

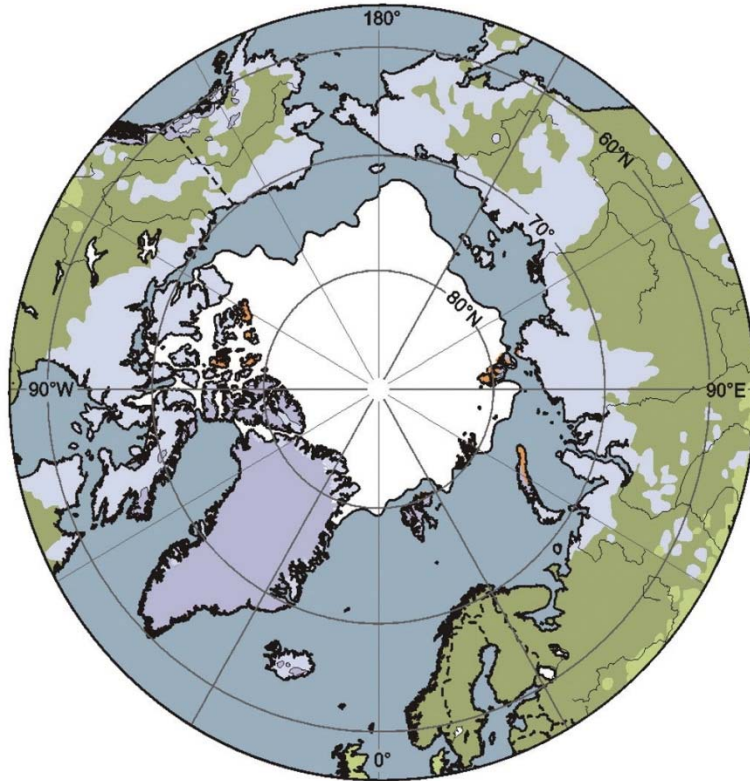
Documenting Vegetation Cover Changes in Northern Alaska

Timothy F. Botting* and Robert D. Hollister
Michigan Academy of Science, Arts and Letters
March 13, 2015

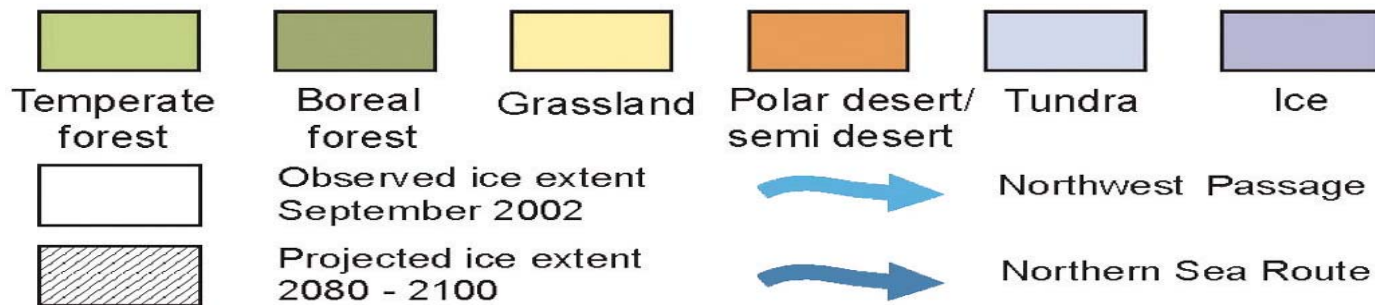
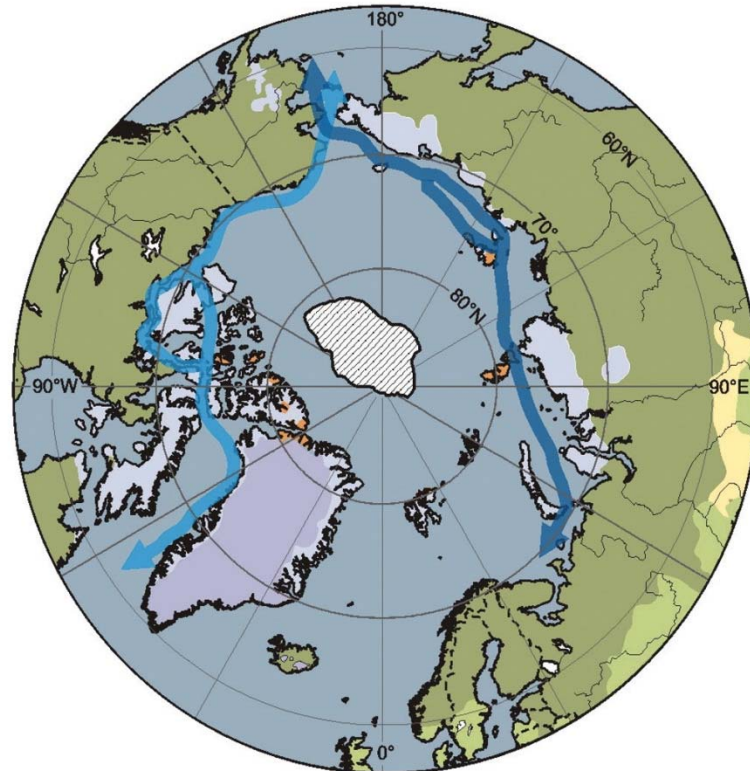


Focus on Arctic Regions

Current Arctic Conditions



Projected Arctic Conditions



Documenting Change - ARCSS

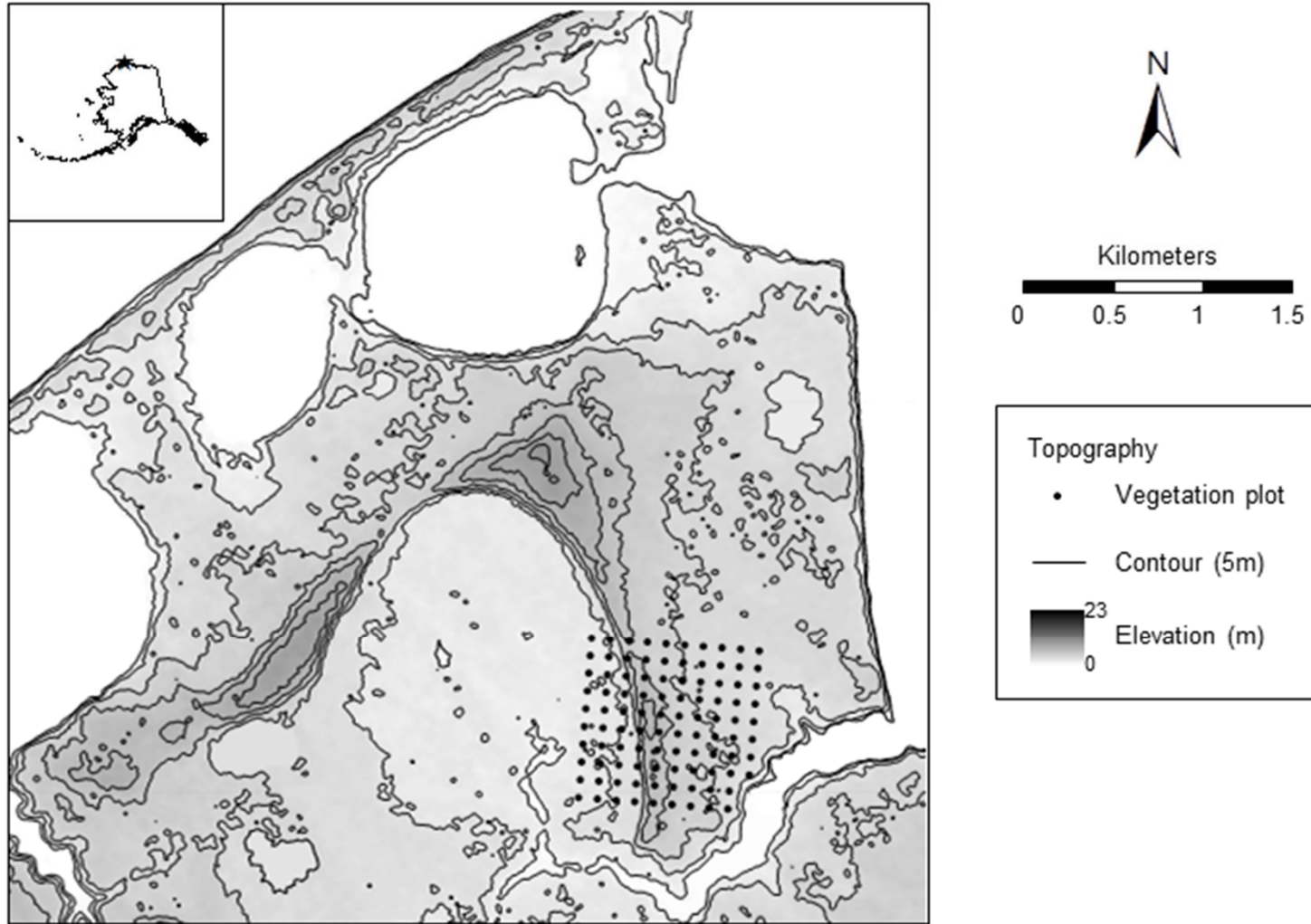
- Long term monitoring
 - Established 1991
 - Active layer/soil temperature
- Scope
 - 200 sites, 15 countries
 - Both hemispheres
- Importance
 - Baseline information
 - Landscape level
 - Long-term

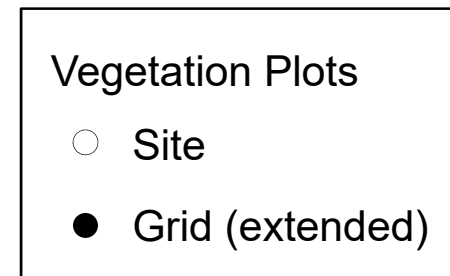
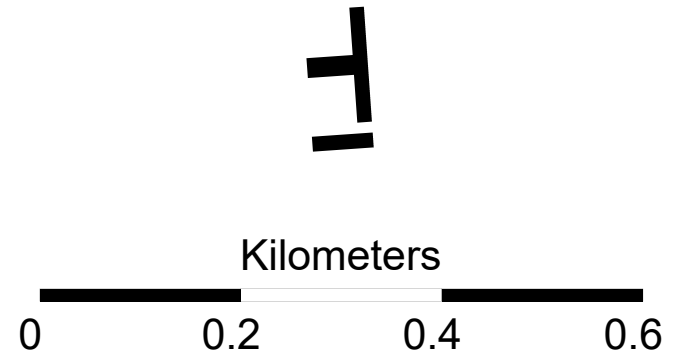
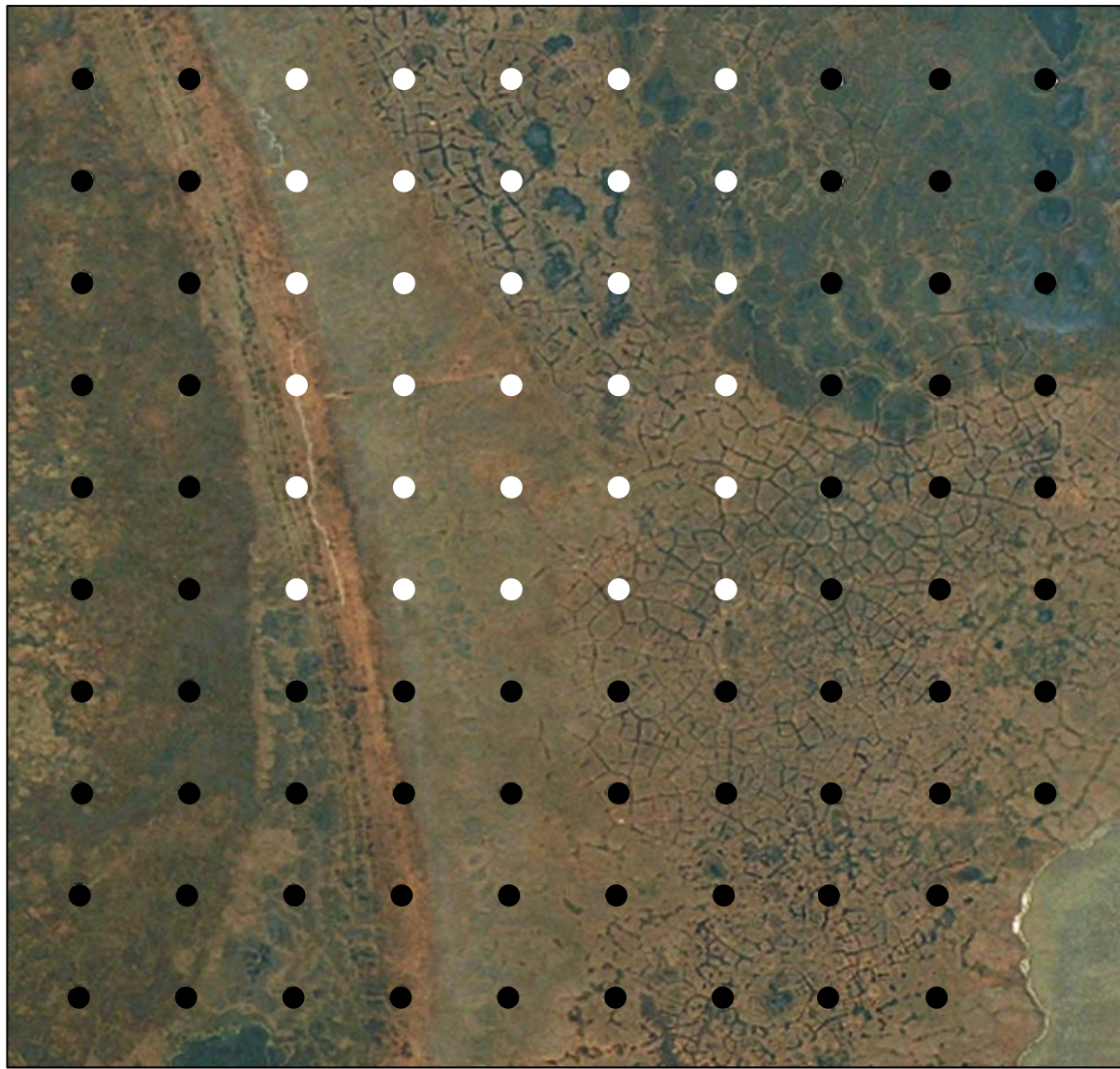


Research Questions

1. How has vegetation cover changed over time?
2. What abiotic factors may explain the observed changes?

Study Location and Site





- Sampling
 - 30 plots in 2010, 2012, 2013, 2014

Data Collection

- Vegetation sampling
 - Permanently marked and resampled
 - 75cm² grid (100 intersections, spaced 7.5 cm apart)
 - All contacts recorded (including height and live or dead status)
 - Vascular plants to spp.
 - Non-vascular to growth form

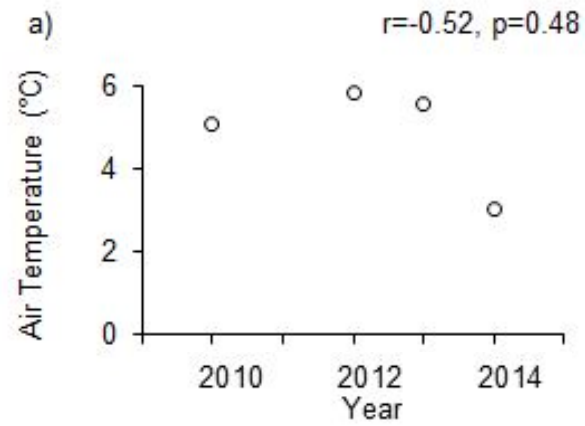


Data Collection

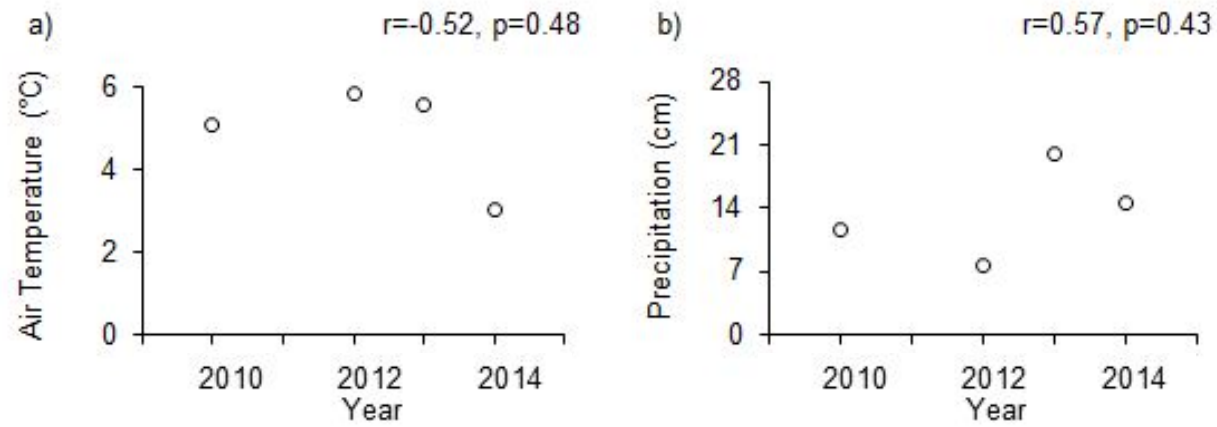
- Abiotic variables (summer)
- Site (1 value)
 - Air temperature (°C)
 - Precipitation (cm)
 - Thawing degree days (TDD)
sum of daily temperatures
- Plot (30 values)
 - Thaw depth (cm)
 - Soil temperature (°C)
 - Soil moisture (VWC %)



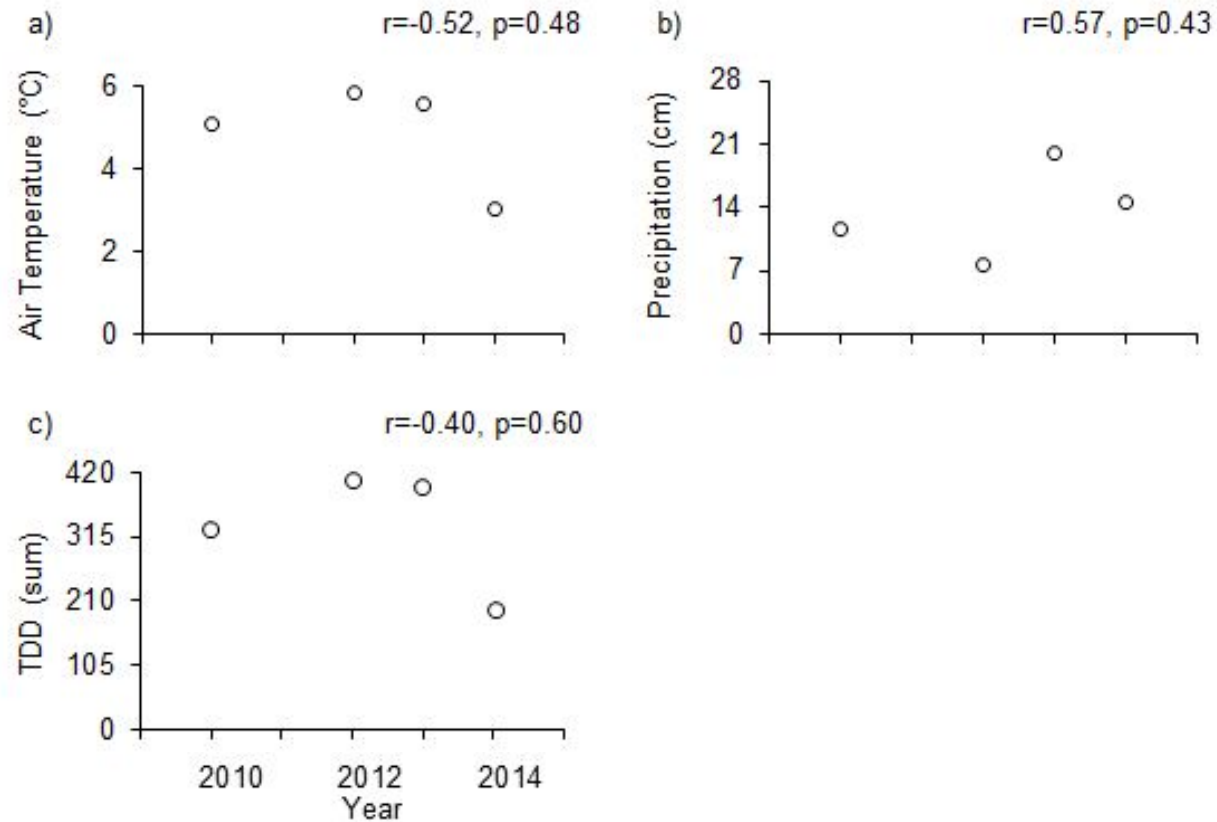
Abiotic Variables – Results



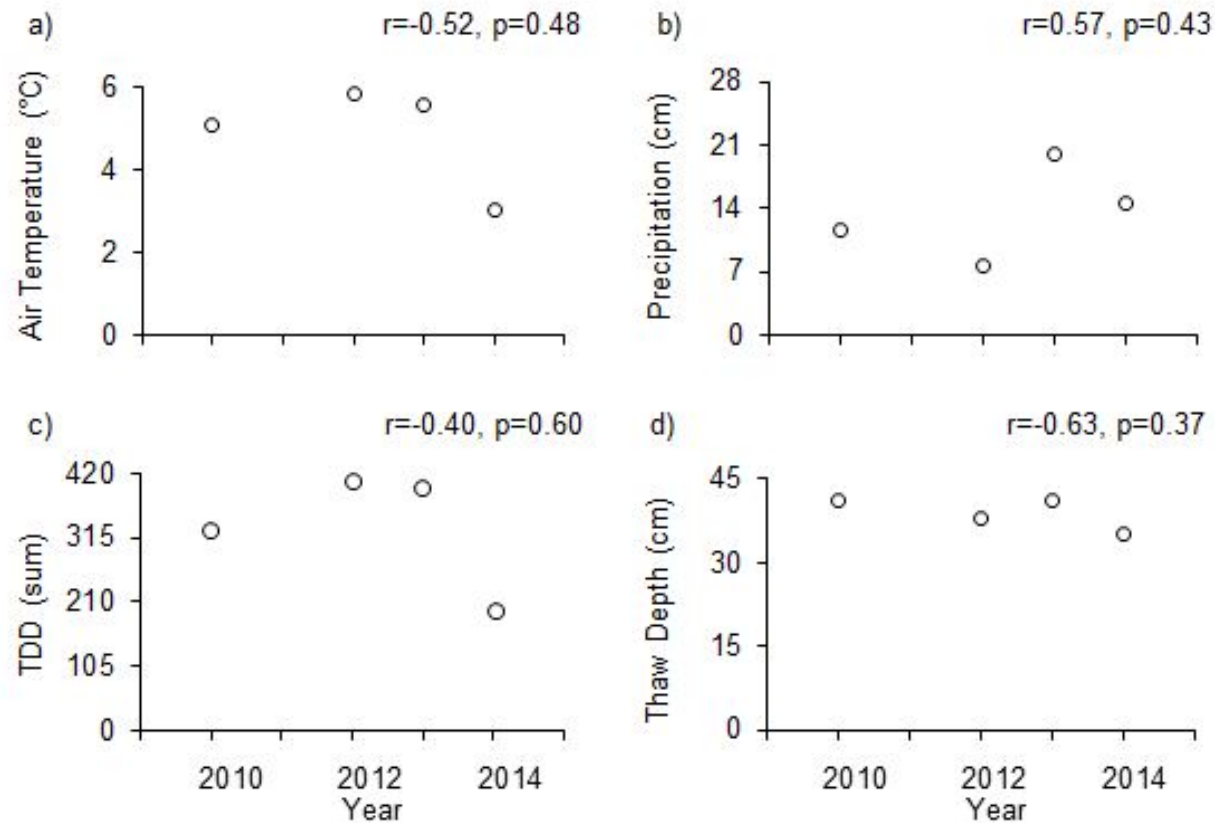
Abiotic Variables – Results



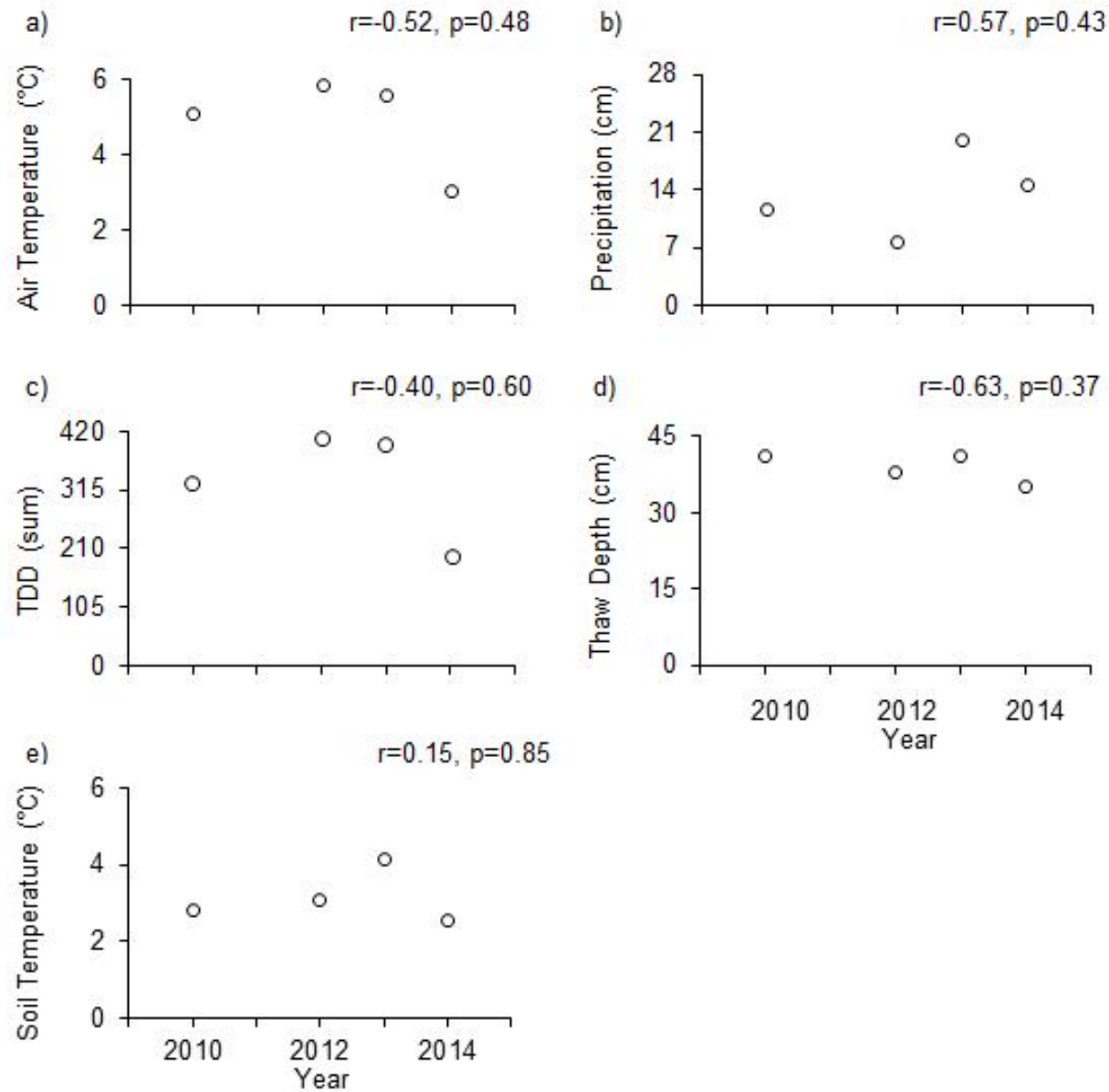
Abiotic Variables – Results



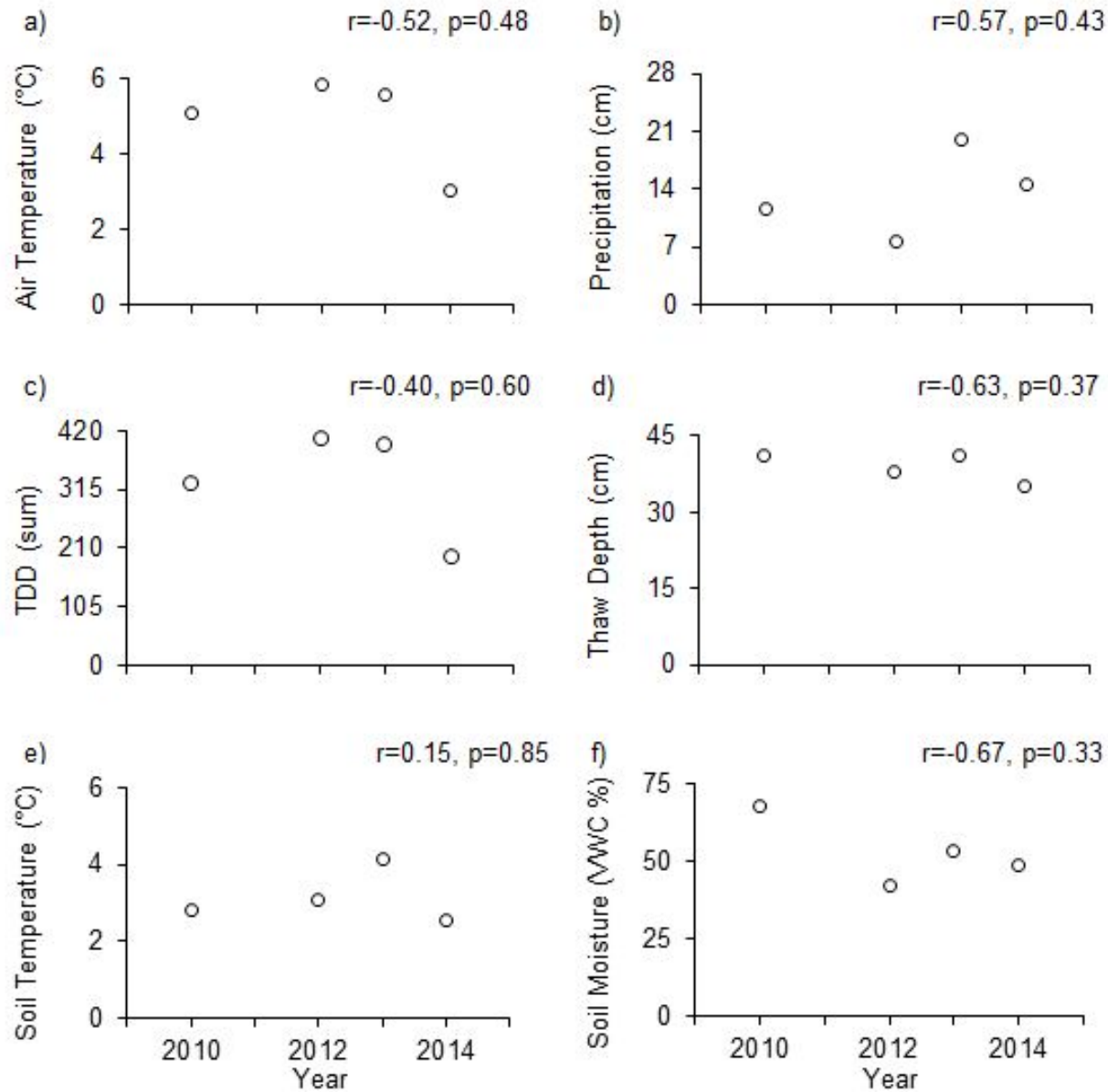
Abiotic Variables – Results



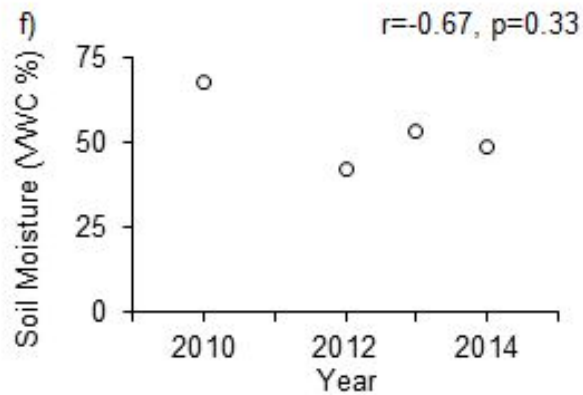
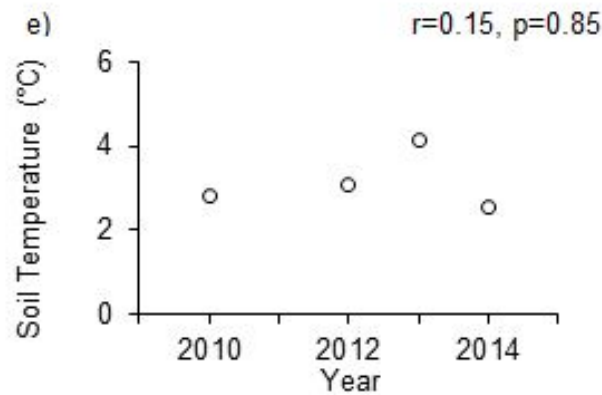
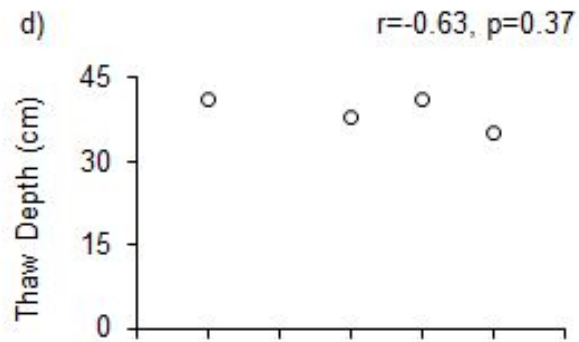
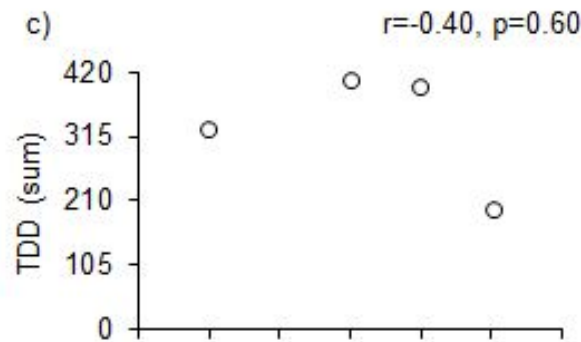
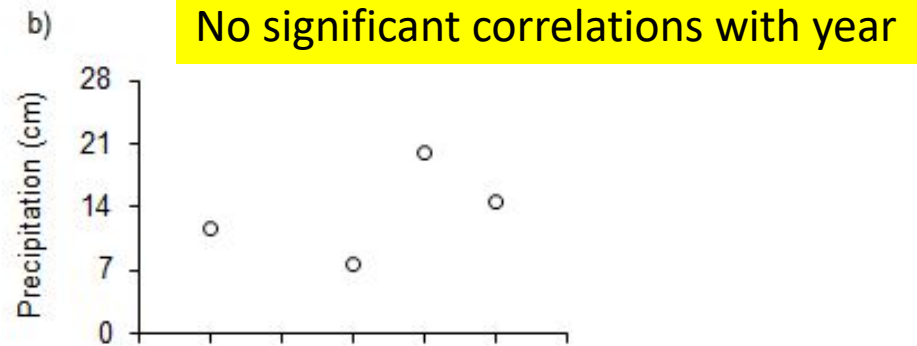
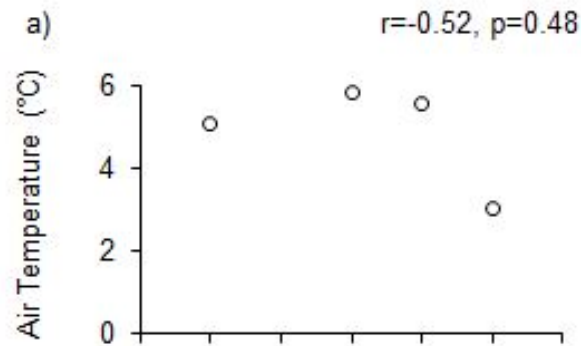
Abiotic Variables – Results



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Abiotic Variables – Results



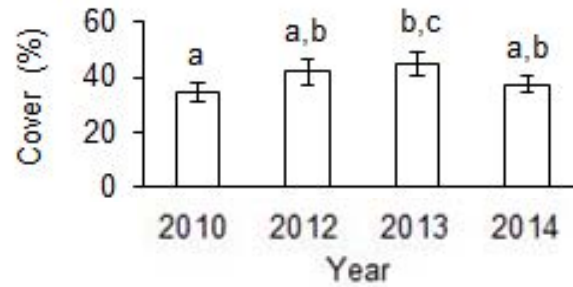
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Change Over Time – Results

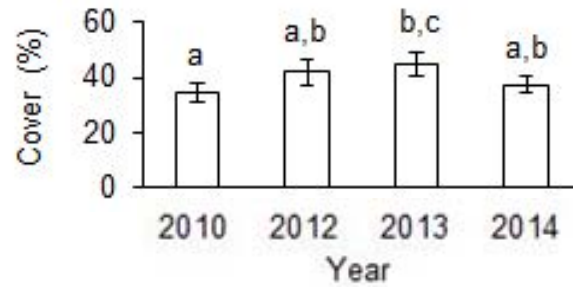


a) bryophytes

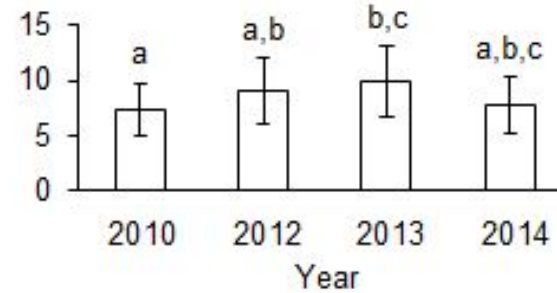


Change Over Time – Results

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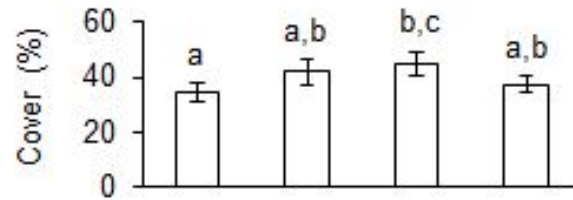


b) deciduous shrubs*

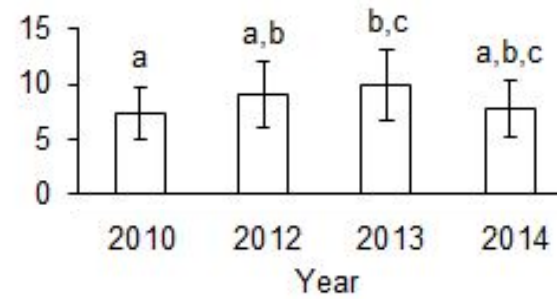


Change Over Time – Results

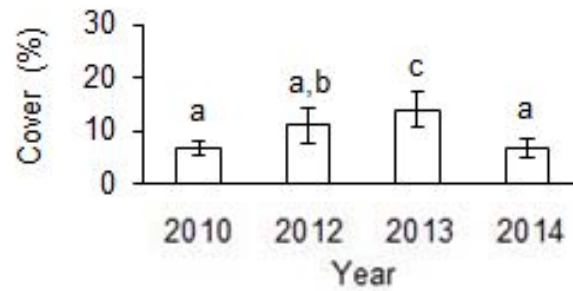
a) bryophytes



b) deciduous shrubs*

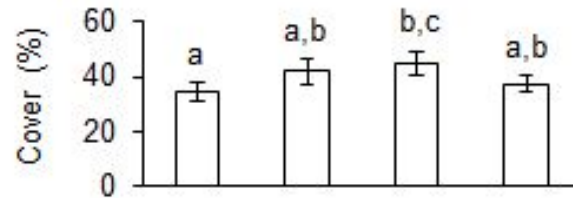


c) forbs*

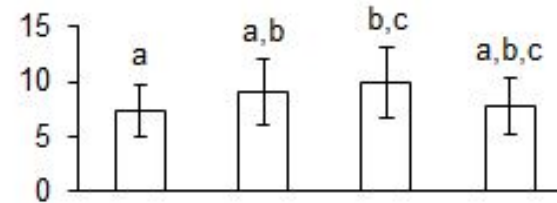


Change Over Time – Results

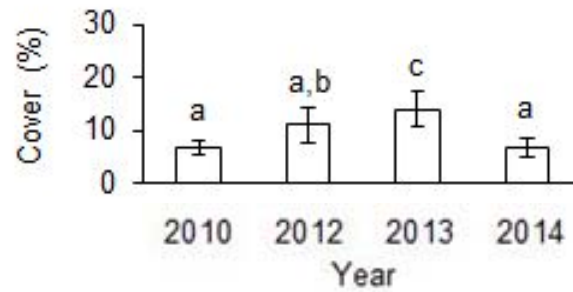
a) bryophytes



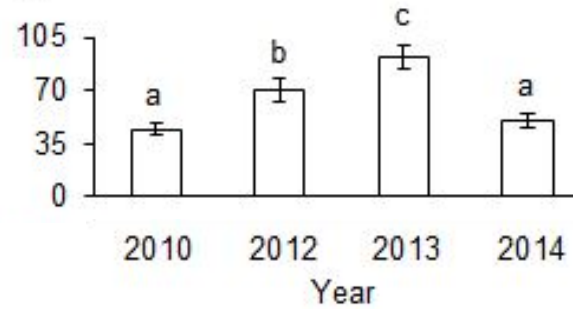
b) deciduous shrubs*



c) forbs*

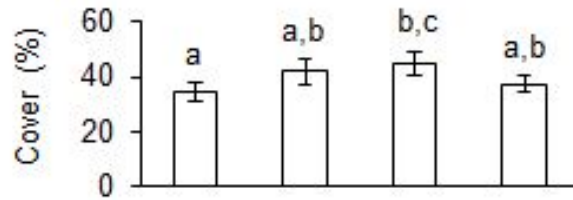


d) graminoids†

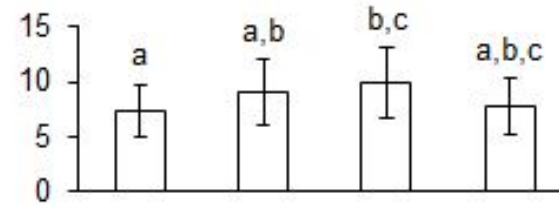


Change Over Time – Results

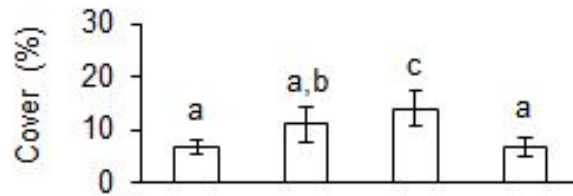
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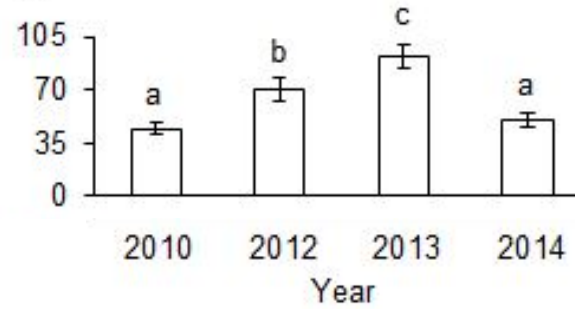
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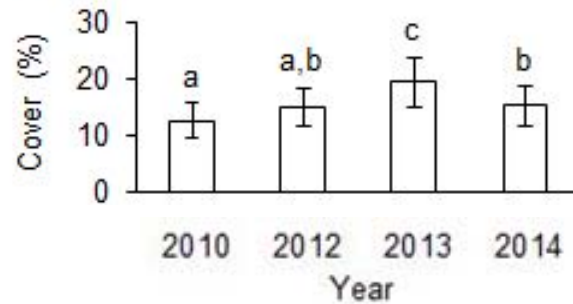
c) forbs*



d) graminoidst

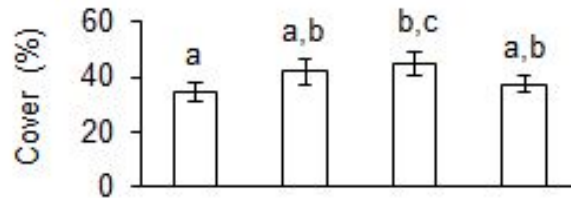


e) lichens*

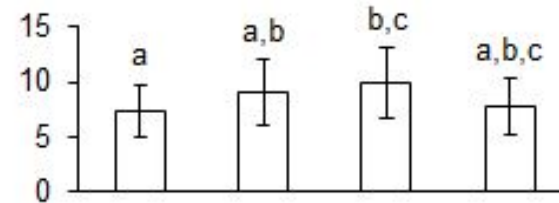


Change Over Time – Results

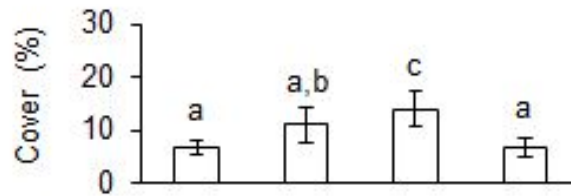
a) bryophytes



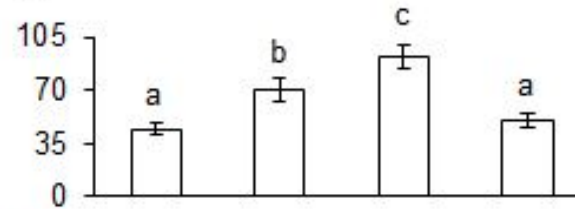
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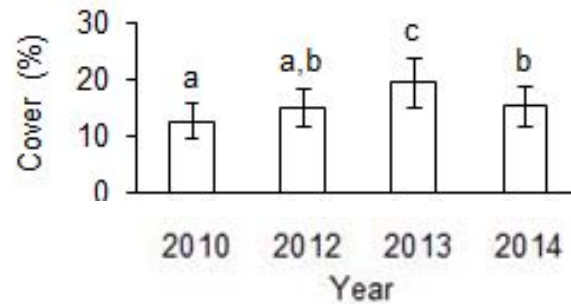
c) forbs*



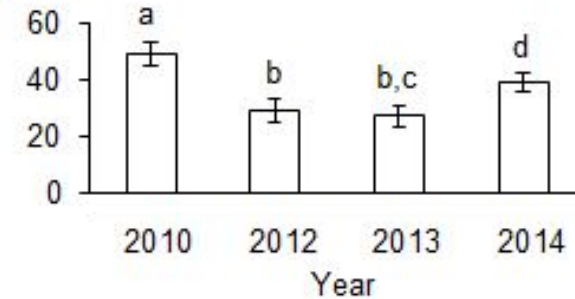
d) graminoids†



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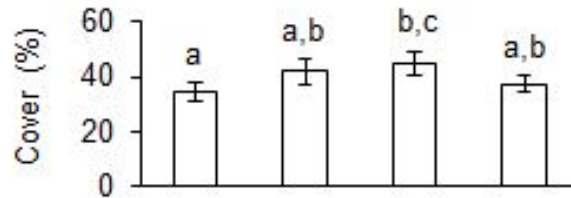


f) litter‡

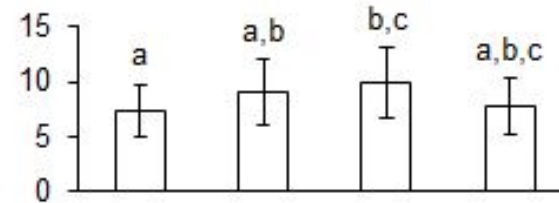


Change Over Time – Results

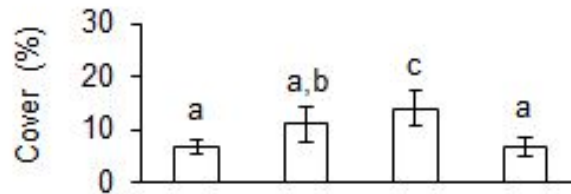
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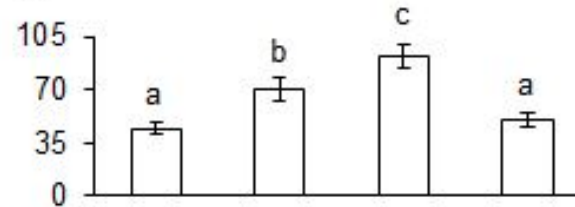
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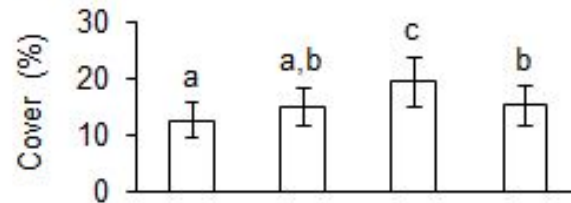
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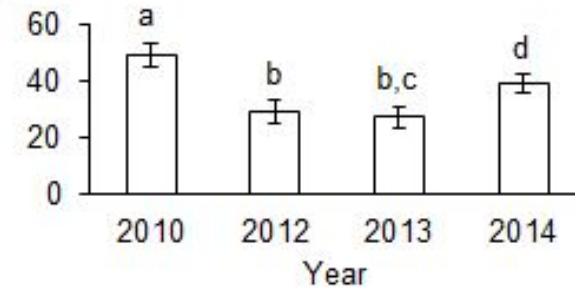
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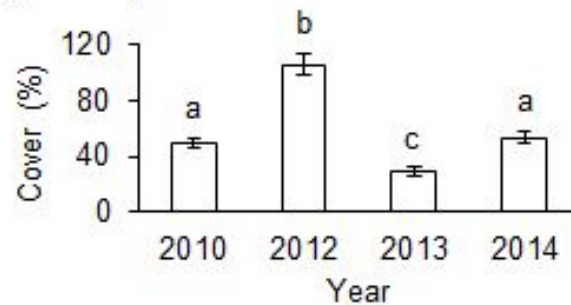
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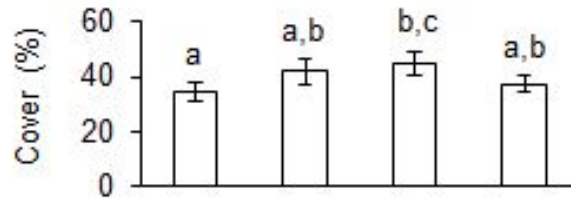


g) standing dead*

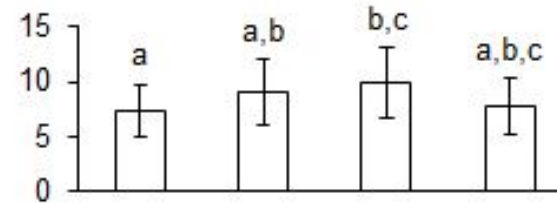


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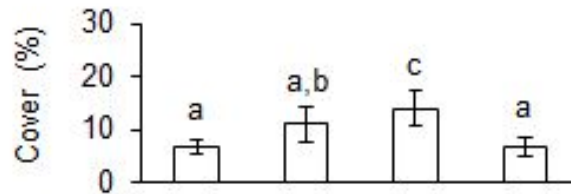
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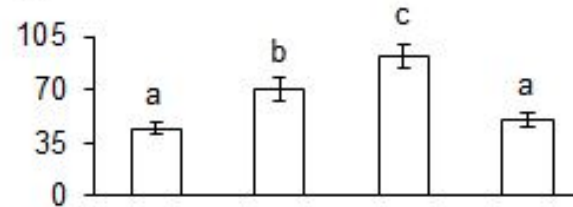
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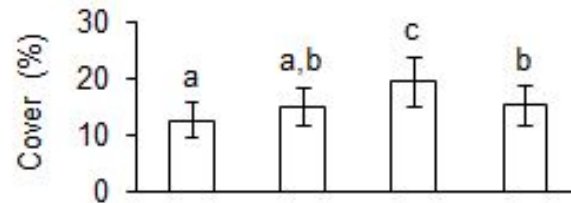
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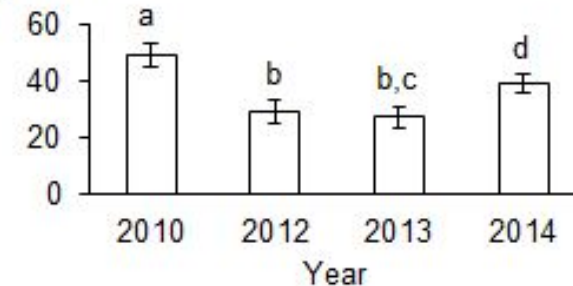
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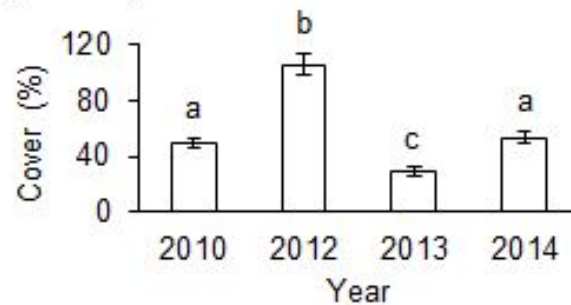
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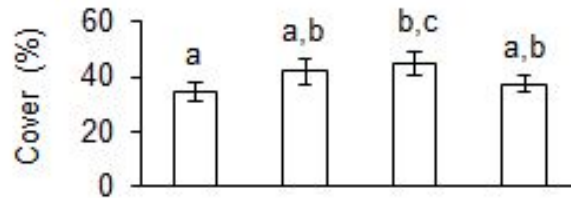
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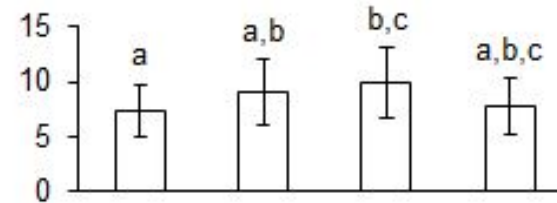
All functional groups changed significantly

Change Over Time – Results

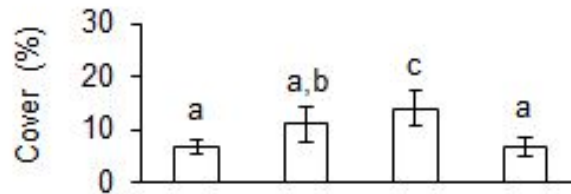
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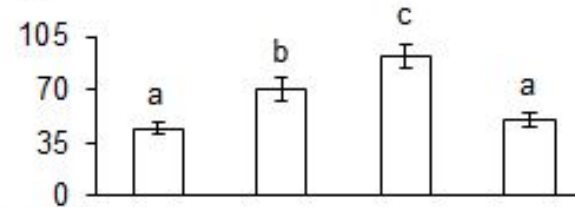
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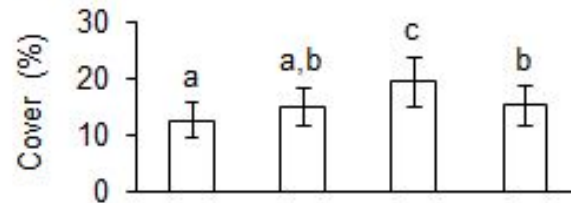
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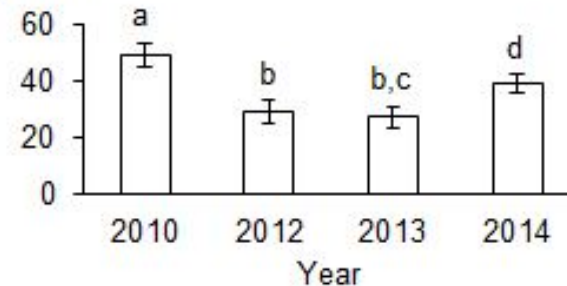
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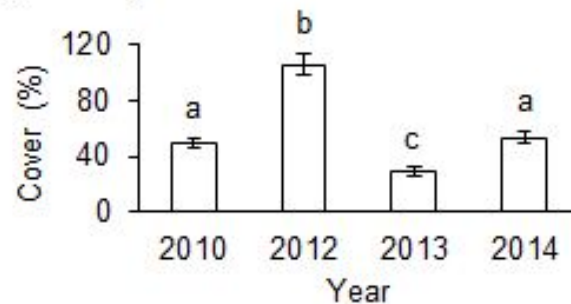
e) lichens*



f) litter‡



g) standing dead*



Changes were large from year to year

Research Questions

1. How has vegetation cover changed over time?
2. **What abiotic factors may explain the observed changes?**

Relating Change to Abiotic Factors - Analyses

- Pearson or Spearman Rank Correlations
 - Each abiotic variable correlated with each functional group



Relating Changes to Abiotic Factors - Results

	Air temperature	Precipitation	TDD (sum)	Thaw depth	Soil temperature	Soil moisture
Bryophytes	0.09	0.08	0.11	0.03	0.15	-0.11
Deciduous shrubs*	0.02	0.04	0.02	0.01	0.05	-0.03
Forbs*	0.20	0.09	0.12	0.15	0.18	0.01
Graminoids [†]	0.24	0.24	0.29	0.16	0.43	-0.19
Lichens*	0.03	0.03	0.03	0.02	0.05	-0.02
Litter [‡]	-0.21	-0.09	-0.26	-0.01	-0.29	0.32
Standing dead*	0.27	-0.67	0.27	-0.45	-0.18	-0.50

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Cover of functional groups correlated significantly with various abiotic factors

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Cover of functional groups correlated the most strongly with different abiotic factors

Conclusions

- Changes were huge from year to year
- Cover of all functional groups changed significantly
 - Therefore caution with monitoring

Conclusions

- Functional groups correlated significantly with different abiotic variables
- Functional groups the most strongly correlated with different abiotic factors
 - Therefore need to consider many abiotic factors

Future Research

- Longer consecutive time series
- Consider other factors
 - Herbivory
 - Analyses incorporating a combination of factors



Acknowledgements

- Committee members: Drs. James Dunn and Heather Rueth
- Drs. Steven Oberbauer and Craig Tweedie
- GVSU, UTEP and UGW researchers
- BASC and UMIAQ for logistical support
- NSF and GVSU Presidential Research Grant for funding



Questions?

