

A Guide to Exploring Caterpillars Count! Data

Whether or not you conducted your own Caterpillars Count! surveys, all of the data submitted by citizen scientists all over the country are available for exploring and visualizing. This type of data exploration can make for productive inquiry-based learning activities with students of almost any age, and can provide a nice classroom-based complement to the outdoor activities of the surveys themselves.

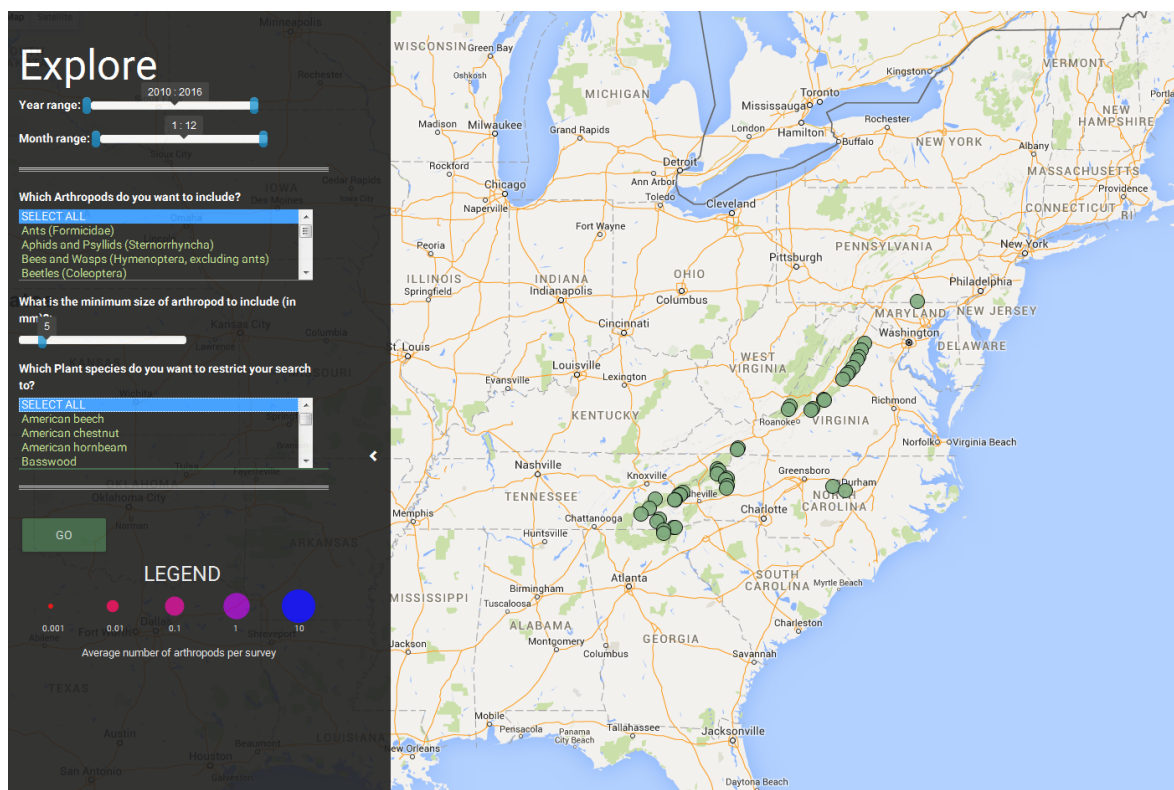
Below are instructions for the different types of data visualization available, the types of questions that may be asked and answered, as well as some background information for teachers that might be helpful for discussing student findings.

Data Visualization

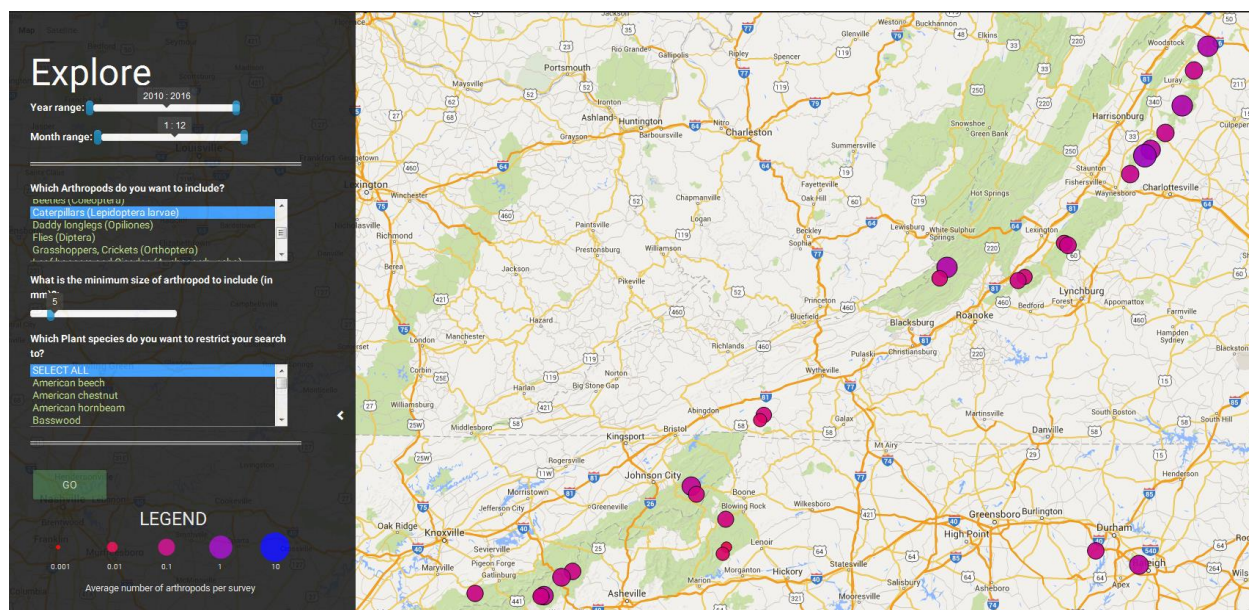
Data may currently be visualized in 3 distinct ways, all through the 'Explore Data' page of our website at <http://caterpillarscount.unc.edu/data/>. First, users may explore how the density of different types of arthropods varies geographically. Second, users may explore how the types of arthropods present varies based on the tree species that the survey was conducted on at a particular site. Third, users may explore the phenology, or seasonal timing, of different arthropod groups at a particular site.

Map-based Visualizations

Upon first loading the Explore Data page, you will see a map of all of the locations where Caterpillars Count! surveys have been conducted. These survey locations can be set so that the size and color of the map symbol reflects the average density (# per survey) of different arthropod groups.



- 1) Adjust the sliders to specify the year(s) and month(s) for which you'd like the data to display.
- 2) Select the Arthropod groups you'd like to include in your visualization. You may select multiple groups by holding down the Ctrl (PC) or Command (Mac) button while you click additional groups. The default is to 'SELECT ALL' arthropod groups.
- 3) Select the minimum size in millimeters that you are interested in summarizing. For example, you might decide you only want to know about arthropods larger than 10 mm. Alternatively, if you want to display data for all arthropods regardless of their size, set this slider to 0.
- 4) If you'd like, you can restrict your analysis of arthropod density to particular tree species. You may select multiple tree species by holding down the Ctrl button while selecting additional species. NOTE: You will quickly realize that not all tree species have been surveyed at every location!
- 5) Click "GO" to display average arthropod density for the arthropod groups and tree species that you selected. Larger, bluer symbols indicate higher densities, while smaller redder symbols indicate lower densities.



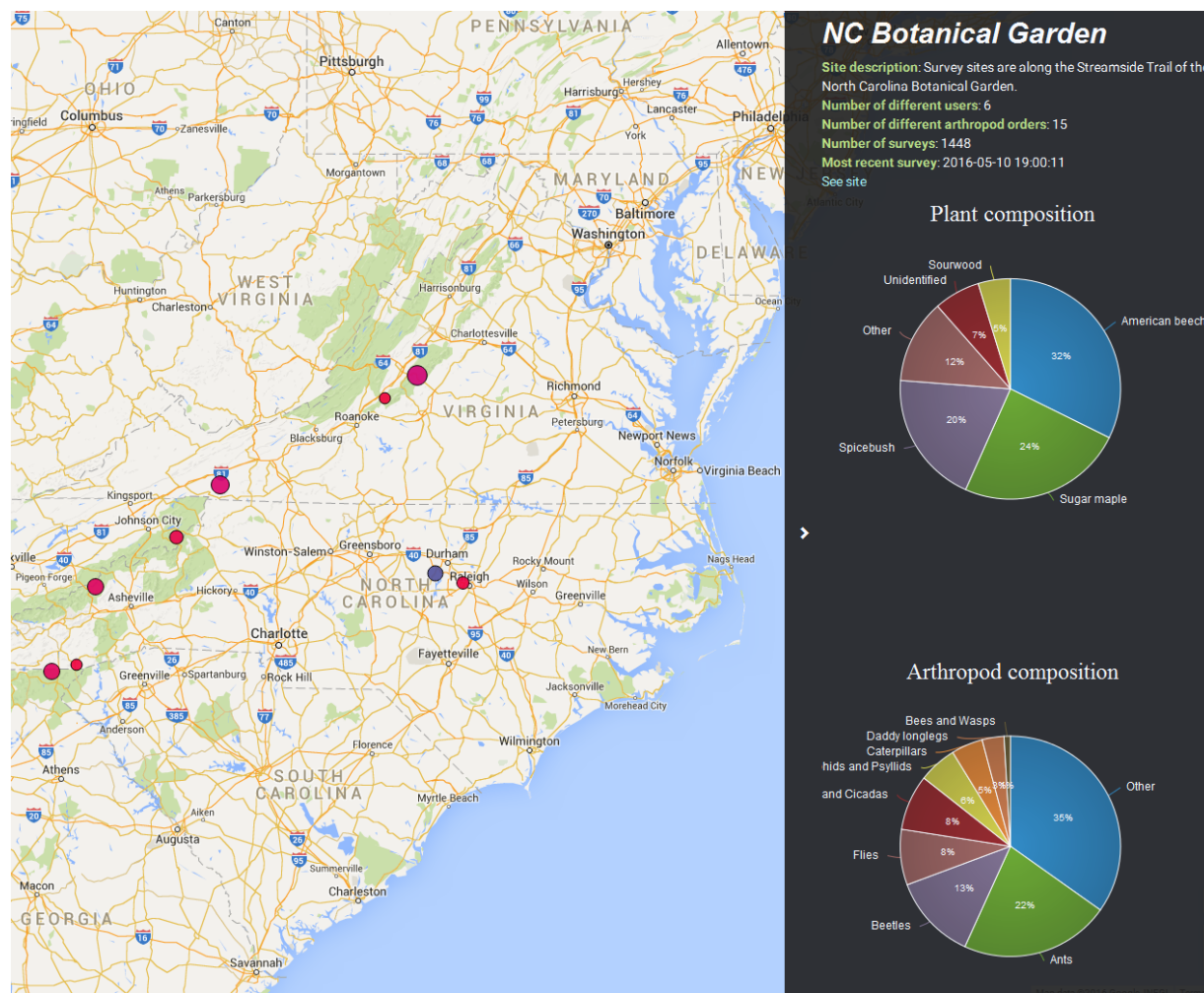
A map of average caterpillar density. Sites with larger, purpler symbols had more caterpillars.

Example questions that could be asked with this data visualization tool:

- Which locations have the most caterpillars?
- How do patterns of arthropod density vary with tree species?
- Which locations have surveys conducted on red oak?
- How do patterns of beetle density vary when including all beetles, versus including only large beetles?

Site-specific Visualizations

A user may explore several facets of the data collected at one particular site by clicking on that site on the map. In some cases when there are multiple sites located near each other on the map, it may be useful to zoom in first before clicking. Once you click on a site, a summary tab will open as shown in the figure below.



At the top you can see how many different participants have submitted data for this site, the total number of arthropod orders that have been observed, the total number of surveys that have ever been submitted for that site, and the date and time of the most recent survey submitted.

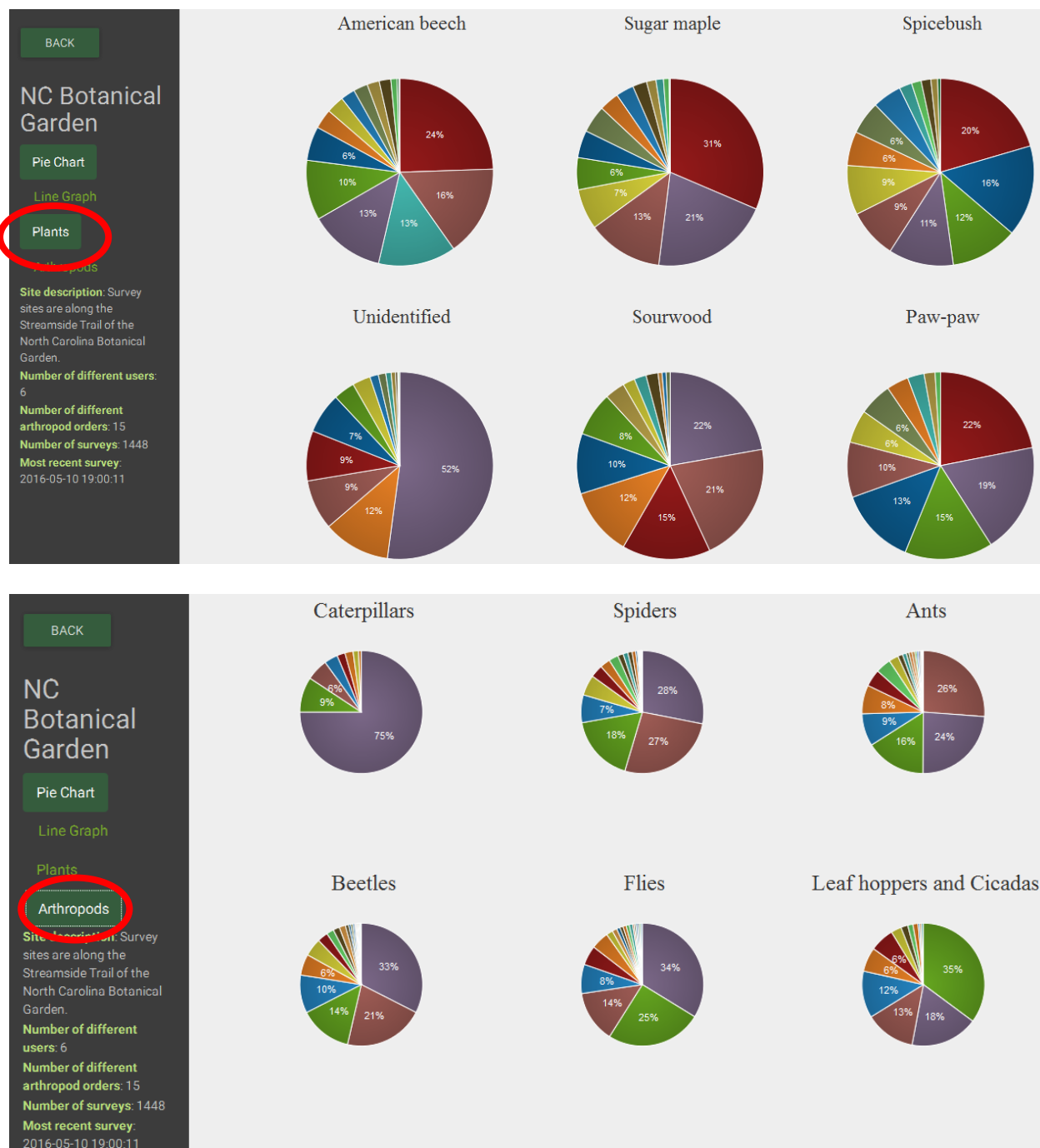
In addition the "Plant composition" pie chart illustrates the breakdown of tree species on which surveys have been conducted at that site. For the site above, most surveys have been conducted on American beech, sugar maple, and spicebush.

The "Arthropod composition" pie chart illustrates the relative frequency of the different arthropod groups at that site.

For more details about the site, click the "See site" link towards the top.

Pie Charts

These provide a more refined breakdown of the composition of different arthropod groups on different tree species. The default breakdown ("Plants") shows how the relative frequency of different arthropod groups varies by plant species. In the top panel below, the red color corresponds to Spiders (you can see what each color corresponds to by mousing over the pie charts), and you can see that 31% of arthropods on sugar maple were spiders, while only 15% of arthropods found on sourwood were. After selecting a breakdown by "Arthropods" (bottom panel), one can see that 75% of all caterpillars found occurred on American beech (in purple).

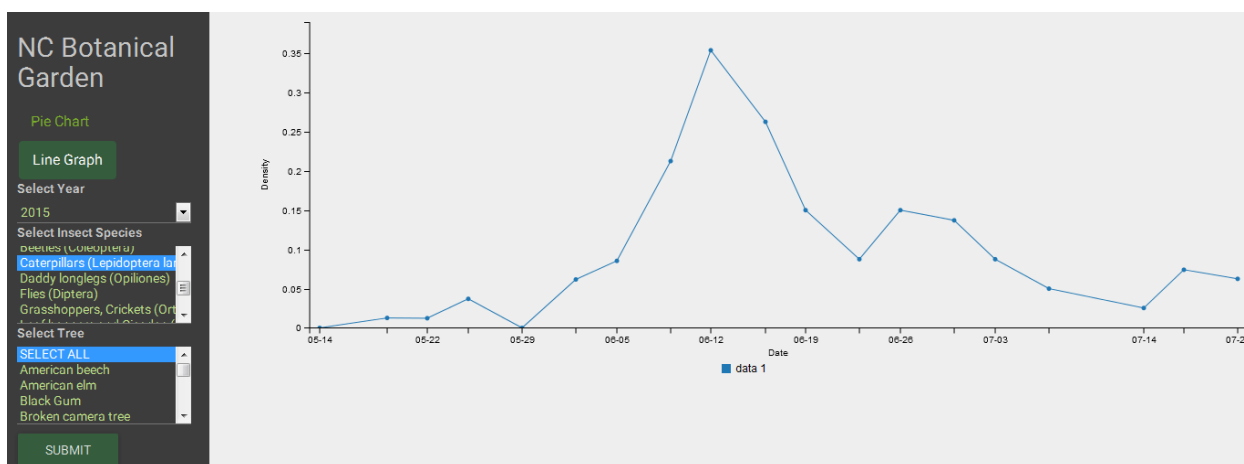


Example questions that could be asked with this data visualization tool:

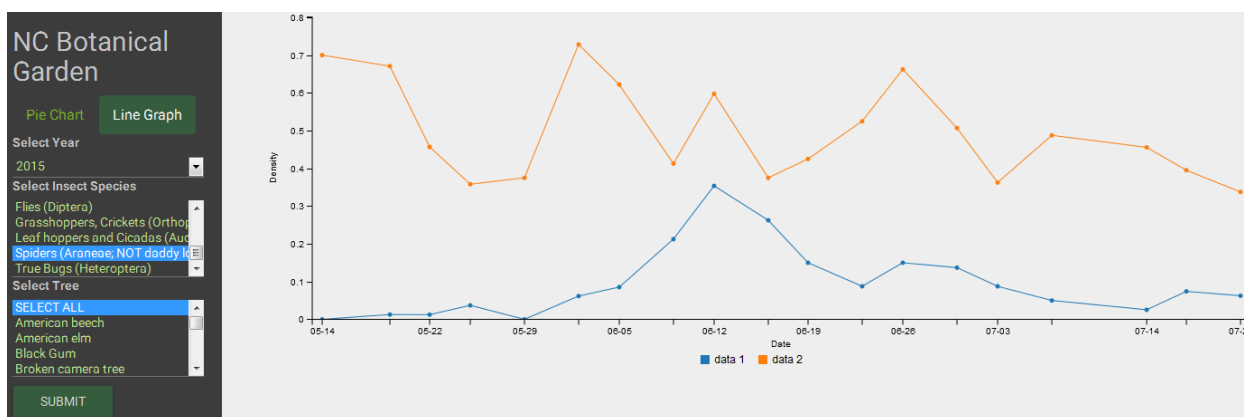
- Which types of arthropods are most frequently encountered?
- Do spiders occur on some tree species more frequently than other tree species?
- How do American beech and sugar maple differ in terms of the types of arthropods that are found on their leaves?

Line Graphs (Phenology)

Click on "Line Graph" on this Site Details page to view seasonal patterns of arthropod density. As on the Maps page, select the year, arthropod group or groups, and tree species that you would like to visualize. The graph below shows how caterpillar density varied from mid-May through late July in 2015 across all survey trees. Note the distinct peak in mid-June!



You may add additional lines to this graph for other groups within the same year by altering your selection of arthropod or tree species and clicking submit. Below, I've added the phenology of spiders to the graph in orange, and you can see they're much less seasonal.



Example questions that could be asked with this data visualization tool:

- Which types of arthropods exhibit a seasonal peak in abundance?
- Is the timing of the peak consistent between years?
- Is the timing of the peak consistent between tree species in the same year?
- Is the timing of the peak consistent across different sites?

Background Information for Instructor

Many of the patterns that will emerge from these data that you help collect have never been well described, so in many cases there is no "answer key"! The students or participants that you engage in this project are contributing important data that will help us better understand how foliage arthropods vary over time and across the map.

That said, here are some things we DO KNOW.

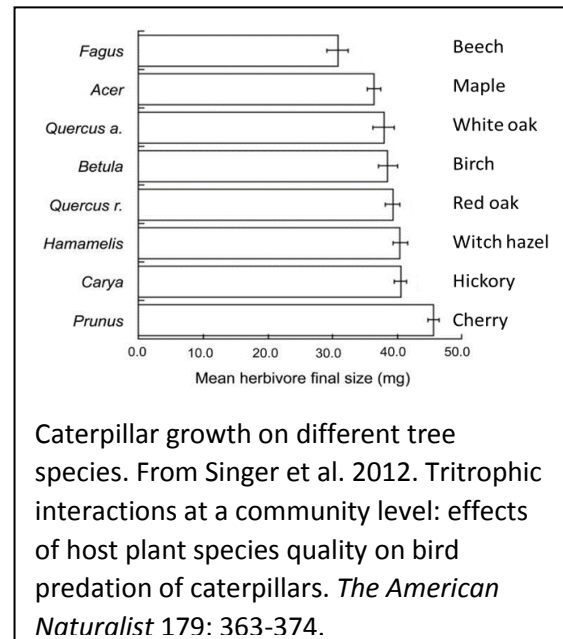
1. Seasonality

Just as leaves bud later and are on the trees for a shorter period of time farther north, we expect the same pattern for many insect groups. Temperature is expected to be a direct controller of both the timing of leaf out as well as insect development time. So expect to see peak densities of arthropods later at higher latitudes and elevations. The National Phenology Network (<http://www.usanpn.org>) has excellent resources and background information on phenology. See also our special Phenology Lesson Plan, linked on the [project website](#).

2. Trees as food

For some arthropods, trees and leaves are merely habitat—a place where they live, hide, and catch other types of food. Spiders and daddy longlegs are great examples of these types of arthropods. But for others, the leaves are not just their habitat, but also their food. Caterpillars, aphids, leafhoppers and many other arthropods eat leaf tissue or suck plant juices. But just as a twinkie, a hamburger, and a potato have different nutritional value to us, different tree species have different concentrations of proteins, carbohydrates, and potentially toxic secondary compounds that a given herbivore species may or may not have evolved to tolerate.

The graph at right shows an example of how different tree species differ in nutritional quality for caterpillars. The study is by Michael Singer of Wesleyan University, who showed that caterpillars raised on cherry tree leaves grow the most, ending at 45 mg before undergoing metamorphosis. In contrast, caterpillars fed only beech leaves grew to only 2/3 that size, a 33% reduction in growth! Tree species matters!



If you observe much higher densities of certain arthropods on some tree species than others, perhaps it is because of such differences in nutritional quality. Only a controlled experiment will let you know for sure. Science project anyone?