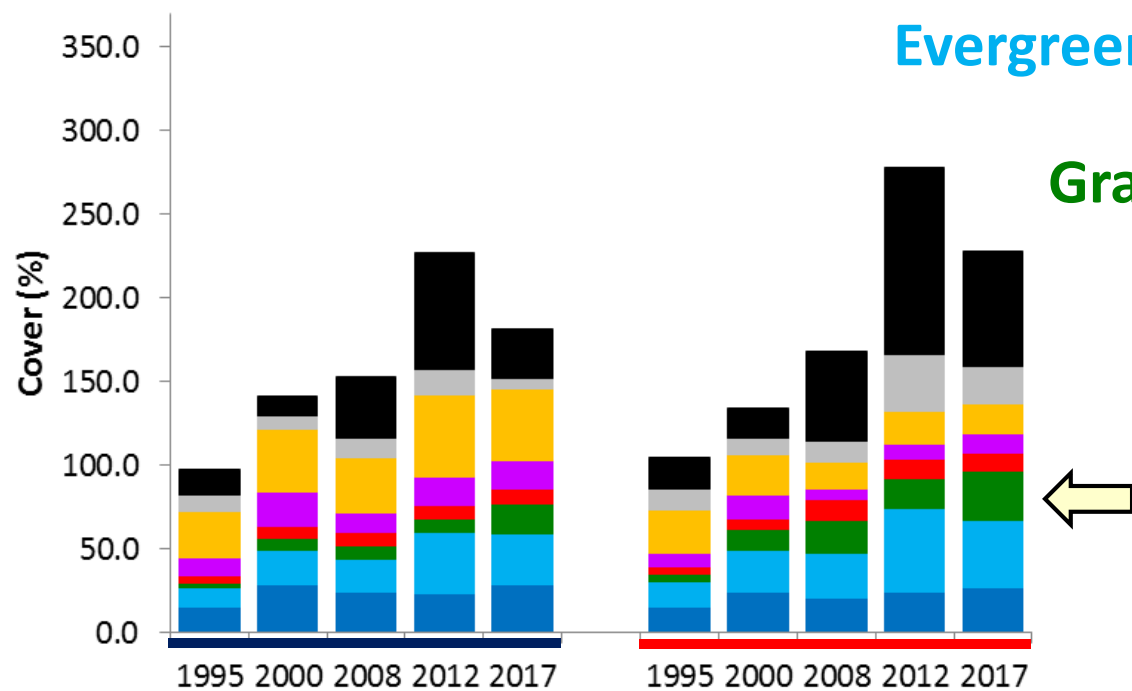
Utqiagvik Dry

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Utqiagvik dry (BD) site																	
Deciduous Shrub	15.0	28.5	24.5	23.0	28.3	I	14.9	24.3	20.0	24.1	27.2	.	-0.1	-4.2	-4.4	1.1	-1.2
Evergreen Shrub	11.4	20.4	19.5	37.1	30.3	D ⁺	15.2	24.8	27.7	50.2	40.2	C ⁺	3.8	4.4	8.2	13.0	9.9
Graminoid	3.0	7.3	8.2	8.0	18.0	D ⁺	4.5	12.3	19.6	17.7	29.4	D ⁺	1.4	5.0	11.4	9.7	11.4
Forb	4.5	7.7	7.7	7.6	9.2	D ⁺	4.3	6.6	12.3	11.3	10.6	.	-0.3	-1.0	4.6	3.7	1.5
Bryophyte	11.0	19.8	11.8	17.5	16.8	I	8.4	13.8	6.3	9.6	11.5	C ⁻	-2.6	-6.0	-5.5	-7.9	-5.3
Lichen	27.0	37.9	32.5	48.4	42.7	I	25.8	24.7	15.9	19.6	18.0	I	-1.3	-13.2	-16.6	-28.8	-24.7



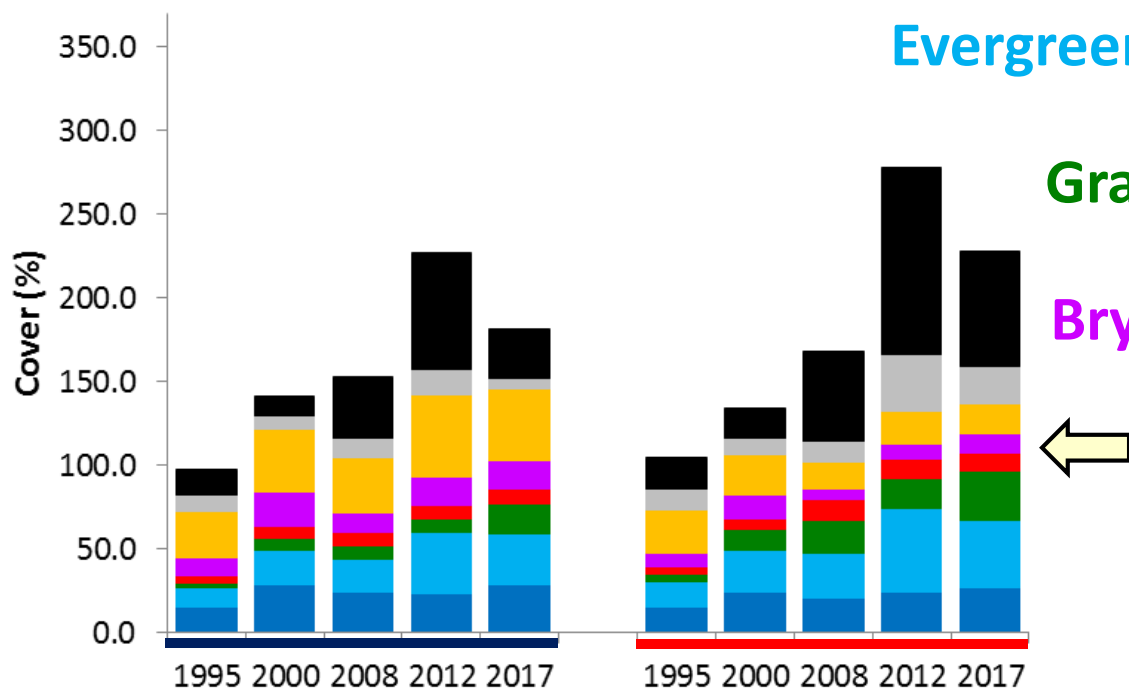
Utqiagvik Dry

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Utqiagvik dry (BD) site																	
Deciduous Shrub	15.0	28.5	24.5	23.0	28.3	I	14.9	24.3	20.0	24.1	27.2	.	-0.1	-4.2	-4.4	1.1	-1.2
Evergreen Shrub	11.4	20.4	19.5	37.1	30.3	D ⁺	15.2	24.8	27.7	50.2	40.2	C ⁺	3.8	4.4	8.2	13.0	9.9
Graminoid	3.0	7.3	8.2	8.0	18.0	D ⁺	4.5	12.3	19.6	17.7	29.4	D ⁺	1.4	5.0	11.4	9.7	11.4
Forb	4.5	7.7	7.7	7.6	9.2	D ⁺	4.3	6.6	12.3	11.3	10.6	.	-0.3	-1.0	4.6	3.7	1.5
Bryophyte	11.0	19.8	11.8	17.5	16.8	I	8.4	13.8	6.3	9.6	11.5	C ⁻	-2.6	-6.0	-5.5	-7.9	-5.3
Lichen	27.0	37.9	32.5	48.4	42.7	I	25.8	24.7	15.9	19.6	18.0	I	-1.3	-13.2	-16.6	-28.8	-24.7



Utqiagvik Dry

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Utqiagvik dry (BD) site																	
Deciduous Shrub	15.0	28.5	24.5	23.0	28.3	I	14.9	24.3	20.0	24.1	27.2	.	-0.1	-4.2	-4.4	1.1	-1.2
Evergreen Shrub	11.4	20.4	19.5	37.1	30.3	D ⁺	15.2	24.8	27.7	50.2	40.2	C ⁺	3.8	4.4	8.2	13.0	9.9
Graminoid	3.0	7.3	8.2	8.0	18.0	D ⁺	4.5	12.3	19.6	17.7	29.4	D ⁺	1.4	5.0	11.4	9.7	11.4
Forb	4.5	7.7	7.7	7.6	9.2	D ⁺	4.3	6.6	12.3	11.3	10.6	.	-0.3	-1.0	4.6	3.7	1.5
Bryophyte	11.0	19.8	11.8	17.5	16.8	I	8.4	13.8	6.3	9.6	11.5	C ⁻	-2.6	-6.0	-5.5	-7.9	-5.3
Lichen	27.0	37.9	32.5	48.4	42.7	I	25.8	24.7	15.9	19.6	18.0	I	-1.3	-13.2	-16.6	-28.8	-24.7



Utqiagvik Wet



Utqiagvik Wet



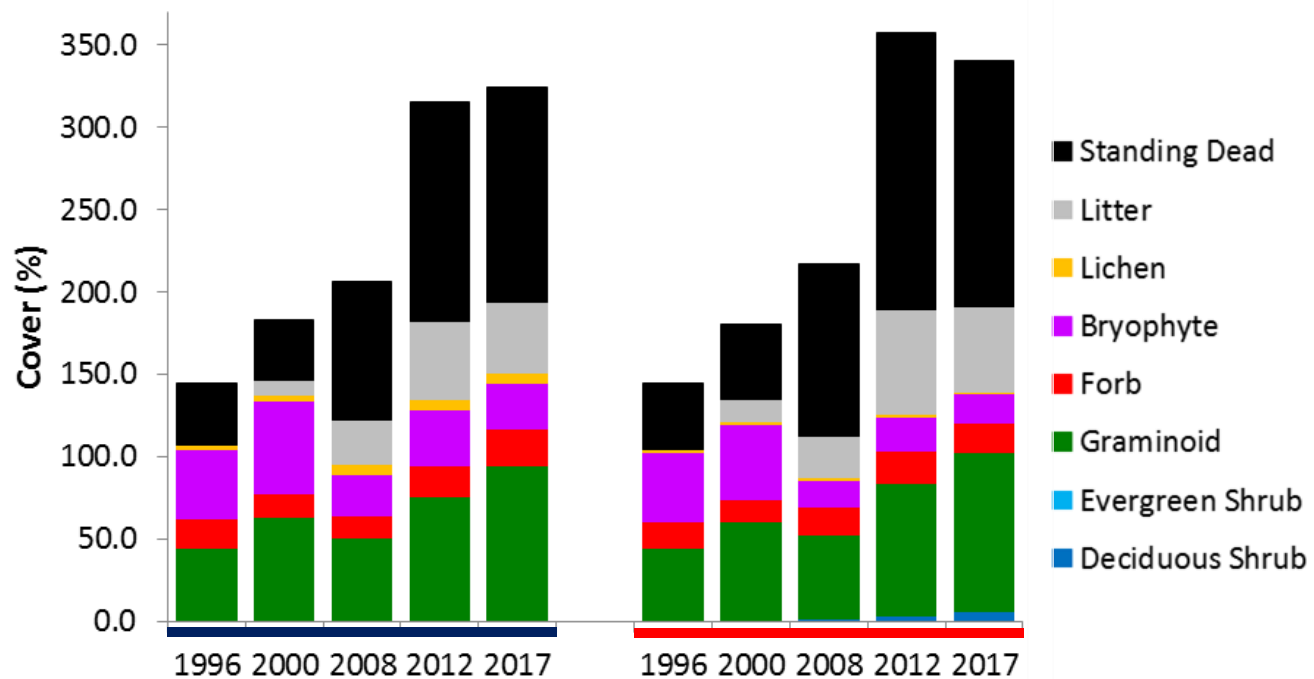
Utqiagvik Wet

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Utqiagvik wet (BW) site																	
■ Deciduous Shrub	0.2	0.0	0.0	0.3	1.0	I	0.3	0.7	1.8	3.8	6.1	D ⁺	0.2	0.6	1.8	3.5	5.1
■ Graminoid	43.3	63.0	50.6	75.6	93.6	D ⁺	44.4	60.4	51.3	80.0	96.6	.	1.1	-2.5	0.7	4.5	3.0
■ Forb	17.8	14.6	14.0	19.1	22.3	.	15.6	13.1	16.5	19.5	18.2	.	-2.2	-1.5	2.5	0.4	-4.1
■ Bryophyte	42.0	56.4	25.1	34.0	27.6	I	42.0	45.6	16.1	20.7	17.5	C ⁻	0.0	-10.8	-9.0	-13.3	-10.1
■ Lichen	2.5	3.3	5.5	6.0	6.1	.	1.8	1.8	1.8	1.9	1.1	D ⁻	-0.8	-1.5	-3.8	-4.2	-5.0



Utqiagvik Wet

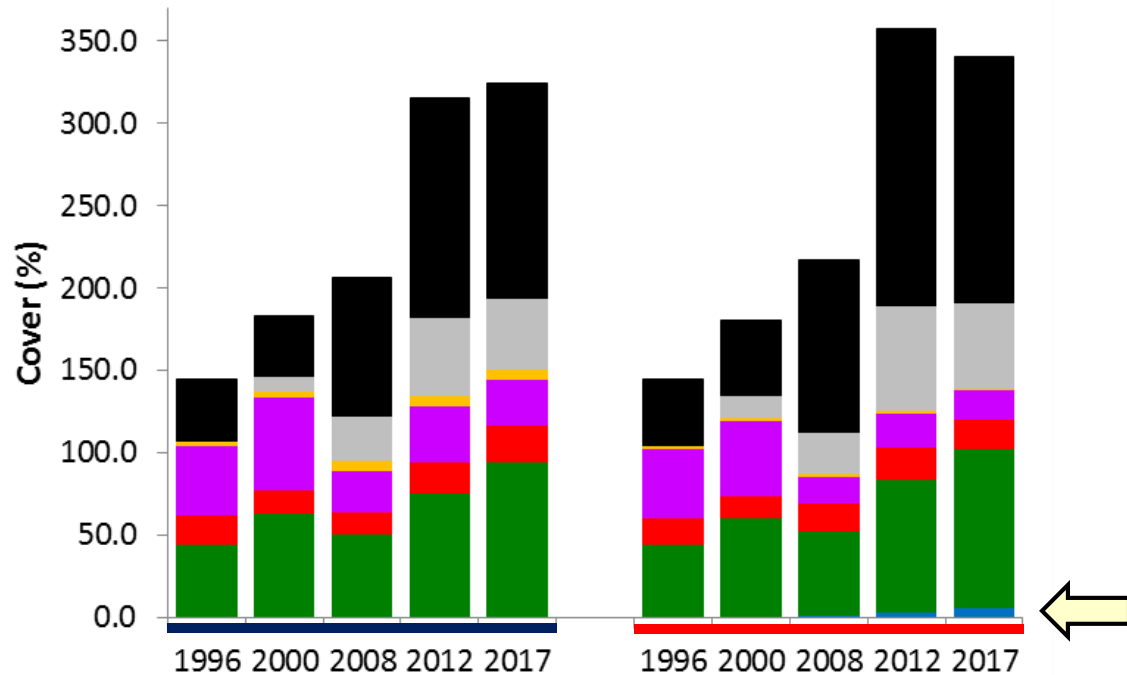
Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Utqiagvik wet (BW) site																	
Deciduous Shrub	0.2	0.0	0.0	0.3	1.0	I	0.3	0.7	1.8	3.8	6.1	D ⁺	0.2	0.6	1.8	3.5	5.1
Graminoid	43.3	63.0	50.6	75.6	93.6	D ⁺	44.4	60.4	51.3	80.0	96.6	.	1.1	-2.5	0.7	4.5	3.0
Forb	17.8	14.6	14.0	19.1	22.3	.	15.6	13.1	16.5	19.5	18.2	.	-2.2	-1.5	2.5	0.4	-4.1
Bryophyte	42.0	56.4	25.1	34.0	27.6	I	42.0	45.6	16.1	20.7	17.5	C ⁻	0.0	-10.8	-9.0	-13.3	-10.1
Lichen	2.5	3.3	5.5	6.0	6.1	.	1.8	1.8	1.8	1.9	1.1	D ⁻	-0.8	-1.5	-3.8	-4.2	-5.0



Utqiagvik Wet

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Utqiagvik wet (BW) site																	
Deciduous Shrub	0.2	0.0	0.0	0.3	1.0	I	0.3	0.7	1.8	3.8	6.1	D ⁺	0.2	0.6	1.8	3.5	5.1
Graminoid	43.3	63.0	50.6	75.6	93.6	D ⁺	44.4	60.4	51.3	80.0	96.6	.	1.1	-2.5	0.7	4.5	3.0
Forb	17.8	14.6	14.0	19.1	22.3	.	15.6	13.1	16.5	19.5	18.2	.	-2.2	-1.5	2.5	0.4	-4.1
Bryophyte	42.0	56.4	25.1	34.0	27.6	I	42.0	45.6	16.1	20.7	17.5	C ⁻	0.0	-10.8	-9.0	-13.3	-10.1
Lichen	2.5	3.3	5.5	6.0	6.1	.	1.8	1.8	1.8	1.9	1.1	D ⁻	-0.8	-1.5	-3.8	-4.2	-5.0

Deciduous Shrubs are

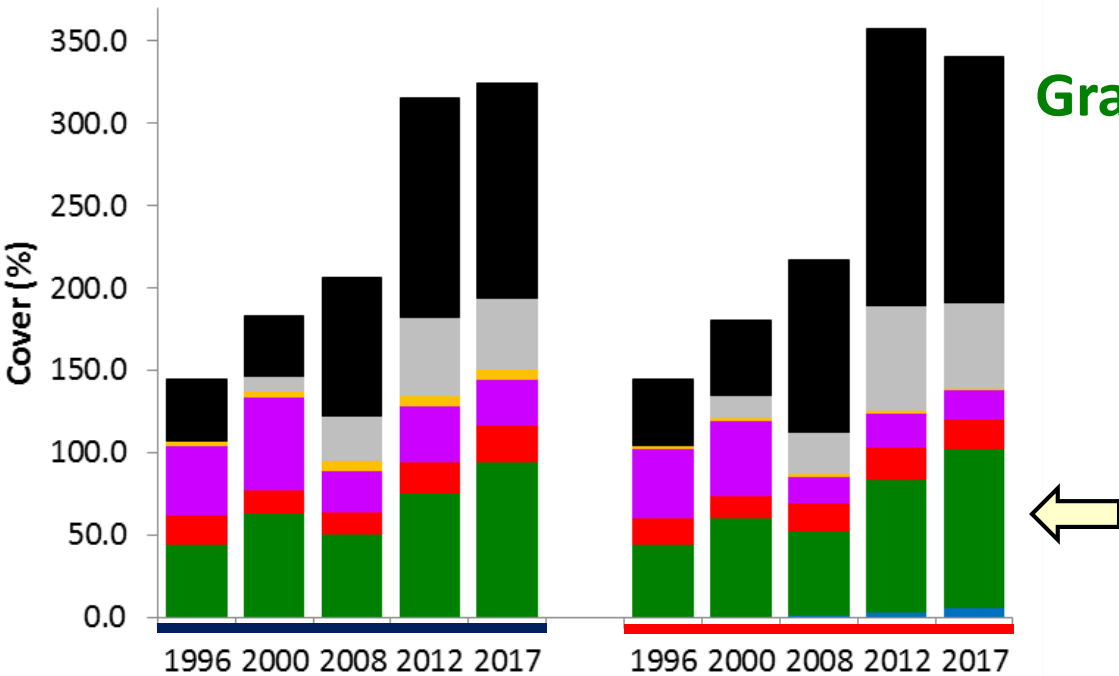
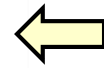


Utqiagvik Wet

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Utqiagvik wet (BW) site																	
Deciduous Shrub	0.2	0.0	0.0	0.3	1.0	I	0.3	0.7	1.8	3.8	6.1	D ⁺	0.2	0.6	1.8	3.5	5.1
Graminoid	43.3	63.0	50.6	75.6	93.6	D ⁺	44.4	60.4	51.3	80.0	96.6	.	1.1	-2.5	0.7	4.5	3.0
Forb	17.8	14.6	14.0	19.1	22.3	.	15.6	13.1	16.5	19.5	18.2	.	-2.2	-1.5	2.5	0.4	-4.1
Bryophyte	42.0	56.4	25.1	34.0	27.6	I	42.0	45.6	16.1	20.7	17.5	C ⁻	0.0	-10.8	-9.0	-13.3	-10.1
Lichen	2.5	3.3	5.5	6.0	6.1	.	1.8	1.8	1.8	1.9	1.1	D ⁻	-0.8	-1.5	-3.8	-4.2	-5.0

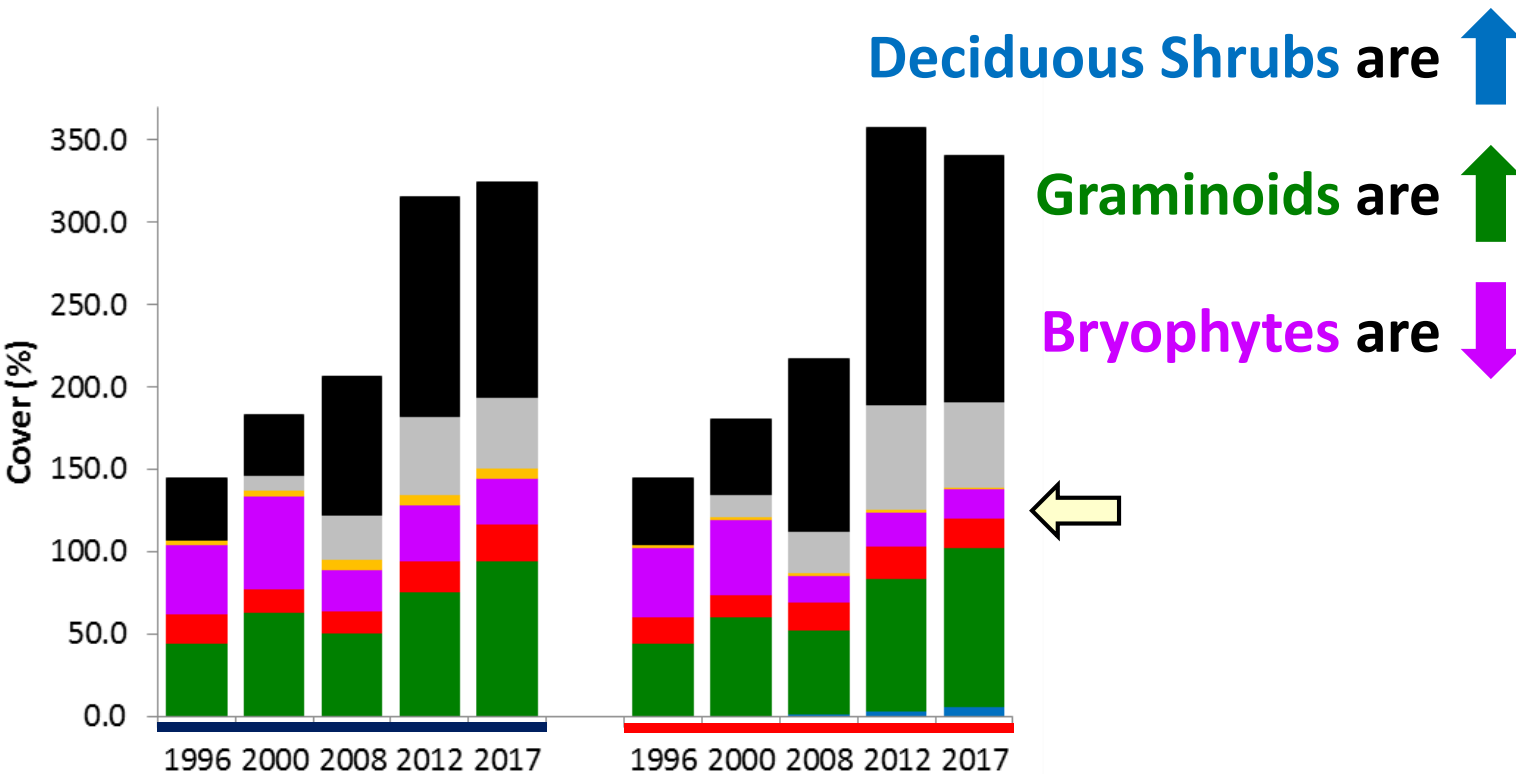
Deciduous Shrubs are 

Graminoids are 



Utqiagvik Wet

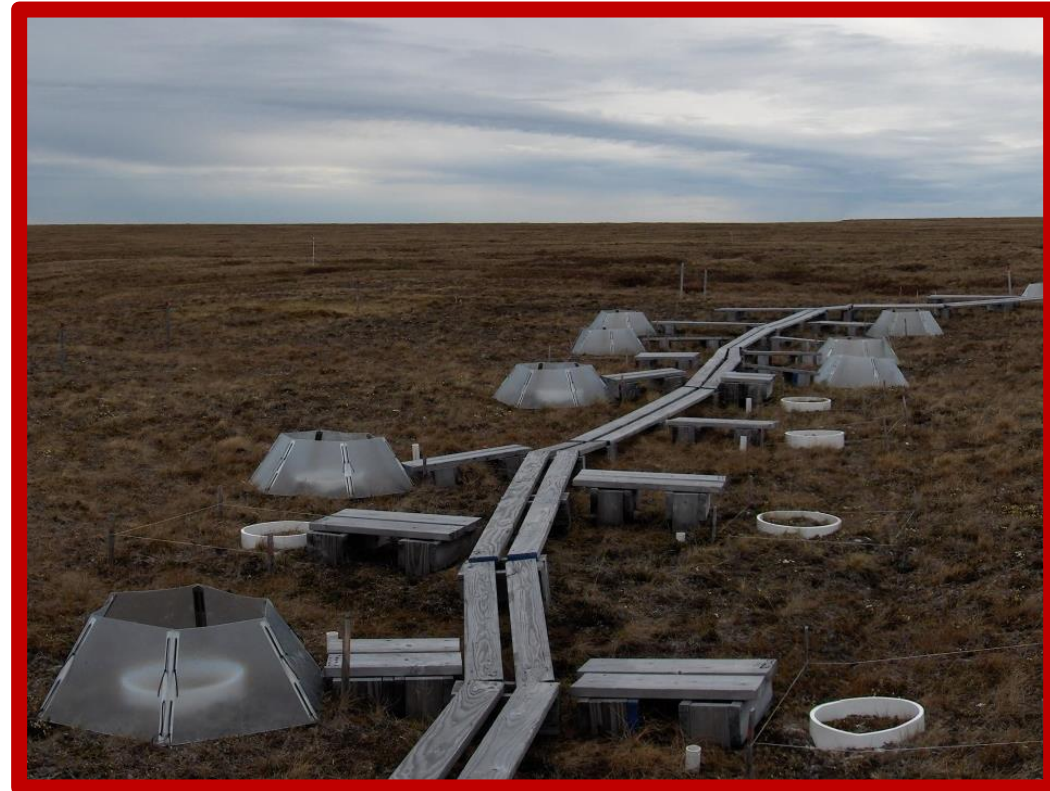
Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Utqiagvik wet (BW) site																	
Deciduous Shrub	0.2	0.0	0.0	0.3	1.0	I	0.3	0.7	1.8	3.8	6.1	D ⁺	0.2	0.6	1.8	3.5	5.1
Graminoid	43.3	63.0	50.6	75.6	93.6	D ⁺	44.4	60.4	51.3	80.0	96.6	.	1.1	-2.5	0.7	4.5	3.0
Forb	17.8	14.6	14.0	19.1	22.3	.	15.6	13.1	16.5	19.5	18.2	.	-2.2	-1.5	2.5	0.4	-4.1
Bryophyte	42.0	56.4	25.1	34.0	27.6	I	42.0	45.6	16.1	20.7	17.5	C ⁻	0.0	-10.8	-9.0	-13.3	-10.1
Lichen	2.5	3.3	5.5	6.0	6.1	.	1.8	1.8	1.8	1.9	1.1	D ⁻	-0.8	-1.5	-3.8	-4.2	-5.0



Atqasuk Dry



Atqasuk Dry



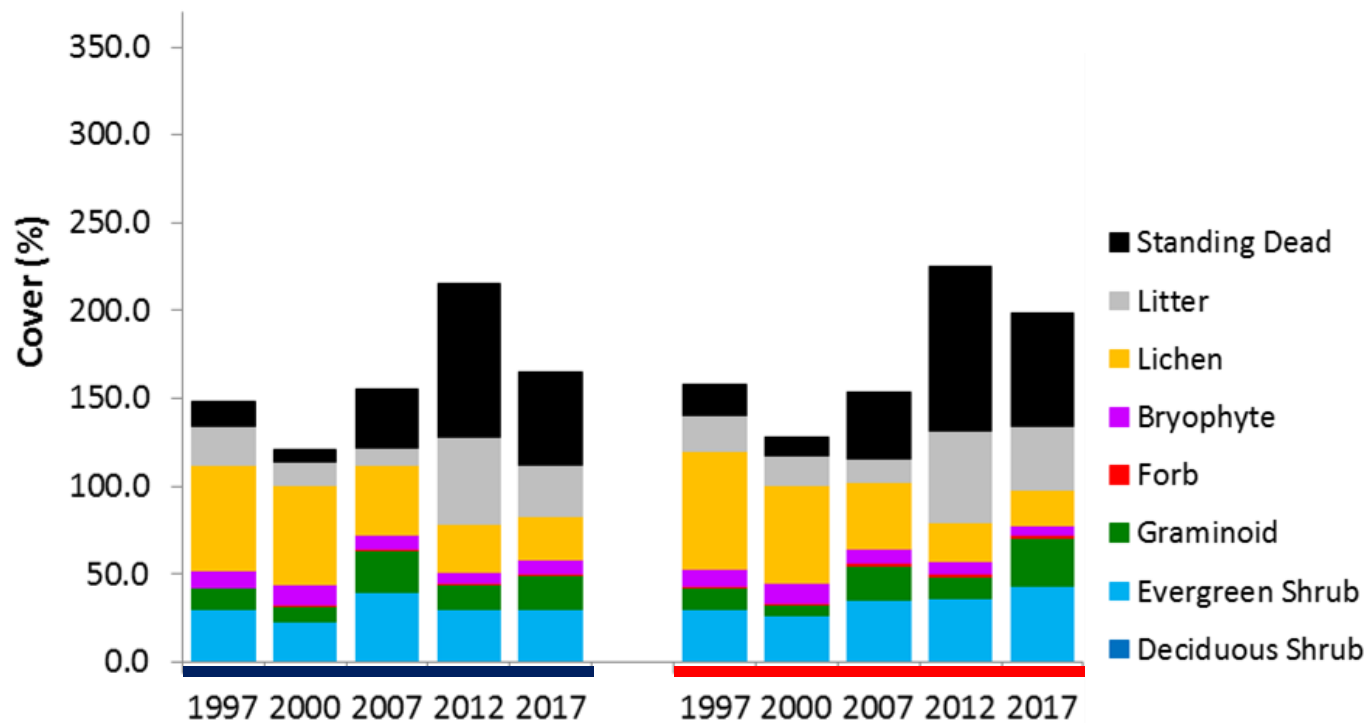
Atqasuk Dry

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Atqasuk dry (AD) site																	
■ Deciduous Shrub	0.5	0.4	0.6	0.5	1.0	.	0.3	0.3	0.5	0.7	0.8	.	-0.3	-0.1	-0.2	0.2	-0.2
■ Evergreen Shrub	29.2	22.6	38.8	29.2	29.1	I	29.8	26.1	35.2	35.7	42.3	I	0.6	3.5	-3.6	6.5	13.3
■ Graminoid	12.3	9.0	24.2	14.3	19.4	I	12.6	6.4	19.2	12.1	27.1	.	0.4	-2.6	-5.0	-2.2	7.7
■ Forb	0.7	0.4	0.9	0.7	1.1	.	0.7	0.8	1.6	1.6	2.2	C ⁺	0.0	0.5	0.7	0.9	1.0
■ Bryophyte	9.1	12.0	7.9	6.8	7.4	I	9.2	11.3	7.9	7.0	5.7	.	0.1	-0.7	0.0	0.3	-1.7
■ Lichen	60.1	56.3	39.9	27.3	25.3	D ⁻	67.2	55.8	37.9	22.2	19.5	I	7.0	-0.5	-2.0	-5.1	-5.9



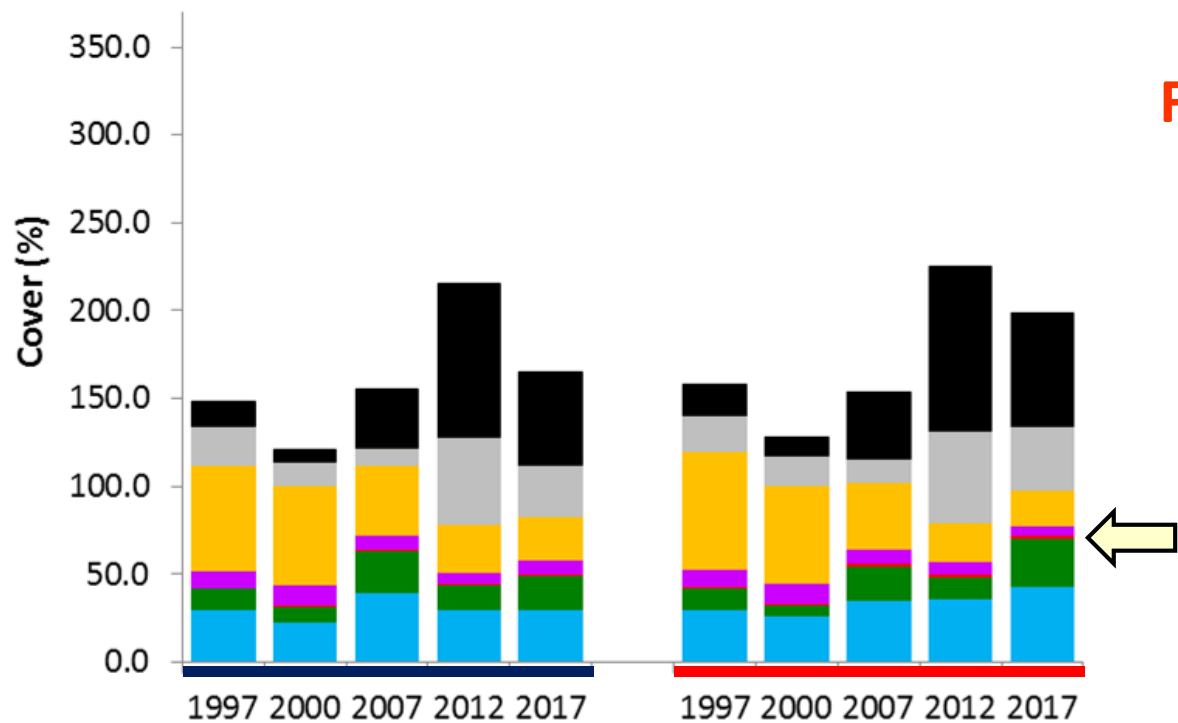
Atqasuk Dry

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Atqasuk dry (AD) site																	
Deciduous Shrub	0.5	0.4	0.6	0.5	1.0	.	0.3	0.3	0.5	0.7	0.8	.	-0.3	-0.1	-0.2	0.2	-0.2
Evergreen Shrub	29.2	22.6	38.8	29.2	29.1		29.8	26.1	35.2	35.7	42.3		0.6	3.5	-3.6	6.5	13.3
Graminoid	12.3	9.0	24.2	14.3	19.4		12.6	6.4	19.2	12.1	27.1	.	0.4	-2.6	-5.0	-2.2	7.7
Forb	0.7	0.4	0.9	0.7	1.1	.	0.7	0.8	1.6	1.6	2.2	C ⁺	0.0	0.5	0.7	0.9	1.0
Bryophyte	9.1	12.0	7.9	6.8	7.4		9.2	11.3	7.9	7.0	5.7	.	0.1	-0.7	0.0	0.3	-1.7
Lichen	60.1	56.3	39.9	27.3	25.3	D ⁻	67.2	55.8	37.9	22.2	19.5		7.0	-0.5	-2.0	-5.1	-5.9



Atqasuk Dry

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Atqasuk dry (AD) site																	
Deciduous Shrub	0.5	0.4	0.6	0.5	1.0	.	0.3	0.3	0.5	0.7	0.8	.	-0.3	-0.1	-0.2	0.2	-0.2
Evergreen Shrub	29.2	22.6	38.8	29.2	29.1	I	29.8	26.1	35.2	35.7	42.3	I	0.6	3.5	-3.6	6.5	13.3
Graminoid	12.3	9.0	24.2	14.3	19.4	I	12.6	6.4	19.2	12.1	27.1	.	0.4	-2.6	-5.0	-2.2	7.7
Forb	0.7	0.4	0.9	0.7	1.1	.	0.7	0.8	1.6	1.6	2.2	C ⁺	0.0	0.5	0.7	0.9	1.0
Bryophyte	9.1	12.0	7.9	6.8	7.4	I	9.2	11.3	7.9	7.0	5.7	.	0.1	-0.7	0.0	0.3	-1.7
Lichen	60.1	56.3	39.9	27.3	25.3	D ⁻	67.2	55.8	37.9	22.2	19.5	I	7.0	-0.5	-2.0	-5.1	-5.9

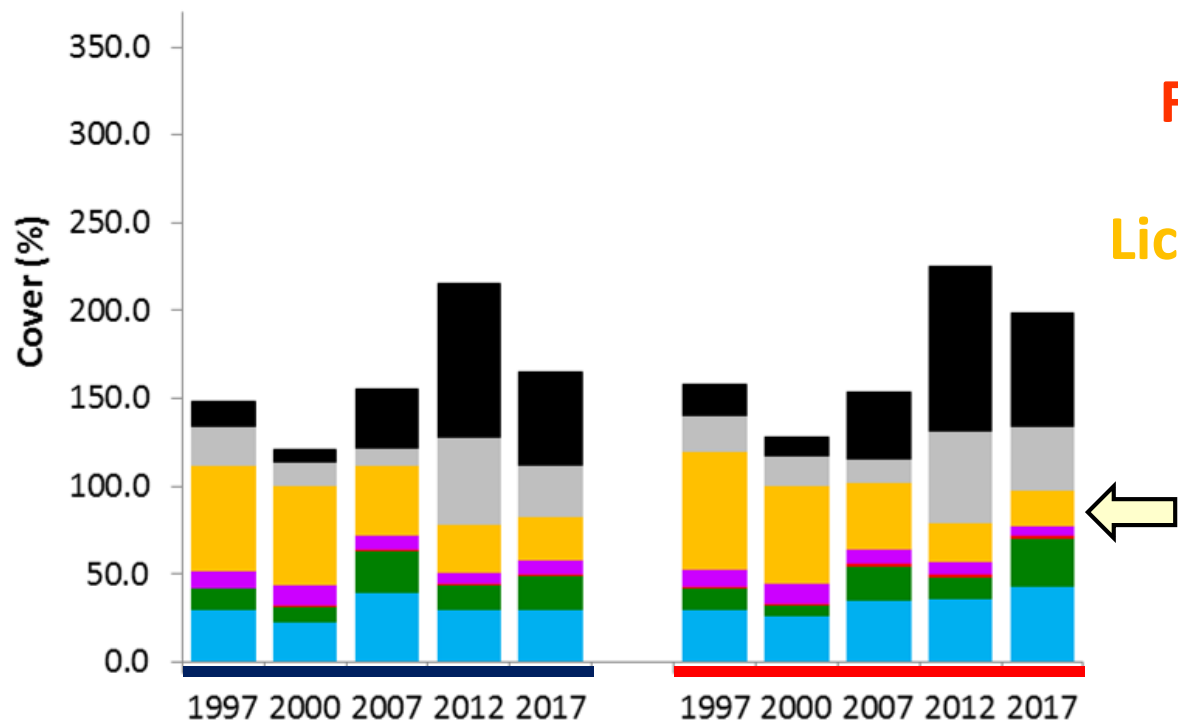


Forbs are



Atqasuk Dry

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Atqasuk dry (AD) site																	
Deciduous Shrub	0.5	0.4	0.6	0.5	1.0	.	0.3	0.3	0.5	0.7	0.8	.	-0.3	-0.1	-0.2	0.2	-0.2
Evergreen Shrub	29.2	22.6	38.8	29.2	29.1		29.8	26.1	35.2	35.7	42.3		0.6	3.5	-3.6	6.5	13.3
Graminoid	12.3	9.0	24.2	14.3	19.4		12.6	6.4	19.2	12.1	27.1	.	0.4	-2.6	-5.0	-2.2	7.7
Forb	0.7	0.4	0.9	0.7	1.1	.	0.7	0.8	1.6	1.6	2.2	C ⁺	0.0	0.5	0.7	0.9	1.0
Bryophyte	9.1	12.0	7.9	6.8	7.4		9.2	11.3	7.9	7.0	5.7	.	0.1	-0.7	0.0	0.3	-1.7
Lichen	60.1	56.3	39.9	27.3	25.3	D ⁻	67.2	55.8	37.9	22.2	19.5		7.0	-0.5	-2.0	-5.1	-5.9



Atqasuk Wet



Atqasuk Wet



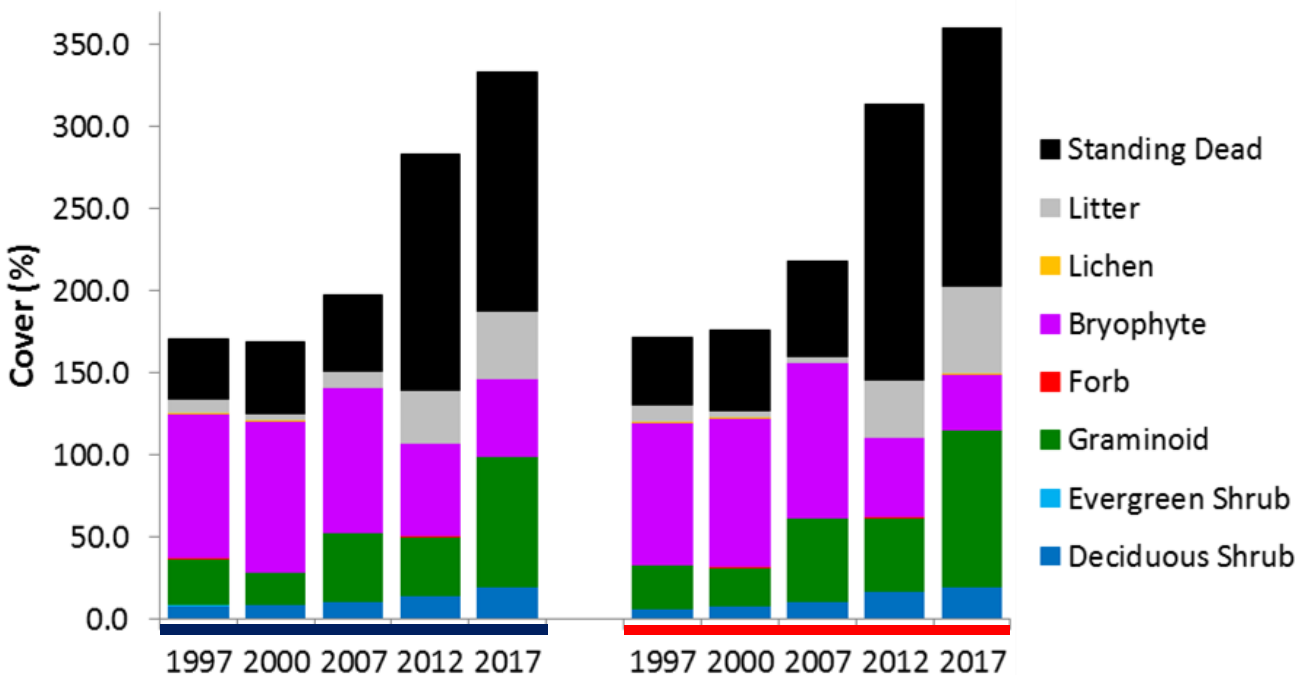
Atqasuk Wet

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Atqasuk wet (AW) site																	
■ Deciduous Shrub	8.0	8.6	10.8	14.3	19.8	D ⁺	6.2	8.0	10.3	17.3	19.9	.	-1.8	-0.6	-0.4	3.0	0.1
■ Graminoid	27.8	19.7	41.8	36.0	79.0	D ⁺	26.5	23.6	50.9	44.5	94.9	I	-1.3	3.9	9.1	8.5	15.9
■ Forb	0.5	0.5	0.5	0.3	0.6	.	0.5	0.3	0.3	0.6	0.3	.	0.0	-0.1	-0.3	0.3	-0.3
■ Bryophyte	87.8	91.8	87.8	56.1	47.0	D ⁻	86.7	90.8	95.0	48.3	33.7	I	-1.1	-1.1	7.3	-7.8	-13.3
■ Lichen	1.0	0.6	0.3	0.7	0.0	I	1.0	0.3	0.2	0.3	1.5	C ⁻	0.0	-0.3	-0.1	-0.4	1.5



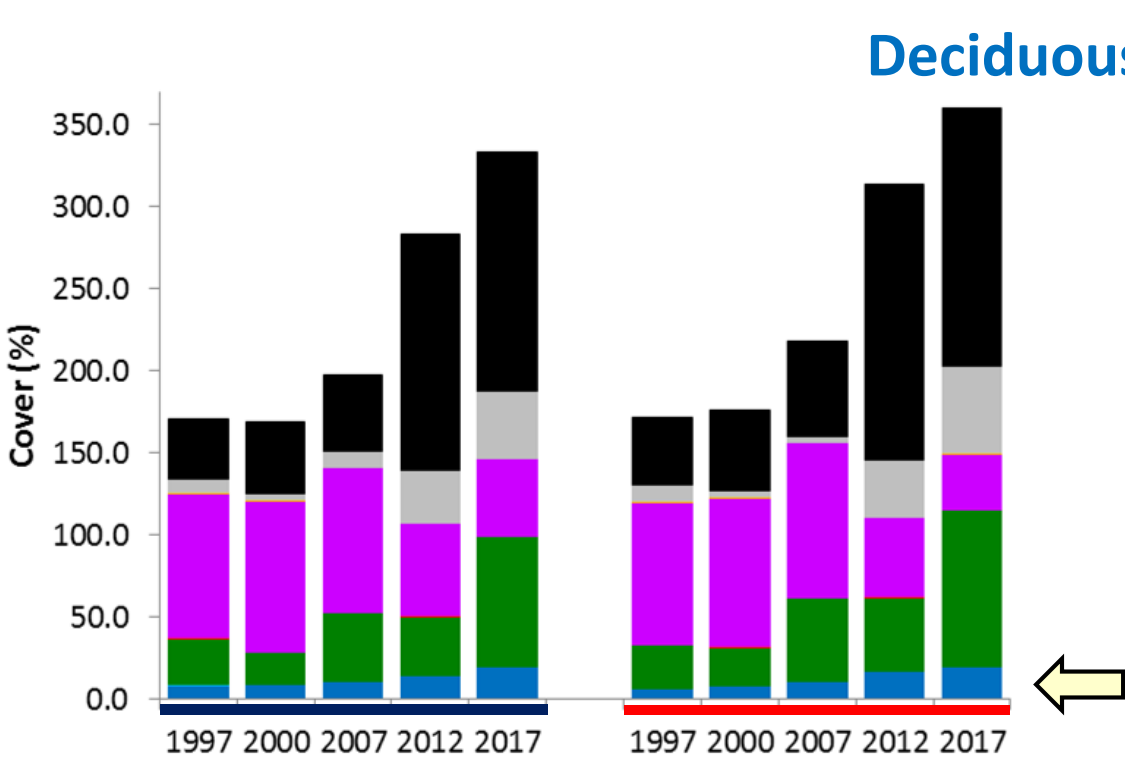
Atqasuk Wet

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Atqasuk wet (AW) site																	
Deciduous Shrub	8.0	8.6	10.8	14.3	19.8	D ⁺	6.2	8.0	10.3	17.3	19.9	.	-1.8	-0.6	-0.4	3.0	0.1
Graminoid	27.8	19.7	41.8	36.0	79.0	D ⁺	26.5	23.6	50.9	44.5	94.9	I	-1.3	3.9	9.1	8.5	15.9
Forb	0.5	0.5	0.5	0.3	0.6	.	0.5	0.3	0.3	0.6	0.3	.	0.0	-0.1	-0.3	0.3	-0.3
Bryophyte	87.8	91.8	87.8	56.1	47.0	D ⁻	86.7	90.8	95.0	48.3	33.7	I	-1.1	-1.1	7.3	-7.8	-13.3
Lichen	1.0	0.6	0.3	0.7	0.0	I	1.0	0.3	0.2	0.3	1.5	C ⁻	0.0	-0.3	-0.1	-0.4	1.5



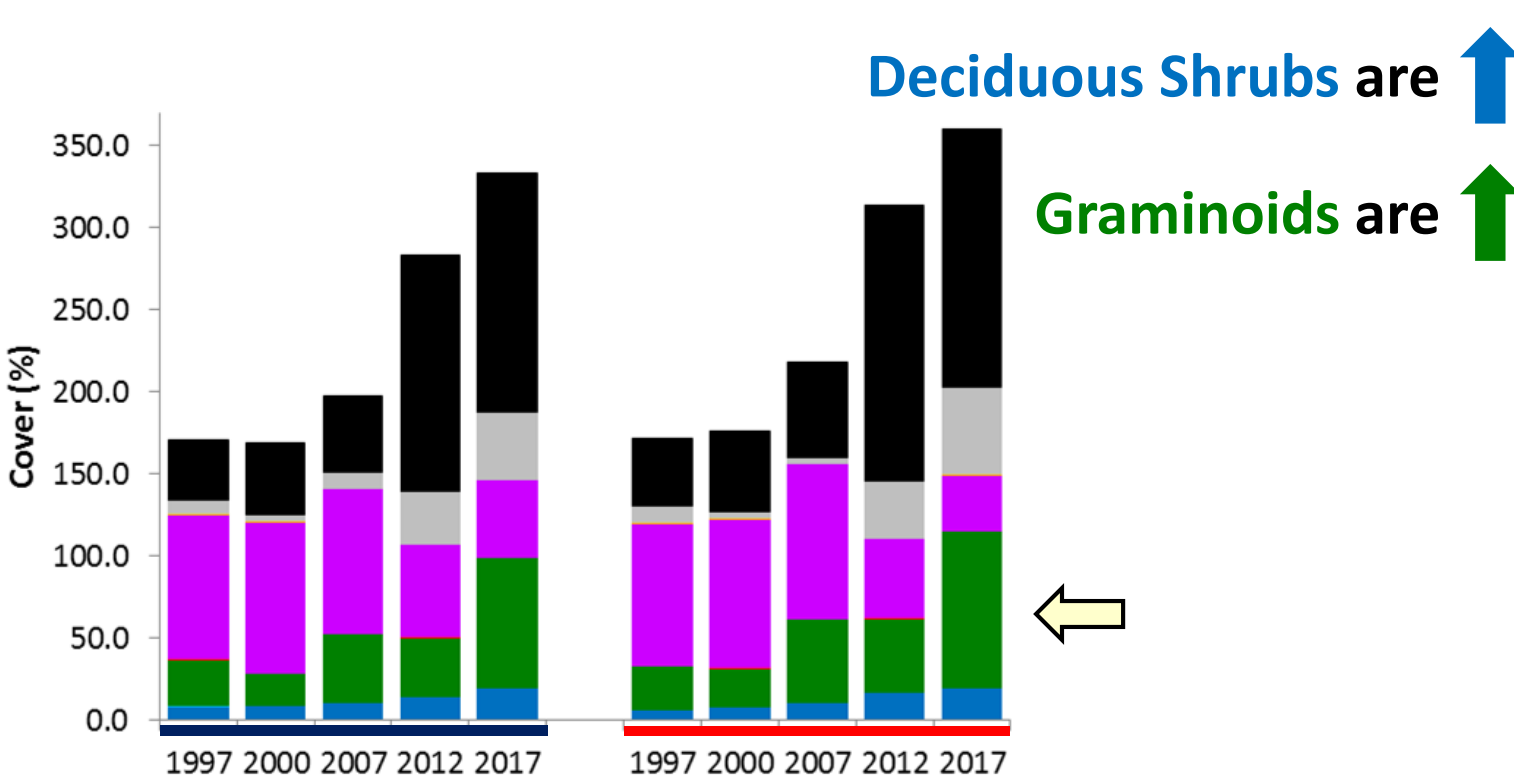
Atqasuk Wet

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Atqasuk wet (AW) site																	
Deciduous Shrub	8.0	8.6	10.8	14.3	19.8	D ⁺	6.2	8.0	10.3	17.3	19.9	.	-1.8	-0.6	-0.4	3.0	0.1
Graminoid	27.8	19.7	41.8	36.0	79.0	D ⁺	26.5	23.6	50.9	44.5	94.9	I	-1.3	3.9	9.1	8.5	15.9
Forb	0.5	0.5	0.5	0.3	0.6	.	0.5	0.3	0.3	0.6	0.3	.	0.0	-0.1	-0.3	0.3	-0.3
Bryophyte	87.8	91.8	87.8	56.1	47.0	D ⁻	86.7	90.8	95.0	48.3	33.7	I	-1.1	-1.1	7.3	-7.8	-13.3
Lichen	1.0	0.6	0.3	0.7	0.0	I	1.0	0.3	0.2	0.3	1.5	C ⁻	0.0	-0.3	-0.1	-0.4	1.5



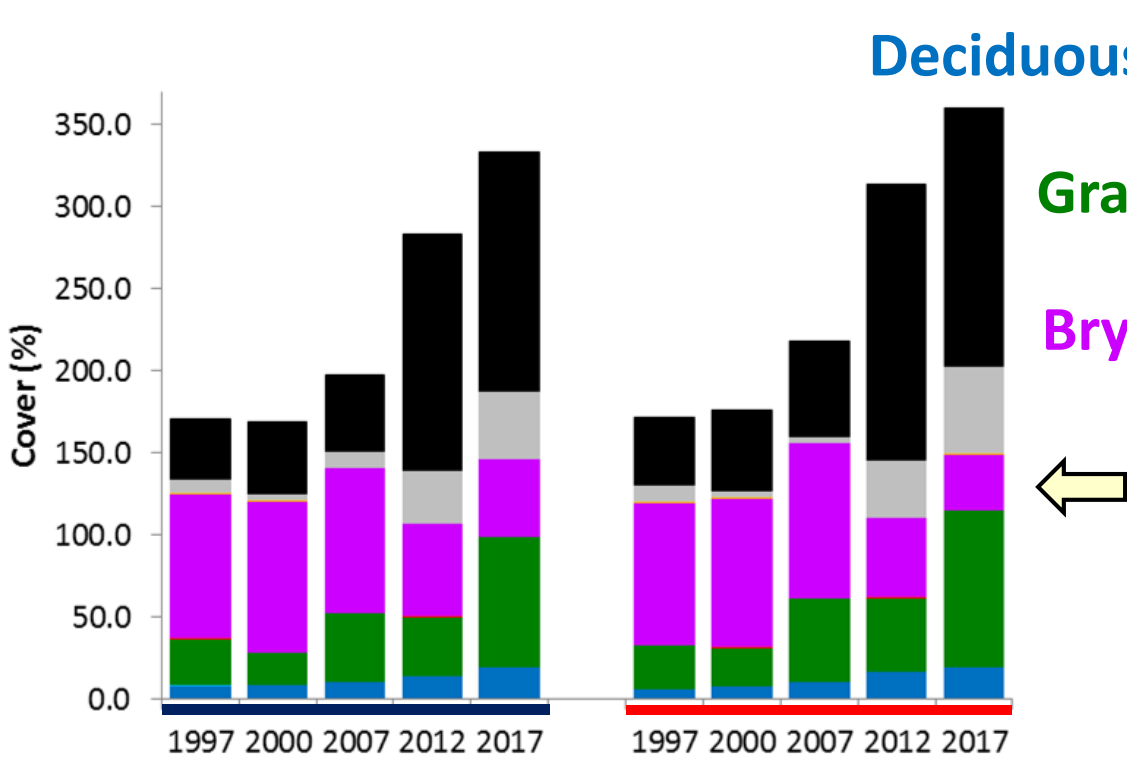
Atqasuk Wet

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Atqasuk wet (AW) site																	
Deciduous Shrub	8.0	8.6	10.8	14.3	19.8	D ⁺	6.2	8.0	10.3	17.3	19.9	.	-1.8	-0.6	-0.4	3.0	0.1
Graminoid	27.8	19.7	41.8	36.0	79.0	D ⁺	26.5	23.6	50.9	44.5	94.9	I	-1.3	3.9	9.1	8.5	15.9
Forb	0.5	0.5	0.5	0.3	0.6	.	0.5	0.3	0.3	0.6	0.3	.	0.0	-0.1	-0.3	0.3	-0.3
Bryophyte	87.8	91.8	87.8	56.1	47.0	D ⁻	86.7	90.8	95.0	48.3	33.7	I	-1.1	-1.1	7.3	-7.8	-13.3
Lichen	1.0	0.6	0.3	0.7	0.0	I	1.0	0.3	0.2	0.3	1.5	C ⁻	0.0	-0.3	-0.1	-0.4	1.5



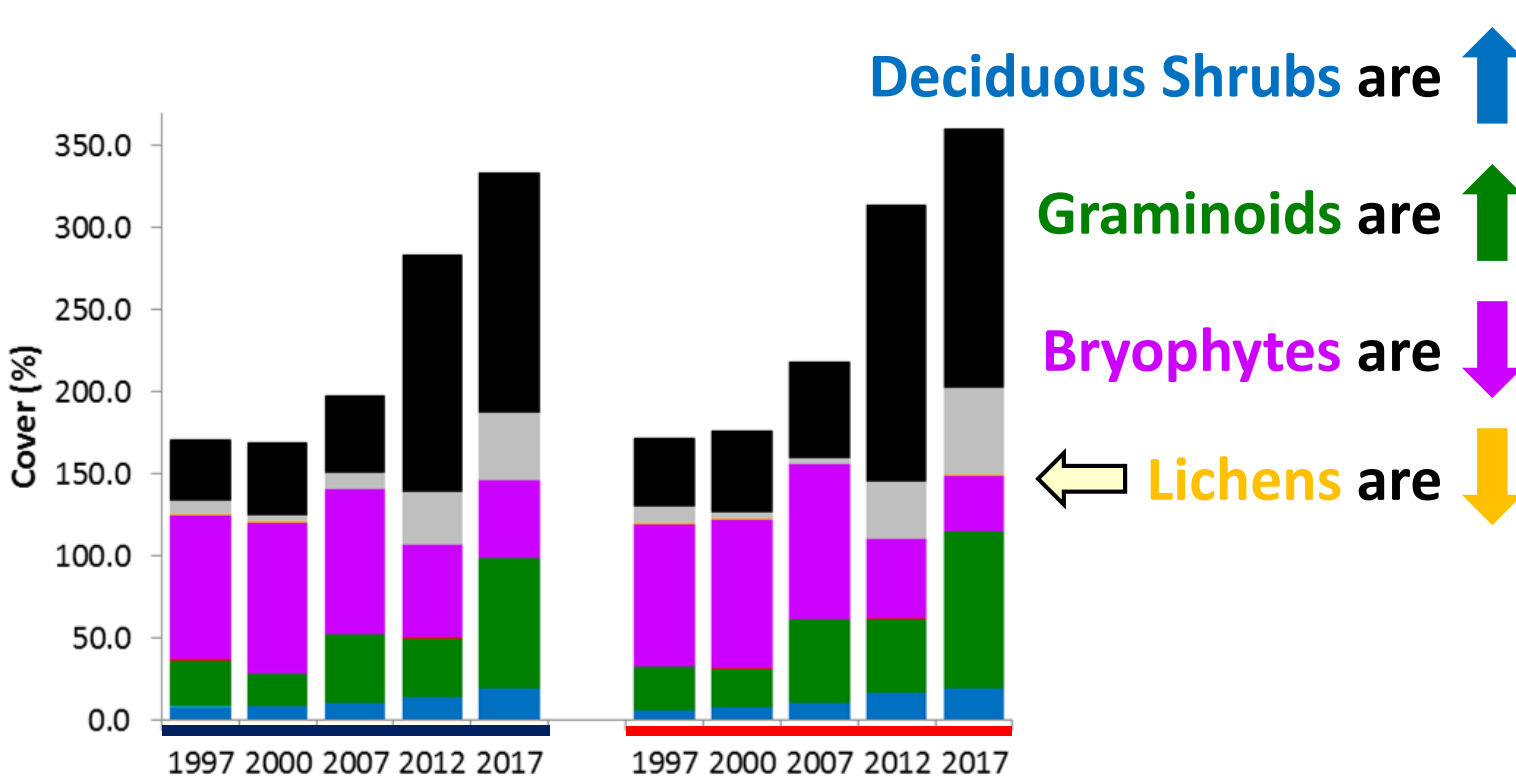
Atqasuk Wet

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Atqasuk wet (AW) site																	
Deciduous Shrub	8.0	8.6	10.8	14.3	19.8	D ⁺	6.2	8.0	10.3	17.3	19.9	.	-1.8	-0.6	-0.4	3.0	0.1
Graminoid	27.8	19.7	41.8	36.0	79.0	D ⁺	26.5	23.6	50.9	44.5	94.9	I	-1.3	3.9	9.1	8.5	15.9
Forb	0.5	0.5	0.5	0.3	0.6	.	0.5	0.3	0.3	0.6	0.3	.	0.0	-0.1	-0.3	0.3	-0.3
Bryophyte	87.8	91.8	87.8	56.1	47.0	D ⁻	86.7	90.8	95.0	48.3	33.7	I	-1.1	-1.1	7.3	-7.8	-13.3
Lichen	1.0	0.6	0.3	0.7	0.0	I	1.0	0.3	0.2	0.3	1.5	C ⁻	0.0	-0.3	-0.1	-0.4	1.5

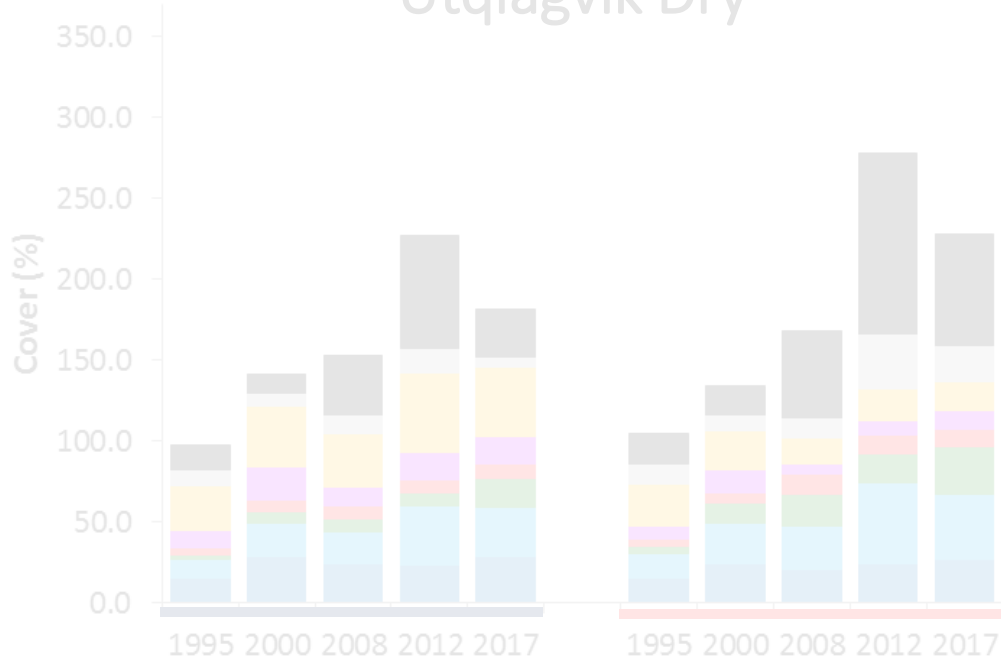


Atqasuk Wet

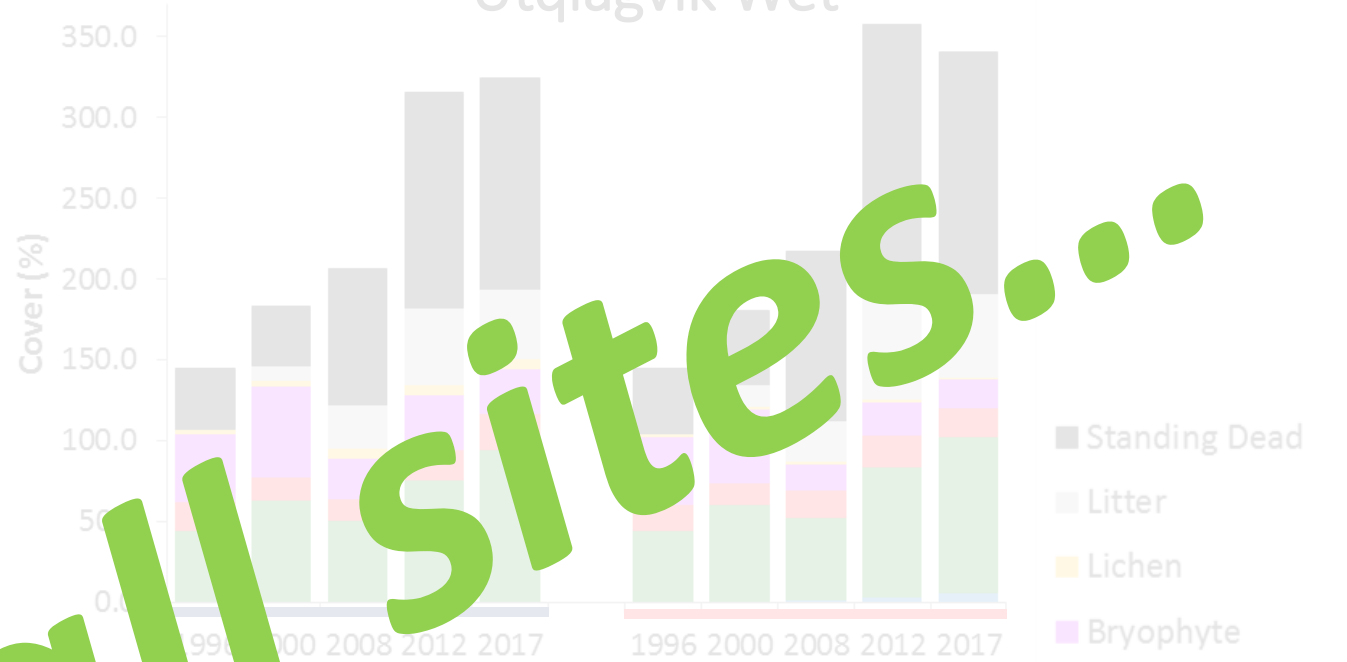
Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Atqasuk wet (AW) site																	
Deciduous Shrub	8.0	8.6	10.8	14.3	19.8	D ⁺	6.2	8.0	10.3	17.3	19.9	.	-1.8	-0.6	-0.4	3.0	0.1
Graminoid	27.8	19.7	41.8	36.0	79.0	D ⁺	26.5	23.6	50.9	44.5	94.9	I	-1.3	3.9	9.1	8.5	15.9
Forb	0.5	0.5	0.5	0.3	0.6	.	0.5	0.3	0.3	0.6	0.3	.	0.0	-0.1	-0.3	0.3	-0.3
Bryophyte	87.8	91.8	87.8	56.1	47.0	D ⁻	86.7	90.8	95.0	48.3	33.7	I	-1.1	-1.1	7.3	-7.8	-13.3
Lichen	1.0	0.6	0.3	0.7	0.0	I	1.0	0.3	0.2	0.3	1.5	C ⁻	0.0	-0.3	-0.1	-0.4	1.5



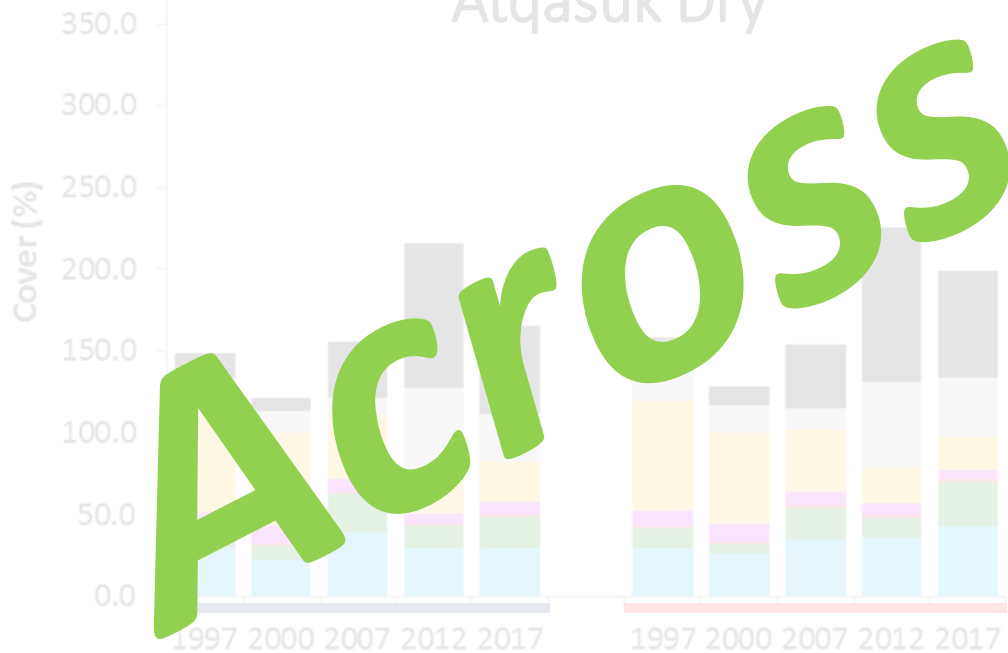
Utqiagvik Dry



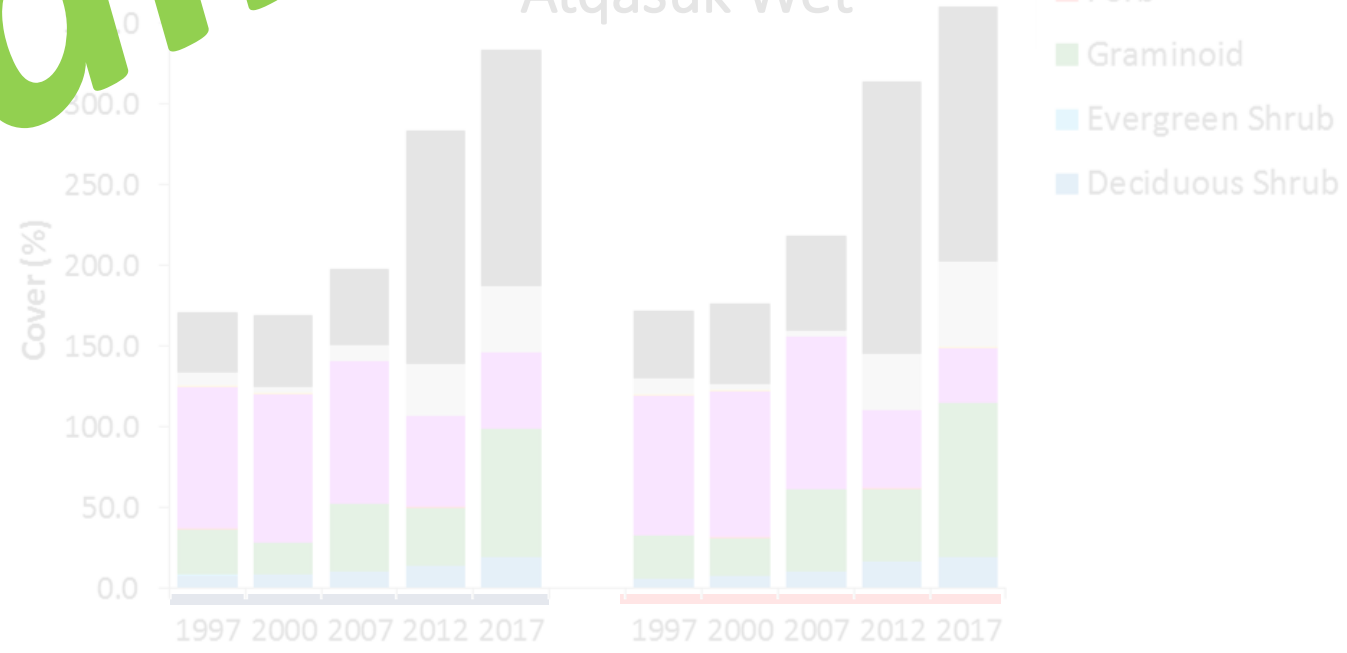
Utqiagvik Wet



Atqasuk Dry



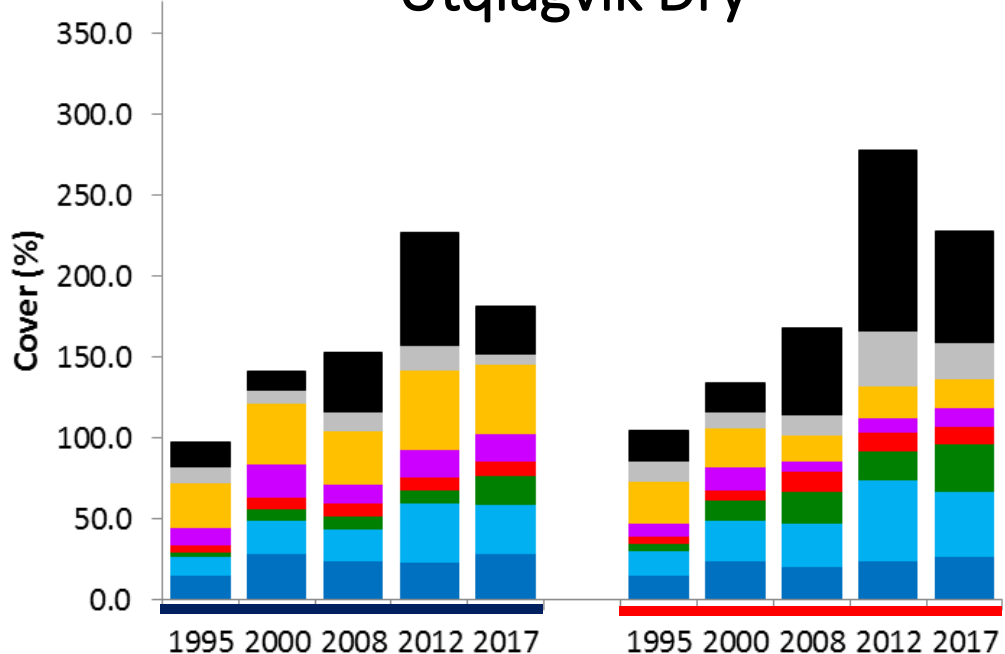
Atqasuk Wet



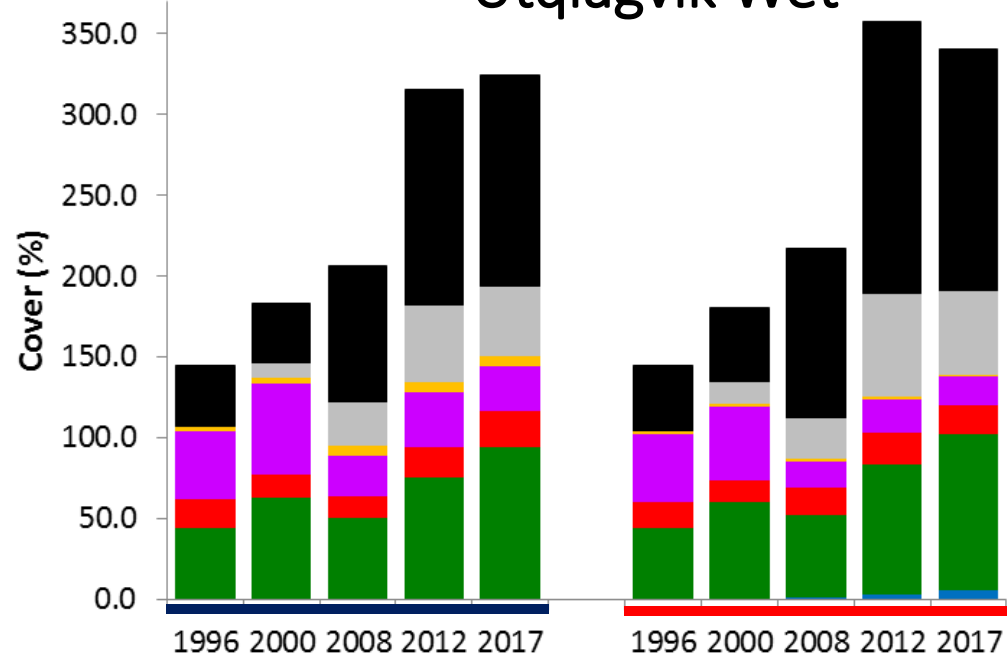
Across

all sites...

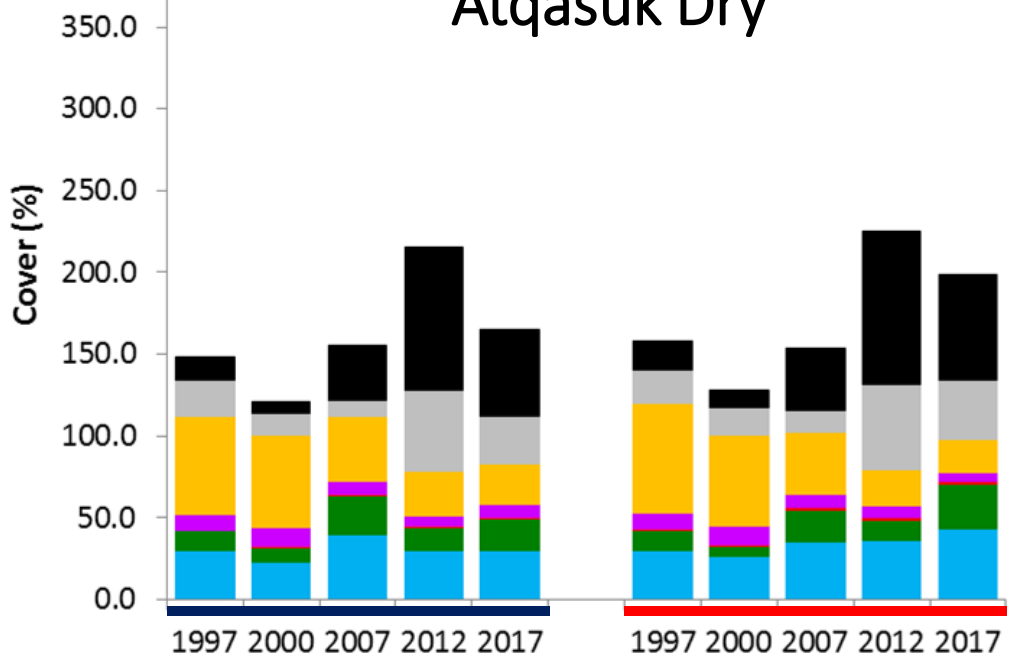
Utqiagvik Dry



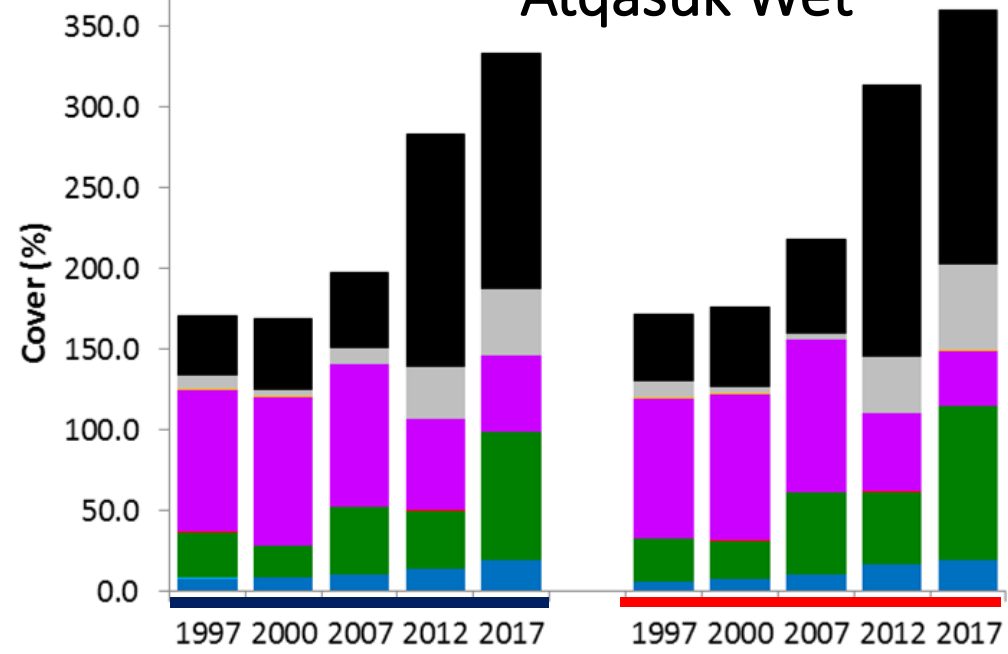
Utqiagvik Wet



Atqasuk Dry

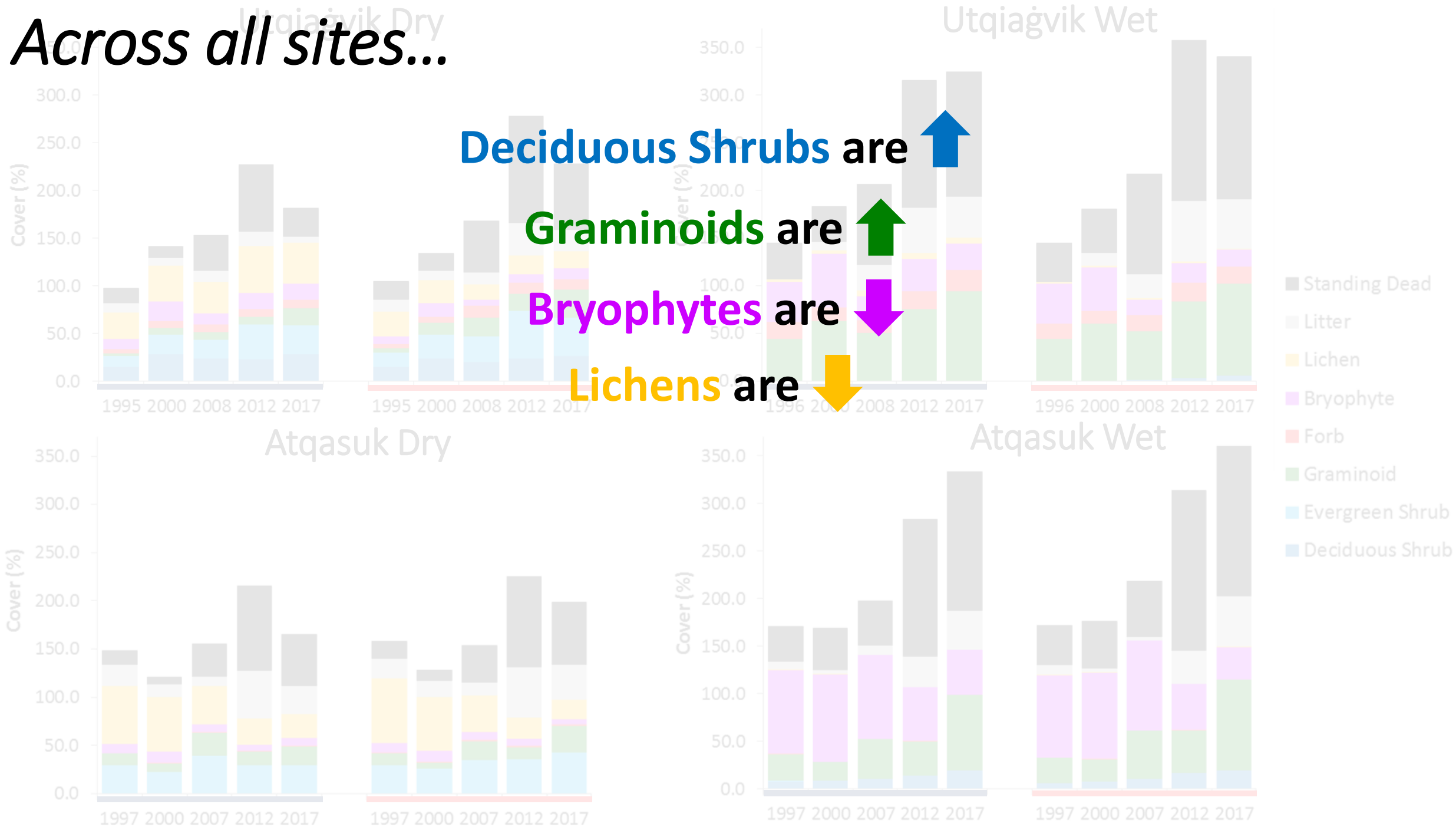


Atqasuk Wet

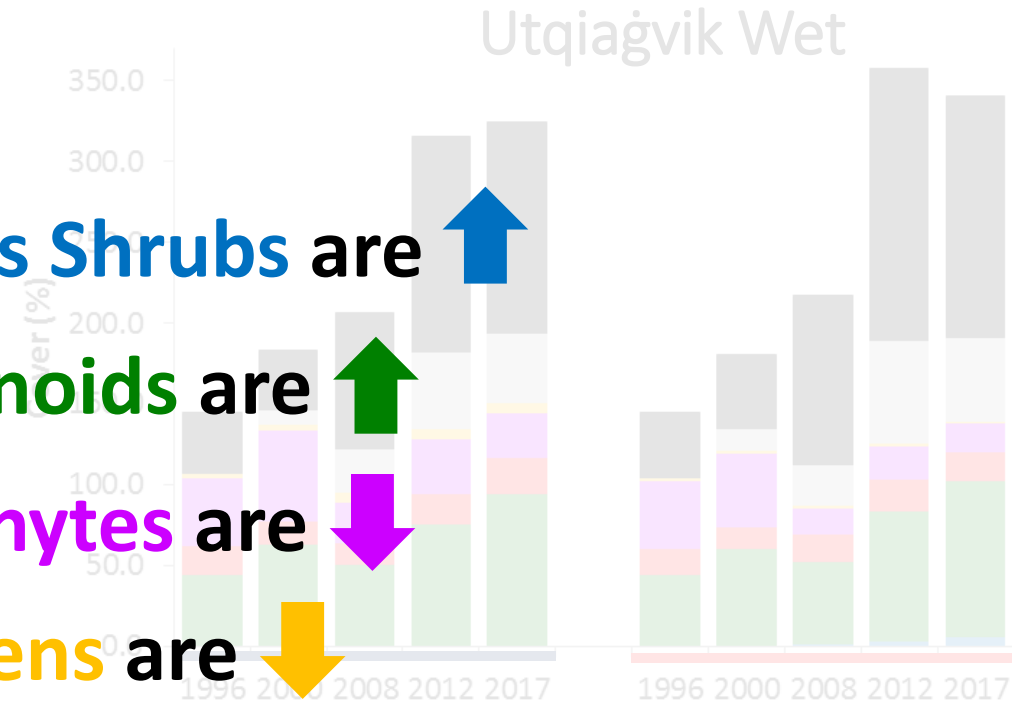
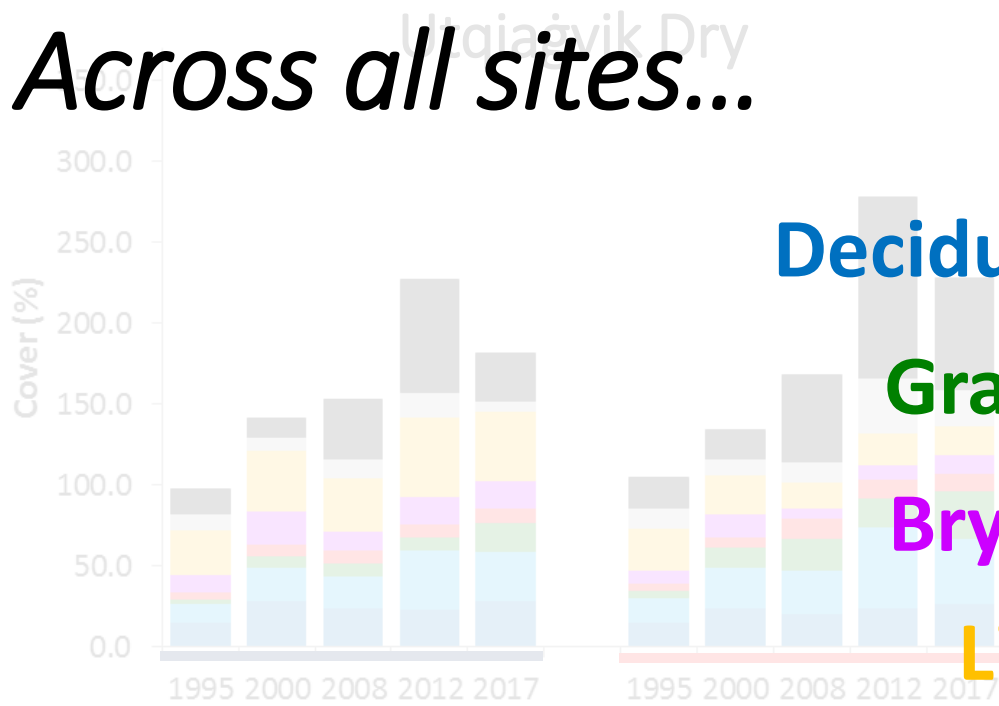


- Standing Dead
- Litter
- Lichen
- Bryophyte
- Forb
- Graminoid
- Evergreen Shrub
- Deciduous Shrub

Across all sites...



Across all sites...



Deciduous Shrubs are 

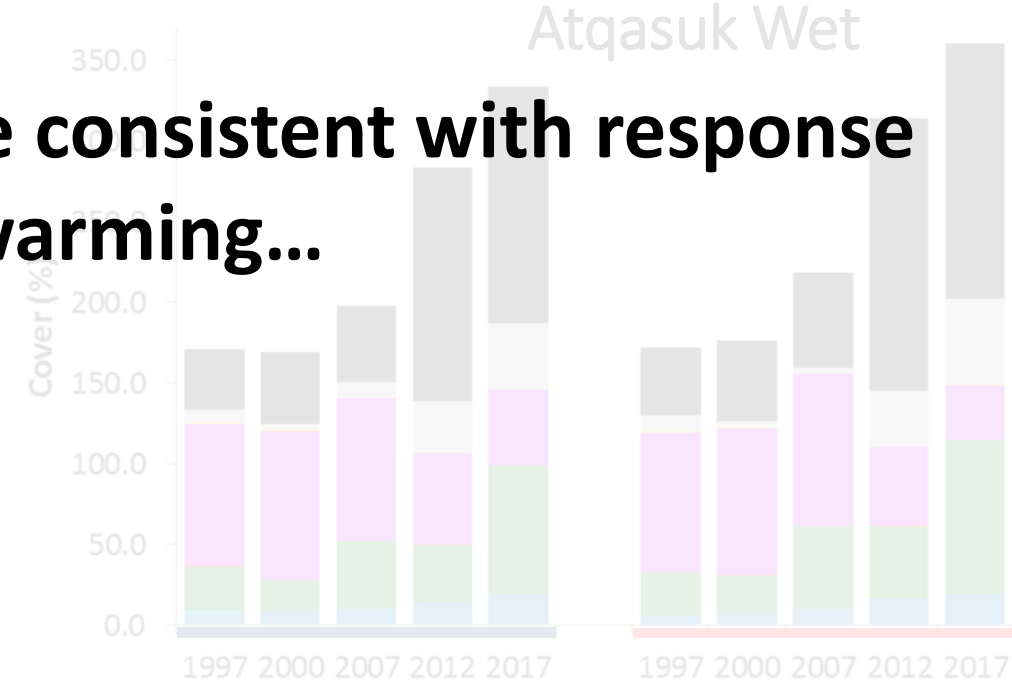
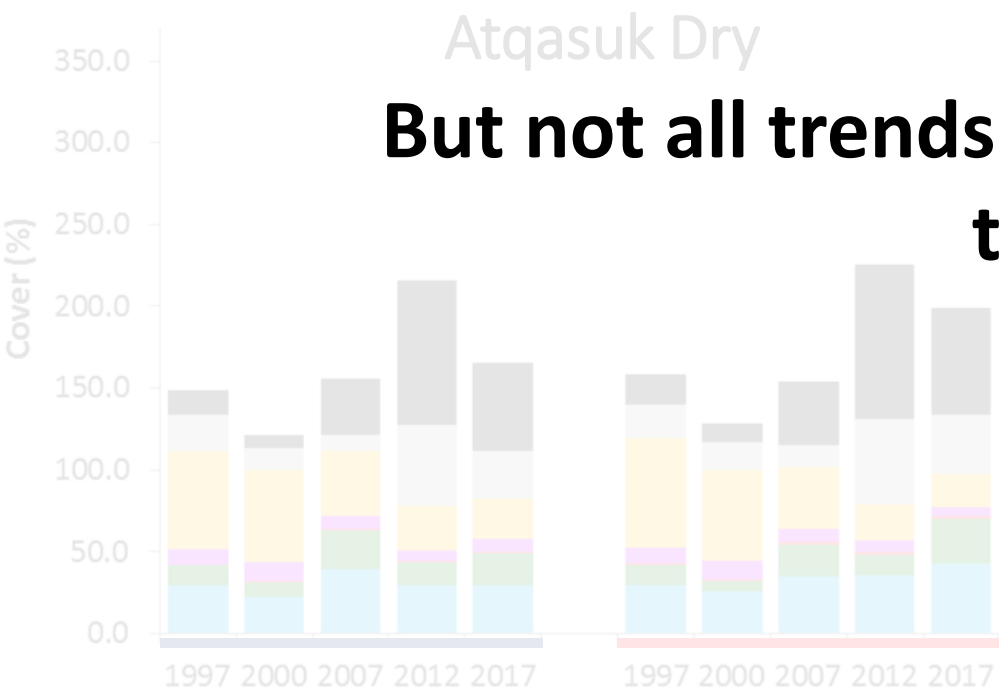
Graminoids are 

Bryophytes are 

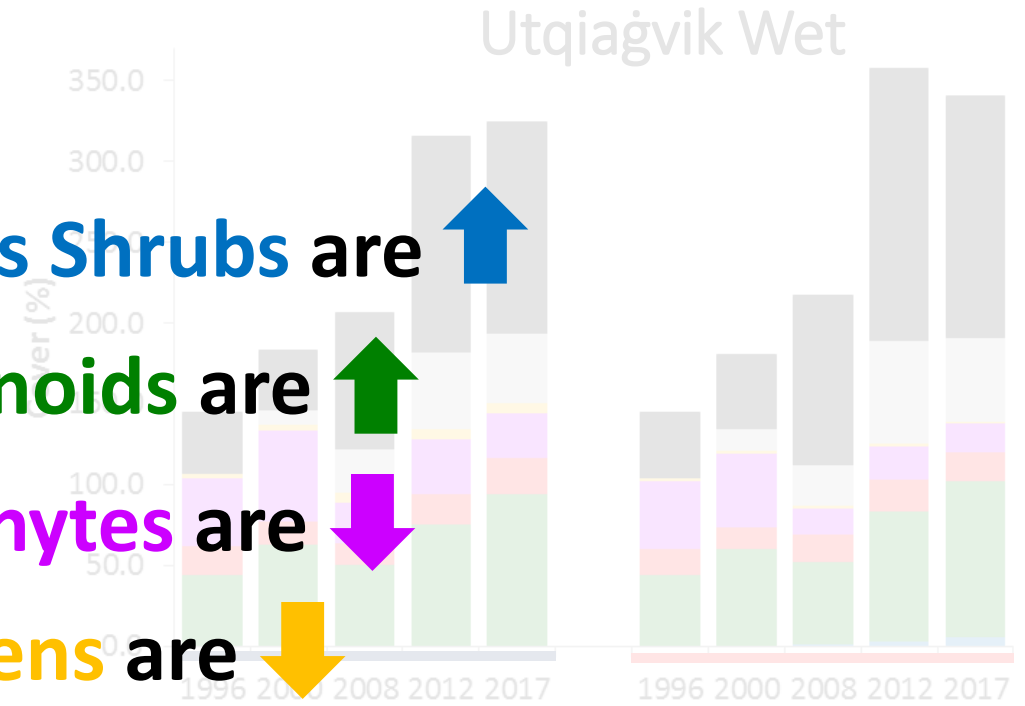
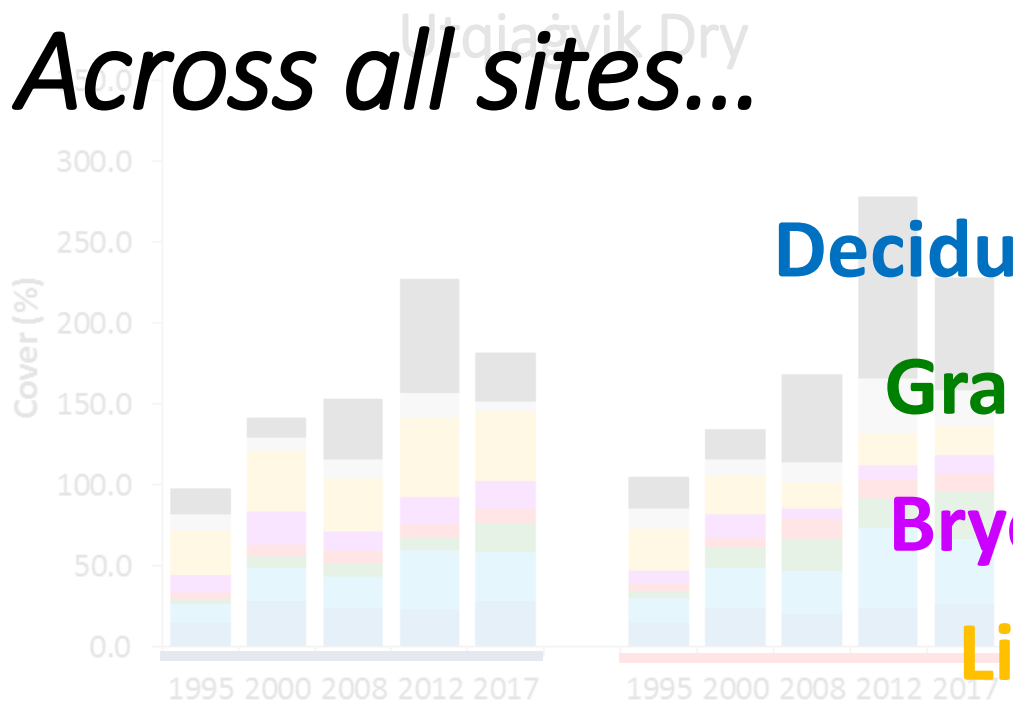
Lichens are 

- Standing Dead
- Litter
- Lichen
- Bryophyte
- Forb
- Graminoid
- Evergreen Shrub
- Deciduous Shrub

But not all trends are consistent with response to warming...



Across all sites...



Deciduous Shrubs are ↑

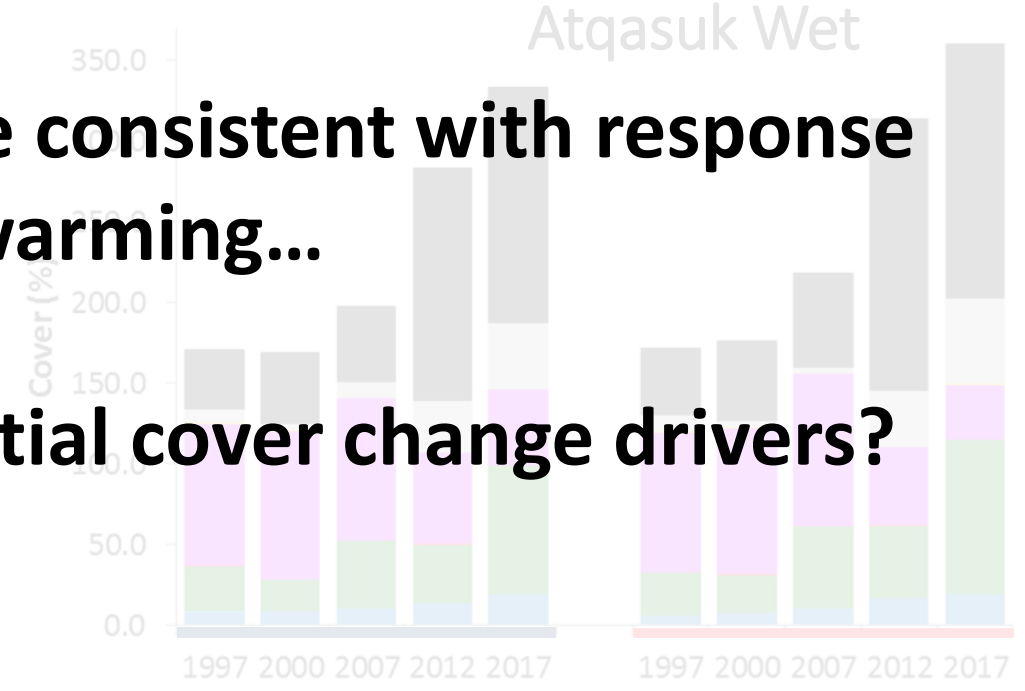
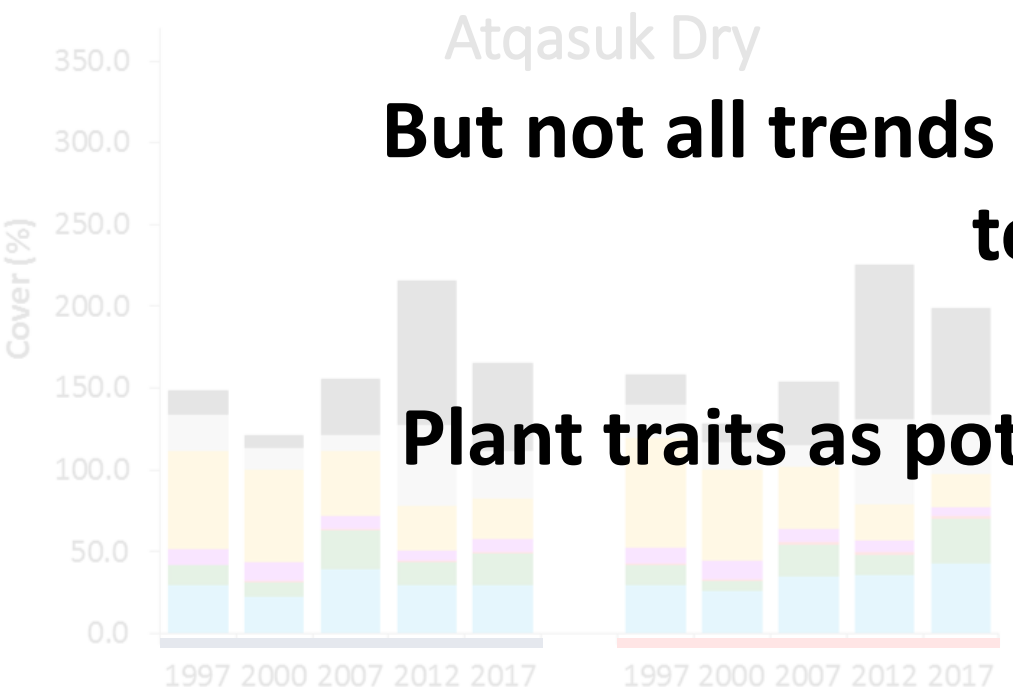
Graminoids are ↑

Bryophytes are ↓

Lichens are ↓

- Standing Dead
- Litter
- Lichen
- Bryophyte
- Forb
- Graminoid
- Evergreen Shrub
- Deciduous Shrub

But not all trends are consistent with response to warming...



Plant traits as potential cover change drivers?

Plant Traits!

Plant Height

C:N Ratio

Leaf Dry Matter Content

Leaf Carbon

Leaf Nitrogen

Leaf Phosphorous

Dry Seed Mass

Specific Leaf Area

Utqiagvik



At Utqiaġvik...



At Utqiagvik...

Site	Plant Height	C:N Ratio	LDMC	Leaf C	Leaf N	Leaf P	Seed Mass	SLA
Utqiagvik	0.45	0.72 *	0.32	0.63 *	-0.22	-0.39	0.73 *	-0.16
Utqiagvik Dry (BD)	0.45	0.67 *	0.41	0.74 *	-0.26	-0.43	0.72 *	-0.42
Utqiagvik Wet (BW)	0.53	-0.69 *	0.28	0.06	0.07	-0.43	0.31	0.07



At Utqiagvik...

Site	Plant Height	C:N Ratio	LDMC	Leaf C	Leaf N	Leaf P	Seed Mass	SLA
Utqiagvik	0.45	0.72 *	0.32	0.63 *	-0.22	-0.39	0.73 *	-0.16
Utqiagvik Dry (BD)	0.45	0.67 *	0.41	0.74 *	-0.26	-0.43	0.72 *	-0.42
Utqiagvik Wet (BW)	0.53	-0.69 *	0.28	0.06	0.07	-0.43	0.31	0.07

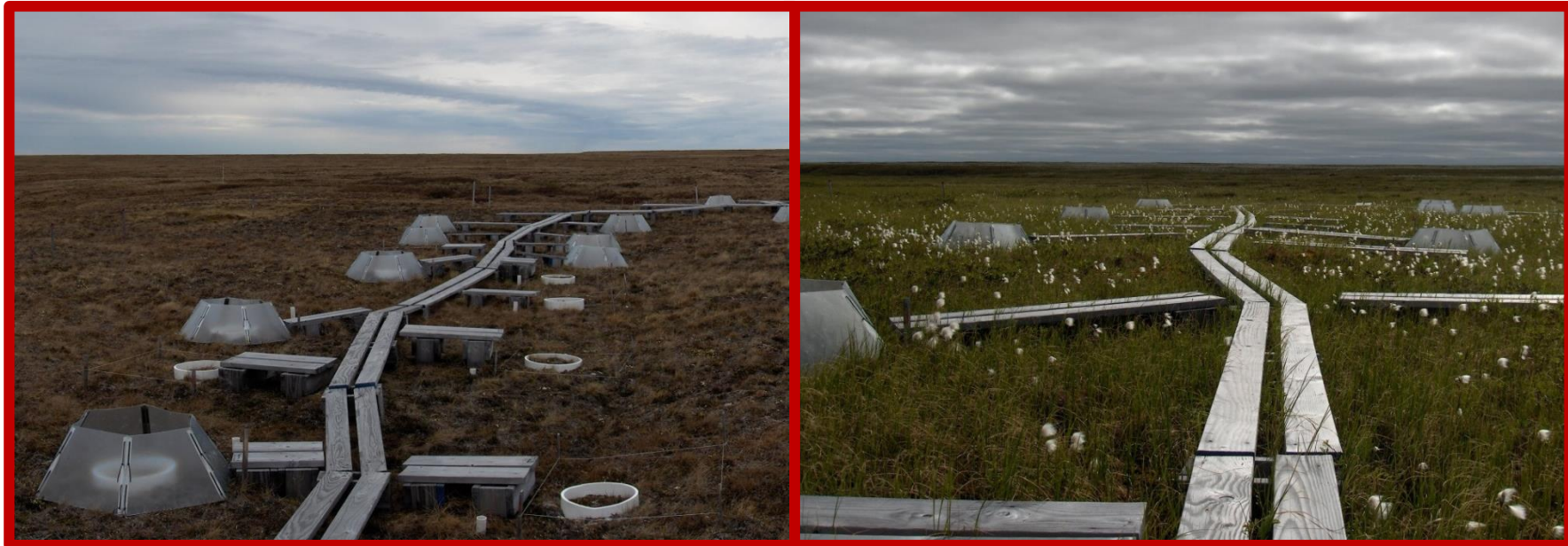
C:N ratio, leaf carbon content and dry seed mass showed the most promise as cover change drivers



Atqasuk



At Atqasuk...



At Atqasuk...

Site	Plant Height	C:N Ratio	LDMC	Leaf C	Leaf N	Leaf P	Seed Mass	SLA
Atqasuk	0.74 *	-0.29	0.34	-0.15	0.10	0.14	-0.18	0.18
Atqasuk Dry (AD)	0.48	-0.13	0.02	0.15	-0.08	-0.32	-0.31	-0.21
Atqasuk Wet (AW)	0.75 *	-0.26	0.53	-0.08	0.00	-0.05	-0.17	0.57



At Atqasuk...

Site	Plant Height	C:N Ratio	LDMC	Leaf C	Leaf N	Leaf P	Seed Mass	SLA
Atqasuk	0.74 *	-0.29	0.34	-0.15	0.10	0.14	-0.18	0.18
Atqasuk Dry (AD)	0.48	-0.13	0.02	0.15	-0.08	-0.32	-0.31	-0.21
Atqasuk Wet (AW)	0.75 *	-0.26	0.53	-0.08	0.00	-0.05	-0.17	0.57

Only **plant height** showed promise as a potential cover change driver...



Taxa	Plant Height	C:N Ratio	LDMC	Leaf C	Leaf N	Leaf P	Seed Mass	SLA
Utqiagvik Dry (BD)								
Evergreen Shrub	4.0325	45.8309	0.5483	513.1429	11.6442	1.1279	0.790	6.5083
<i>Cassiope tetragona</i>	7.0650	48.9064	0.5911	533.7090	11.6439	1.1538	0.3500	5.5376
<i>Vaccinium vitis-idaea</i>	1.0000	42.7554	0.5055	492.5768	11.6445	1.1021	0.2308	7.4790
Forb	2.7841	24.0367	0.2325	421.0000	17.6333	1.6067	0.0863	14.0783
<i>Saxifraga punctata</i>	3.8750	24.0367		421.0000	17.6333	1.6067		
<i>Senecio atropurpureus</i>	1.4000		0.2325				0.9339	12.7256
<i>Stellaria laeta</i>	3.0774						0.0386	15.4309
Graminoid	6.0264	30.9133	0.5232	484.7861	17.3223		0.1325	13.5835
<i>Alopecurus alpinus</i>	7.3043		0.5113		16.0000			9.7237
<i>Arctagrostis latifolia</i>	7.4423		0.4336		17.3333		0.0350	12.9074
<i>Carex aquatilis</i>	8.8889		0.6203					18.2833
<i>Luzula arctica</i>	1.3922		0.5274				0.1646	15.4656
<i>Luzula confusa</i>	5.0867	30.9133		484.7861	17.3223		0.1979	
<i>Poa arctica</i>	6.0442							11.5373
Utqiagvik Wet (BW)								
Deciduous Shrub	7.3333	28.3290	0.5610	436.6750	17.2950	2.0500		12.6203
<i>Salix pulchra</i>	7.3333	28.3290	0.5610	436.6750	17.2950	2.0500		12.6203
Forb	3.2188	28.6129	0.1904	447.7713	30.9275	2.6808	0.2554	22.1072
<i>Petasites frigidus</i>	2.9767	28.6129	0.2423	441.3650	20.4750	1.4429	0.4722	15.0724
<i>Ranunculus nivalis</i>	2.1053		0.1385	454.1775	41.3800	3.9187		35.8183
<i>Stellaria laeta</i>	3.0774						0.0386	15.4309
Graminoid	8.5500	30.9133	0.5449	486.7080	18.9089	2.1996	0.2080	13.9015
<i>Carex aquatilis</i>	3.8750		0.6203					18.2833
<i>Eriophorum vaginatum</i>	5.0776		0.4869	488.6300	20.4956	2.1996	0.2616	10.3199
<i>Luzula arctica</i>	3.6563		0.5274				0.1646	15.4656
<i>Luzula confusa</i>	7.8000	30.9133		484.7861	17.3223		0.1979	
<i>Poa arctica</i>	7.8231							11.5373

Master's Thesis!



People that made this work possible



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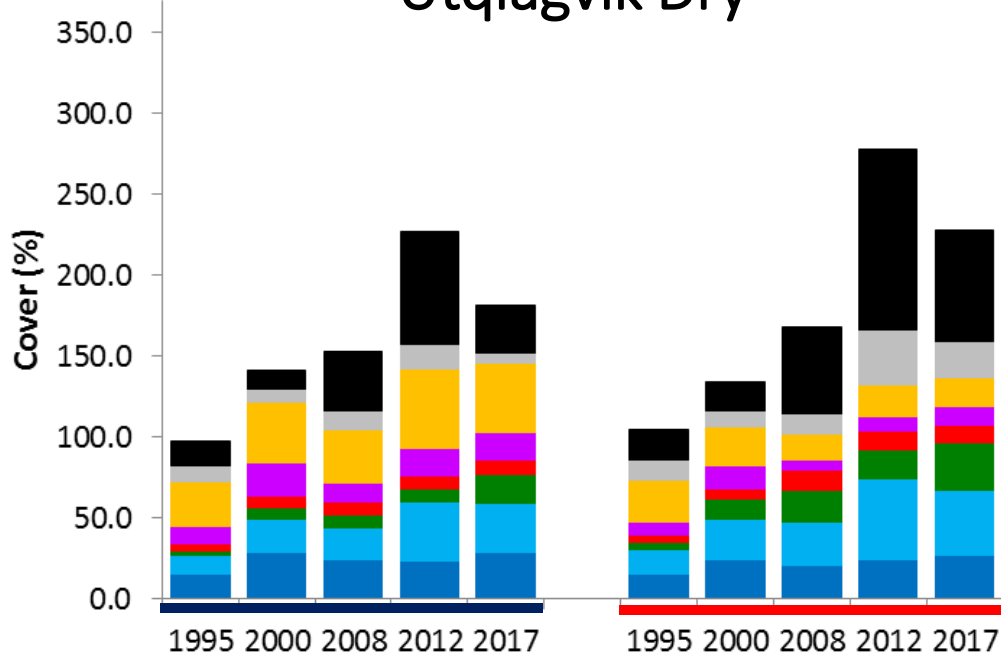
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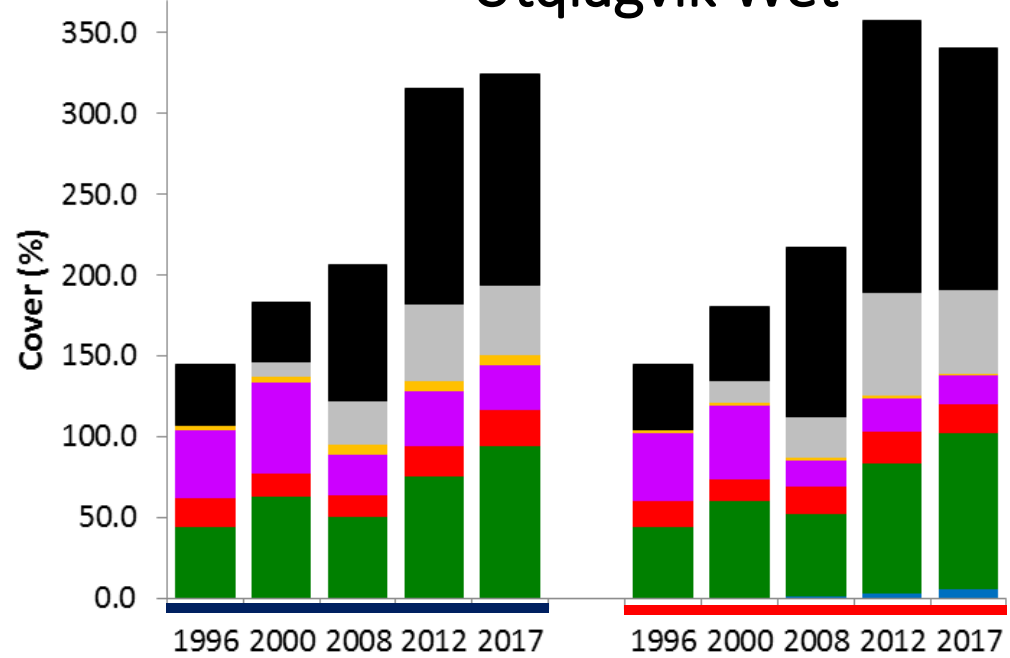
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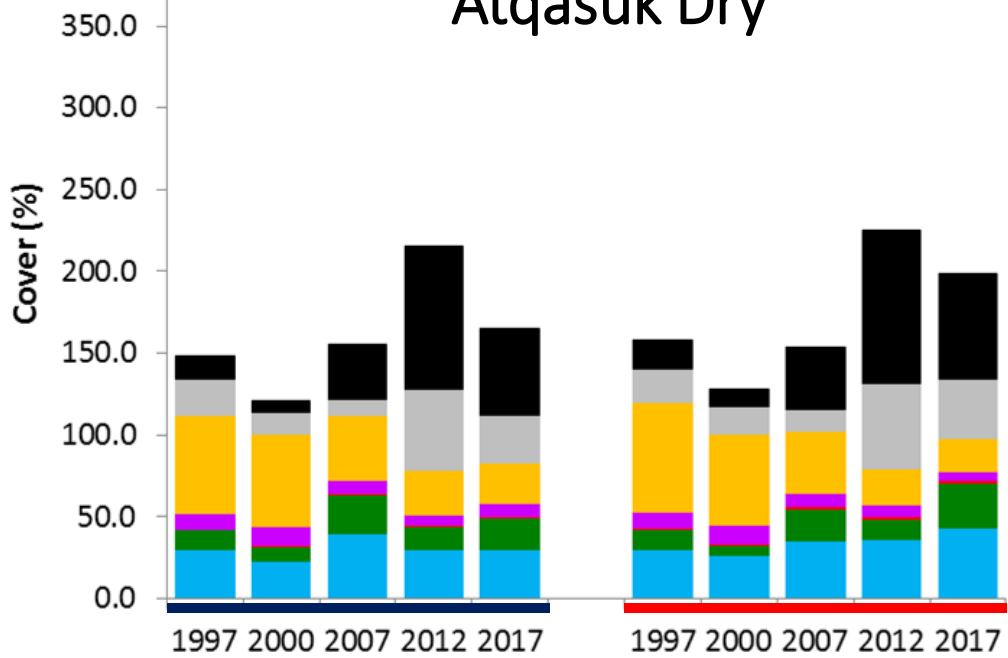
Utqiagvik Dry



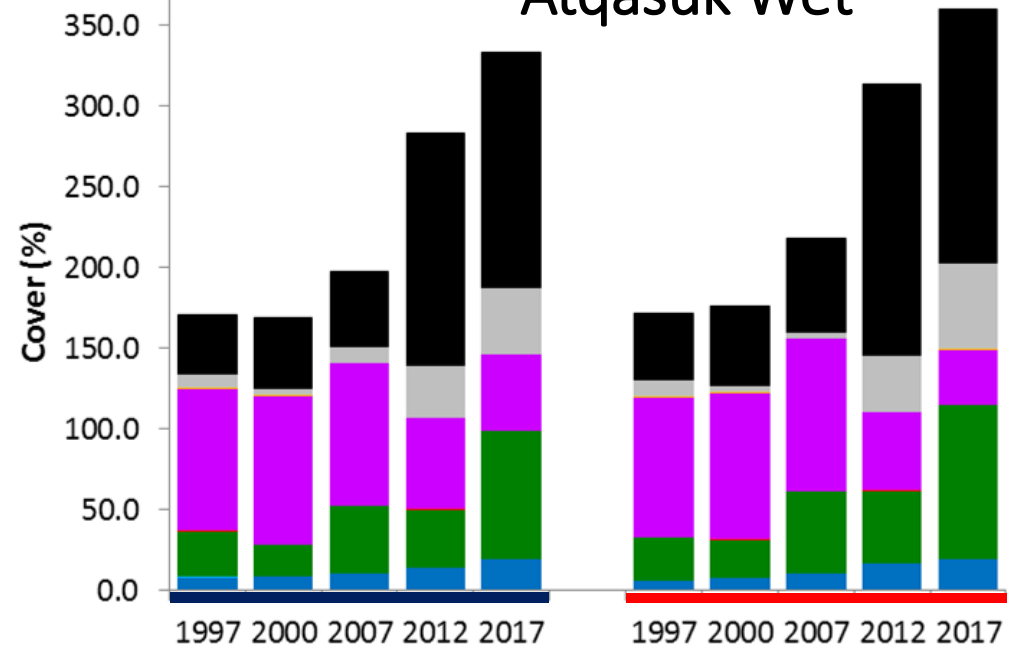
Utqiagvik Wet



Atqasuk Dry

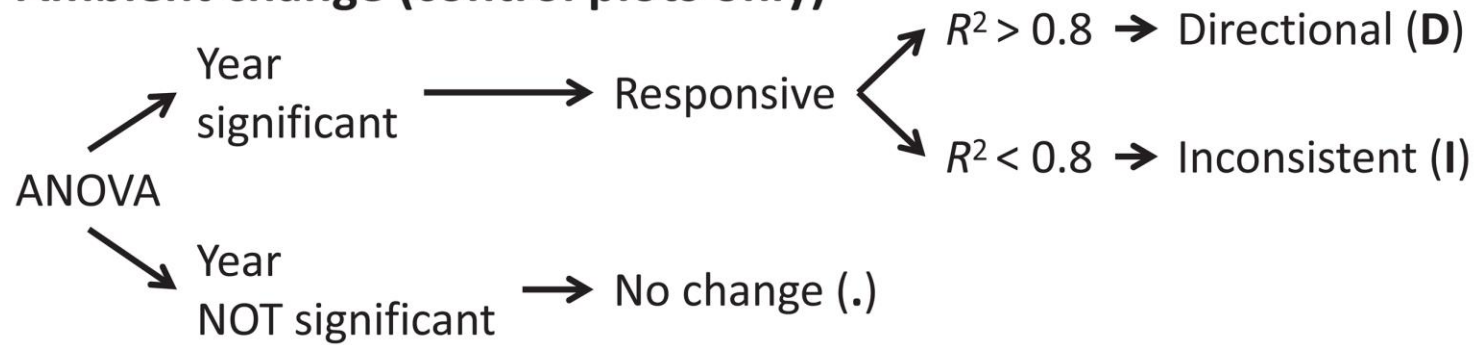


Atqasuk Wet

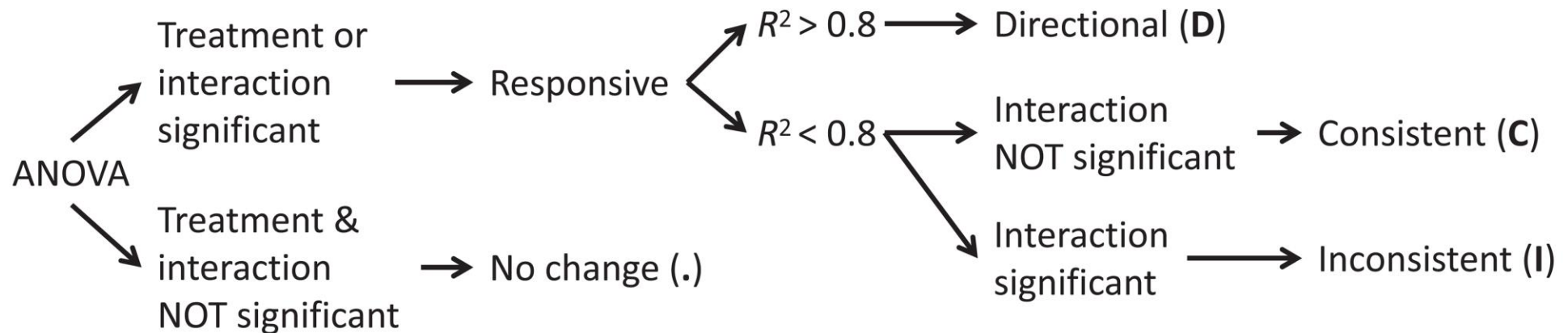


- Standing Dead
- Litter
- Lichen
- Bryophyte
- Forb
- Graminoid
- Evergreen Shrub
- Deciduous Shrub

Ambient change (control plots only)



Warming response (all plots)



Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Utqiagvik dry (BD) site																	
Deciduous Shrub	15.0	28.5	24.5	23.0	28.3	I	14.9	24.3	20.0	24.1	27.2	.	-0.1	-4.2	-4.4	1.1	-1.2
Evergreen Shrub	11.4	20.4	19.5	37.1	30.3	D ⁺	15.2	24.8	27.7	50.2	40.2	C ⁺	3.8	4.4	8.2	13.0	9.9
Graminoid	3.0	7.3	8.2	8.0	18.0	D ⁺	4.5	12.3	19.6	17.7	29.4	D ⁺	1.4	5.0	11.4	9.7	11.4
Forb	4.5	7.7	7.7	7.6	9.2	D ⁺	4.3	6.6	12.3	11.3	10.6	.	-0.3	-1.0	4.6	3.7	1.5
Bryophyte	11.0	19.8	11.8	17.5	16.8	I	8.4	13.8	6.3	9.6	11.5	C ⁻	-2.6	-6.0	-5.5	-7.9	-5.3
Lichen	27.0	37.9	32.5	48.4	42.7	I	25.8	24.7	15.9	19.6	18.0	I	-1.3	-13.2	-16.6	-28.8	-24.7
Utqiagvik wet (BW) site																	
Deciduous Shrub	0.2	0.0	0.0	0.3	1.0	I	0.3	0.7	1.8	3.8	6.1	D ⁺	0.2	0.6	1.8	3.5	5.1
Graminoid	43.3	63.0	50.6	75.6	93.6	D ⁺	44.4	60.4	51.3	80.0	96.6	.	1.1	-2.5	0.7	4.5	3.0
Forb	17.8	14.6	14.0	19.1	22.3	.	15.6	13.1	16.5	19.5	18.2	.	-2.2	-1.5	2.5	0.4	-4.1
Bryophyte	42.0	56.4	25.1	34.0	27.6	I	42.0	45.6	16.1	20.7	17.5	C ⁻	0.0	-10.8	-9.0	-13.3	-10.1
Lichen	2.5	3.3	5.5	6.0	6.1	.	1.8	1.8	1.8	1.9	1.1	D ⁻	-0.8	-1.5	-3.8	-4.2	-5.0
Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Atqasuk dry (AD) site																	
Deciduous Shrub	0.5	0.4	0.6	0.5	1.0	.	0.3	0.3	0.5	0.7	0.8	.	-0.3	-0.1	-0.2	0.2	-0.2
Evergreen Shrub	29.2	22.6	38.8	29.2	29.1	I	29.8	26.1	35.2	35.7	42.3	I	0.6	3.5	-3.6	6.5	13.3
Graminoid	12.3	9.0	24.2	14.3	19.4	I	12.6	6.4	19.2	12.1	27.1	.	0.4	-2.6	-5.0	-2.2	7.7
Forb	0.7	0.4	0.9	0.7	1.1	.	0.7	0.8	1.6	1.6	2.2	C ⁺	0.0	0.5	0.7	0.9	1.0
Bryophyte	9.1	12.0	7.9	6.8	7.4	I	9.2	11.3	7.9	7.0	5.7	.	0.1	-0.7	0.0	0.3	-1.7
Lichen	60.1	56.3	39.9	27.3	25.3	D ⁻	67.2	55.8	37.9	22.2	19.5	I	7.0	-0.5	-2.0	-5.1	-5.9
Atqasuk wet (AW) site																	
Deciduous Shrub	8.0	8.6	10.8	14.3	19.8	D ⁺	6.2	8.0	10.3	17.3	19.9	.	-1.8	-0.6	-0.4	3.0	0.1
Graminoid	27.8	19.7	41.8	36.0	79.0	D ⁺	26.5	23.6	50.9	44.5	94.9	I	-1.3	3.9	9.1	8.5	15.9
Forb	0.5	0.5	0.5	0.3	0.6	.	0.5	0.3	0.3	0.6	0.3	.	0.0	-0.1	-0.3	0.3	-0.3
Bryophyte	87.8	91.8	87.8	56.1	47.0	D ⁻	86.7	90.8	95.0	48.3	33.7	I	-1.1	-1.1	7.3	-7.8	-13.3
Lichen	1.0	0.6	0.3	0.7	0.0	I	1.0	0.3	0.2	0.3	1.5	C ⁻	0.0	-0.3	-0.1	-0.4	1.5

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Utqiagvik dry (BD) site																	
Deciduous Shrub	15.0	28.5	24.5	23.0	28.3		14.9	24.3	20.0	24.1	27.2	.	-0.1	-4.2	-4.4	1.1	-1.2
<i>Salix rotundifolia</i>	15.0	28.5	24.5	23.0	28.3		14.9	24.3	20.0	24.1	27.2	.	-0.1	-4.2	-4.4	1.1	-1.2
Evergreen Shrub	11.4	20.4	19.5	37.1	30.3	D ⁺	15.2	24.8	27.7	50.2	40.2	C ⁺	3.8	4.4	8.2	13.0	9.9
<i>Cassiope tetragona</i>	11.3	19.8	19.4	36.8	30.1		15.2	24.8	27.7	50.2	40.2	C ⁺	3.9	5.0	8.3	13.3	10.1
<i>Vaccinium vitis-idaea</i>	0.1	0.5	0.1	0.3	0.2	.	0.0	0.0	0.0	0.0	0.0	.	-0.1	-0.5	-0.1	-0.3	-0.2
Forb	4.5	7.7	7.7	7.6	9.2	D ⁺	4.3	6.6	12.3	11.3	10.6	.	-0.3	-1.0	4.6	3.7	1.5
<i>Saxifraga punctata</i>	0.3	1.3	1.8	1.3	2.2		0.6	0.8	1.9	1.4	2.1	.	0.3	-0.5	0.1	0.2	-0.1
<i>Senecio atropurpureous</i>	0.3	0.3	0.0	0.1	0.2	.	0.3	0.6	0.0	0.1	0.2	.	0.0	0.3	0.0	0.0	0.0
<i>Stellaria laeta</i>	1.6	3.0	1.5	1.5	2.5		1.0	2.8	3.7	3.0	3.0	C ⁺	-0.6	-0.1	2.2	1.5	0.5
Graminoid	3.0	7.3	8.2	8.0	18.0	D ⁺	4.5	12.3	19.6	17.7	29.4	D ⁺	1.4	5.0	11.4	9.7	11.4
<i>Alopecurus alpinus</i>	0.1	0.0	0.3	0.3	0.5	.	0.3	1.1	0.1	0.9	1.5	C ⁺	0.2	1.1	-0.1	0.6	1.0
<i>Arctagrostis latifolia</i>	0.8	2.1	1.4	1.1	2.8	.	1.0	3.1	3.5	2.1	6.6	C ⁺	0.3	1.0	2.1	1.0	3.9
<i>Carex aquatilis</i>	0.0	0.2	0.1	0.2	0.8	.	0.6	0.8	2.2	1.7	5.1	C ⁺	0.5	0.6	2.1	1.5	4.4
<i>Luzula arctica</i>	0.2	0.3	0.3	0.3	0.1	.	0.5	0.7	0.6	0.8	0.4	C ⁺	0.3	0.4	0.3	0.4	0.3
<i>Luzula confusa</i>	1.3	3.0	4.2	2.7	4.9		1.3	2.8	5.5	3.0	4.2	.	0.0	-0.2	1.3	0.4	-0.7
<i>Poa arctica</i>	0.5	1.6	2.0	3.0	8.5		0.6	3.8	7.7	9.1	11.3		0.2	2.1	5.7	6.1	2.8
Bryophyte	11.0	19.8	11.8	17.5	16.8		8.4	13.8	6.3	9.6	11.5	C ⁻	-2.6	-6.0	-5.5	-7.9	-5.3
Acrocarpous Moss	7.5	11.8	7.7	8.0	8.5		5.4	9.6	3.6	5.8	7.2	C ⁻	-2.1	-2.2	-4.1	-2.3	-1.3
Pleurocarpous Moss	2.0	5.7	3.1	9.0	7.7		1.3	3.2	2.1	3.5	3.8	C ⁻	-0.7	-2.5	-1.0	-5.4	-4.0
Lichen	27.0	37.9	32.5	48.4	42.7		25.8	24.7	15.9	19.6	18.0		-1.3	-13.2	-16.6	-28.8	-24.7
Crustose Lichen	3.0	3.1	0.5	1.1	0.5		3.0	2.9	0.5	0.8	0.4	.	0.0	-0.2	0.0	-0.4	-0.1
Foliolose Lichen	6.3	8.5	8.5	10.1	10.1		6.0	6.0	4.3	5.6	5.0	D ⁻	-0.3	-2.5	-4.3	-4.5	-5.2
Fruticose Lichen	16.7	26.3	23.4	37.2	32.0		15.7	15.8	11.1	13.3	12.6		-1.0	-10.5	-12.3	-23.9	-19.4
Utqiagvik wet (BW) site																	
Deciduous Shrub	0.2	0.0	0.0	0.3	1.0		0.3	0.7	1.8	3.8	6.1	D ⁺	0.2	0.6	1.8	3.5	5.1
<i>Salix pulchra</i>	0.0	0.0	0.0	0.0	0.0	.	0.0	0.0	0.1	0.3	0.8	.	0.0	0.0	0.1	0.3	0.8
<i>Salix rotundifolia</i>	0.2	0.0	0.0	0.3	1.0		0.3	0.7	1.7	3.5	5.4	D ⁺	0.2	0.6	1.7	3.2	4.4
Forb	17.8	14.6	14.0	19.1	22.3	.	15.6	13.1	16.5	19.5	18.2	.	-2.2	-1.5	2.5	0.4	-4.1
<i>Petasites frigidus</i>	0.2	0.1	0.7	1.1	1.4	.	0.3	0.5	0.4	0.5	0.4	.	0.1	0.4	-0.3	-0.6	-1.0
<i>Ranunculus nivalis</i>	0.0	0.1	1.1	0.0	0.1		0.0	0.0	0.4	0.0	0.0	.	0.0	-0.1	-0.7	0.0	-0.1
<i>Stellaria laeta</i>	3.9	2.1	2.4	2.8	4.6		3.6	3.1	2.2	2.9	4.0	.	-0.3	1.0	-0.2	0.1	-0.6
Graminoid	43.3	63.0	50.6	75.6	93.6	D ⁺	44.4	60.4	51.3	80.0	96.6	.	1.1	-2.5	0.7	4.5	3.0
<i>Carex aquatilis</i>	17.0	12.7	23.2	26.3	44.5		23.0	16.3	32.3	37.9	51.5	C ⁺	6.0	3.6	9.1	11.7	7.0
<i>Eriophorum angustifolium</i>	9.7	19.0	5.8	12.8	10.6		8.4	18.6	4.6	12.6	9.9	.	-1.3	-0.4	-1.2	-0.1	-0.7
<i>Luzula arctica</i>	0.2	0.2	0.3	0.3	0.5	.	0.2	0.1	0.1	0.2	0.2		0.0	0.0	-0.2	-0.1	-0.4
<i>Luzula confusa</i>	0.2	0.0	0.0	0.4	0.5	.	0.2	0.1	0.4	0.2	0.4	.	0.0	0.1	0.4	-0.2	-0.1
Poaceae spp.	2.8	11.3	5.3	9.5	13.8		2.2	11.8	3.2	10.4	11.4	.	-0.6	0.5	-2.2	0.9	-2.4
Bryophyte	42.0	56.4	25.1	34.0	27.6		42.0	45.6	16.1	20.7	17.5	C ⁻	0.0	-10.8	-9.0	-13.3	-10.1
Acrocarpous Moss	17.2	25.1	9.1	16.4	8.3		16.5	20.6	7.4	10.8	6.4	C ⁻	-0.7	-4.5	-1.7	-5.6	-2.0
Pleurocarpous Moss	20.5	27.0	14.6	16.8	18.1	.	21.2	20.9	7.3	9.3	10.0	C ⁻	0.7	-6.1	-7.2	-7.5	-8.1
Lichen	2.5	3.3	5.5	6.0	6.1	.	1.8	1.8	1.8	1.9	1.1	D ⁻	-0.8	-1.5	-3.8	-4.2	-5.0
Foliolose Lichen	2.5	3.3	5.5	6.0	5.3	.	1.6	1.7	1.7	1.8	0.8	D ⁻	-0.9	-1.6	-3.8	-4.2	-4.5
Fruticose Lichen	0.0	0.0	0.0	0.1	0.8		0.2	0.0	0.1	0.1	0.3	.	0.2	0.0	0.0	0.0	-0.5

Taxa	C1	C2	C3	C4	C5		E1	E2	E3	E4	E5		W1	W2	W3	W4	W5
Atqasuk dry (AD) site																	
Deciduous Shrub	0.5	0.4	0.6	0.5	1.0	.	0.3	0.3	0.5	0.7	0.8	.	-0.3	-0.1	-0.2	0.2	-0.2
<i>Salix phlebophylla</i>	0.5	0.4	0.6	0.5	0.3	.	0.3	0.3	0.5	0.7	0.8	.	-0.3	-0.1	-0.2	0.2	0.4
<i>Salix pulchra</i>	0.0	0.0	0.0	0.0	0.7		0.0	0.0	0.0	0.0	0.1		0.0	0.0	0.0	0.0	-0.6
Evergreen Shrub	29.2	22.6	38.8	29.2	29.1		29.8	26.1	35.2	35.7	42.3		0.6	3.5	-3.6	6.5	13.3
<i>Cassiope tetragona</i>	6.3	4.7	7.6	4.8	4.2		7.2	5.5	9.0	8.5	8.6	D ⁺	0.9	0.8	1.5	3.8	4.4
<i>Diapensia lapponica</i>	3.8	2.2	3.9	2.7	2.8	.	3.5	3.3	3.9	2.6	3.0	.	-0.2	1.0	0.0	0.0	0.2
<i>Ledum palustre</i>	11.5	9.8	15.9	12.5	9.2		11.9	10.6	14.5	16.5	18.4	D ⁺	0.3	0.8	-1.3	4.0	9.2
<i>Vaccinium vitis-idaea</i>	7.6	6.0	11.4	9.3	12.8		7.2	6.8	7.7	8.1	12.3	.	-0.4	0.8	-3.7	-1.3	-0.5
Forb	0.7	0.4	0.9	0.7	1.1	.	0.7	0.8	1.6	1.6	2.2	C ⁺	0.0	0.5	0.7	0.9	1.0
<i>Minuartia obtusiloba</i>	0.0	0.1	0.1	0.0	0.1	.	0.3	0.4	0.7	0.7	0.7	C ⁺	0.3	0.3	0.5	0.7	0.6
<i>Polygonum bistorta</i>	0.6	0.3	0.8	0.7	0.9	.	0.3	0.4	0.7	0.6	1.0	.	-0.3	0.2	-0.1	0.0	0.1
Graminoid	12.3	9.0	24.2	14.3	19.4		12.6	6.4	19.2	12.1	27.1	.	0.4	-2.6	-5.0	-2.2	7.7
<i>Carex bigelowii</i>	2.1	1.2	3.8	2.8	3.8	.	1.0	0.6	1.0	0.4	2.0	C ⁺	-1.2	-0.6	-2.8	-2.3	-1.9
<i>Hierochloa alpina</i>	3.0	1.4	4.5	2.8	4.4		2.8	1.3	6.0	2.9	5.3	.	-0.1	-0.1	1.4	0.0	0.8
<i>Luzula arctica</i>	0.1	0.1	0.3	0.1	0.0	.	0.4	0.2	0.3	0.0	0.1	.	0.3	0.1	0.1	-0.1	0.1
<i>Luzula confusa</i>	5.3	4.4	12.1	4.9	6.0		6.3	3.1	8.3	4.3	8.4	.	0.9	-1.3	-3.8	-0.6	2.4
<i>Trisetum spicatum</i>	1.7	2.0	3.5	3.7	5.1	.	2.0	1.3	3.7	4.5	11.4	.	0.3	-0.7	0.1	0.8	6.3
Bryophyte	9.1	12.0	7.9	6.8	7.4		9.2	11.3	7.9	7.0	5.7	.	0.1	-0.7	0.0	0.3	-1.7
Acrocarpous Moss	8.0	10.2	4.5	5.7	7.3		7.2	8.3	4.7	5.8	5.0	.	-0.8	-2.0	0.2	0.1	-2.3
Pleurocarpous Moss												.					
Lichen	60.1	56.3	39.9	27.3	25.3	D ⁻	67.2	55.8	37.9	22.2	19.5		7.0	-0.5	-2.0	-5.1	-5.9
Crustose Lichen	1.8	8.1	2.1	4.8	5.3		1.5	7.8	2.3	4.3	4.9	.	-0.3	-0.3	0.2	-0.5	-0.4
Foliolose Lichen	16.6	12.3	10.8	6.8	8.9		15.9	8.5	9.3	5.7	6.5	C ⁻	-0.8	-3.8	-1.5	-1.2	-2.4
Fruticose Lichen	41.8	36.0	27.0	15.6	11.1	D ⁻	49.8	39.5	26.3	12.3	8.0	D ⁻	8.0	3.5	-0.7	-3.4	-3.1
Atqasuk wet (AW) site																	
Deciduous Shrub	8.0	8.6	10.8	14.3	19.8	D ⁺	6.2	8.0	10.3	17.3	19.9	.	-1.8	-0.6	-0.4	3.0	0.1
<i>Betula nana</i>	0.4	0.5	0.7	1.4	2.0	.	0.0	0.0	0.0	0.0	0.0	D ⁺	-0.4	-0.5	-0.7	-1.4	-2.0
<i>Salix phlebophylla</i>	0.0	0.0	0.1	0.0	0.0	.	0.0	0.0	0.0	0.0	0.0	.	0.0	0.0	-0.1	0.0	0.0
<i>Salix polaris</i>	1.1	0.8	2.6	4.7	6.0	D ⁺	0.9	1.3	1.3	7.9	11.2		-0.2	0.6	-1.3	3.2	5.2
<i>Salix pulchra</i>	6.5	7.3	7.3	8.3	11.8	.	5.3	6.6	9.0	9.4	8.8	.	-1.3	-0.7	1.7	1.1	-3.0
Forb	0.5	0.5	0.5	0.3	0.6	.	0.5	0.3	0.3	0.6	0.3	.	0.0	-0.1	-0.3	0.3	-0.3
<i>Polygonum viviparum</i>	0.0	0.0	0.1	0.1	0.3	.	0.0	0.0	0.0	0.1	0.0	C ⁺	0.0	0.0	-0.1	0.0	-0.3
Graminoid	27.8	19.7	41.8	36.0	79.0	D ⁺	26.5	23.6	50.9	44.5	94.9		-1.3	3.9	9.1	8.5	15.9
<i>Carex aquatilis</i>	15.2	12.1	29.8	22.7	50.5		15.9	14.8	38.3	31.2	70.1	D ⁺	0.7	2.7	8.6	8.5	19.5
<i>Dupontia psilosantha</i>	0.2	0.2	1.3	0.9	1.2		0.3	0.3	1.4	0.5	1.6	.	0.2	0.1	0.1	-0.4	0.5
<i>Eriophorum angustifolium</i>	3.2	4.5	5.6	6.7	17.7		3.1	3.6	6.1	7.7	13.6	.	-0.1	-0.9	0.5	1.0	-4.1
Bryophyte	87.8	91.8	87.8	56.1	47.0	D ⁻	86.7	90.8	95.0	48.3	33.7		-1.1	-1.1	7.3	-7.8	-13.3
Acrocarpous Moss	31.5	32.0	30.6	22.8	19.8	.	31.8	31.0	29.9	17.3	13.6	.	0.2	-1.0	-0.7	-5.5	-6.2
Pleurocarpous Moss	13.2	9.8	10.0	26.3	14.3		14.1	11.5	17.2	23.7	8.4		0.9	1.8	7.1	-2.6	-5.9
Sphagnum Moss	3.5	4.5	8.2	5.4	7.6	.	3.8	3.5	8.2	6.7	7.9	.	0.3	-1.0	0.0	1.3	0.3
Lichen	1.0	0.6	0.3	0.7	0.0		1.0	0.3	0.2	0.3	1.5	C ⁻	0.0	-0.3	-0.1	-0.4	1.5
Foliolose Lichen	0.3	0.1	0.2	0.2	0.0	.	0.3	0.1	0.0	0.1	0.0	.	0.1	0.0	-0.1	-0.1	0.0
Fruticose Lichen	0.7	0.5	0.1	0.5	0.0		0.6	0.2	0.2	0.2	0.1	.	-0.1	-0.3	0.0	-0.3	0.1

Site	Plant Height	C:N Ratio	LDMC	Leaf C	Leaf N	Leaf P	Seed Mass	SLA
Utqiagvik	0.45	0.72 *	0.32	0.63 *	-0.22	-0.39	0.73 *	-0.16
Utqiagvik Dry (BD)	0.45	0.67 *	0.41	0.74 *	-0.26	-0.43	0.72 *	-0.42
Utqiagvik Wet (BW)	0.53	-0.69 *	0.28	0.06	0.07	-0.43	0.31	0.07
Atqasuk	0.74 *	-0.29	0.34	-0.15	0.10	0.14	-0.18	0.18
Atqasuk Dry (AD)	0.48	-0.13	0.02	0.15	-0.08	-0.32	-0.31	-0.21
Atqasuk Wet (AW)	0.75 *	-0.26	0.53	-0.08	0.00	-0.05	-0.17	0.57
All Sites	0.63 *	0.28	0.32	0.35	-0.13	-0.24	0.10	0.00