



Harvard Forest Schoolyard Ecology

Our Changing Forests
Experience of a HS teacher



August
2013:
Summer
training
workshop
at
Harvard
Forest

First Step



Setting up the plot

If students do it with you.....

Compass practise is a must. Practise on an athletic field first!

Set up plot, use hypotenuse to check (14.2 ft.) and adjust. Place stakes.

This is a suggested way to keep a class of 24 busy, however you could also divide the class in half and have 2 teams of 12 compete to make the most perfect plot. In the woods- 6 students per corner (2 in charge of compass, 2 drag out the tape, and 1 place the stake. Three students in charge of checking hypotenuse and adjusting corners).

Takes a full block to practise and a full block to set up the plot with students. My blocks are 82 minutes long. If you don't have time set up the plots without the students.



Next the ecologist and I (or students and I) identified some of the major species in the plot- red maple, scrub oak, hemlock and white pine

Tagging the trees

Teach students about DBH in classroom.

Have students measure something. I have used beakers, trash cans, students heads..

Then go out, approximate how many trees on the plot, hand out the number of tags per group and nails or wire, remind students about the 2.5 cm rule. If time students can try to ID trees also. (this can be chaotic and students may miss some trees or skip some in the numbering scheme. I fixed my trees after students had skipped a couple)



**All the trees
greater than 2.5 cm
diameter were tagged
with a metal marker.**

I set up my first plot with an ecologist from Harvard Forest. The second one I did with students.

Both are within a ten minute walk from the school.

It is easier to set up the plots and tag the trees without students but not as fun!

After plot has been set up and Before going out to plot

[Harvard forest presentation by Josh Rapp](#)

Students practice identifying trees by branches in the classroom

Students practice measuring DBH and learn what it is in the classroom

Students set up a mock 10 m x 10 m plot (most fun) outside on an athletic field

Identify the trees and fill out the field description

Practice identification in the classroom. Cut some twigs from the plot and have student groups ID them.

Some basics:

- trees are evergreen or deciduous

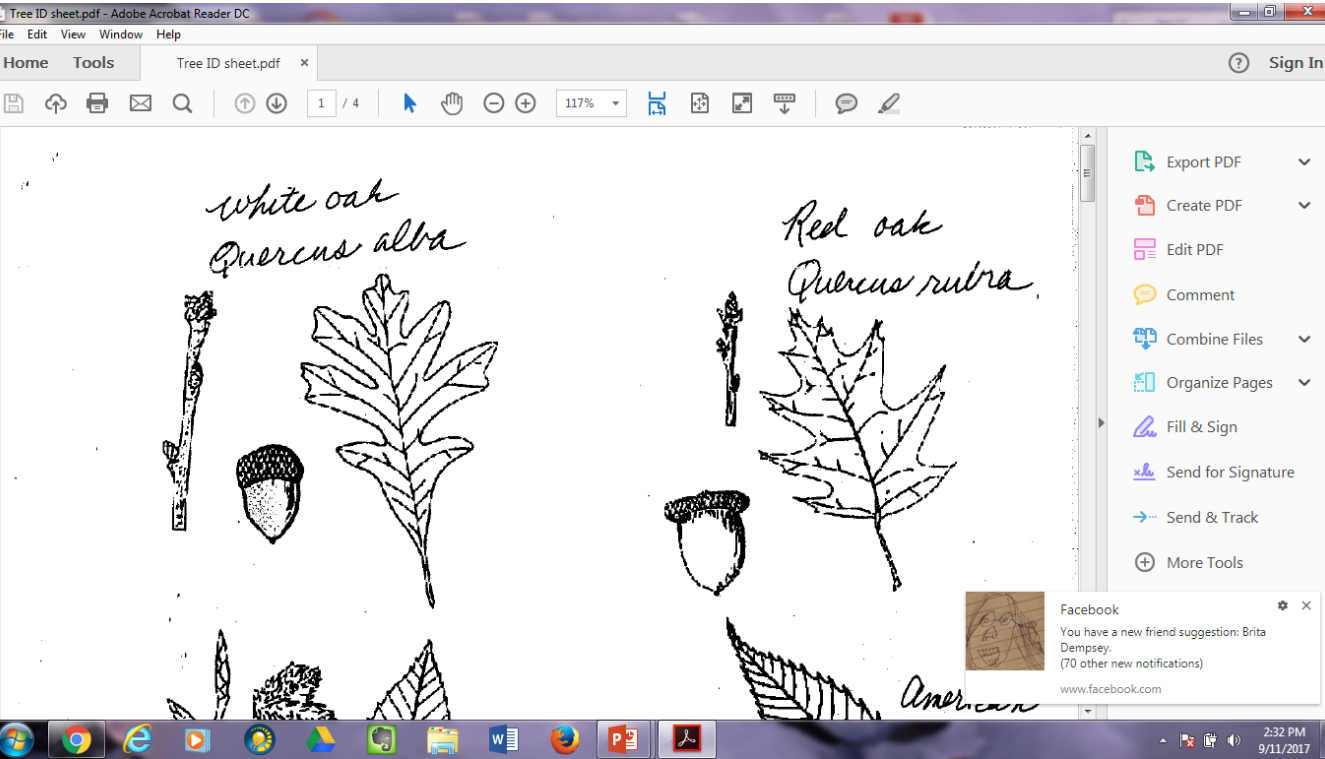
- leaves are opposite or alternate, or

- simple or compound

An acronym for oppositely branched trees MADCapHorse

- Maple, ash, dogwood, caprifoliaceae (mostly viburnum) and horse chestnut

This is a screen-shot of part of the document I hand out to students to help them ID trees.



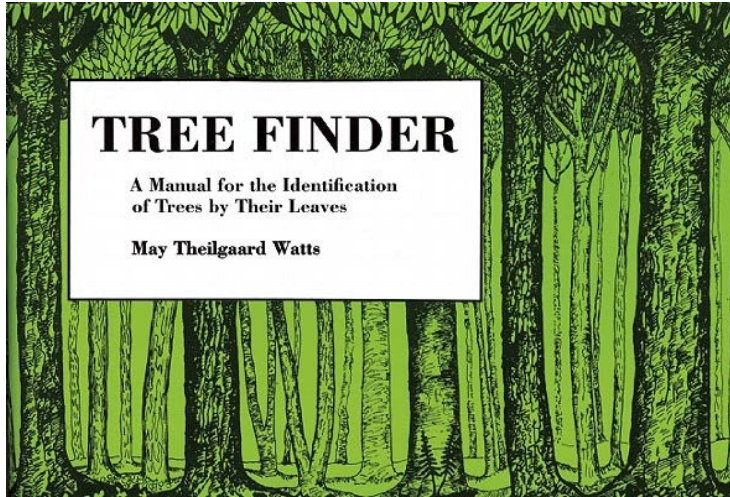


Dr. Albertine came out for the second time to help introduce three classes of from 18 to 25 students, to the site. The ecologists are very helpful!



Students worked in groups of 3. They each had clipboards, id books, and shared the dbh tape and dbh stick.

Identifying Trees



Includes native and commonly introduced trees of the U.S. and Canada east of the Rockies and north of Florida.

By May Theilgaard Watts.

[Website for the "Finder Series" of Dichotomous Keys](#)

I recommend this inexpensive pocket dichotomous key. Students find these keys easy to use.





Harvard Forest Schoolyard Ecology
Our Changing Forests

Field Site Description Sheet

School Name: Brookline Middle School Date (month, day, year): Sept. 18, 2013

Teacher Name: Mrs. McCracken

Plot ID plot 1

Time Start: _____ Time End: _____

Plot Location: County Middlesex State MA Coordinates: Lat _____

Long _____

Additional Directions to Plot: _____

Topography/Physical Features:

1. Landscape position - Check one:

ridge/hilltop hillside dry flat wet flat rolling upland

2. Aspect _____°

3. Slope - Check one:

none slight moderate steep

4. Rock Cover in Plot - Check one:

<1% 1-5% 6-25% 26-50% 51-75% >75%

5. Water in Plot - Check one or more:

stream temporary stream flooded area vernal pool

Forest Canopy Characteristics:

1. Canopy Cover Estimate: Check one

10-25%, 26-50%, 51-75%, 76-100%

Changing Forests Field Site Description Sheet-Page 2

Evidence of Disturbance:

1. Forest Pests and Pathogens in Plot: Check one or more:

Hemlock Woolly Adelgid Gypsy Moth Ash Yellows
 Asian Long-horned Beetle Beech Bark Disease Emerald Ash Borer
 Hemlock Borer other _____

2. Human Activity in or Near Plot: Check one or more

cut stumps footpath stone wall other _____
 forest road building cellar hole
 barbed wire Open Field skid trail

3. Weather Events in or Near Plot: Check one or more

uprooted trees snapped trees large downed branches
 fire scars river flooding other _____

4. Downed Woody Debris Cover in Plot (pieces at least 10 cm in diameter): Check one:

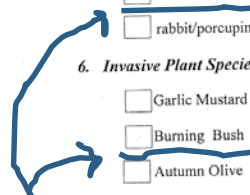
<1%, 1-5%, 6-25%, 26-50%, 51-75%, >75%

5. Wildlife Sign in Plot Check one or more

deer pellets moose pellets deer/moose browsing
 moose bark-stripping deer antler rubs tree girdling [porcupine]
 beaver felled trees woodpecker holes bear claw marks on beech
 rabbit/porcupine browse other _____

6. Invasive Plant Species in Plot: Check One or More:

Garlic Mustard Oriental Bittersweet Japanese Barberry
 Burning Bush Multiflora Rose Honeysuckle (shrub/Vine)
 Autumn Olive Buckthorn Japanese Stilt Grass



**Note student left out information

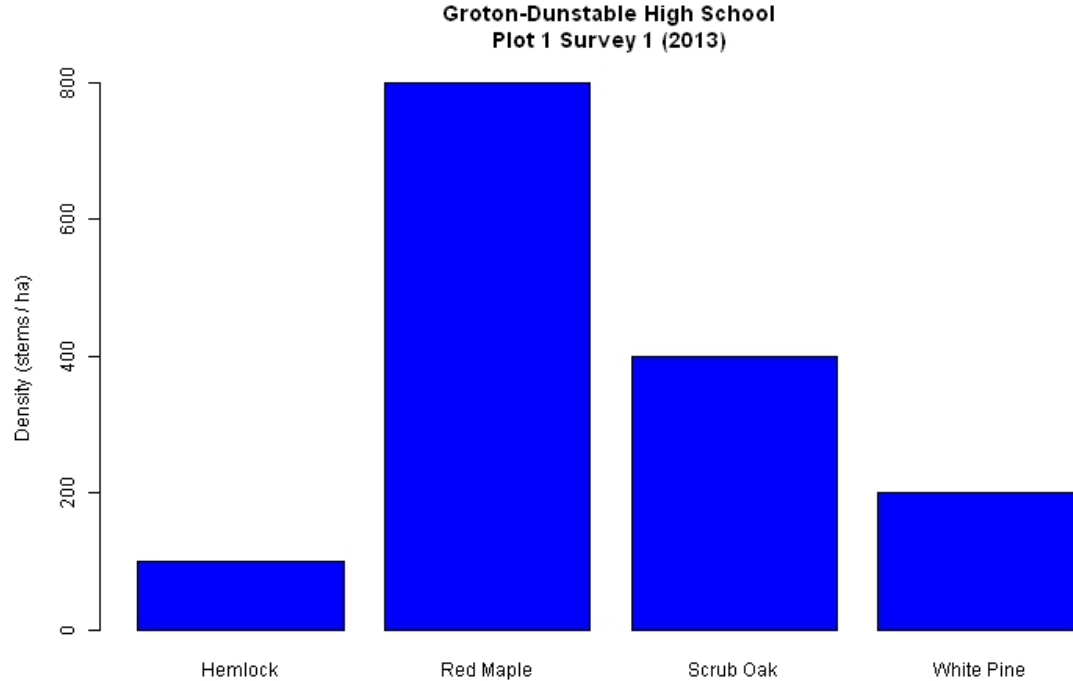
Beaver sign in plot



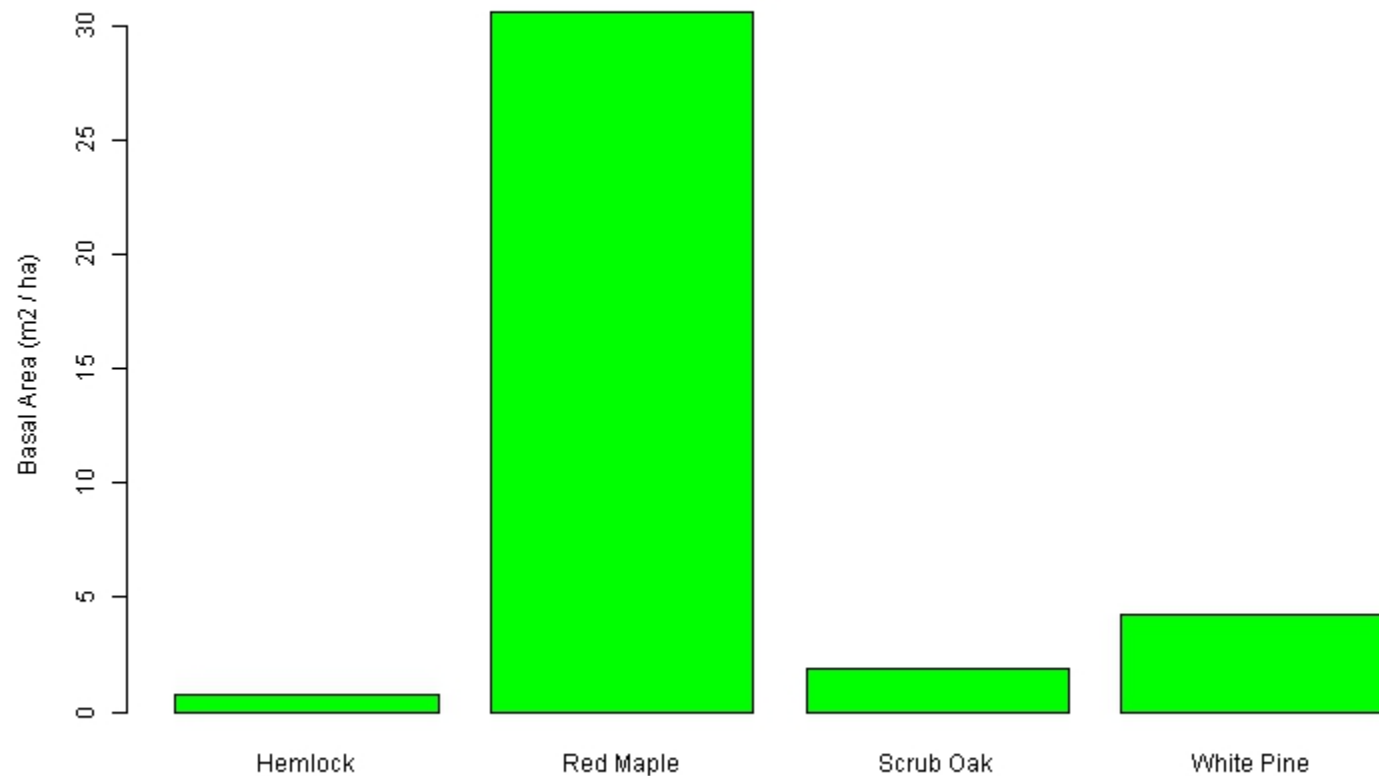
Tree Identification Number	Tree Species	Diameter at Breast Height (DBH) Record all stems \geq 2.5cm DBH	Condition (living, dead)
89	scrub oak	6.2	living
88	red maple	57.8	living
90	red maple	8.9	living
90	red maple	4.5	living
99	scrub oak	10.7	living
100	scrub oak	3.5	living
94	white pine	9.1	living
95	eastern Hemlock WP	21.5	living
92		24.2	dead
85	red maple	4.9	living
86	red maple	6.3	living
93	Eastern Hemlock		living
97	red maple	9.2 cm	living
98	red maple	11.9 cm	living
91	r.M.		
90	r.M.		
87	scrub oak		

Optional Field Notes (weather, animals, plants) :

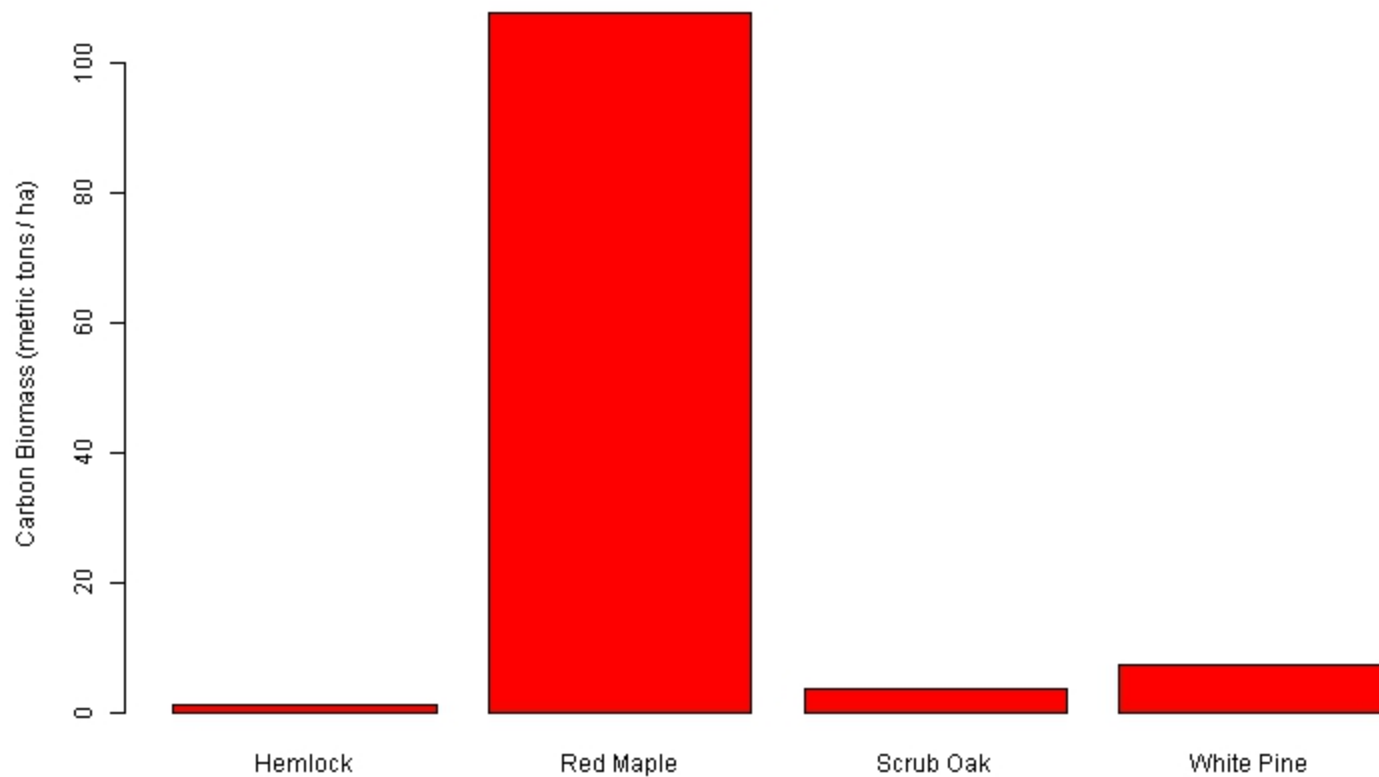
Students can use graphing tools on the Harvard website to compare basal area, stand density and carbon biomass after data has been submitted.



Groton-Dunstable High School
Plot 1 Survey 1 (2013)



Groton-Dunstable High School
Plot 1 Survey 1 (2013)



Forest Management Plot survey Lab

Plot _____

Name(s) _____ Block _____

Objective: Students will analyze the data from their plot survey to determine board feet, carbon biomass storage, stand density and basal area.

Make sure you have a completed set of data for your plot survey. You may have to find other students to help complete it.

Print out a set of graphs for your plot data. Use the information your teacher gives you or go to the Harvard Forest Website, Schoolyard LTER program, Schoolyard LTER database, graph data, changing forests, select Groton-Dunstable high school, choose your site and print out the graphs. Try to put all on one sheet.

DEFINITIONS:

Hectare – 1 hectare = 10,000 m², 1 hectare = 2.47 acres

Metric ton = 2200 lbs

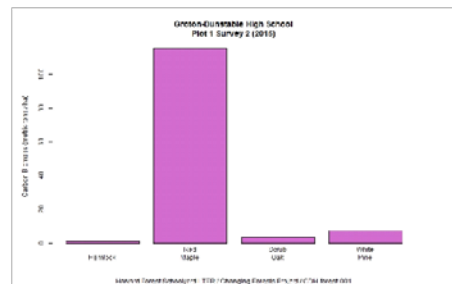
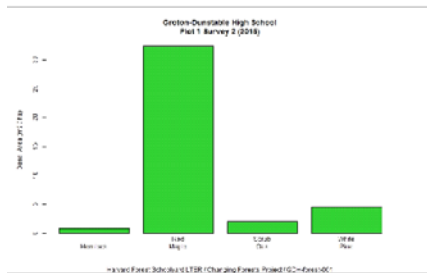
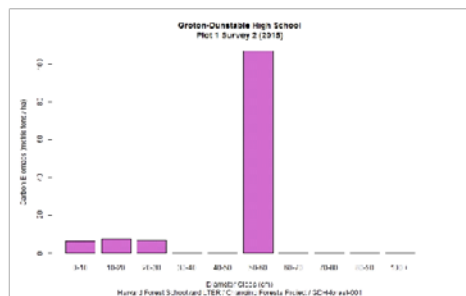
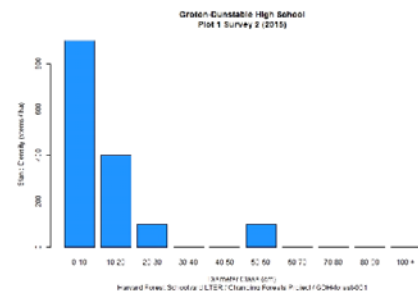
Stand density – number of stems per each species per hectare

Basal area – the number of square meters of cross sectional area of each species per hectare

Carbon biomass – the number of metric tons of above ground carbon of each species per hectare

Answer the following questions in complete sentences on a separate piece of lined paper. Show all your work for math problems.

1. Look at the graphs, does the diameter class with the most stems/ha always have the most carbon biomass? Why or why not?
2. Do you think the species with the highest basal area would also always have the most stems per hectare? Why or why not?
3. Why might ecologists be interested in carbon biomass?
4. Use the board foot volumes table to determine how many board foot of lumber our tree plot has. Assume each tree has two logs of merchantable wood.
5. A 42 X 76 foot barn requires about 5700 board feet of lumber (<https://permies.com/t/63545/Building-Calculating-Trees>). Can our tree plot (10 x 10 m) provide enough wood to build a barn? If not how many plots like ours would it take?
6. How many **hectares** (hint: divide the answer to #5 by 10) of forest similar to the one from our plot would it take to build a 42 x 76 ft. barn?
7. If you create 20 lbs of carbon dioxide for each gallon of gas you burn and you use 2000 gallons per year how many hectares of forest similar to our plot would you need to store the carbon you emitted by driving in one year? (please show all math for full credit)



Alternatively students can use dbh to calculate carbon biomass

Tree biomass equations

Units: biomass = kilograms, dbh = centimeters

Biomass (metric tons) = biomass (kilograms)/1000

Carbon biomass = 0.5 * biomass

Default = red maple if biomass equation not available

Acer pensylvanicum (ST) biomass = $(\exp(7.227+1.6478*\log(\text{dbh}/2.54)))/1000$

Acer rubrum (RM) biomass = $0.1262*(\text{dbh}^2.3804)$

Acer saccharum (SM) biomass = $0.1008*(\text{dbh}^2.5735)$

Betula alleghaniensis (YB) biomass = $0.1684*(\text{dbh}^2.4150)$

Betula lenta (BB) biomass = $0.0629*(\text{dbh}^2.6606)$

Betula papyrifera (WB) biomass = $0.0612*(\text{dbh}^1.6287)$

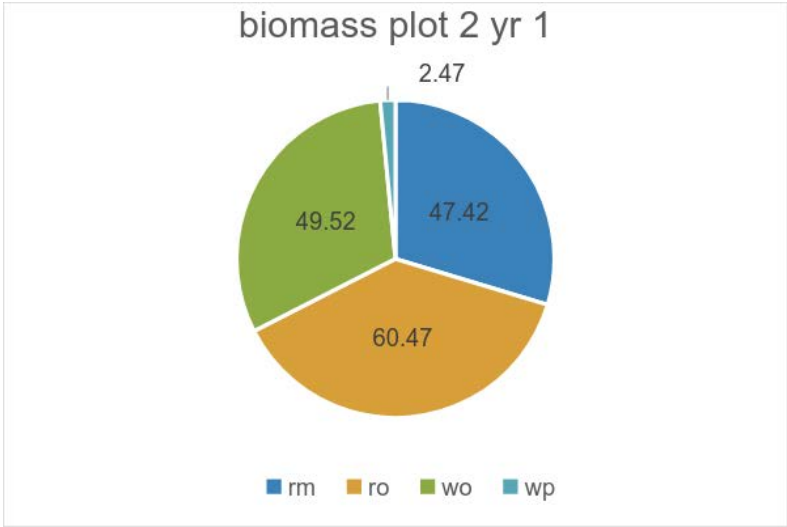
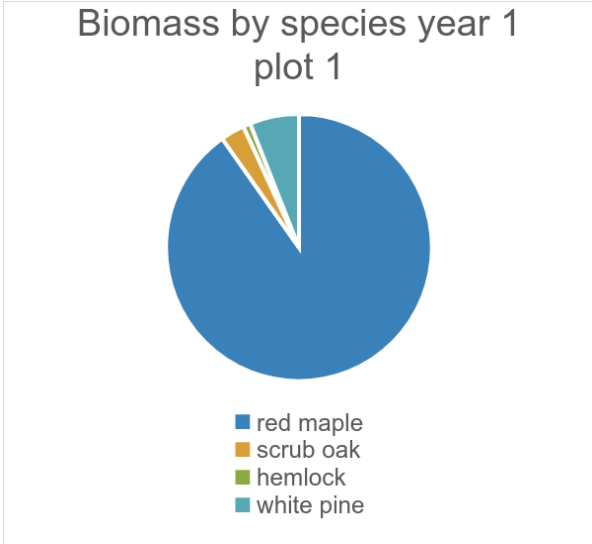
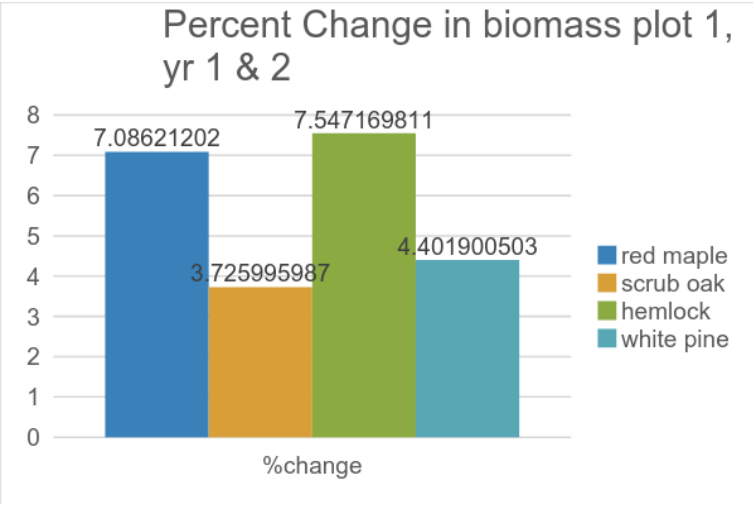
Betula populifolia (GB) biomass = $0.1564*(\text{dbh}^2.3146)$

Betula spp. (RB) biomass = $0.0629*(\text{dbh}^2.6606)$

Castanea dentate (CH) biomass = $2.204*(\exp(0.95595+2.4264*\log(\text{dbh}/2.54)))$

Fagus grandifolia (BE) biomass = $0.1967*(\text{dbh}^2.3916)$

Follow up workshops in the fall using the data are very helpful



Students learn:

How to look closely at an outdoor site

How to measure DBH and identify common tree species

What field ecology is like and how to measure change in a forest

About stand density and basal area and how they relate to carbon biomass

How fun it is to go outside!