

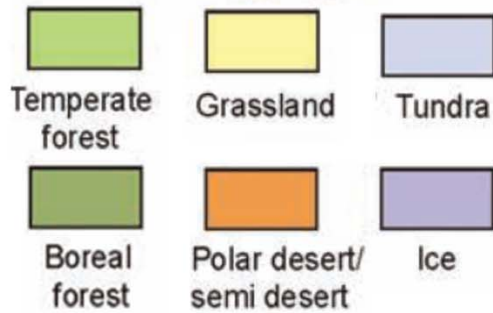
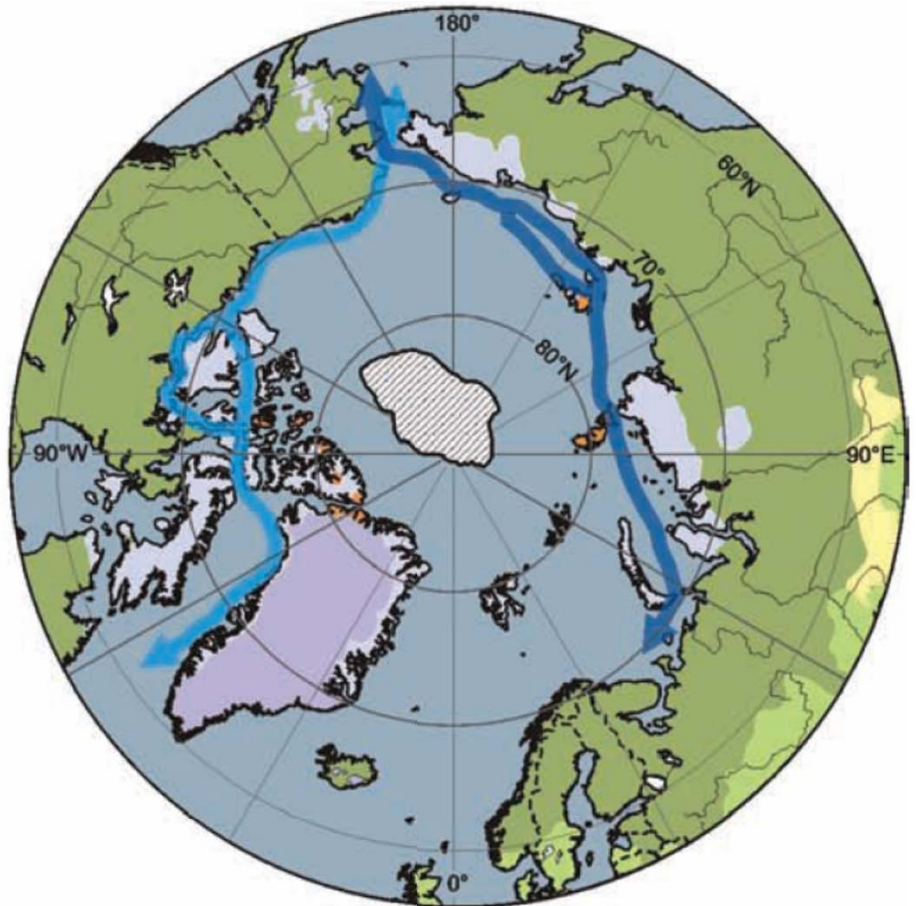
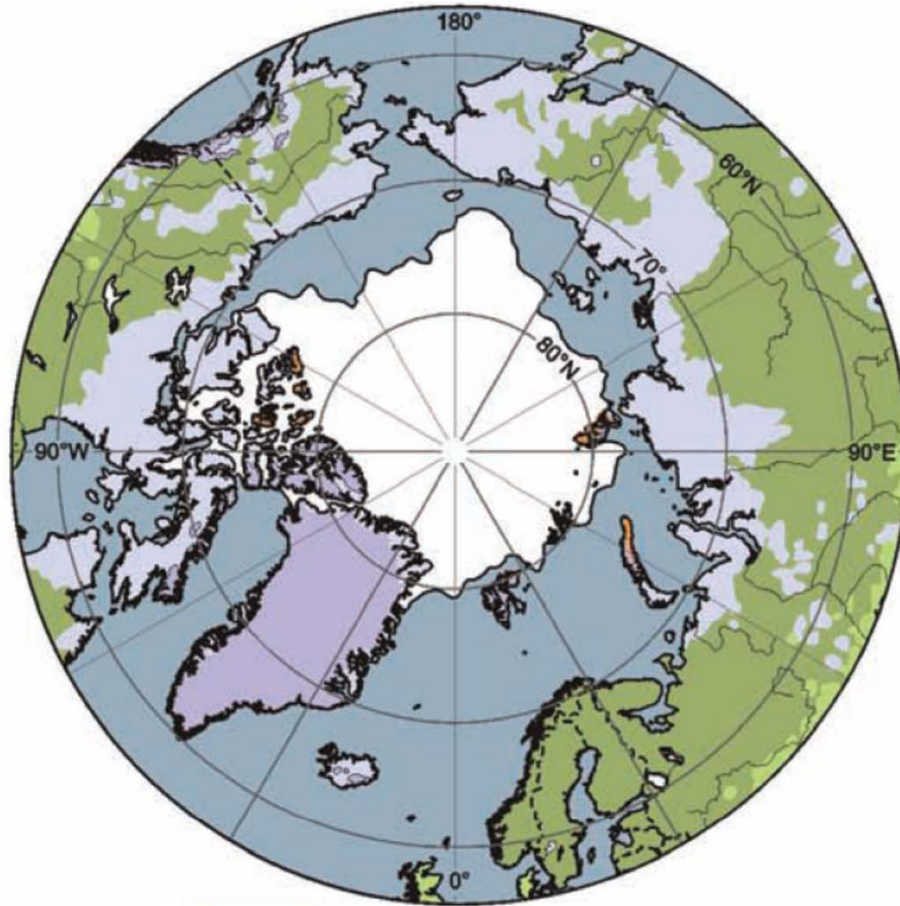
Using Abiotic Measures to Predict Arctic Plant Species Abundance

Jennifer A. Liebig* and Robert D. Hollister
Grand Valley State University



Current

Projected



Northwest Passage
Northern Sea Route



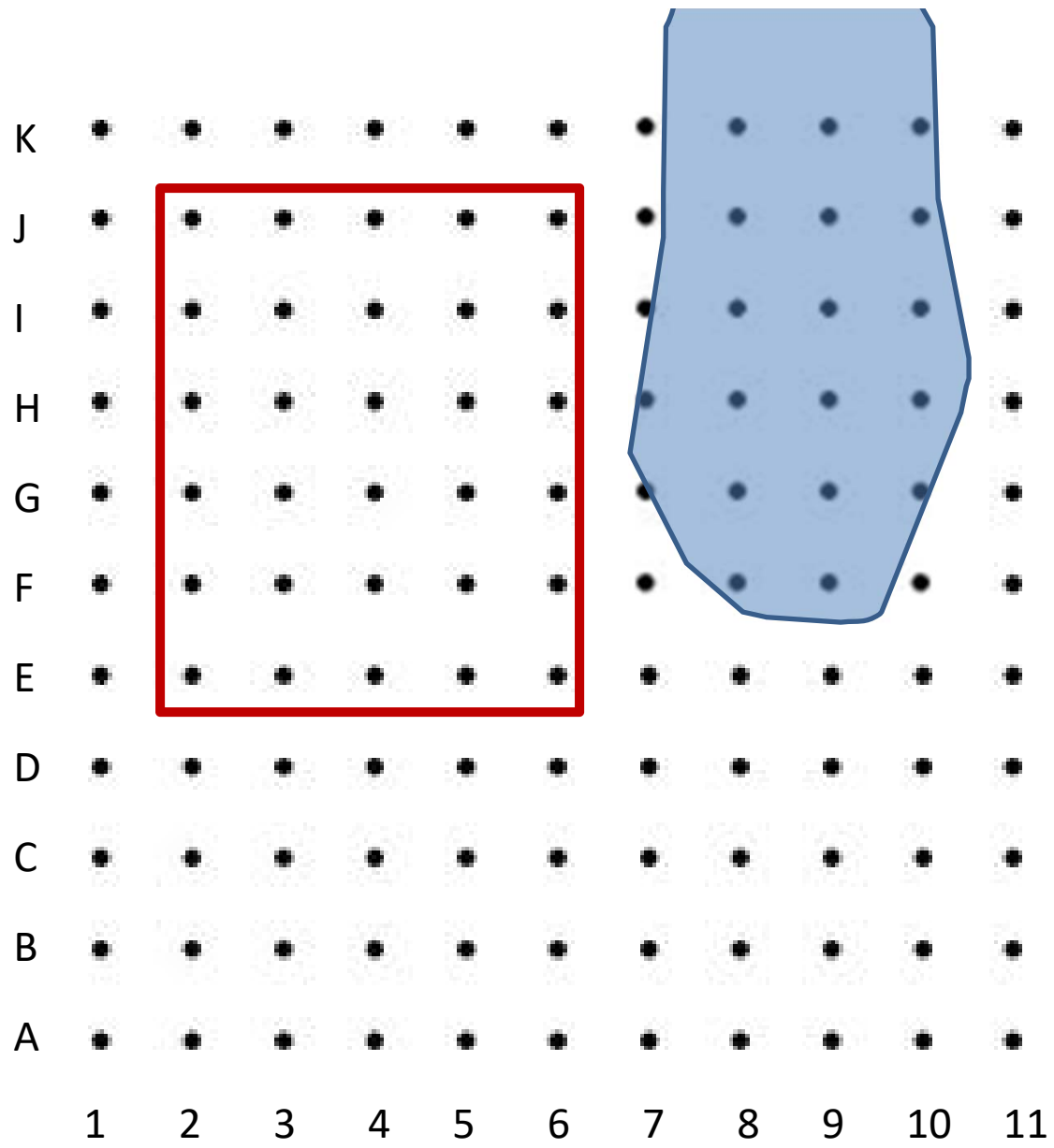
Observed ice extent
September 2002



Projected ice extent
2080 - 2100

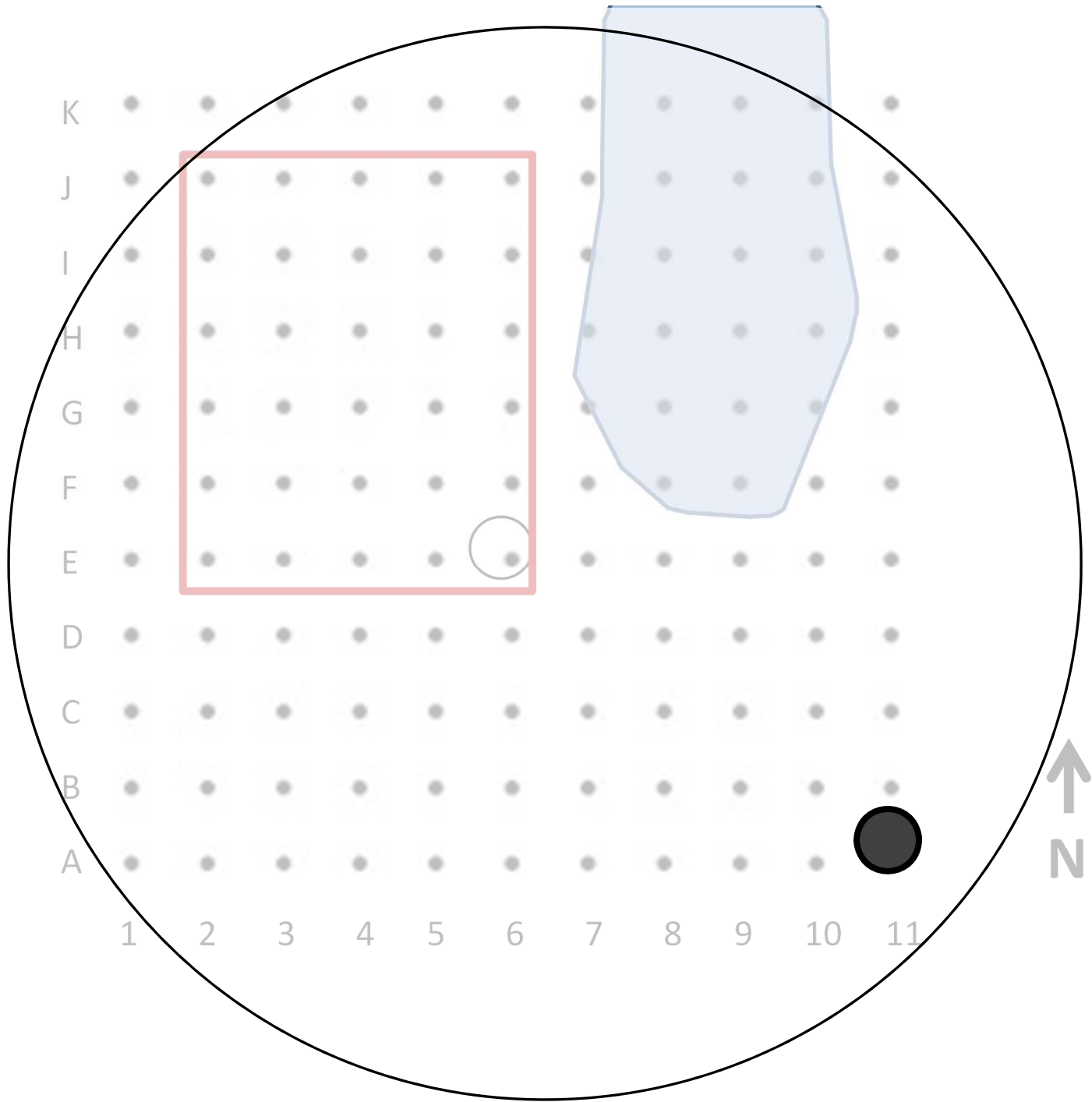
Study Location

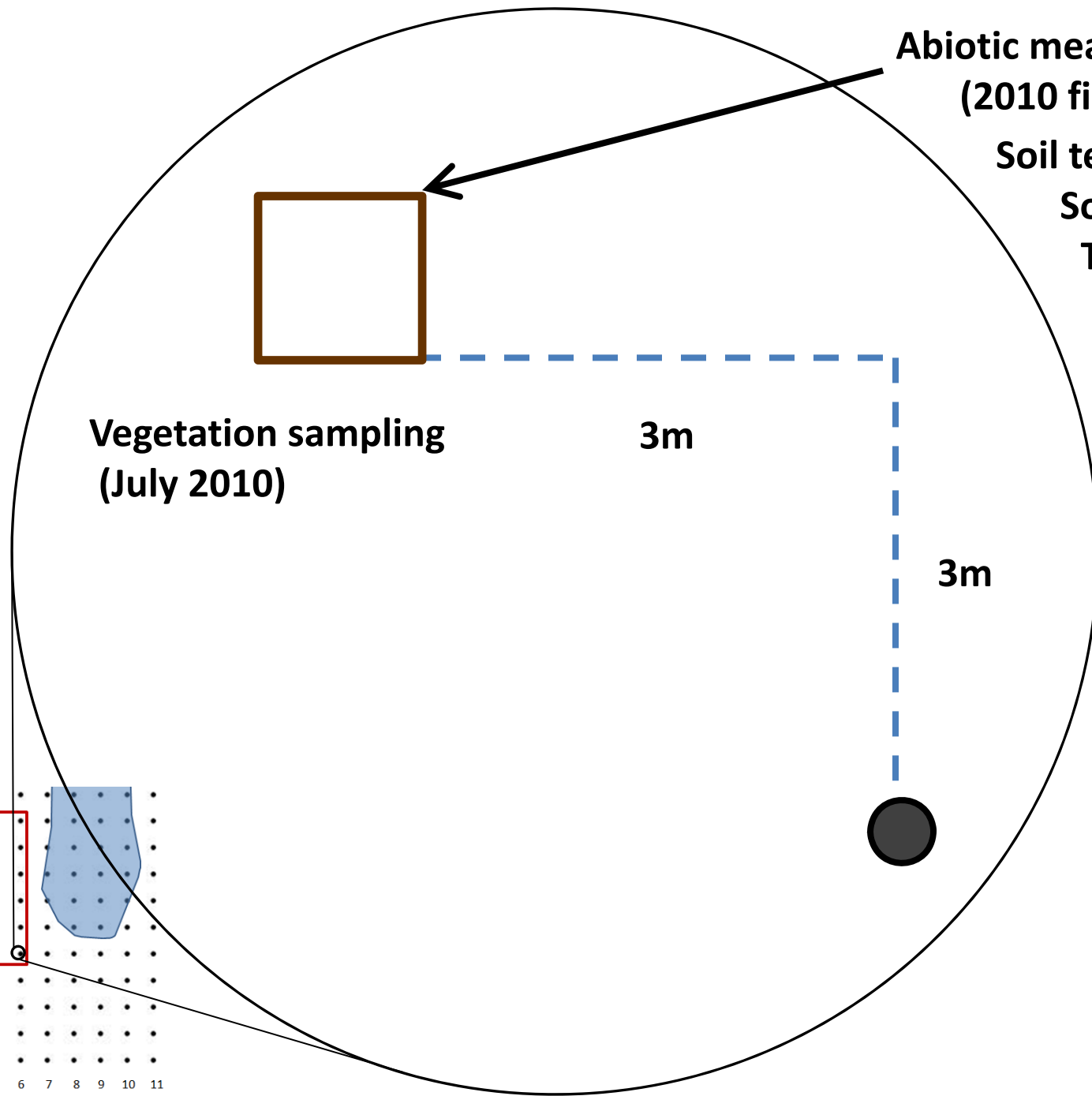




1 km







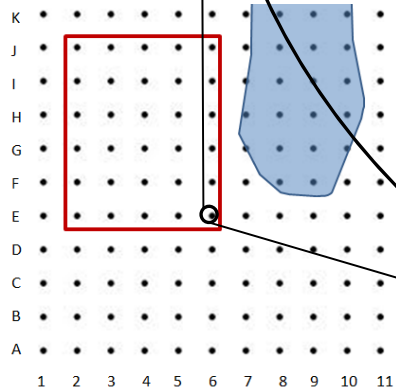
**Abiotic measurements
(2010 field season)**

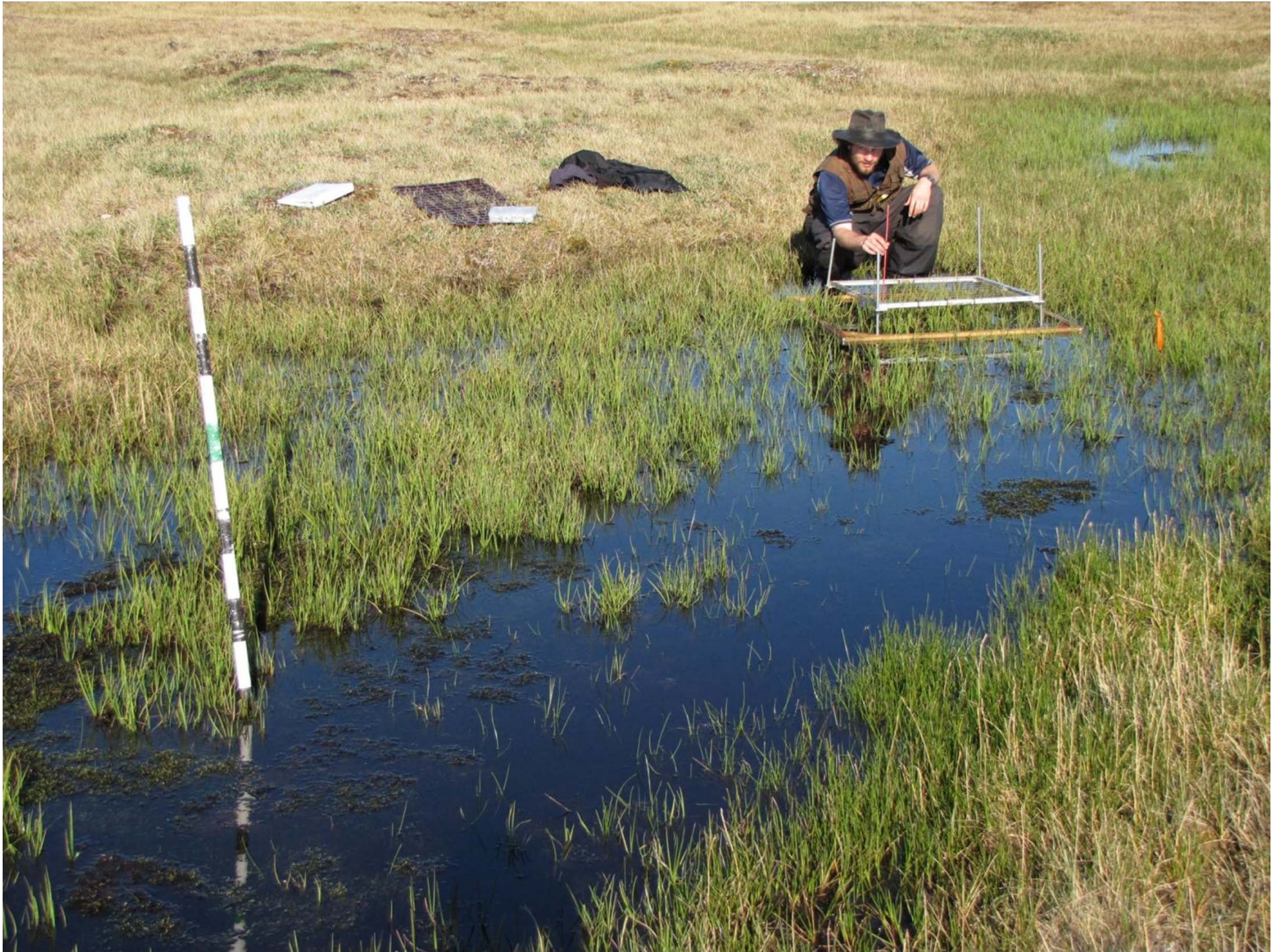
- Soil temperature**
- Soil moisture**
- Thaw depth**

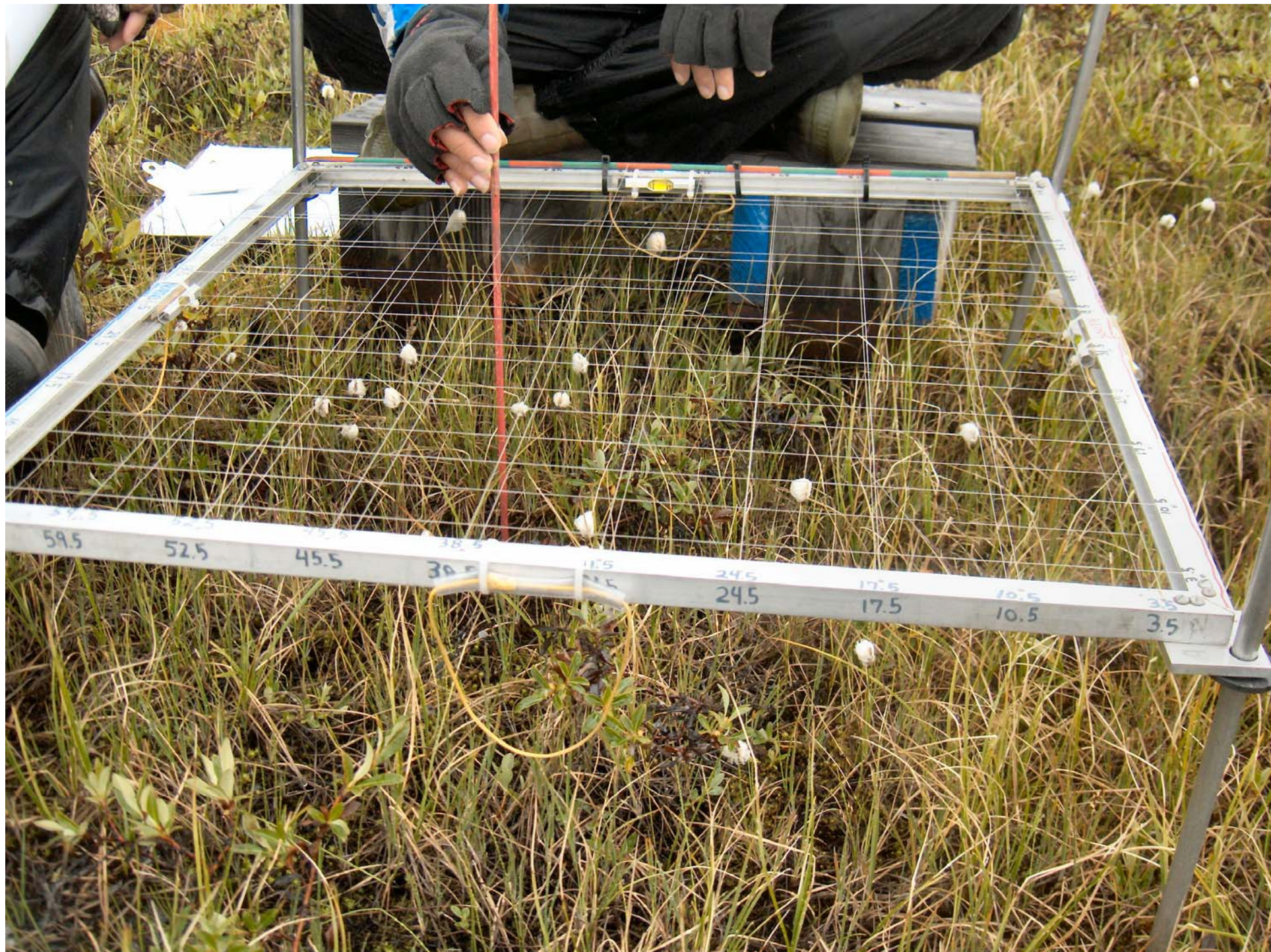
**Vegetation sampling
(July 2010)**

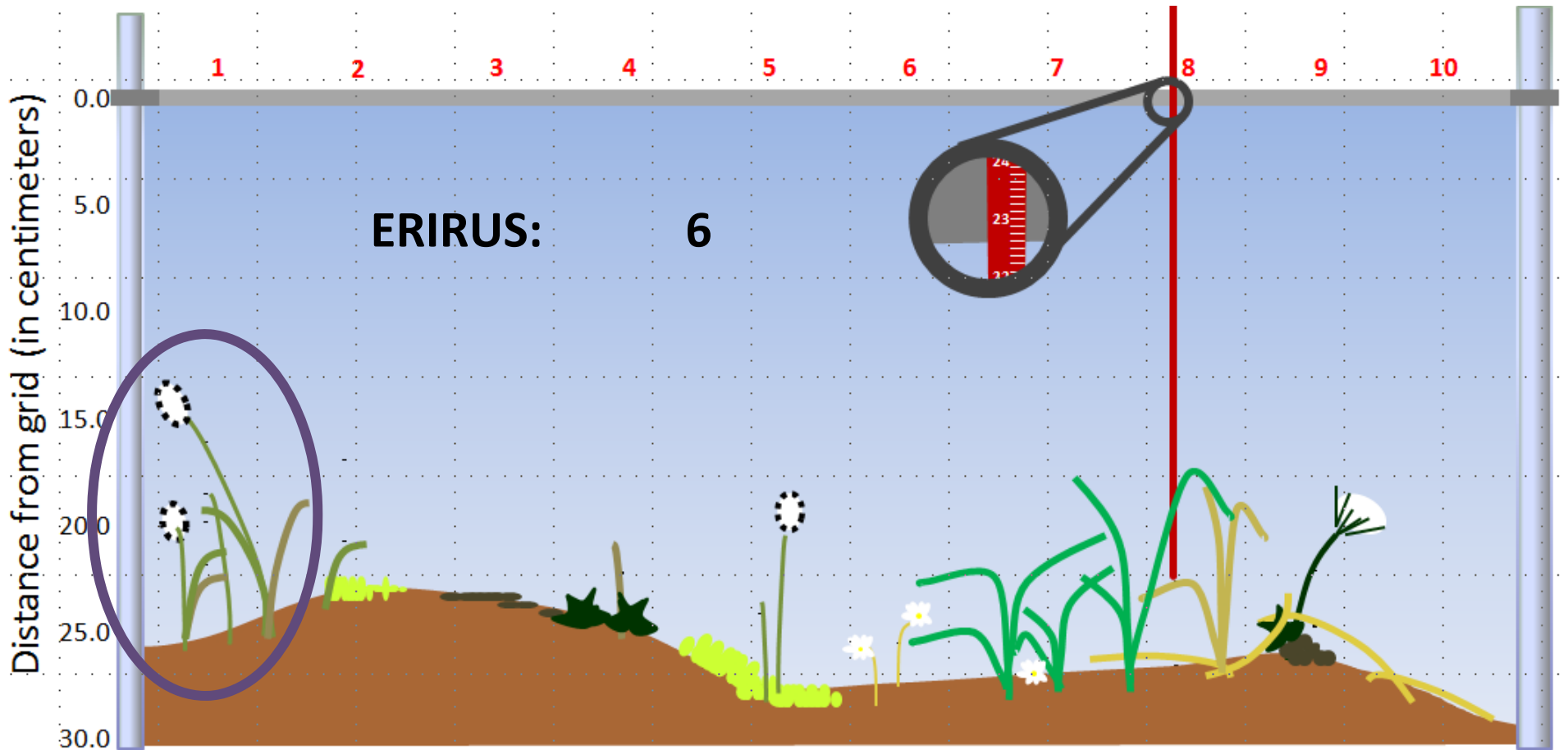
3m

3m

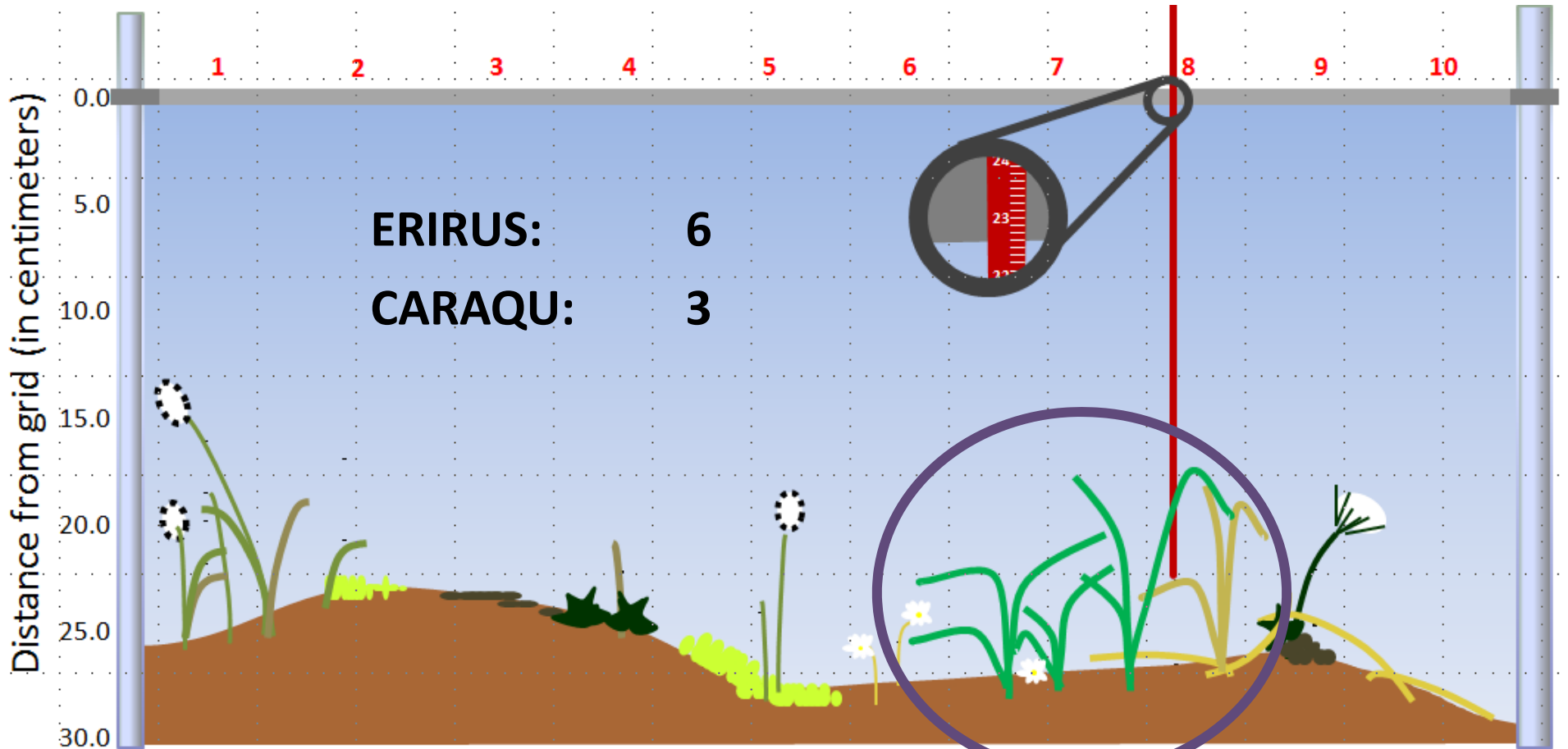




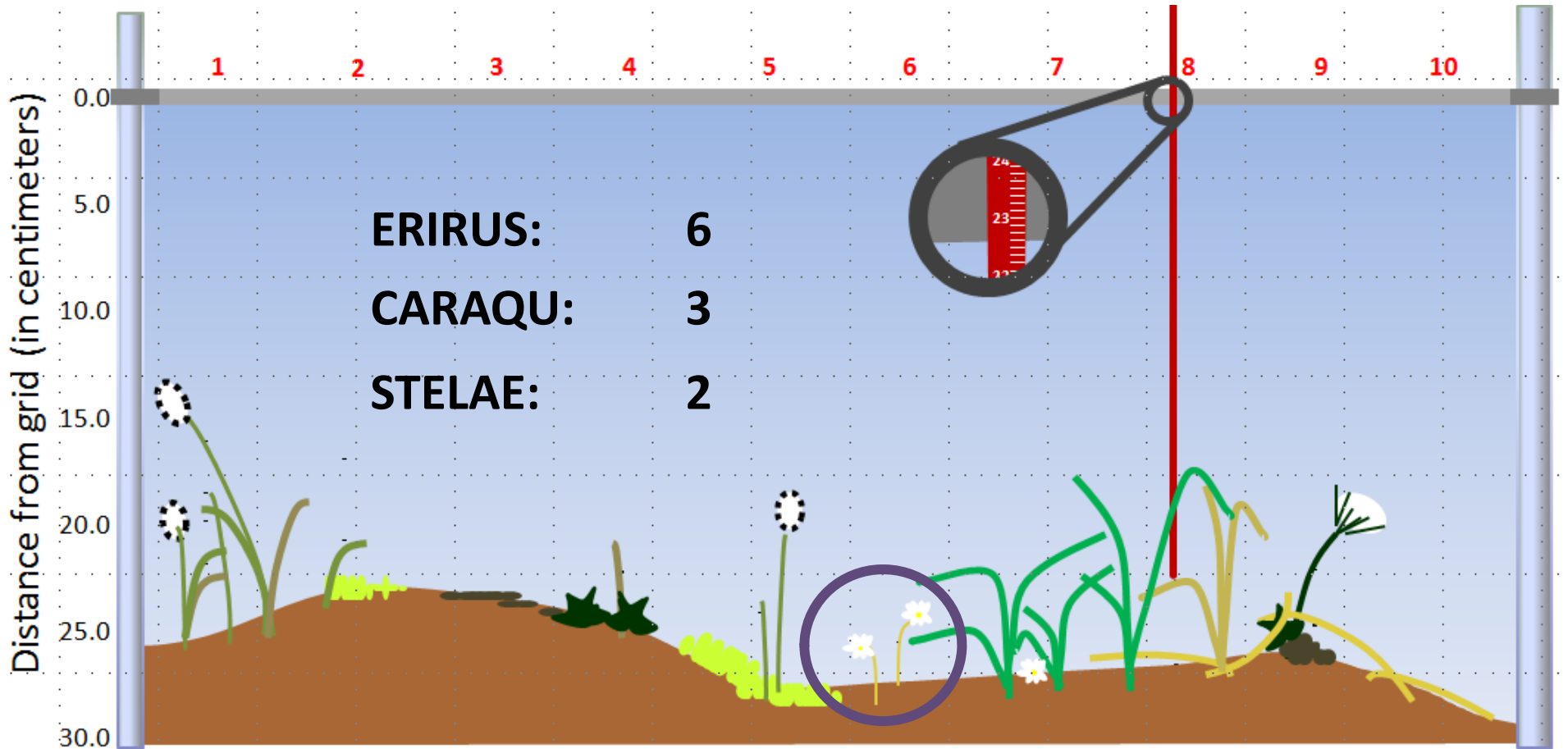




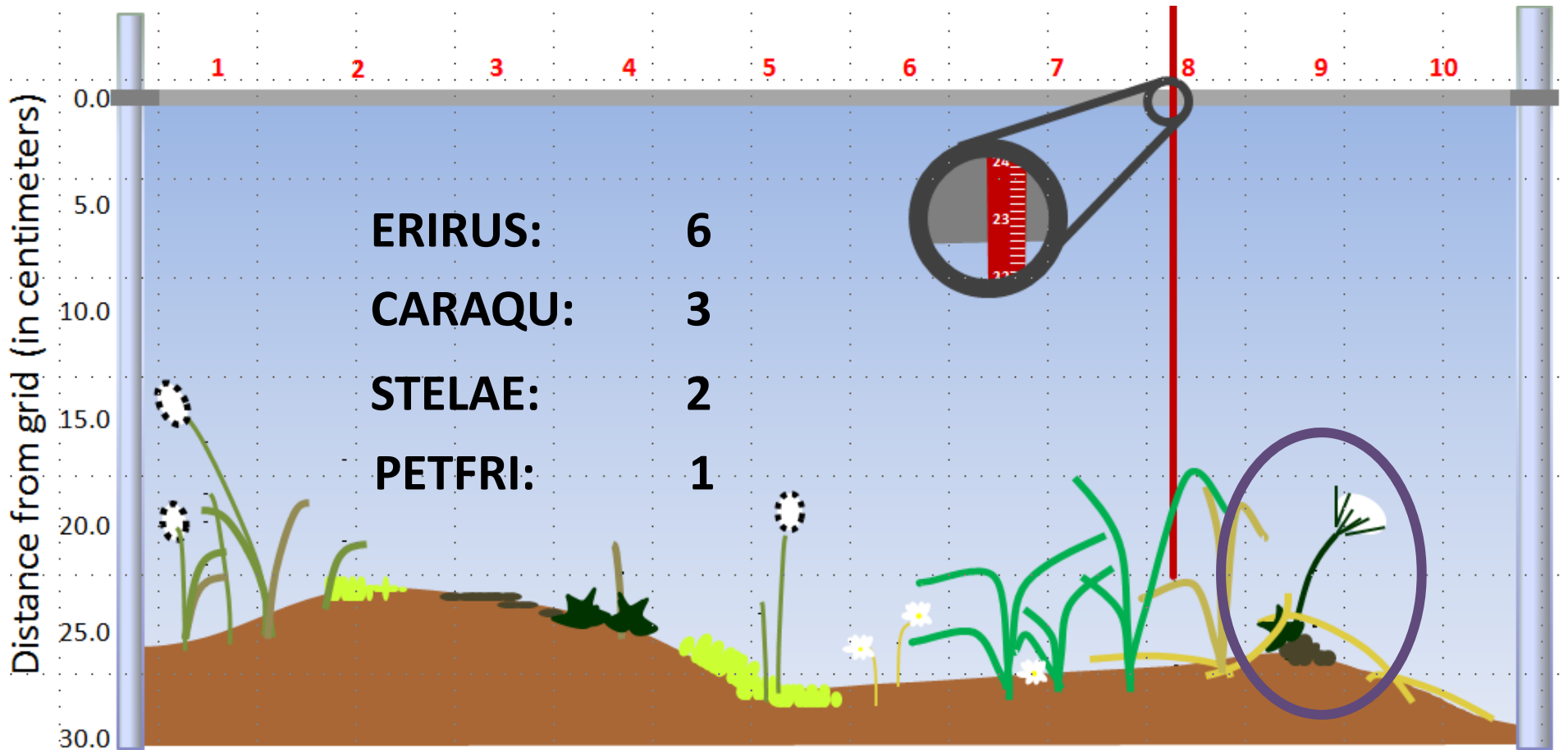
Grid Point1	Grid Point2	Grid Point3	Grid Point4	Grid Point5	Grid Point6	Grid Point7	Grid Point8	Grid Point9	Grid Point10
ERIRUS, A: 16.1	ERIRUS, A: 16.9	GYMINE, A: 23.2	ERIRUS, D: 22.2	ERIRUS, A: 24.1	STELAE, A: 25.5	CARAQU, A: 22.3	CARAQU, A: 18.5	PETFRI, A: 22.1	LITTER, D: 28.5
ERIRUS, D: 18.5	ERIRUS, A: 20.7		PETFRI, D: 24.5	AULTUR, A: 27.4		CARAQU, A: 25.9	CARAQU, D: 22.6	LITTER, D: 24.7	
ERIRUS, A: 19.8	AULTUR, A: 22.7					STELAE, A: 26.3	LITTER, D: 26.5	GYMINE, A: 25.9	
ERIRUS, A: 21.8									
ERIRUS, D: 22.8									
Ground ---: 25.3	Ground ---: 25.3	Ground ---: 23.4	Ground ---: 24.7	Ground ---: 27.6	Ground ---: 27.6	Ground ---: 27.1	Ground ---: 26.7	Ground ---: 26.1	Ground ---: 28.7



Grid Point1	Grid Point2	Grid Point3	Grid Point4	Grid Point5	Grid Point6	Grid Point7	Grid Point8	Grid Point9	Grid Point10
ERIRUS, A: 16.1	ERIRUS, A: 16.9	GYMINF, A: 23.2	ERIRUS, D: 22.2	ERIRUS, A: 24.1	STELAE, A: 25.5	CARAQU, A: 22.3	CARAQU, A: 18.5	PETFRI, A: 22.1	LITTER, D: 28.5
ERIRUS, D: 18.5	ERIRUS, A: 20.7		PETFRI, D: 24.5	AULTUR, A: 27.4		CARAQU, A: 25.9	CARAQU, D: 22.6	LITTER, D: 24.7	
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ERIRUS, A: 21.8									
ERIRUS, D: 22.8									
Ground ---: 25.3	Ground ---: 25.3	Ground ---: 23.4	Ground ---: 24.7	Ground ---: 27.6	Ground ---: 27.6	Ground ---: 27.1	Ground ---: 26.7	Ground ---: 26.1	Ground ---: 28.7



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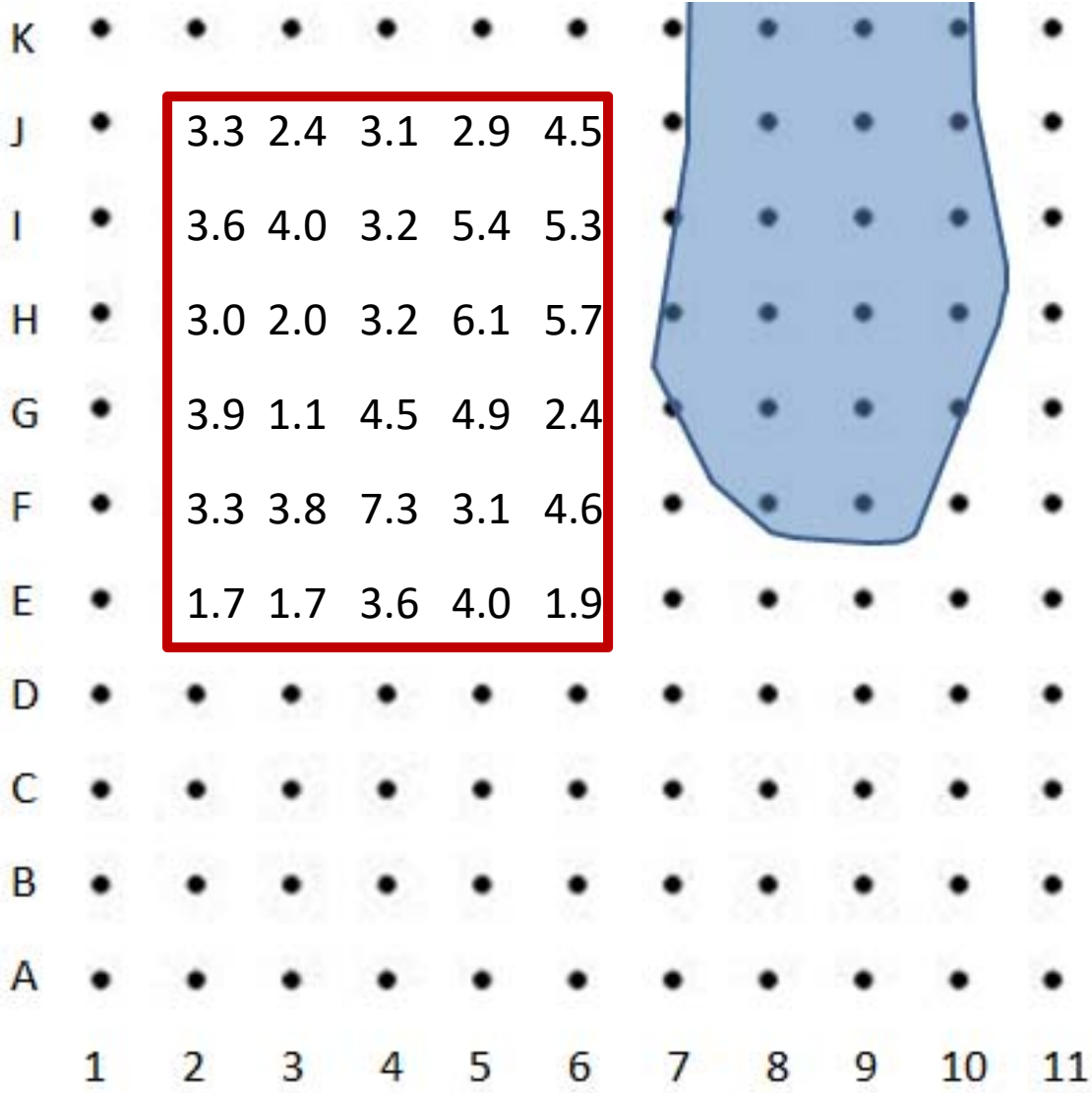
Grid Point1	Grid Point2	Grid Point3	Grid Point4	Grid Point5	Grid Point6	Grid Point7	Grid Point8	Grid Point9	Grid Point10
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Abiotic measures

- Thaw depth
 - Maximum thaw depth for the 2010 season
- Soil moisture
 - Minimum percent water for the 2010 season based on three sample dates
- Soil temperature
 - Mean temperature based on three sample dates in July and August 2010



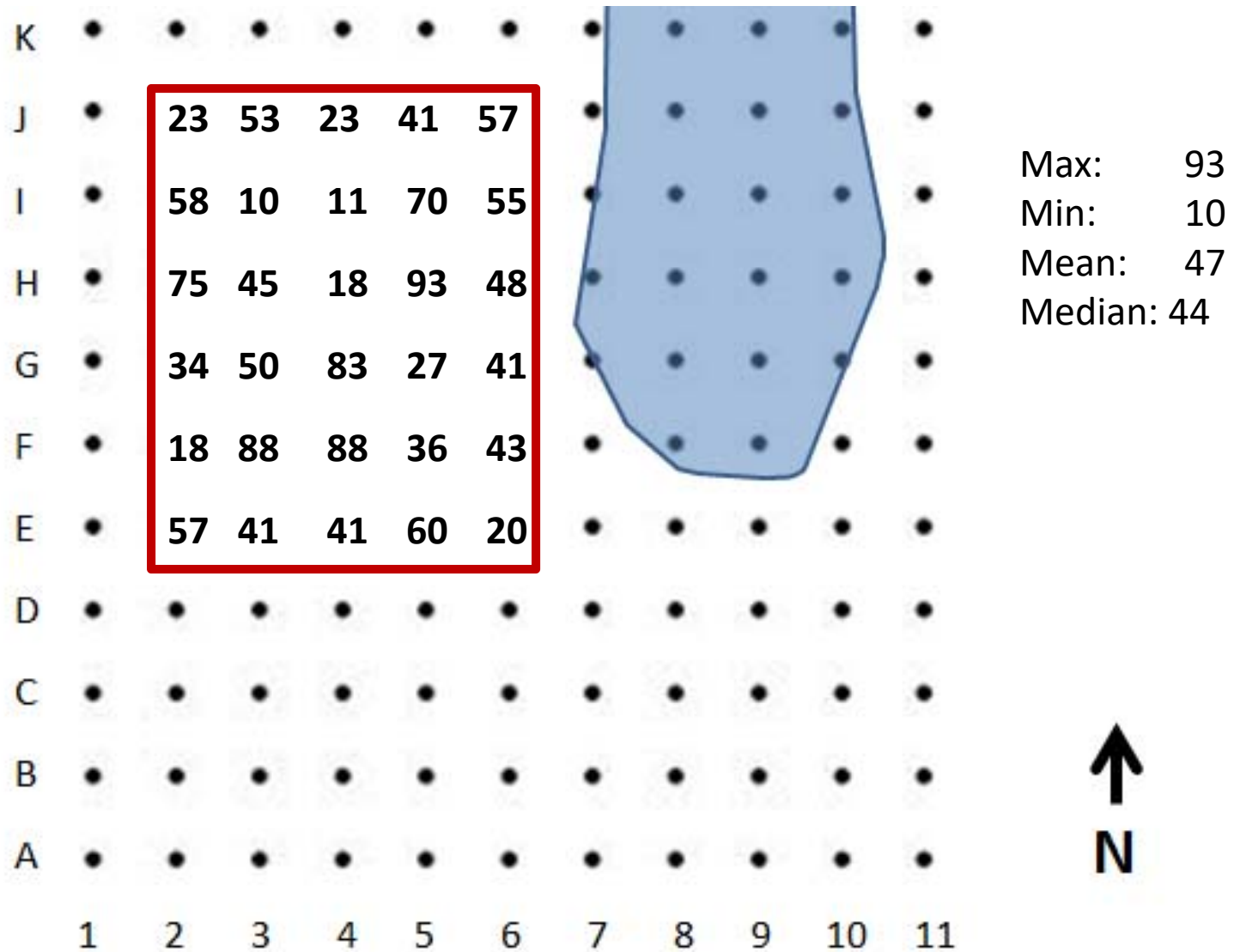
Variation in Soil Temperature (°C)



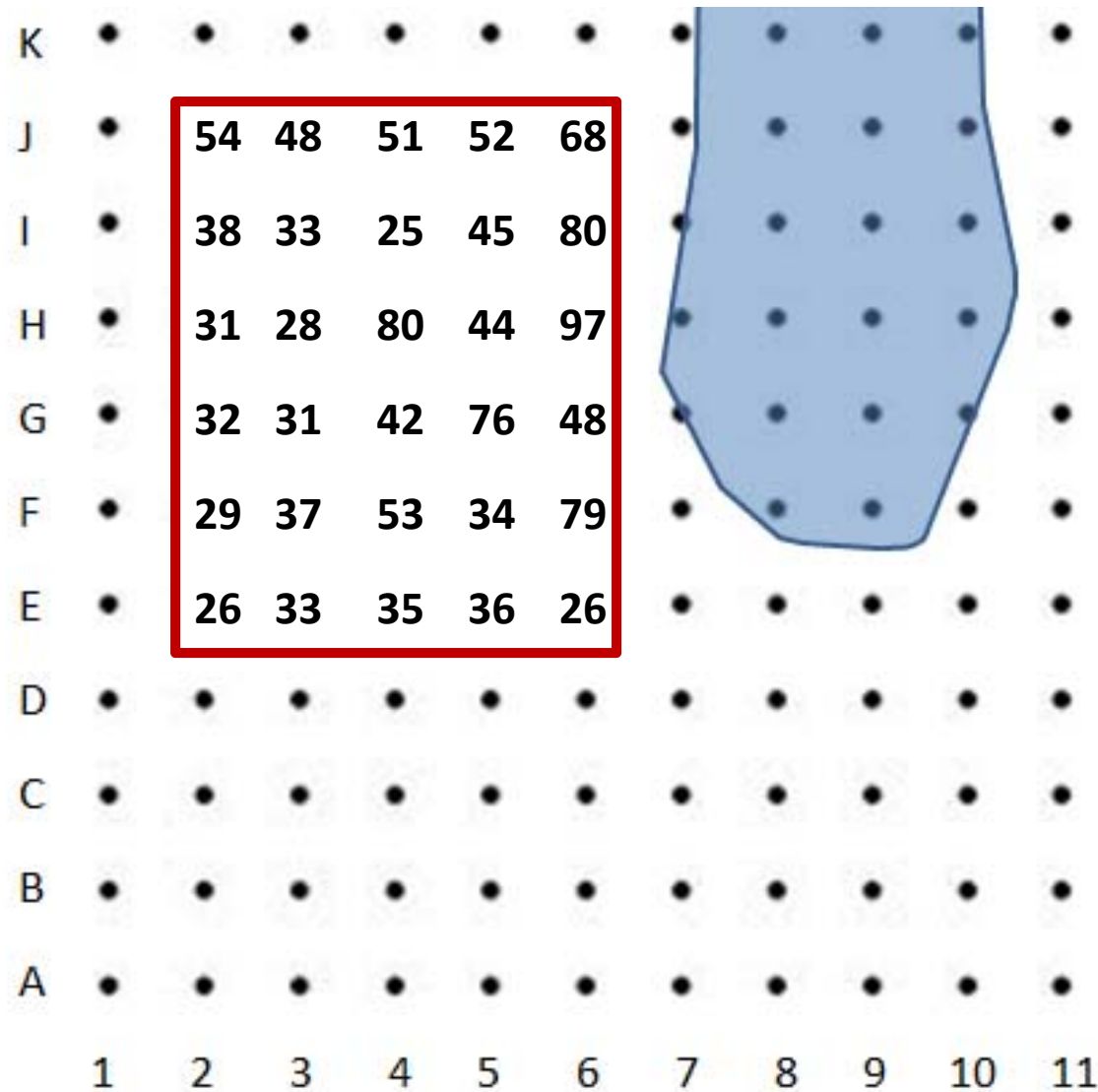
Max: 7.3
Min: 1.1
Mean: 3.7
Median: 3.5



Variation in Soil Moisture (% water)



Variation in Thaw Depth (cm)

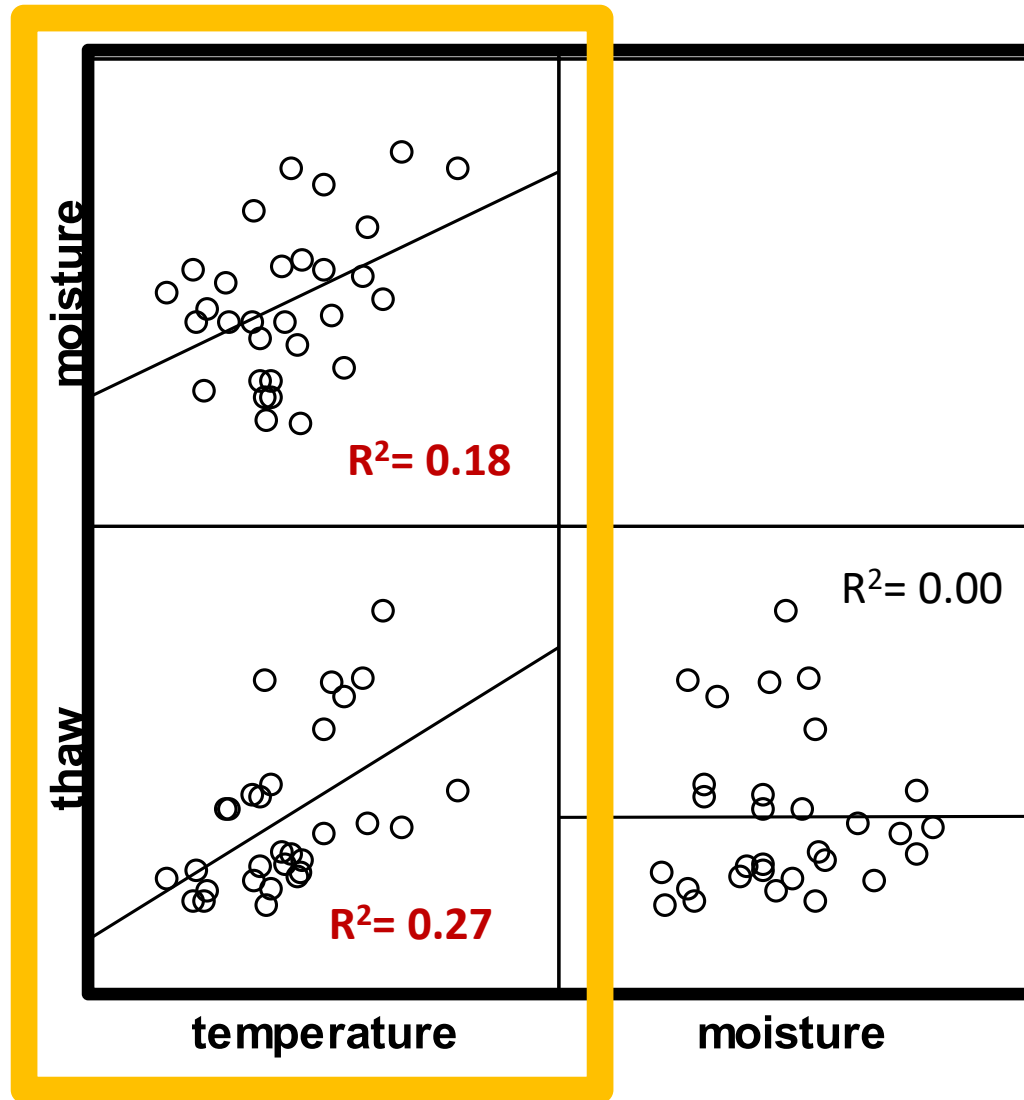


Max: 97
Min: 25
Mean: 46
Median: 40





Correlation of Abiotic Measures



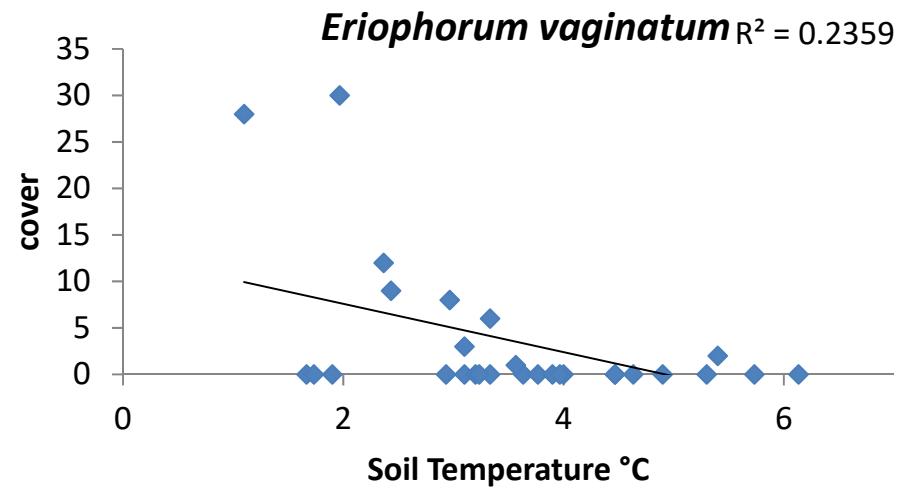
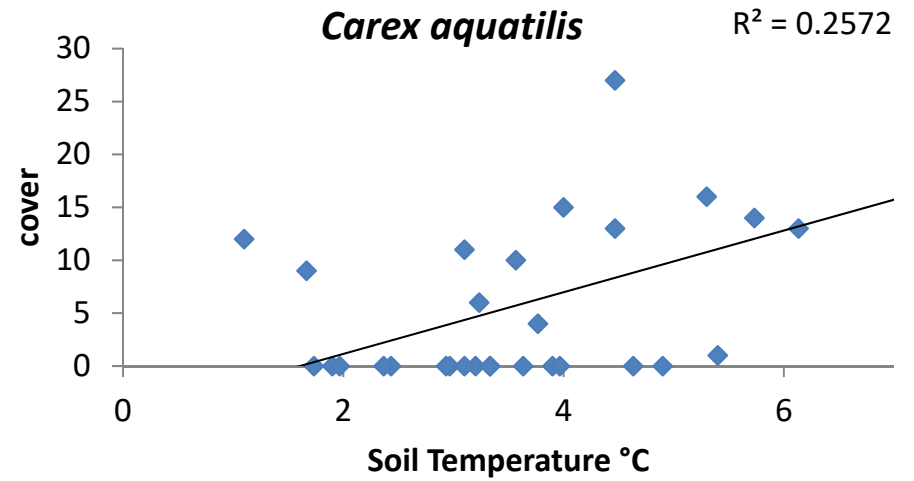
* $p < 0.05$

Summary of regression analyses

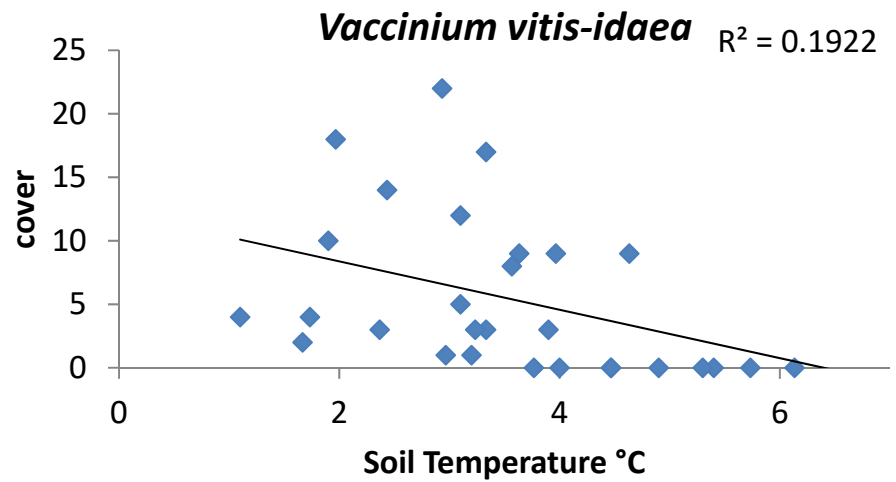
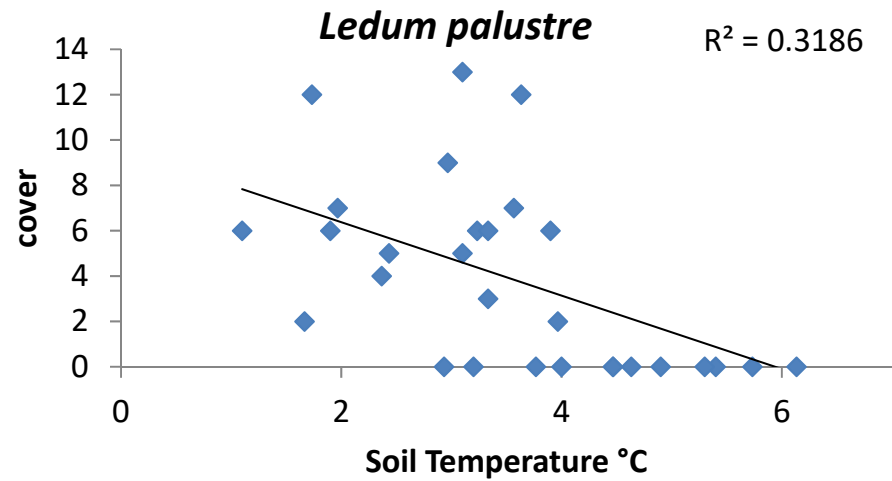
	Thaw Depth	Soil Moisture	Soil Temperature	# of plots
Deciduous Shrub				
<i>Betula nana</i>				12
<i>Salix polaris</i>				6
<i>Salix pulchra</i>			*	9
Evergreen shrub				
<i>Cassiope tetragona</i>		*		14
<i>Ledum palustre</i>	*		*	17
<i>Vaccinium vitis-idaea</i>	*	*		20
Sedge				
<i>Carex aquatilis</i>	*	*		14
<i>Carex bigelowii</i>				13
<i>Eriophorum russeolum</i>		*		9
<i>Eriophorum vaginatum</i>	*			14
Rush				
<i>Luzula confusa</i>				10
Grass				
<i>Trisetum spicatum</i>				8
Forb				
<i>Rubus chamaemorus</i>		*		10

*p<0.05

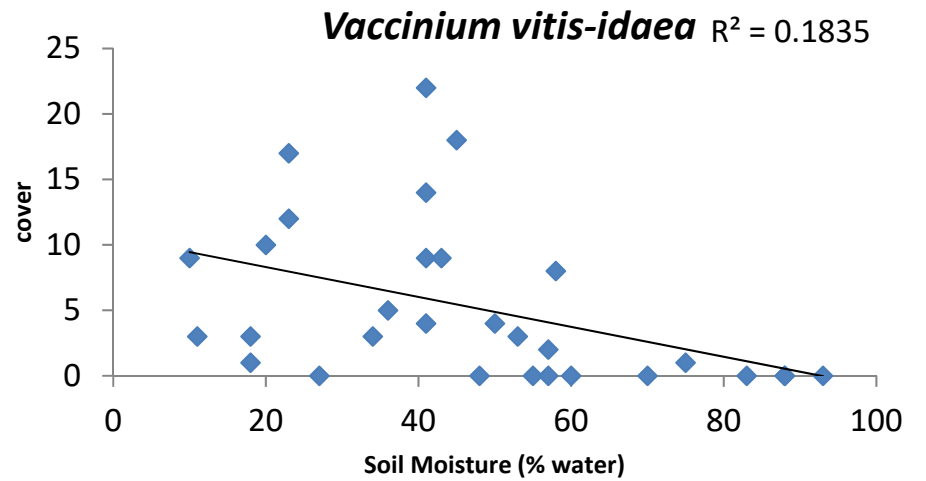
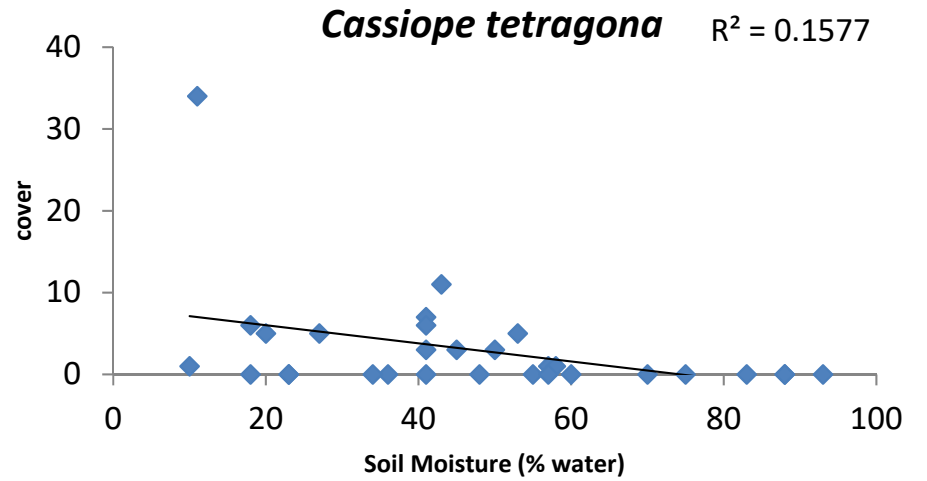
Soil Temperature



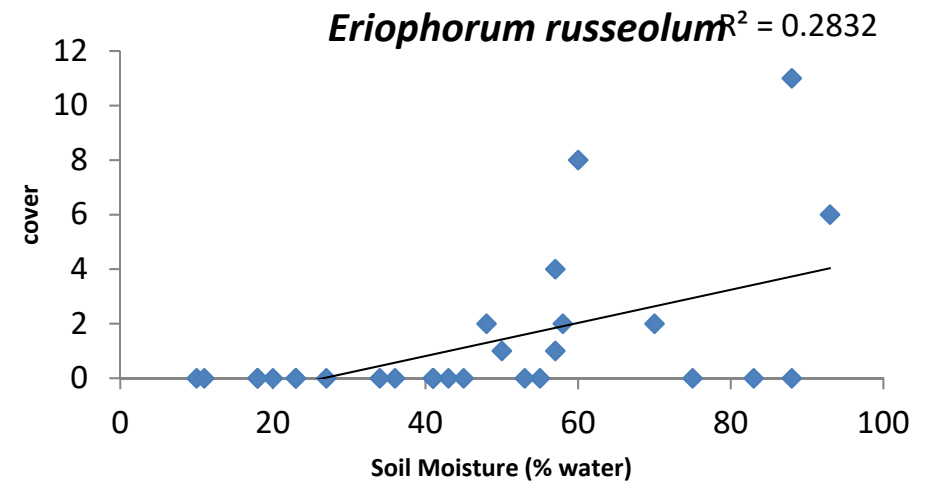
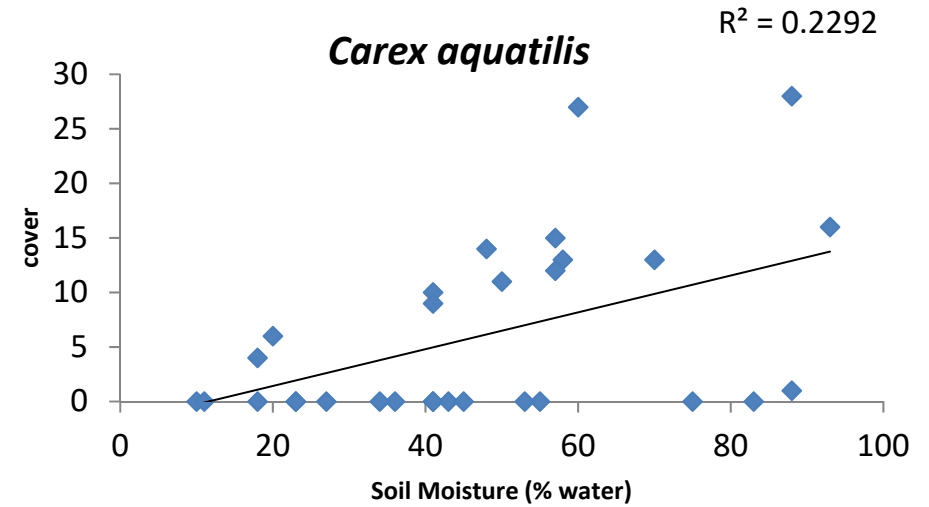
Soil Temperature continued



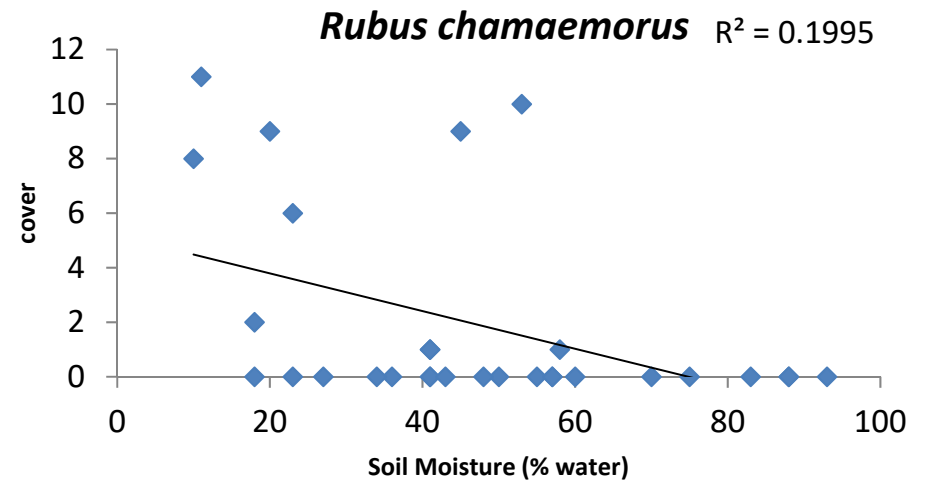
Soil Moisture



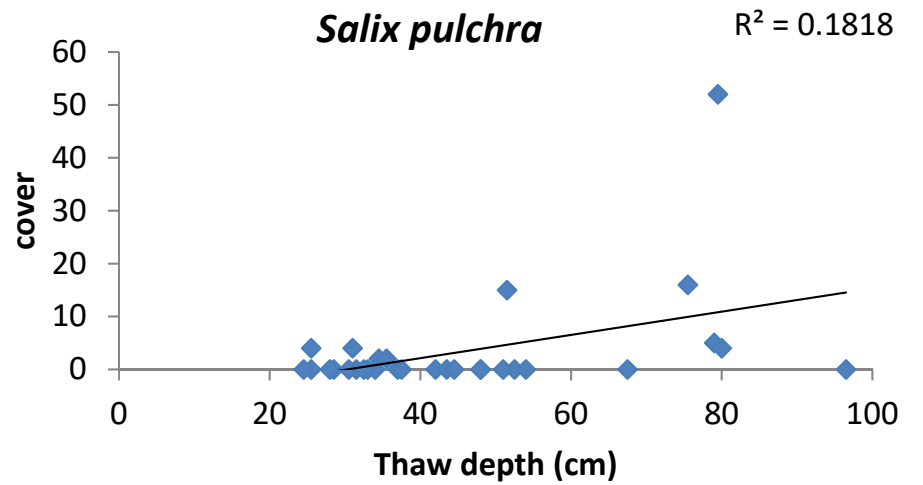
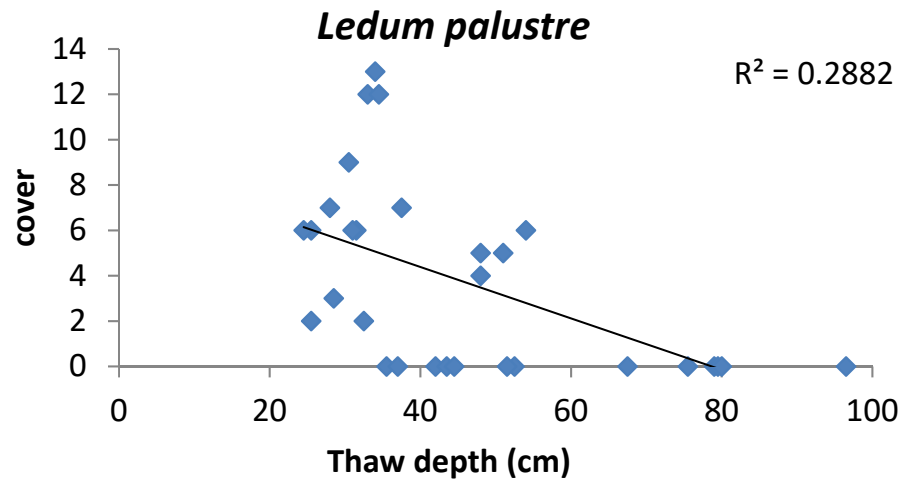
Soil Moisture continued



Soil Moisture continued



Thaw depth



Summary

- Soil temperature was found to covary with soil moisture and thaw depth.
- When abundance varies with an abiotic measure, it should not be assumed that the change in abiotic measure causes the change in abundance.
- Soil moisture changes are “obvious.”
- These preliminary investigations lead to other questions and investigations...

Future directions

- Other abiotic measures
- Increase sample size of abiotic measures
- Presence/absence analysis
- Use abiotic measures to predict communities instead of abundance of a single species
- Expand to other existing grids

Thanks to the members of the Arctic Ecology Program in 2010:
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Questions?