# PHAE Part 6: National tree diversity with NEON data

In this week’s lab, we will add national tree diversity information to the findings you have generated by summarizing our class’s PHAE tree data.

## Tree diversity data from the National Ecological Observatory Network

To collect our woody plant data, we used methods consistent with the National Ecological Observatory Network (NEON)’s woody plant vegetation structure project. Therefore, we can compare our data to other plots in this national network.

NEON has [81 field sites](https://www.neonscience.org/about-neon-field-sites) across the United States, spread across 20 different ecoclimatic domains. At ESU, we are right on the edge of the Northeast and Mid-Atlantic domains. Many ecological variables are monitored at each site – the woody plant vegetation structure is just a piece of the puzzle.



**Figure 1: Map of NEON field sites**

We will be analyzing woody plant data from the core terrestrial site from each ecoclimatic domain (except tundra, since there are no trees there to analyze). There are many plots within each domain – we’ll be working with average values from each domain. Just like our data, these values represent woody plants found within 400m2 plots (for NEON, all 20m x 20m). In the NEON protocol, all woody plants are included, even very small ones – so abundances can be very high, in plots with a lot of seedlings or saplings.

The table below provides summary statistics for the NEON data – how many plots were in each ecodomain, and average values of richness and woody plant abundance (# individual plants) within each ecodomain. Note that the values are *averages* of the 20 x 20 m plots – it isn’t the overall richness for an entire ecodomain, but for the average plot within that domain. Therefore, these values are comparable with the data we collected, even though they have many more plots.

**Table 1: Summary of NEON woody vegetation plots across ecoclimatic domains**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Site Name** | **Plots** | **Land Cover Type** | **Richness** | **Abundance** |
| Northeast | 42 | Deciduous Forest | 10.29 | 174.40 |
| Mid Atlantic | 34 | Deciduous Forest | 13.44 | 139.59 |
| Southeast | 39 | Evergreen Forest | 5.31 | 119.64 |
| Atlantic Neotropical | 40 | Evergreen Forest | 23.43 | 157.68 |
| Great Lakes | 40 | Deciduous Forest | 8.93 | 106.15 |
| Prairie Peninsula | 33 | Grassland/Herbaceous | 4.39 | 69.15 |
| Appalachians & Cumberland Plateau | 40 | Deciduous Forest | 15.85 | 116.18 |
| Ozarks Complex | 40 | Deciduous Forest | 15.70 | 97.13 |
| Northern Plains | 14 | Cultivated Crops | 1.29 | 32.50 |
| Central Plains | 13 | Grassland/Herbaceous | 1.15 | 20.77 |
| Southern Plains | 47 | Deciduous Forest | 7.30 | 59.66 |
| Northern Rockies | 22 | Shrub/Scrub | 2.23 | 41.82 |
| Southern Rockies & Colorado Plateau | 38 | Shrub/Scrub | 2.82 | 59.79 |
| Desert Southwest | 38 | Shrub/Scrub | 8.50 | 74.50 |
| Great Basin | 47 | Shrub/Scrub | 2.02 | 81.45 |
| Pacific Northwest | 39 | Evergreen Forest | 6.97 | 80.05 |
| Pacific Southwest | 36 | Shrub/Scrub | 2.89 | 18.03 |
| Taiga | 19 | Shrub/Scrub | 4.89 | 83.95 |
| Pacific Tropical | 24 | Evergreen Forest | 8.00 | 65.58 |

## NEON Data Analysis

The datasheet for this lab contains the following information for each of the NEON ecoclimatic domains, as well as for our EREN PHAE plots:

* Environmental data: land cover, mean temperature, precipitation
* Woody plants data: richness, abundance (# individual plants), Shannon diversity, Simpson diversity

### Part 1: Making figures

You practiced making figures in last week’s lab. This week, you will make a few more figures to explore vegetation patterns at a national scale. Using the NEON data, you should make:

* Scatterplots – include trendline, equation, and R-squared value:
	+ Temperature vs. Richness
	+ Precipitation vs. Richness
	+ Temperature vs. Abundance
	+ Precipitation vs. Abundance
* A barplot:
	+ Average richness in each domain, with standard error bars

Follow the formatting instructions from last week for each of these (e.g., make sure to have axis labels, etc.)

If you wish to explore the data further and submit additional figures and analyses, please do! This is a very rich dataset, and there are a lot of ways to examine it – there’s a lot more information here than we’re using for the figures above. I’d love to see what you come up with, and what ideas you have for how to compare these sites.

While you are exploring the data, keep in mind that the NEON values are averages across many plots, while each of our sites is a single plot. Within each NEON region, there is likely a lot of variation in the number of species, the number of woody plants, etc. (which you can examine with the standard deviation and standard error values also provided for each region). It might make the most sense to average all of our plots, and compare our *average* against the averages in each NEON region. We could also do separate averages for PHAE plots from different domains (14 of our plots fall in the “Northeast” area, and 3 are in the “Mid Atlantic” area).

**Paste your figures for this lab here.**

### Part 2: Summary questions

Answer the questions below.

Describe the relationships we observed between climate conditions (precipitation, temperature) and woody plant communities (richness, abundance of individuals). Would we have seen patterns this strong if we limited our analyses to our PHAE plots? Why or why not?

Describe the differences in richness seen in different biomes. How do the ESU Mid Atlantic plots compare to the NEON Mid Atlantic plots? How do the ESU Northeast plots compare to the NEON Northeast plots?

You’ve already examined the relationship between temperature and richness in the NEON dataset. Here is a modified version of that figure, which also includes the values for each of our individual class PHAE plots, as well as the averages of our plots found within each ecodomain.

In this figure, examine the overall variation in species richness across the NEON plots (green triangles), as well as the overall variation among individual PHAE plots (orange circles). Next, compare the overall range of richness across our PHAE plots to the average richness for the PHAE plots (red +).

What does this tell you about variation in species richness at different spatial scales? Why do you think there is nearly as much variation in species richness across our individual PHAE plots as there is in the average richness of different domains across the country? (Hint: what effect does averaging have on the PHAE plot data?)