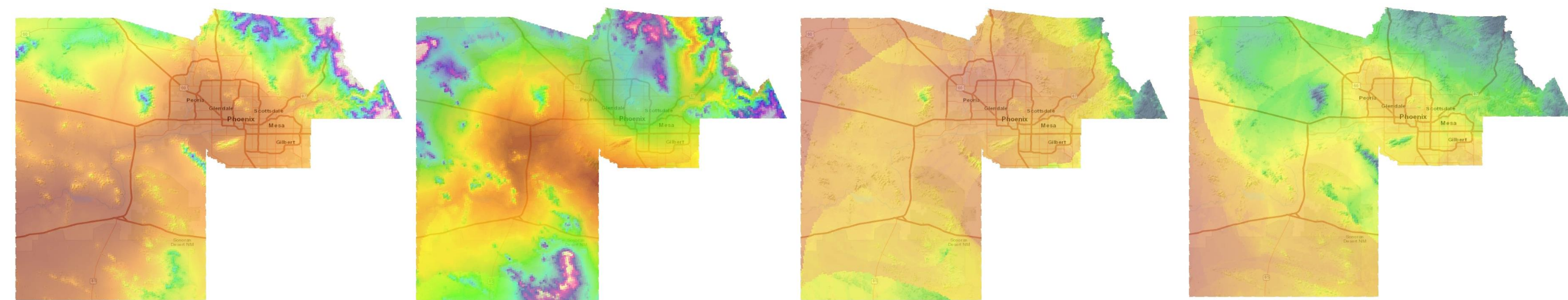


## Background

- Previous studies have seen declines in richness and abundance from point count surveys in riparian sites.
- CAP LTER has 17 years of bird point count survey data. We used data from winter (Dec. – Mar. 15<sup>th</sup>) and spring (Mar. 16<sup>th</sup> – May) counts from 51 sites in the ESCA and Riparian surveys from 2001-2002 and 2004-2016.
- We generated a **geodatabase** of over 50 environmental variables including: **Bioclimatic Variables** (Seasonality etc.), **Vegetation Indices** (NDVI and EVI), **soil variables**, and **geomorphological variables** for use in our models.



Mean Temp. Temp. Range Total PPT & PPT of the coldest qtr.

## Research Questions

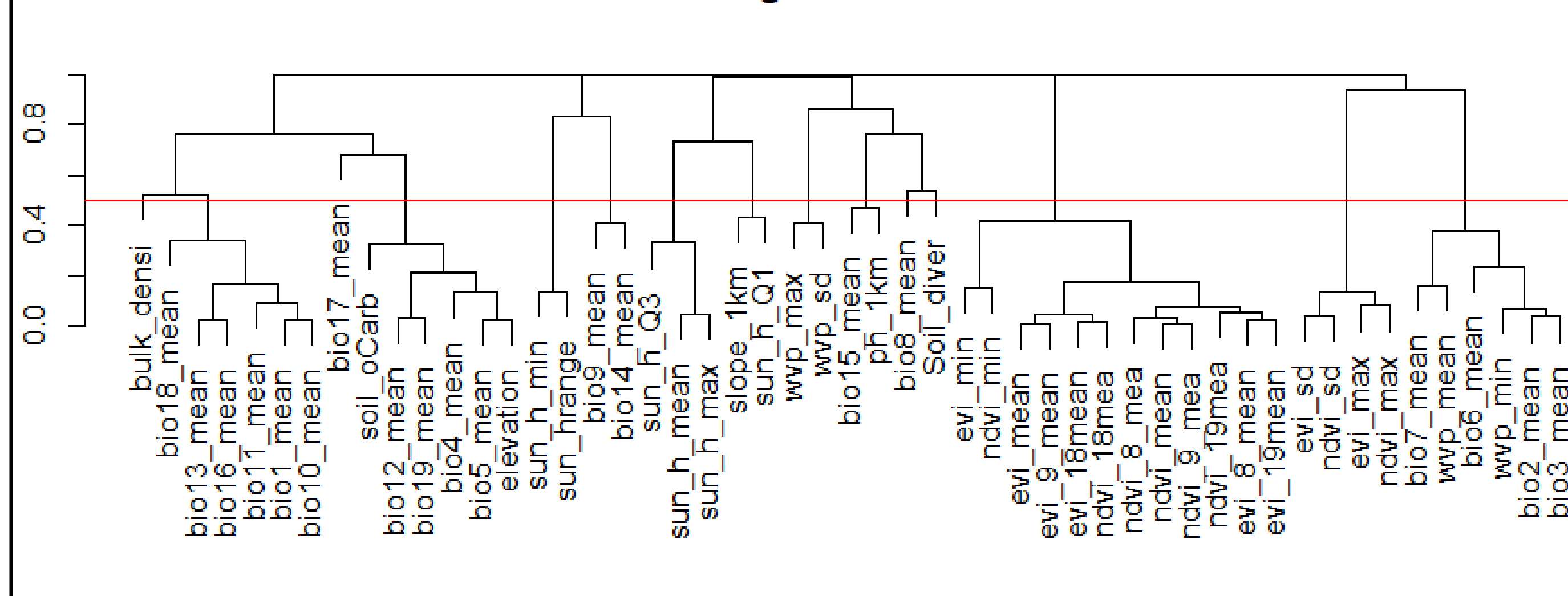
1. Are environmental variables driving bird species richness in Phoenix? If they are, how much do they contribute to annual species richness?
2. Which environmental variables have the largest effect on species richness in Phoenix?

## Research

### Research Question 1

- Cluster analysis conducted between correlation of all environmental variables for all years at each site. Groups were split at the cluster difference height of 0.5 (Fig. 1).
- Variance inflation factor (VIF) was accessed for each component keeping only those groups with values < 5.

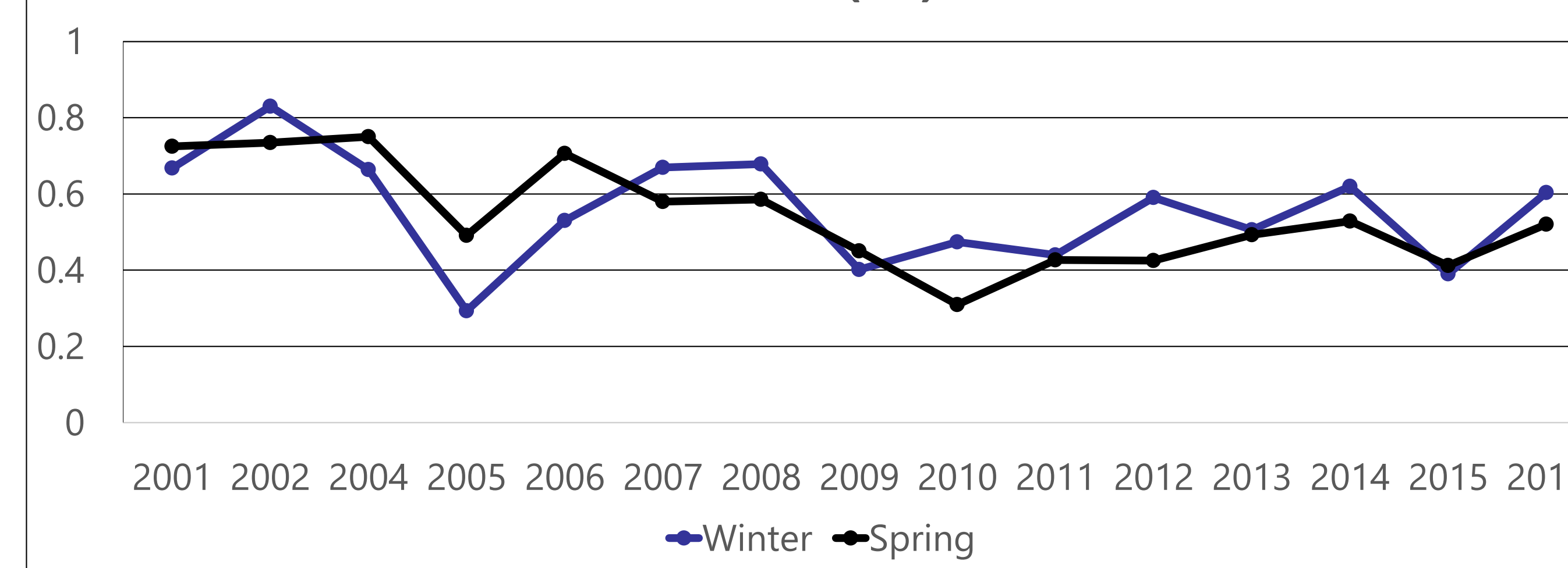
Cluster Dendrogram - Predictor Variables



## Research

- We used generalized linear models with Poisson regression to build our models in R keeping data separated by season and year.
- The R<sup>2</sup> value for each model was used to assess the overall contribution of environmental factors on species richness (Fig. 2).

Goodness of Fit (R<sup>2</sup>) Over Time



### Research Question 2

- In order to access each independent variable against each other, we used the standardized beta coefficients ( $\beta$ ) from each model.
- The two highest coefficients for each model were highlighted to determine patterns over time (Table 1,2).

	2001	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
BIO6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BIO8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BIO16	-0.1	0.1	-0.1	0.1	-0.1	-0.2	0.1	0.1	-0.6	0.0	0.3	-0.2	-1.2	0.0	0.0
BIO17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NDVI Max	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
NDVI 19	-0.1	0.3	-0.2	-0.5	0.9	0.1	0.1	0.5	0.0	0.0	0.1	0.1	-0.3	0.0	0.0
WVP SD	0.0	0.1	0.1	0.1	0.1	0.1	0.4	-0.1	0.3	0.0	0.0	0.1	0.2	0.0	0.3
Slope	-0.4	-0.5	-0.3	0.0	0.3	-0.1	0.6	0.0	0.8	0.0	-0.3	0.1	0.4	0.0	0.6
Sun Hrs Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sun Hrs Q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bulk Density	-1.0	-0.5	-0.3	-0.4	-0.2	-0.4	-0.5	-0.7	-0.5	0.0	-0.3	-0.6	-0.9	0.0	-0.6
Soil pH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Soil Diversity	0.1	0.0	0.1	0.0	0.2	0.0	-0.1	0.0	0.0	0.0	0.1	0.0	-0.1	0.0	0.0
Organic Matter	0.0	0.1	-0.1	0.0	0.0	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0

Table 1(above): Winter yearly comparison of ( $\beta$ ). First and Second highest  $\beta$  marked for each year.

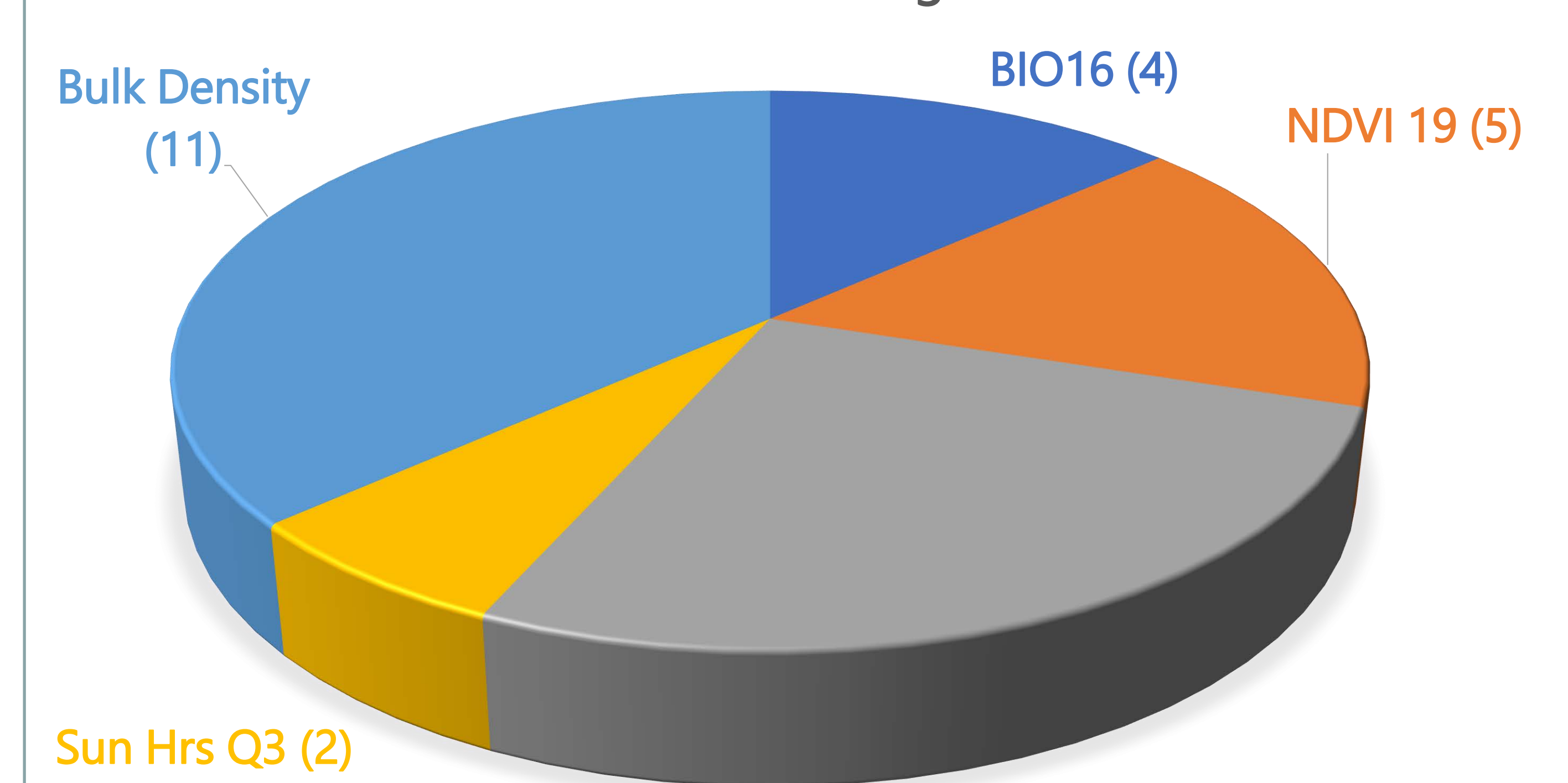
Table 2(below): Fall yearly comparison of  $\beta$ . First and Second highest  $\beta$  marked for each year.

	2001	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
BIO6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BIO8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BIO16	-0.1	0.1	-0.1	-0.1	0.0	-0.1	0.1	0.1	-0.1	0.0	0.2	-0.2	-0.9	0.0	0.0
BIO17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NDVI Max	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
NDVI 19	0.7	0.4	-0.1	0.1	0.4	-0.3	0.0	0.0	0.0	0.0	0.0	0.1	-0.2	0.0	0.0
WVP SD	0.0	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	0.0	0.2	0.0	0.2	0.2	0.0	0.1
Slope	-0.5	-0.4	0.0	-0.2	-0.5	-0.4	0.0	0.0	0.2	0.0	-0.2	-0.1	0.1	0.0	0.3
Sun Hrs Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sun Hrs Q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bulk Density	-0.6	-0.5	-0.4	-0.6	-0.2	-0.1	-0.4	-0.3	-0.6	0.0	-0.3	-0.4	-0.4	0.0	-0.5
Soil pH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Soil Diversity	0.2	0.0	0.0	0.0	0.1	0.2	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Organic Matter	0.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

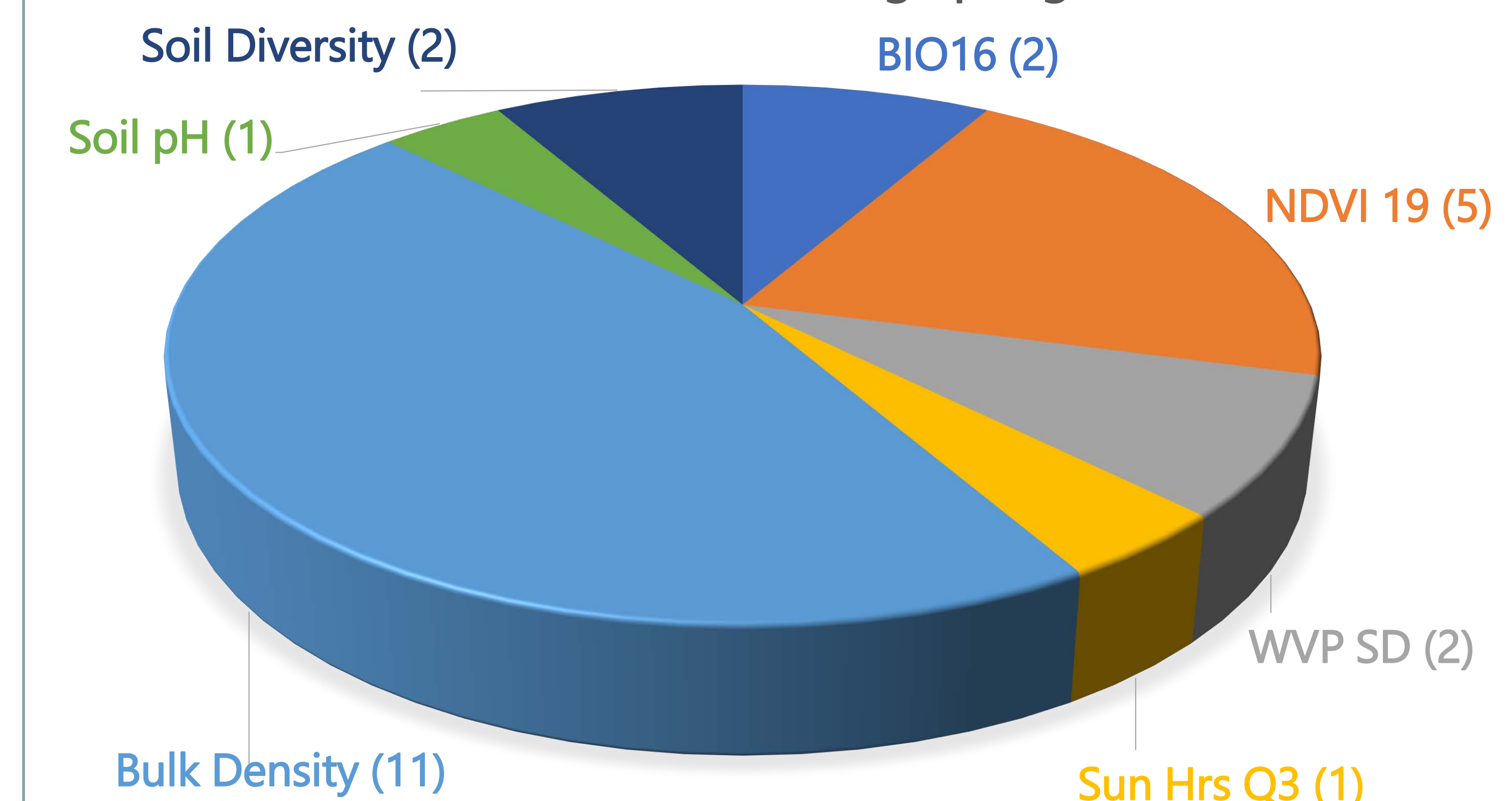
## Research

- Highest two  $\beta$  values for each year and season were then compared against each other in proportion of 30 (and frequency or count of 30) (Fig. 3, 4).

Environmental Variables Driving Winter Richness



Environmental Variables Driving Spring Richness



## Discussion

- Environmental variables affect bird species richness. The R<sup>2</sup> value for spring was 54% and winter was 55%. We need to further investigate the large declines in 2005, 2010, and 2015.
- Soil bulk density (-), slope (- in winter + in spring), NDVI 19 (NDVI of the wettest qtr.)(+), and BIO16 (PPT of the wettest qtr.) (-) were most influencing richness.

Our acknowledgement and thanks go to CAP LTER and all the CAP technicians that continue to gather bird point count data.