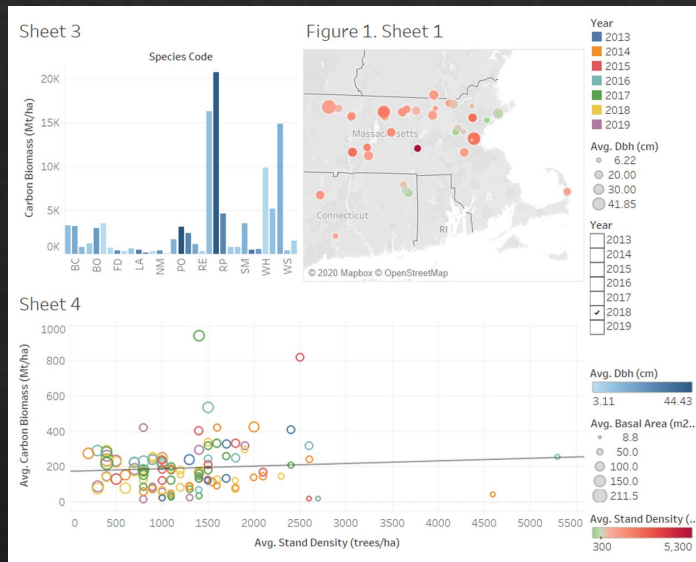


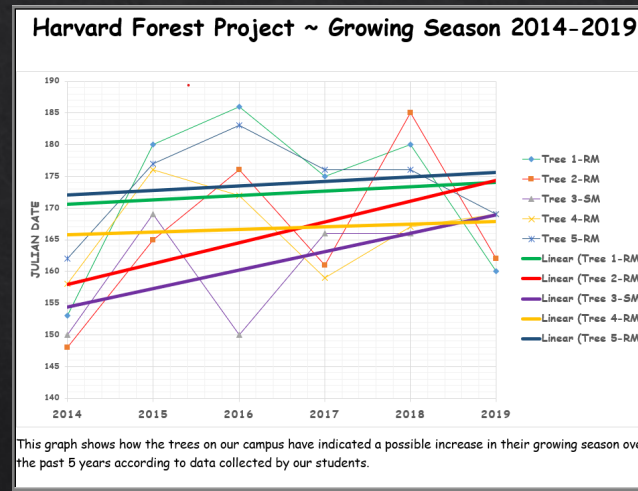


Works in Progress: Teacher Created Graphs and Data Documents

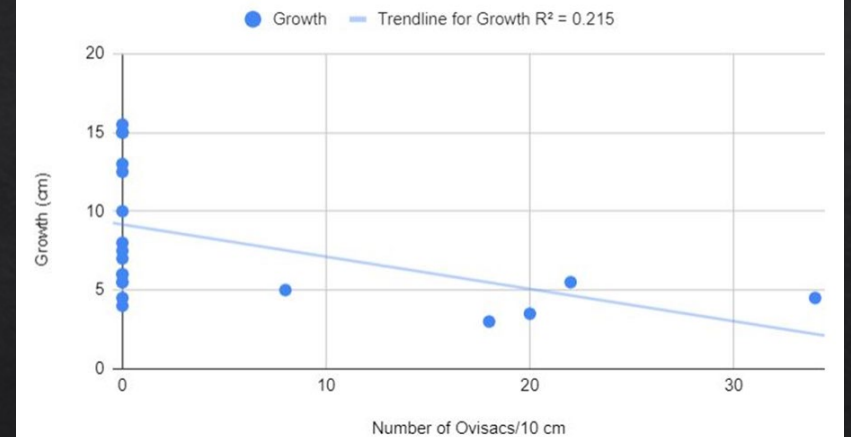
Harvard Forest Schoolyard Ecology Looking at Data Workshop 2020



Compiled by Pamela Snow



Growth vs. Egg Sacs for Harvard Forest 2017-2019



Schoolyard Ecology Teachers: Melanie McCracken, Joseph Scanio, Diane Bugler, Marjorie Porter, Arline Maynard, Rachel Calderara, Colleen Casey, Lori Primavera, Jane Lucia, Elisa Margarita, Laura Schofield, Dan Thomases, Tara Alcorn, Elicia Andrews, Sally Farrow

Harvard Forest Staff: Betsy Colburn, Emery Boose, John O'Keefe, David Orwig, Greta VanScoy, Joshua Plisinski

Mentor Teachers: JoAnn Mossman, Joseph Scanio

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Section One: Representing Our Changing Forests Project Data

Schoolyard Ecology Teachers: Melanie McCracken, Joe Scanio, Diane Bugler, Marjorie Porter, Arline Maynard, Rachel Calderara

Harvard Forest Staff and Mentors: Betsy Colburn, John O'Keefe, Lucy Lee, Ann Lewis, Clarisse Hart, Emery Boose



Figure 1: Our Changing Forests Data Visualization Series 2020

Description of graph and related data table:

Sheet 1: Shows avg. stand density (color with green being lower and red higher) and avg. diameter using size of the circle for each location for 2018.

Sheet 3: Carbon Biomass and Avg. diameter (shades of blue) per species in 2018.

Sheet 4: Avg. Carbon Biomass; Avg. Basal Area (size of circle) and Avg. Stand Density by year (color) with trend line.

Teacher/Author:

Melanie McCracken

School:

Groton Dunstable High School

Grade Level: 11,12

Schoolyard Ecology Mentor:

Joseph Scanio

Notes: See notes below

Sheet 3

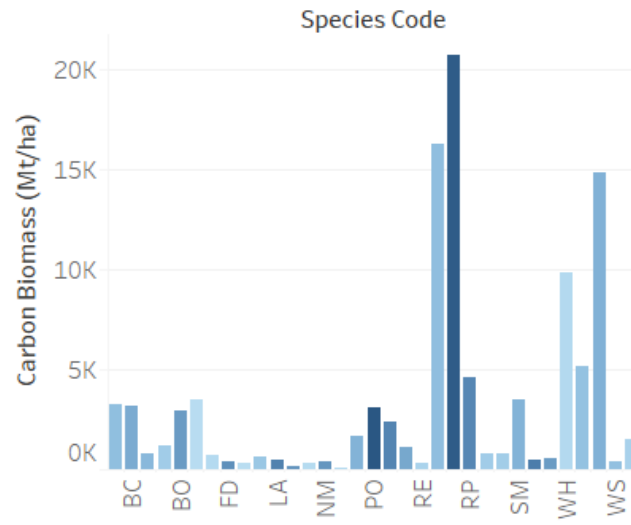
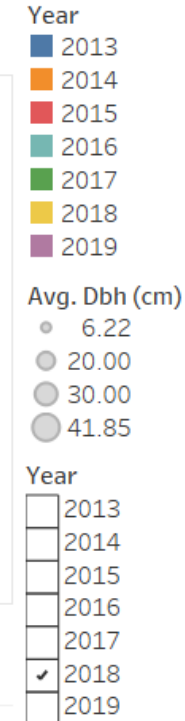
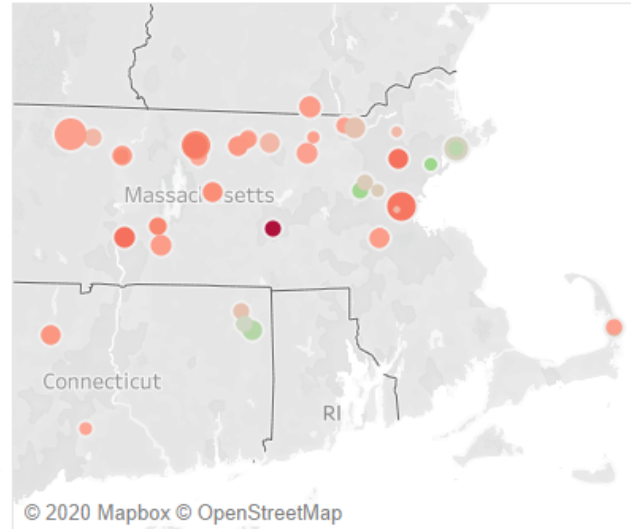


Figure 1. Sheet 1



Sheet 4

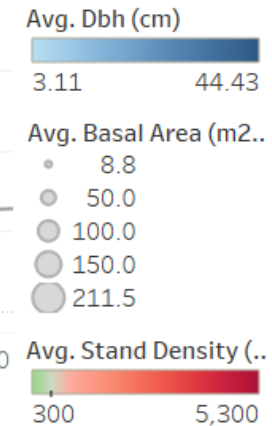
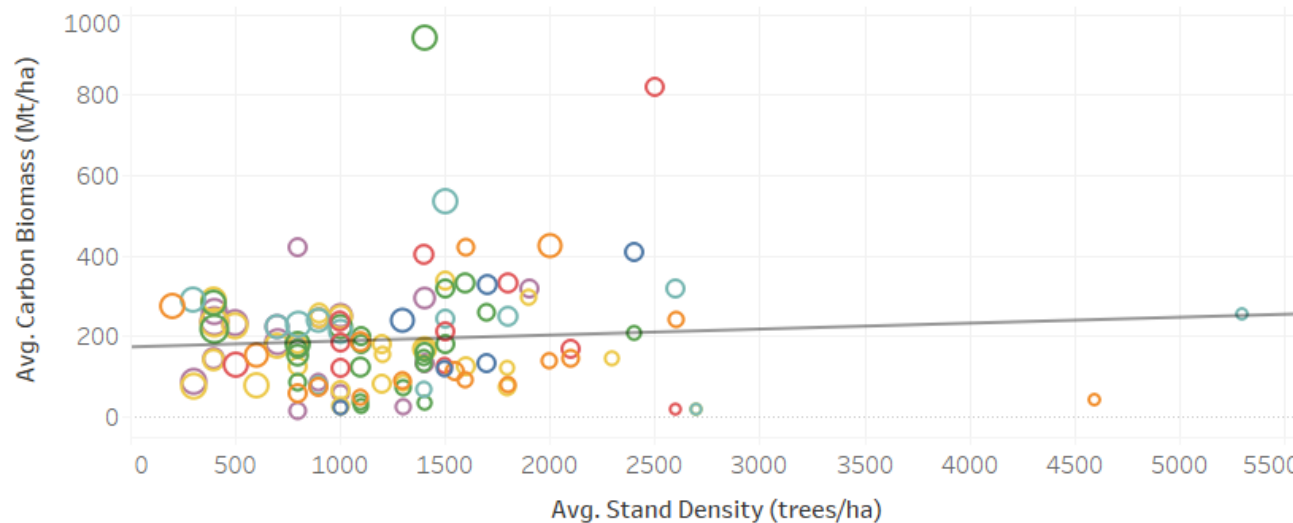


Figure 2: Our Changing Forests Study Tableau Map Graph



◆ Description of graph and related data table:

This data visualization shows the location, average stand density, and average carbon biomass storage of each plot from 2013-2019, in the Our Changing Forests study across New England.

◆ Created using Tableau software.

◆ Teacher/Author:

Joseph Scanio

◆ School:

Choate Rosemary Hall

◆ Grade Level:

11,12

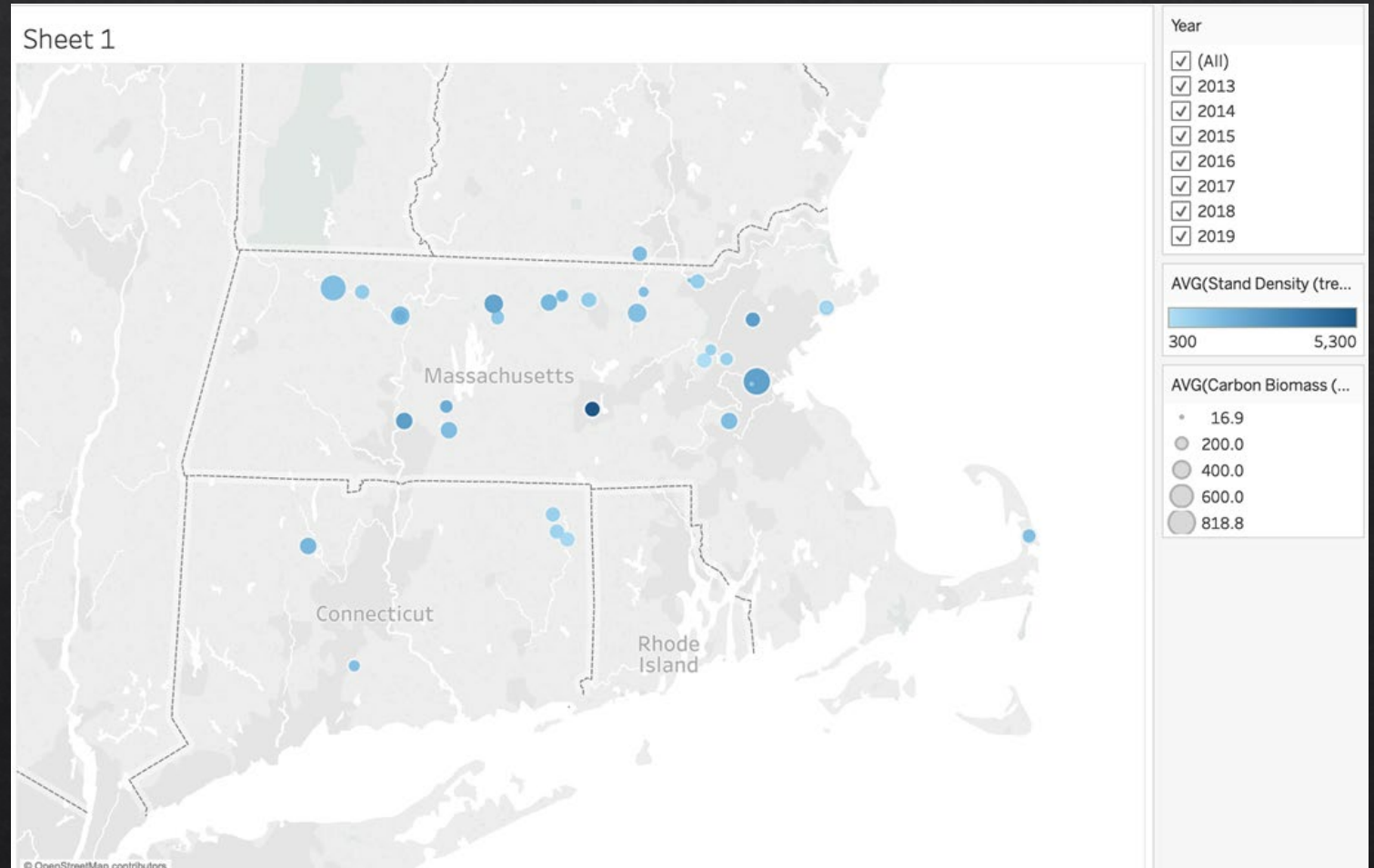


Figure 3: Our Changing Forests Study Tableau Graph



◆ Description of graph and related data table:

This graph shows the relationship between Carbon Biomass and Stand Density in all OCF study sites from 2013 through 2019. The trend line is an especially helpful feature of this graph.

◆ Created using Tableau software.

◆ Teacher/Author:

Joseph Scanio

◆ School:

Choate Rosemary Hall

◆ Grade Level:

11,12

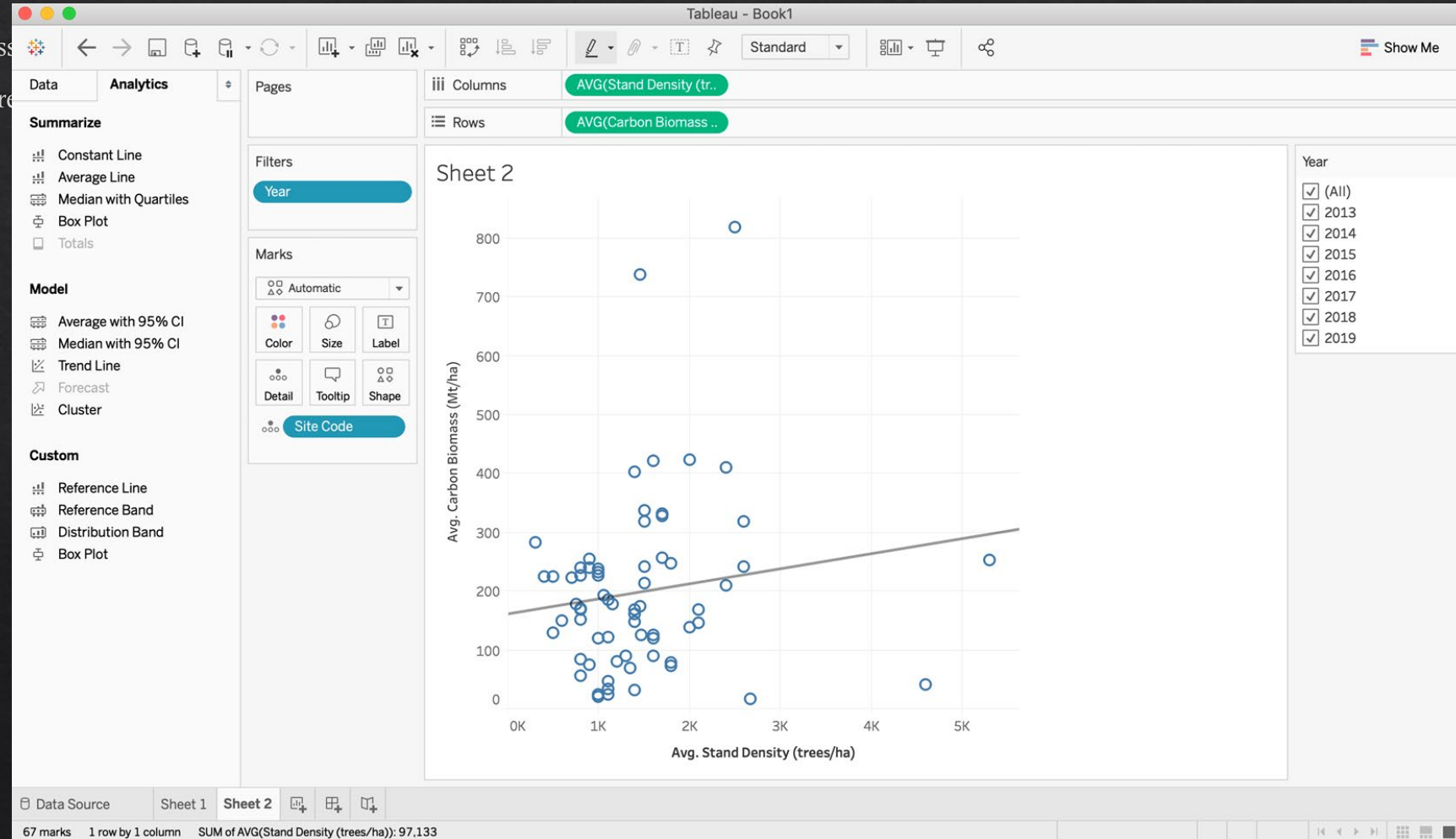
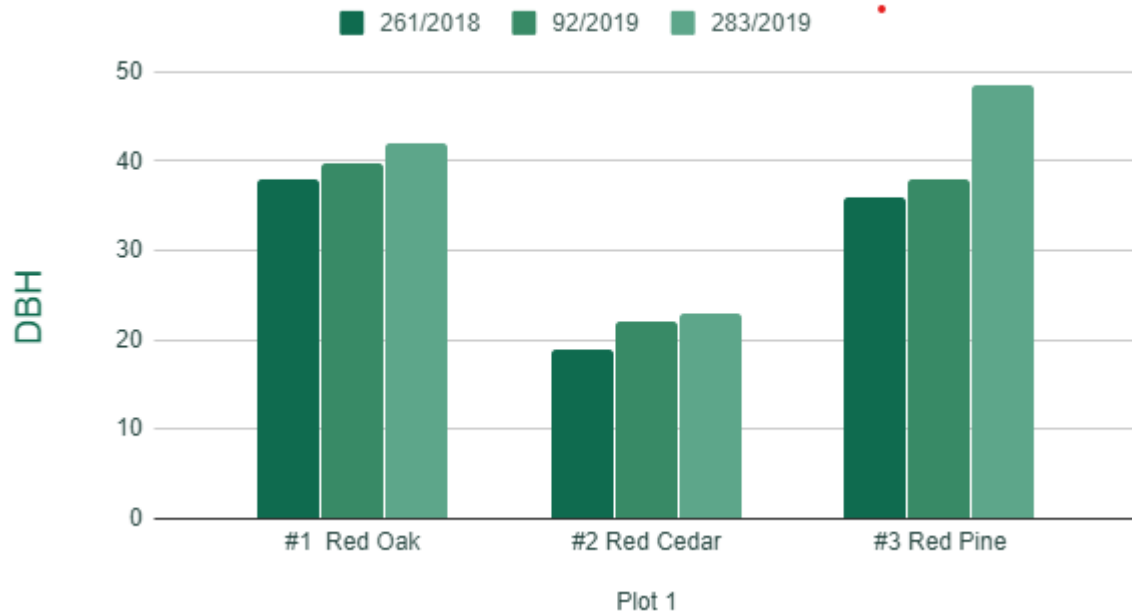


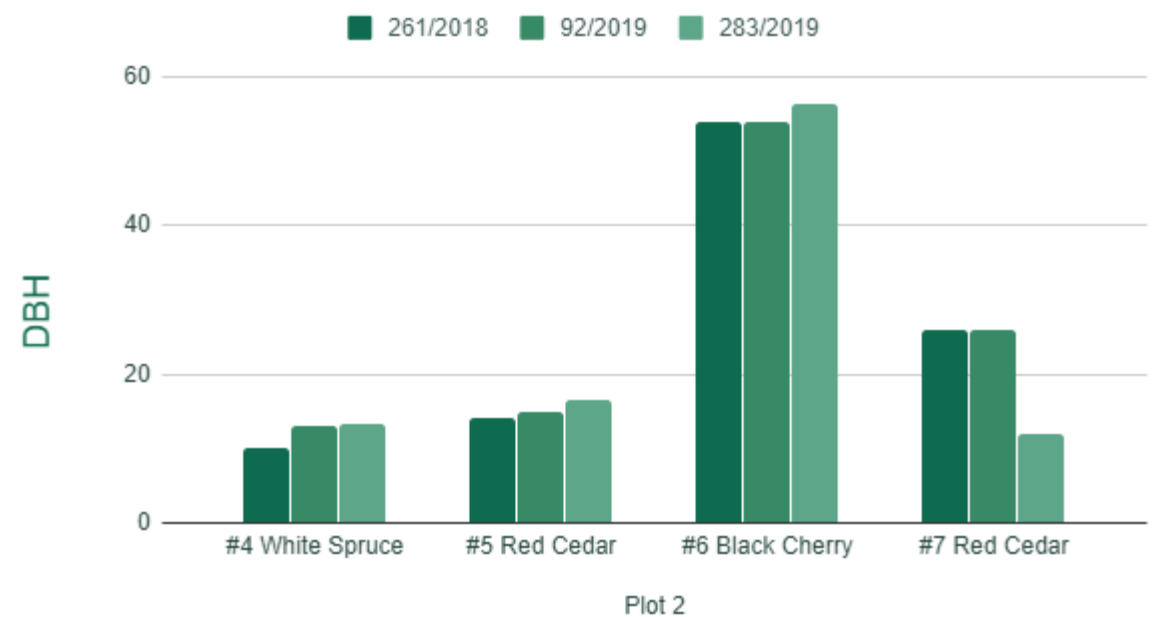
Figure 4: Diameter Growth of Our Changing Forests Study Trees By Species and Year



Growth of Trees in Plot 1 CBS 2018-2019



Growth of Trees in CBS Plot 2 2018-2019



◆ Description of graph and related data table:

Graph 1 shows the growth in diameter of each study tree in plot 1 between 2018 and 2019.

Graph 2 shows the same for plot 2.

Note that Julian dates are used in the key for measurement dates.

261= Sept. 18 ; 92=Apr. 2; 283=Oct. 10

▶ **Created using:** HF Schoolyard Online Database Graphing Tools

▶ **Teacher/Author:** Diane Bugler

▶ **School:** Captain Samuel Brown School

▶ **Grade Level:** 5

Figure 5: Three Graphs of Our Changing Forests study at Connecticut Audubon, Pomfret, CT.



◆ **Description of graphs and related data table:**

Graph 1 shows tree species composition in Plot 1, using a pie chart.

Graph 2 similarly shows tree species composition of Plot 2 using a pie chart.

Graph 3 shows tree diameter growth in almost 2 years (Jan. and Nov. 2019) of study for each individual study tree.

◆ **Created using:** “Create-a-Graph”, online graphing software

◆ **Teacher/Author:**

Marjorie Porter

◆ **Site:** Ct. Audubon, Pomfret, Ct.

◆ **Grade Level:** Middle School

◆ **Harvard Forest Mentor:** Fiona Jevon

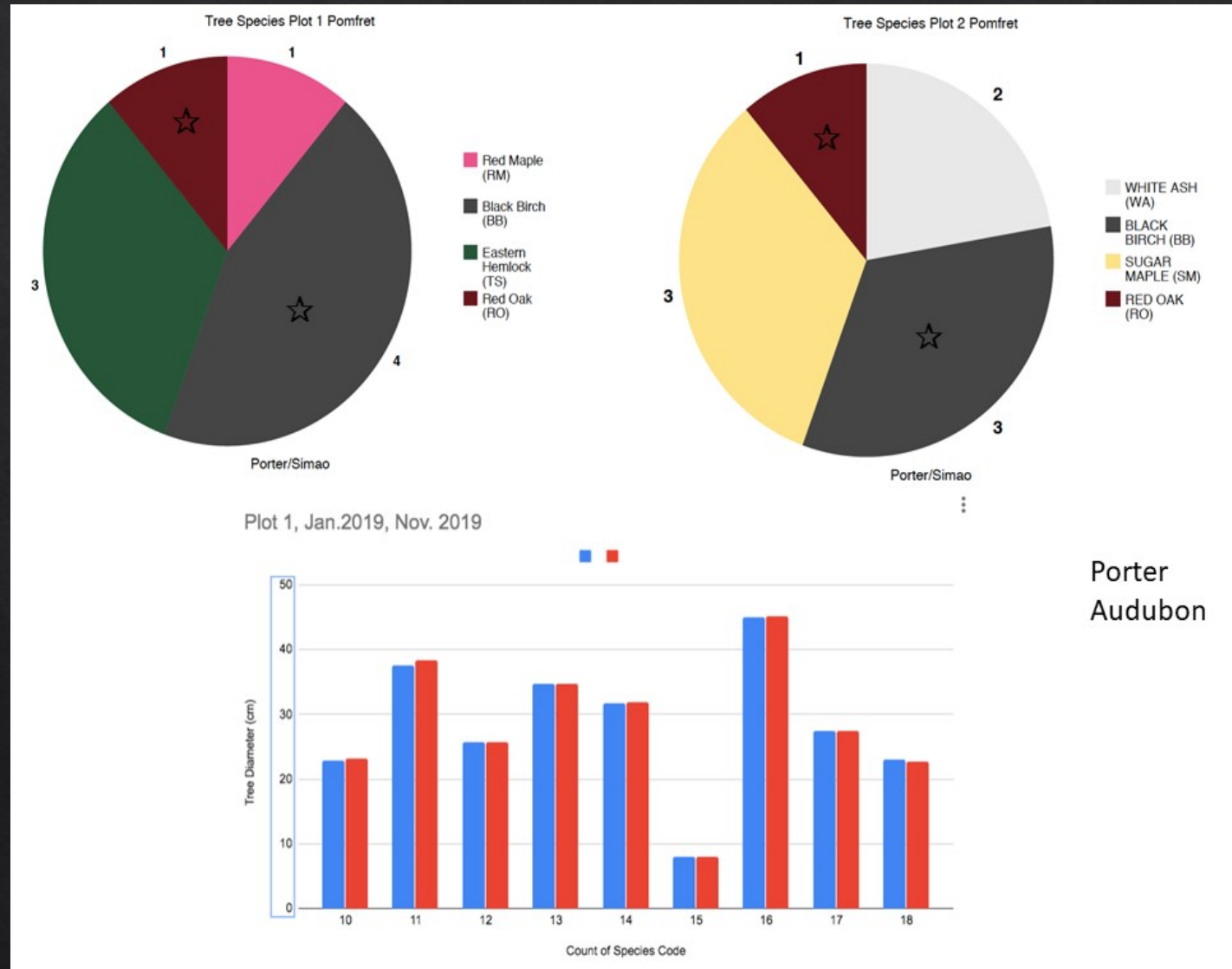


Figure 6: Tree Species Composition of Our Changing Forests study Plot in Woodstock , CT.



Description of graphs and related data table:

This pie chart shows tree species composition at the OCF study plot at Woodstock Middle School.

Created using:

“Create-a-Graph”, online graphing software

Teacher/Author:

Arline Maynard

Site:

Woodstock Middle School , Ct.

Grade Level:

7,8

Harvard Forest Mentor: Fiona Jevon

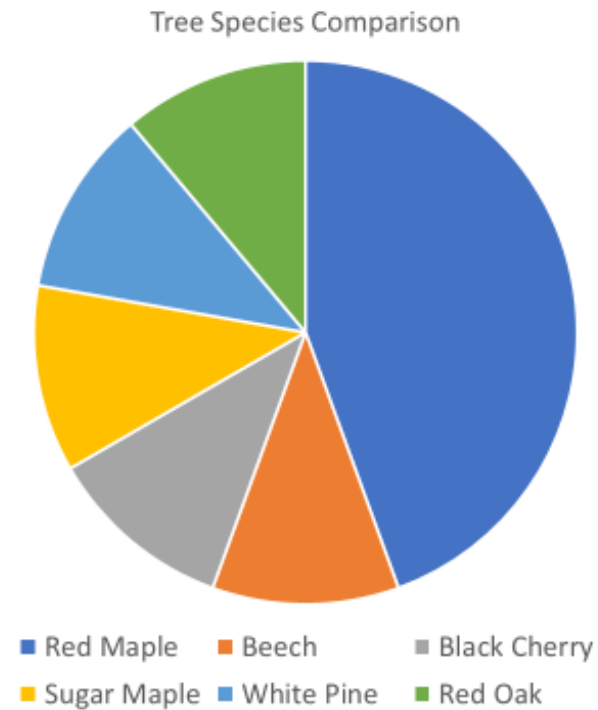


Figure 7: Tree Diameter Growth of Our Changing Forests study trees at Woodstock Middle School Over 2 Years.



◆ Description of graphs and related data table:

This bar graph shows tree diameter growth of Woodstock Middle School study trees by species over 2 years (2018 and 2019).

◆ Created using:

“Create a Graph” online graphing Software

◆ Teacher/Author:

Arline Maynard

◆ School: Woodstock Middle School, Ct.

◆ Grade Level: 7,8

◆ Harvard Forest Mentor:

Fiona Jevon

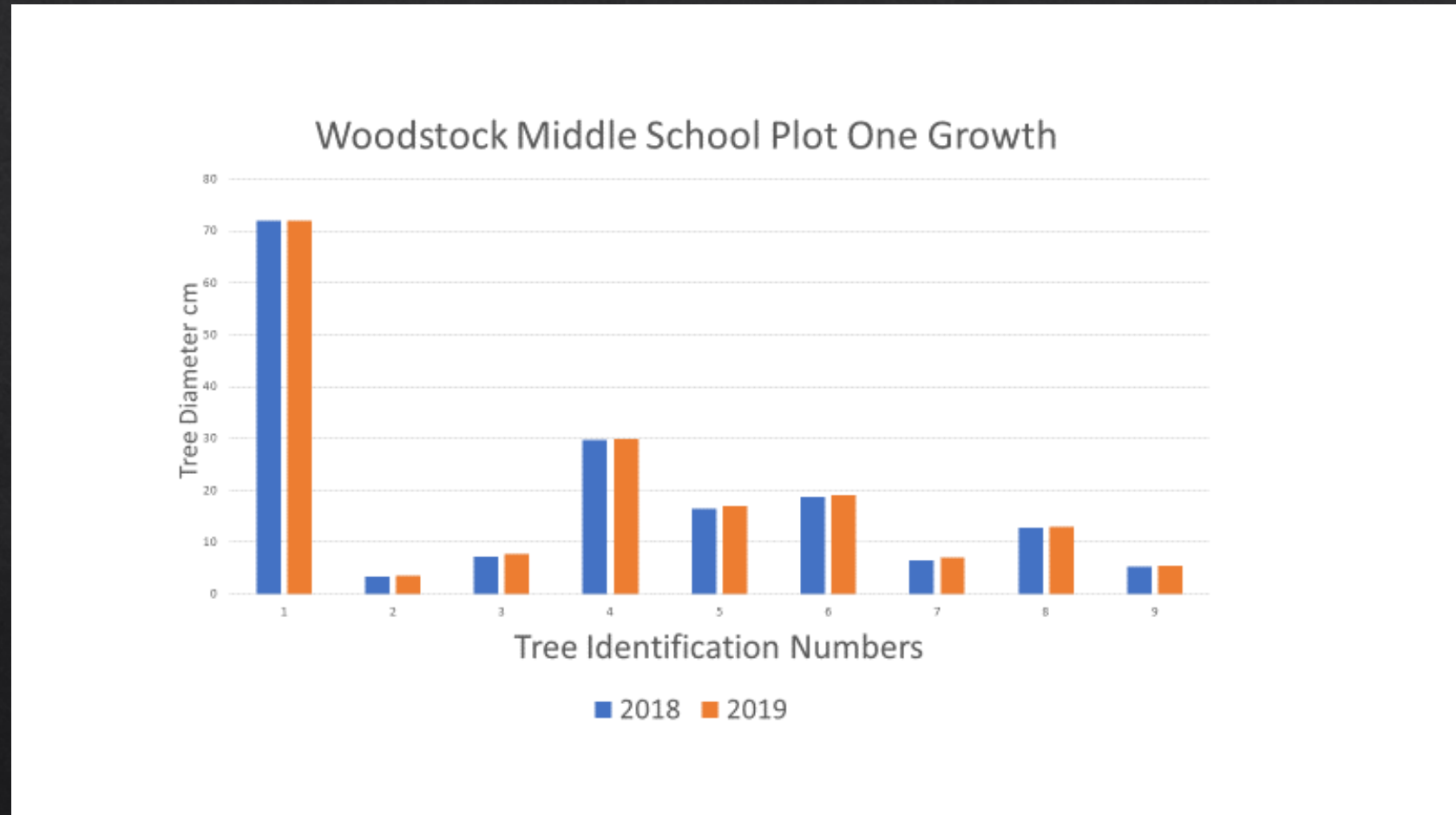


Figure 8: Brockton High School



◆ Description of graphs and related data table:

Graph 1 shows Carbon Biomass by tree species in Plot 1, using a bar graph.

Graph 2 shows tree Stand Density by tree species in plot 1, using a bar graph.

◆ **Created using:** Harvard Forest Schoolyard Database Online Graphing Tool.

◆ **Teacher/Author:** Rachel Calderara

◆ **School:**

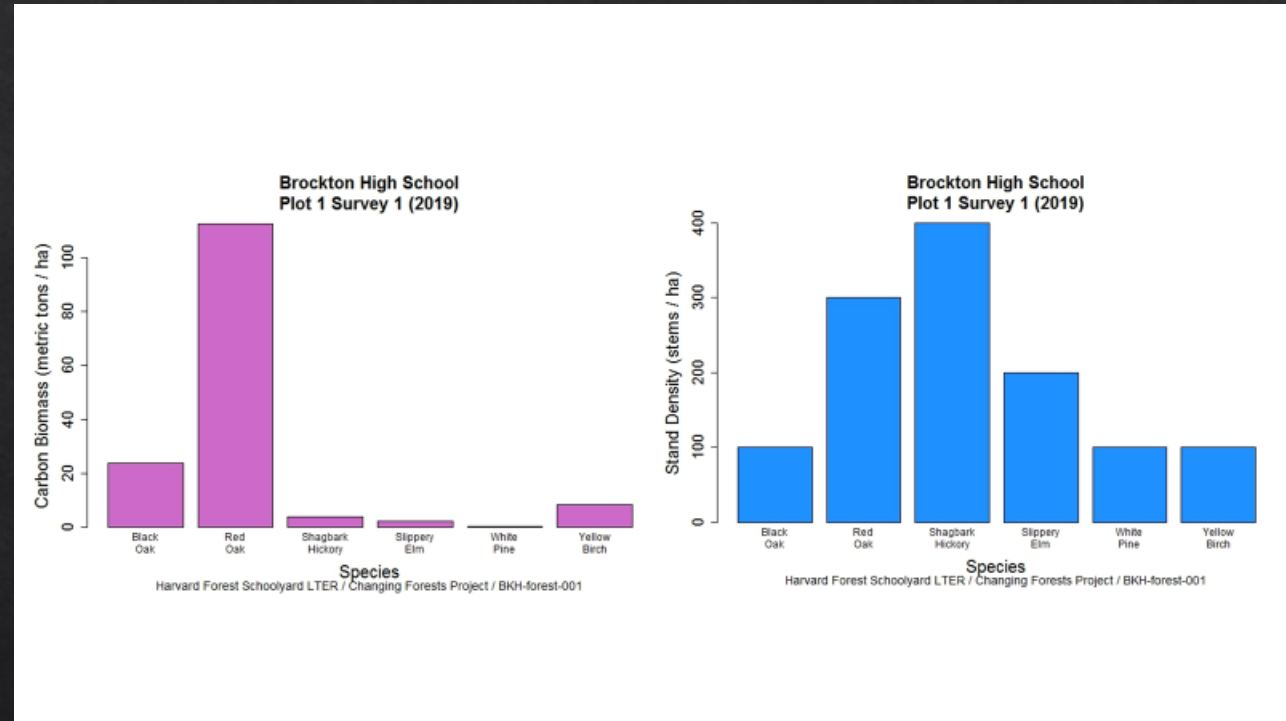
Brockton High School and Wildlands Trust

◆ **Grade Level:**

11, 12

◆ **Harvard Forest Mentors:**

Emery Boose, Greta VanScoy



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Section Two: Representing Buds, Leaves and Global Warming Project Data

Schoolyard Ecology Teachers: Colleen Casey, Lorie Primavera, Elisa Margarita, Laura Schofield, Jane Lucia, Dan Thomases

Figure 9 : Trinity Catholic Academy 50% Leaf Fall Timing from 2013 Through 2019.



◇ Description of graph and related data table:

This graph shows 50% leaf fall dates for each autumn season by study tree (Red Maples and Sugar Maple) over 7 years. Each bar here represents an individual tree.

◇ **Teacher/Author:** Colleen Casey

◇ **School:** Trinity Catholic Academy

◇ **Grade Level:** 4,5

◇ **Harvard Forest Mentors:**

Betsy Colburn, Greta VanScoy

◇ **Notes :** See notes below

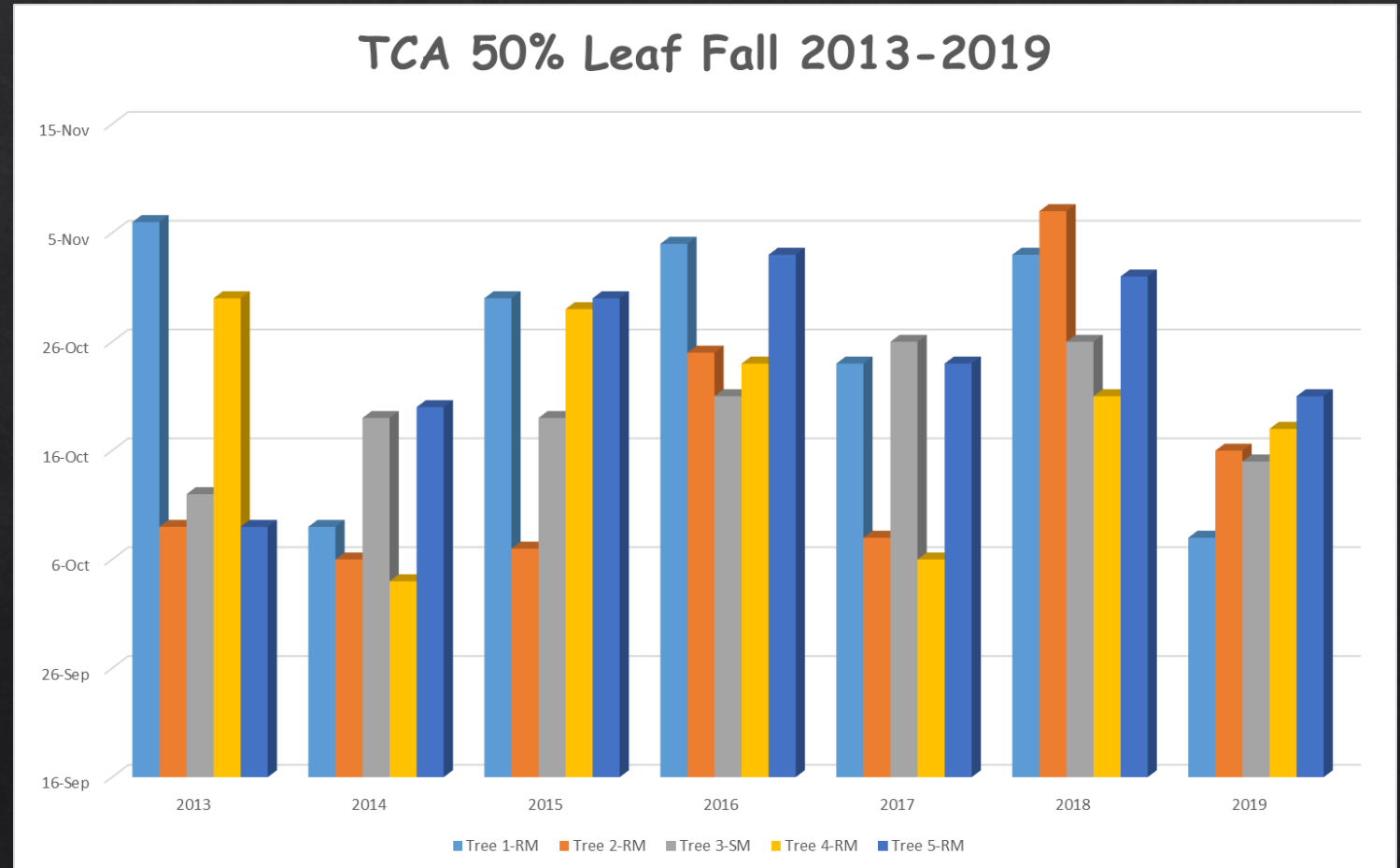


Figure 10 : Length of Growing Season at Trinity Catholic Academy Over 6 years



◆ Description of graph and related data table:

This line graph shows changes in the length of the growing season at Trinity Catholic School between 2014 and 2019 by study tree.

◆ **Created using:** Harvard Forest Schoolyard Database Online graphing tool.

◆ **Teacher/Author:** Colleen Casey

◆ **School:** Trinity Catholic Academy

◆ **Grade Level:** 4,5

◆ **Harvard Forest Mentors:**

Betsy Colburn, Greta VanScoy

◆ **Notes :** See notes below

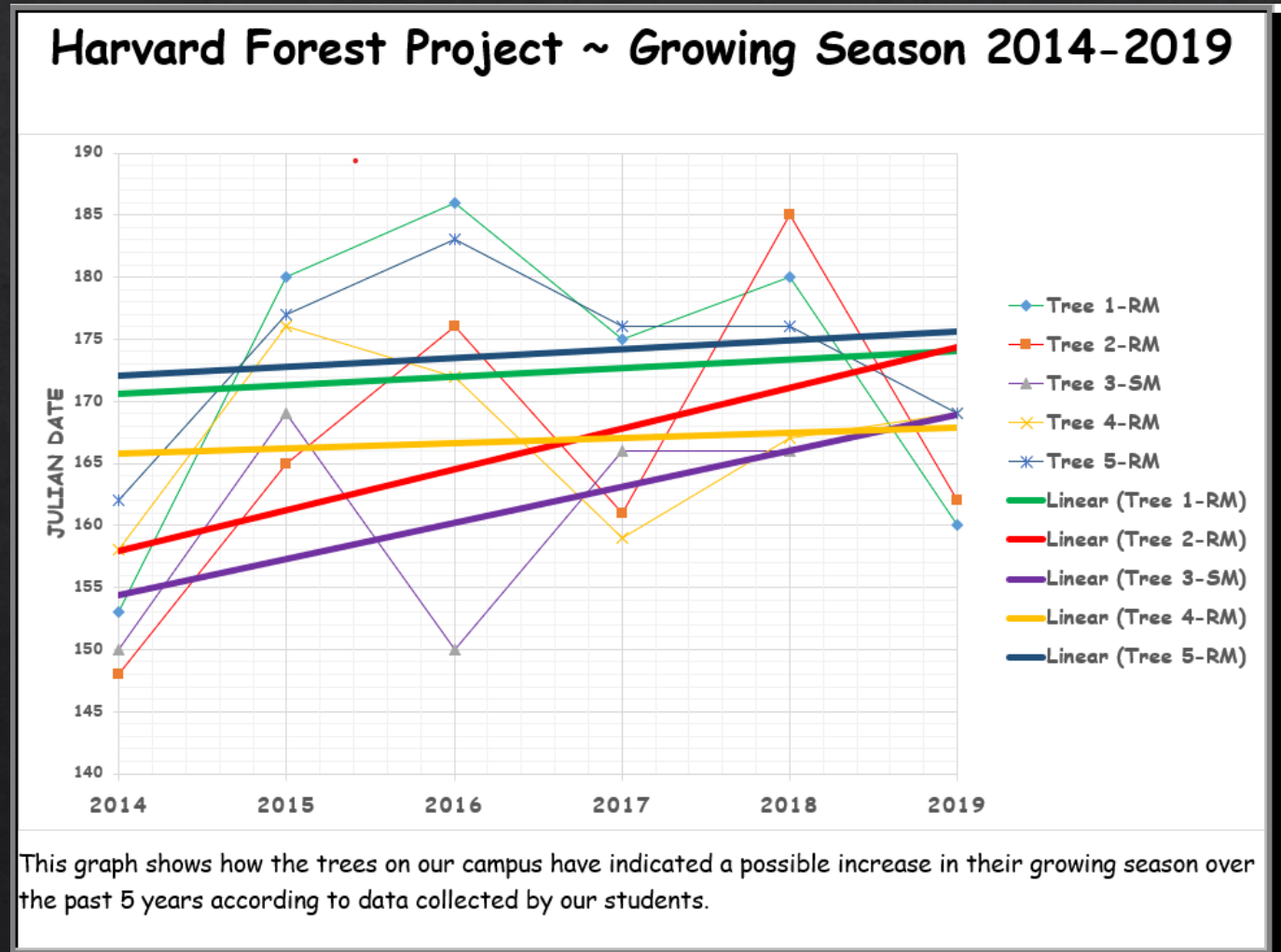


Figure 11: Length of Growing Season at Trinity Catholic Academy Red Maples 2014-19



◆ **Description of graph and related data table:**

This line graph shows how the growing season for Red Maples at Trinity Catholic Academy has changed over 6 years of study.

◆ **Created using:** Harvard Forest Schoolyard Database Online graphing tool.

◆ **Teacher/Author:** Lori Primavera

◆ **School:** Trinity Catholic Academy

◆ **Grade Level:** 4,5

◆ **Harvard Forest Mentors:**

Greta VanScoy, Betsy Colburn, John O'Keefe

◆ **Notes :** See notes below

See notes below

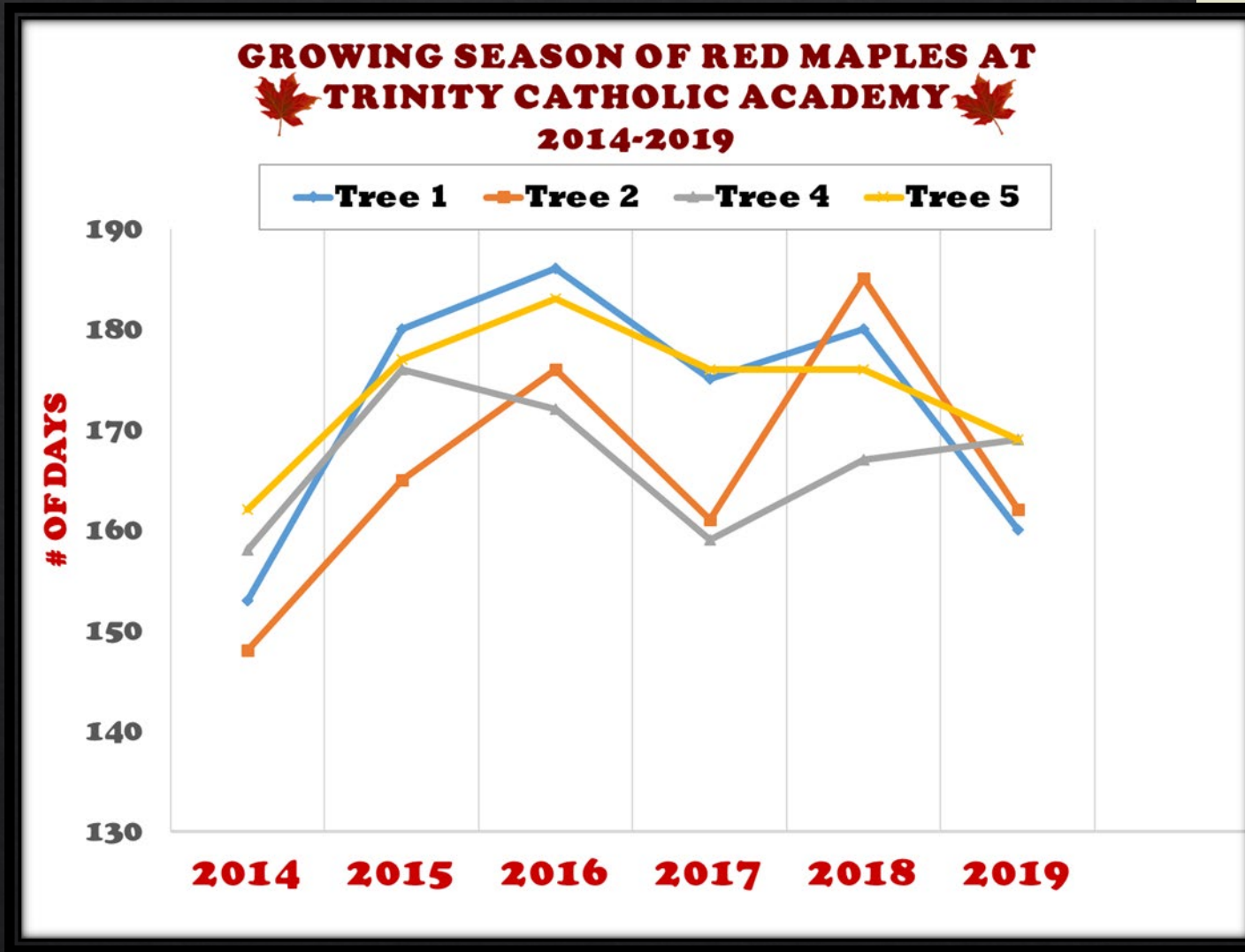
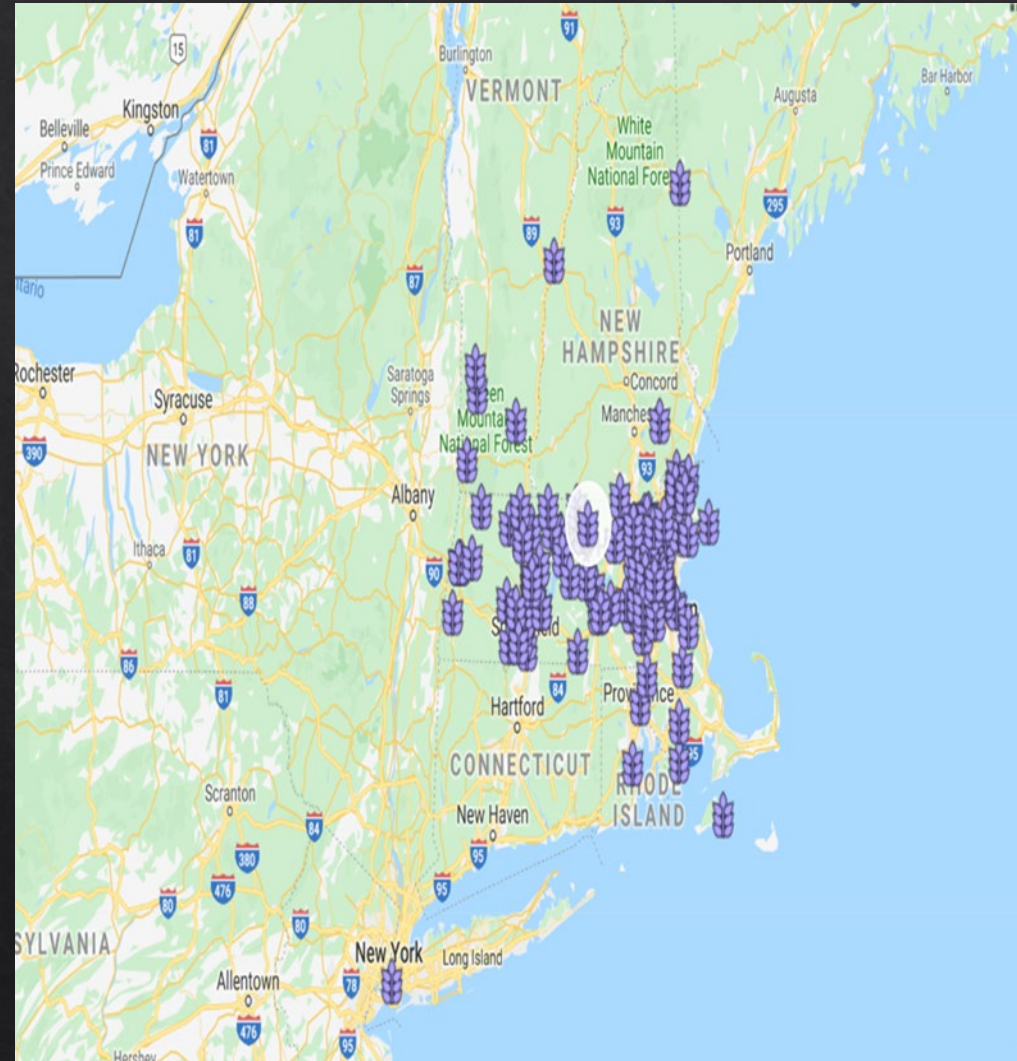


Figure 12: Examining field sites by Geographical Locations



◇ Description of graph and related data table:

In working towards the learning goal of supporting students more effectively in data representation, Elisa worked on modifying the online graphing tool exercises Pamela developed for teachers into exercises appropriate for her students' use. In the first exercise, students will refer to the Harvard Forest interactive Google Maps, which show all HF Schoolyard field sites geographically..

◇ Teacher/Author:

Elisa Margarita

◇ School:

Brooklyn Technical School

◇ Grade Level:

High School

◇ Harvard Forest Mentors:

John O'Keefe, Betsy Colburn, Greta VanScoy



Figure 13: Compare Latitude or Elevation from different sites

◆ **Description of data table:** Students use this data table taken from the HF online database to mine field site data in order to compare phenology data using latitude and elevation from different sites.

◆ **Teacher/Author:**
Elisa Margarita

◆ **School:**
Brooklyn Technical School

◆ **Grade Level:**
High School

◆ **Harvard Forest Mentors:**
John O’Keefe, Betsy Colburn

status: A=Active, I=Inactive, N=Not Participating

ID	School Code	School Name	Teachers	Street Address	Town	State	Latitude (deg)	Longitude (deg)	Elevation (m)	Buds	Hwa	Vernal	Stream	Forest
142	RBM	Robinson Middle School	Farrow	110 June Street	Lowell	MA				I	N	N	N	N
143	LWH	Lowell High School	Farrow	50 Morrisette Blvd.	Lowell	MA				A	N	N	N	N
163	JSE	John J Shaughnessy Elementary School	Slone	1158 Gorham Street	Lowell	MA				A	N	N	N	N
197	BKH	Brockton High School	Calderara; Kelly; Voorhis	470 Forest Ave	Brockton	MA	42.0673	-71.0443		N	N	N	N	A
51	SHS	Shady Hill School	McDermott	178 Coolidge Hill	Cambridge	MA	42.3722	-71.1374	3	I	N	N	N	N
104	CSM	Cambridge Street Upper Campus	Feynman	850 Cambridge Street	Cambridge	MA	42.371	-71.0915	3	I	N	N	N	N
178	OMM	OMaley Innovation School	Donnelly; Duff; Sumner; Thomasas	32 Cherry St,	Gloucester	MA	42.6292	-70.6735	3	A	N	N	N	N
106	VLM	Vassal Lane Upper School	Feynman	197 Vassal Lane	Cambridge	MA	42.3839	-71.1397	4	I	N	N	N	N
93	BKE	Beechwood Knoll School	Natola	225 Fenno Street	Quincy	MA	42.2694	-71.0053	5	I	N	N	N	N
58	TMS	Triton Regional Middle School	Randall	112 Elm Street	Byfield	MA	42.744	-70.9161	6	I	N	N	N	N
174	EDG	Edgartown School	Gelinas; Look	35 Robinson Rd	Edgartown	MA	41.3896	-70.5213	6	A	N	N	N	I
91	CLH	Chelsea High School	Erickson	299 Everett Avenue	Chelsea	MA	42.4005	-71.0403	7	N	N	N	N	N
97	SWM	Salemwood School	Serio-Vienneau	529 Salem Street	Malden	MA	42.4316	-71.0503	7	I	N	N	N	N
99	ATM	Atlantic Middle School	Hanlon	86 Hollis Avenue	Quincy	MA	42.2775	-71.0241	7	I	N	N	N	N
49	RNM	Rupert A. Nock Middle School	Reynolds	70 Low Street	Newburyport	MA	42.8089	-70.8873	8	I	N	N	N	N
136	WIH	The Winsor School	Dorokhin	103 Pilgrim Road	Boston	MA	42.341	-71.1076	8	N	N	N	N	A
96	LEE	Lesley-Ellis School	Curtis	41 Foster Street	Arlington	MA	42.4104	-71.1454	9	I	N	N	N	N
139	NLE	Nantucket Lighthouse School	Dresser	1 Rugged Road	Nantucket	MA	41.2628	-70.0916	9	I	N	N	N	N
79	PRM	Pentucket Regional Middle School	Wile	20 Main Street	West Newbury	MA	42.7804	-71.0138	11	I	N	N	N	N
110	SCM	Shore Country Day School	Koval	545 Cabot Street	Beverly	MA	42.5689	72.8875	12	I	N	N	N	N
128	DVM	Davisville Middle School	Warburton	200 School Street	North Kingston	RI	41.6196	-71.4646	13	I	N	N	N	N
155	BAH	Blackstone Academy	Balke; Berman; Capra; Horton	334 Pleasant St. #2	Pawtucket	RI	41.869	-71.3848	13	A	N	N	N	N
170	CGH	Common Ground High School	Sinusas	358 Springside Ave	New Haven	CT	41.3382	-72.9591	13	N	N	N	N	A
105	CLE	Conservatory Lab Charter School	Dwyer	25 Arlington Street	Brighton	MA	42.3522	-71.1532	14	I	N	N	N	N
137	GUM	Glen Urquhart School	Cushing	74 Hart Street	Beverly	MA	42.5694	-70.816	15	N	N	N	N	A
171	NRH	Nauset Regional High School	Simpson	100 Cable Rd	Eastham	MA	41.8568	-69.9689	15	N	N	N	N	A
184	MYH	Monomoy Middle School	Forist		Chatham	MA	41.6949	-69.9735	16	N	N	N	N	A
92	MIH	Milton Academy	Richards	170 Centre Street	Milton	MA	42.2572	-71.0717	17	N	N	N	N	N
86	CHS	Carver High School	Littleton	60 South Meadow Road	Carver	MA	41.8938	-70.7547	21	N	N	I	N	N
176	MVH	Marthas Vineyard Regional High School		100 Edgartown Vineyard Haven Rd	Oak Bluffs	MA	41.4175	-70.5961	22	N	N	N	N	I
186	CBS	Captain Samuel Brown Elementary School	Bugler	150 Lynn St.	Peabody	MA	42.5069	-70.9512	23	N	N	N	N	A
182	NRS	NEARI School	Banas	70 N Summer St,	Holyoke	MA	42.2042	-72.595	25	N	N	N	N	I

Figure 14: Compare the Length of the Growing Season between the northern most school to our school (Brooklyn Technical School)



◇ Description of graph and related data table:

Students create a graph comparing the data from the school at the northern most field site compared with the southern most to show differences in the length of the growing season. This graph is first completed using the Harvard Forest online graphing tool. Students who are comfortable with Excel graphing are then given a chance to try producing a similar graph with that software.

◇ **Created using:** Harvard Forest Schoolyard Database Online graphing tool.

◇ **Teacher/Author:** Elisa Margarita

◇ **School:** Brooklyn Technical School

◇ **Grade Level:** High School

◇ **Harvard Forest Mentors:**

John O'Keefe, Betsy Colburn, Greta VanScoy

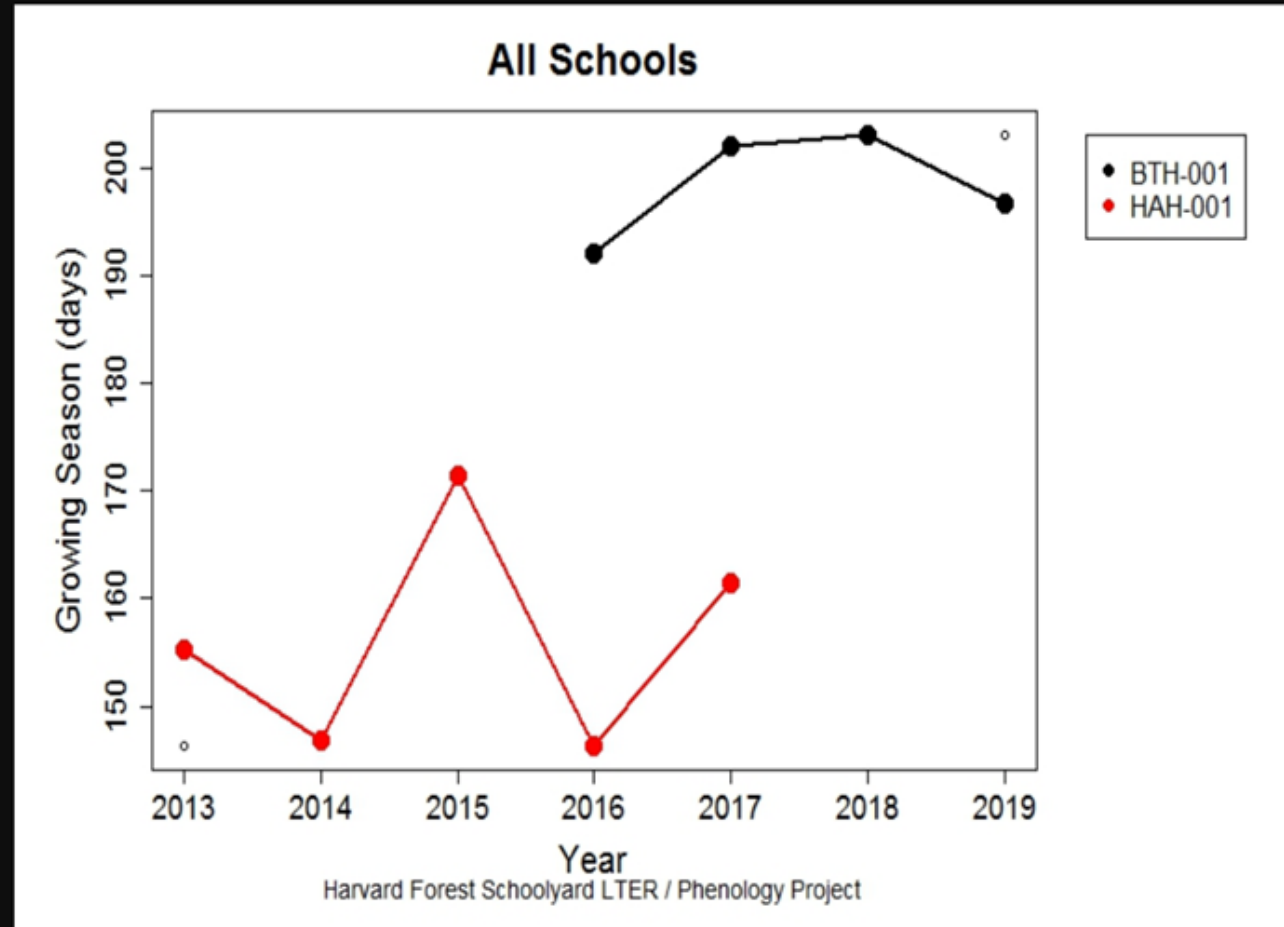


Figure 15: Timing of 50% Budburst at Bartlett School



◇ **Description of graph and related data table:**

This graph shows the timing of 50% budburst at the Bartlett School in Lowell, Ma. in spring of 2019.

◇ **Teacher/Author:** Laura Schofield

◇ **Created Using:** Excel

◇ **School:** Bartlett Community Partnership School

◇ **Grade Level:** 6

◇ **Harvard Forest Mentors:** John O'Keefe, Betsy Colburn

◇ **See Data Tables Below**

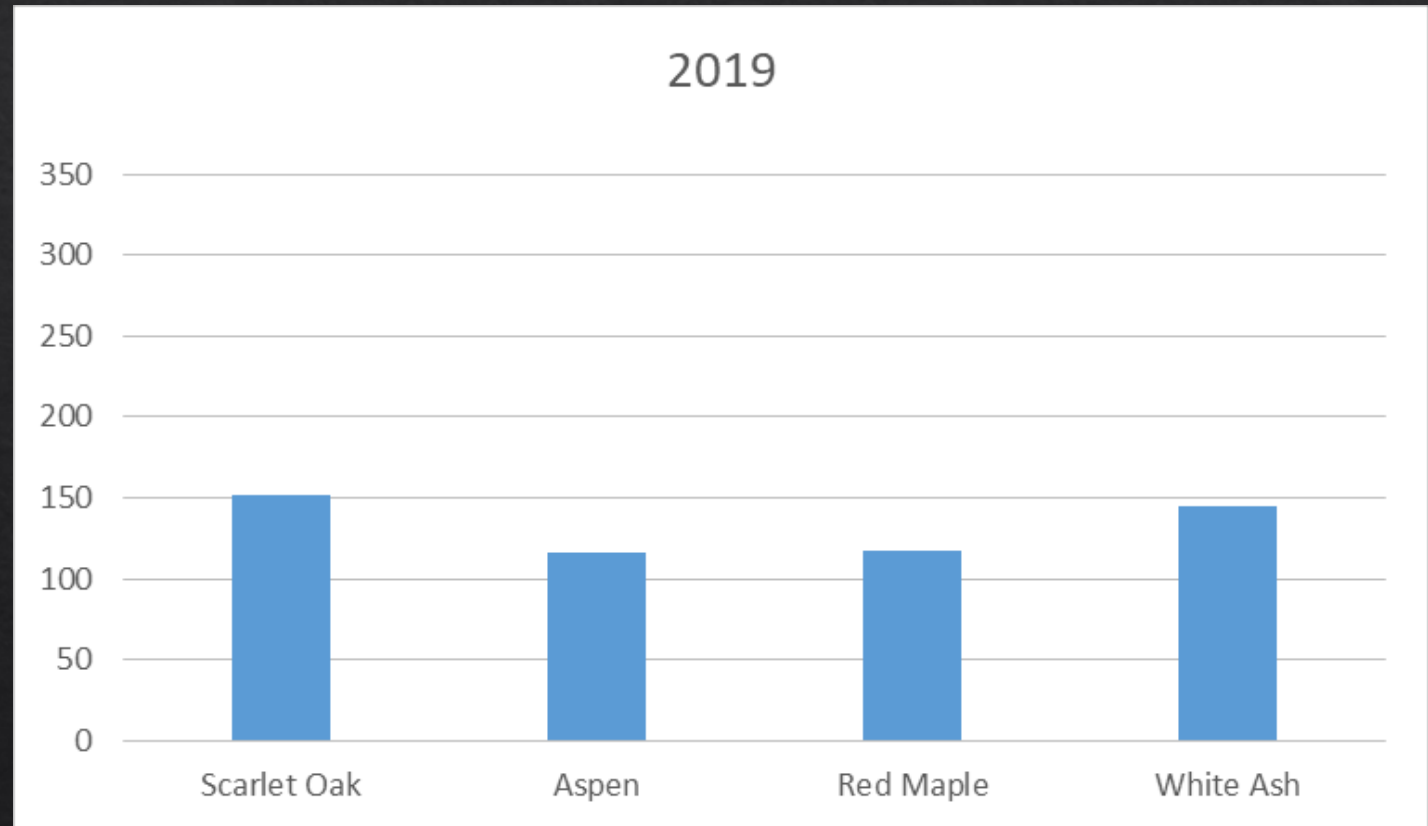




Figure 16: Timing of 50% Leaf Drop on Black Gum Tree Over 8 Years at Williston School

Description of graph and related data table:

This graph shows timing of 50% of leaves dropped by study tree from 2012 through 2019. Julian Date is shown on the Y axis and Years are shown on the X axis.

Created using: Excel

Teacher/Author: Jane Lucia

School: Williston Northampton School

Grade Level: 7

Harvard Forest Mentors:

Josh Plisinski, John O'Keefe, Greta VanScoy
Betsy Colburn

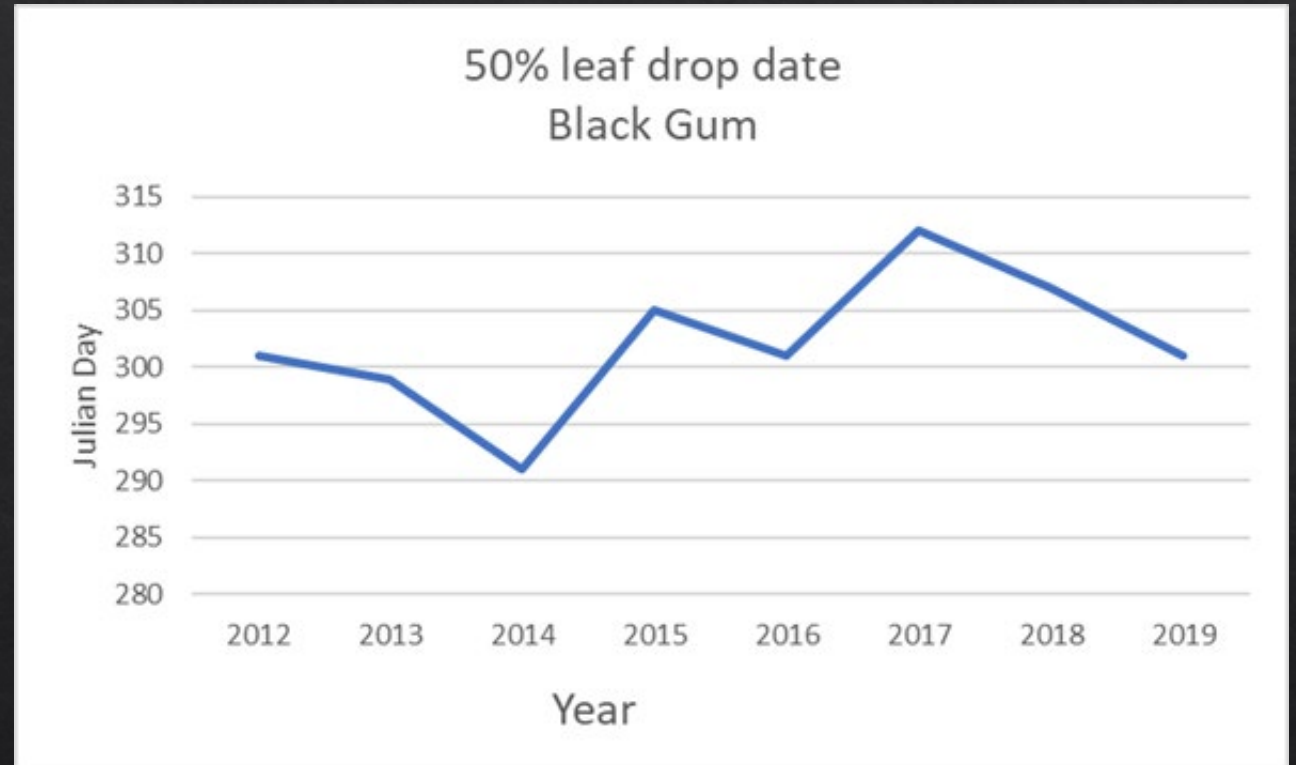




Figure 17: Timing of 50% Leaf Drop on Red Maple Tree Over 5 Years at Williston School

◆ Description of graph and related data table:

This graph shows the timing of 50% leaf drop on the Red Maple Tree (s) at Williston School between 2014 and 2019.

◆ Created using: Excel

◆ Teacher/Author: Jane Lucia

◆ School: Williston Northampton School

◆ Grade Level: 7

◆ Harvard Forest Mentors:

Josh Plisinski, Greta VanScoy, John O'Keefe,
Betsy Colburn

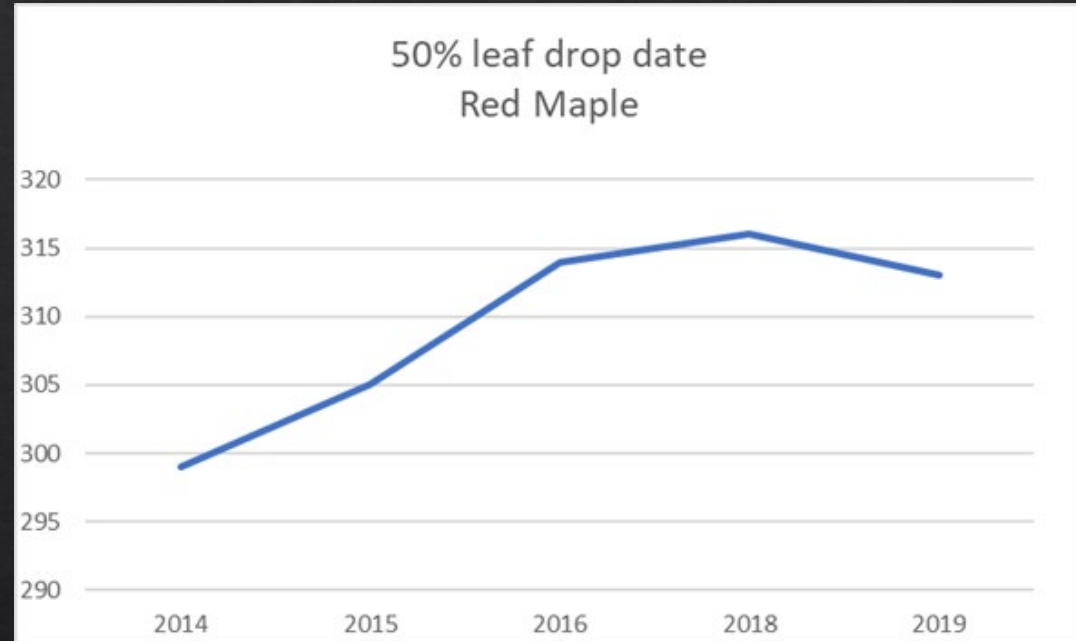


Figure 18: Timing of 50% Leaf Drop on Pin Oak Tree Over 6 Years at Williston School



◆ Description of graph and related data table:

This graph shows the timing of 50% leaf drop on the Pin Oak Tree at Williston School between 2011 and 2019.

◆ Created using: Excel

◆ Teacher/Author: Jane Lucia

◆ School: Williston Northampton School

◆ Grade Level: 7

◆ Harvard Forest Mentors:

Josh Plisinski, Greta VanScoy, John O'Keefe,
Betsy Colburn

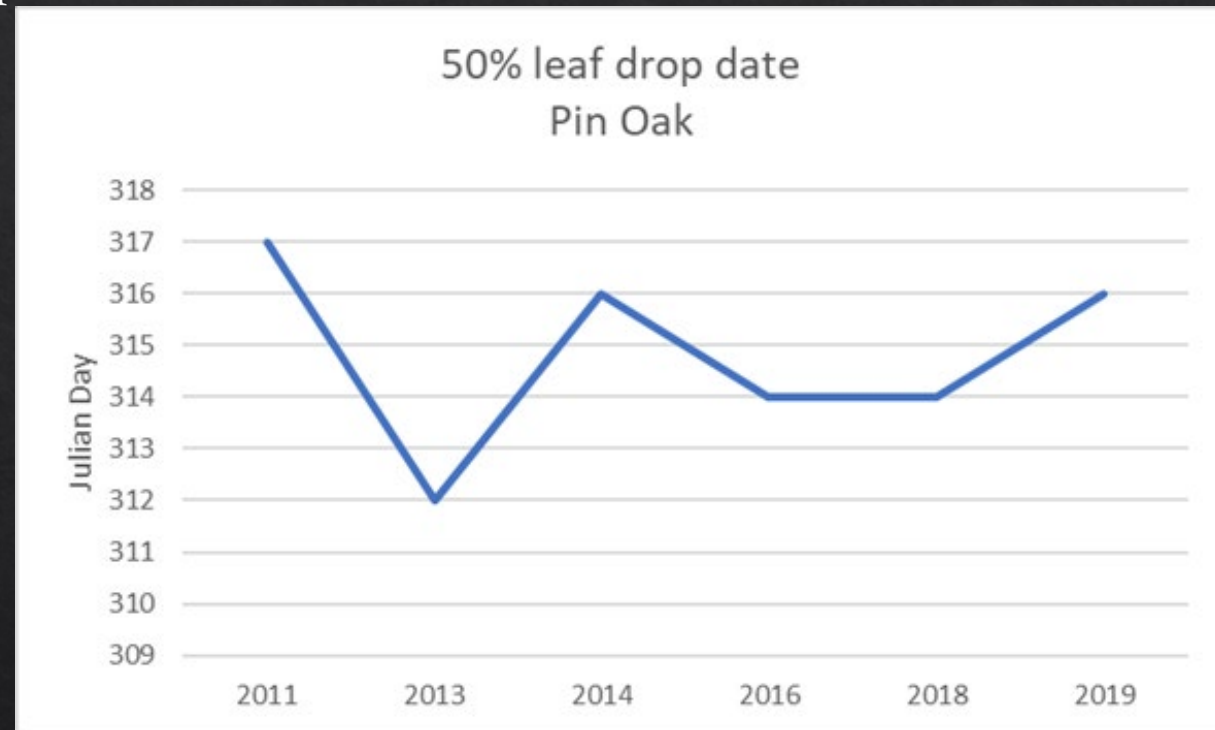




Figure 19: Comparison of the Timing of 50% Leaf Drop of 3 Study Trees Over Time at Williston School

◇ Description of graph and related data table:

This graph allows for the comparison of the timing of 50% leaf drop on three of the study trees at Williston School between 2011 and 2019.

◇ Created using: Excel

◇ Teacher/Author: Jane Lucia

◇ School: Williston Northampton School

◇ Grade Level: 7

◇ Harvard Forest Mentors:

Josh Plisinski, Greta VanScoy, John O'Keefe,
Betsy Colburn

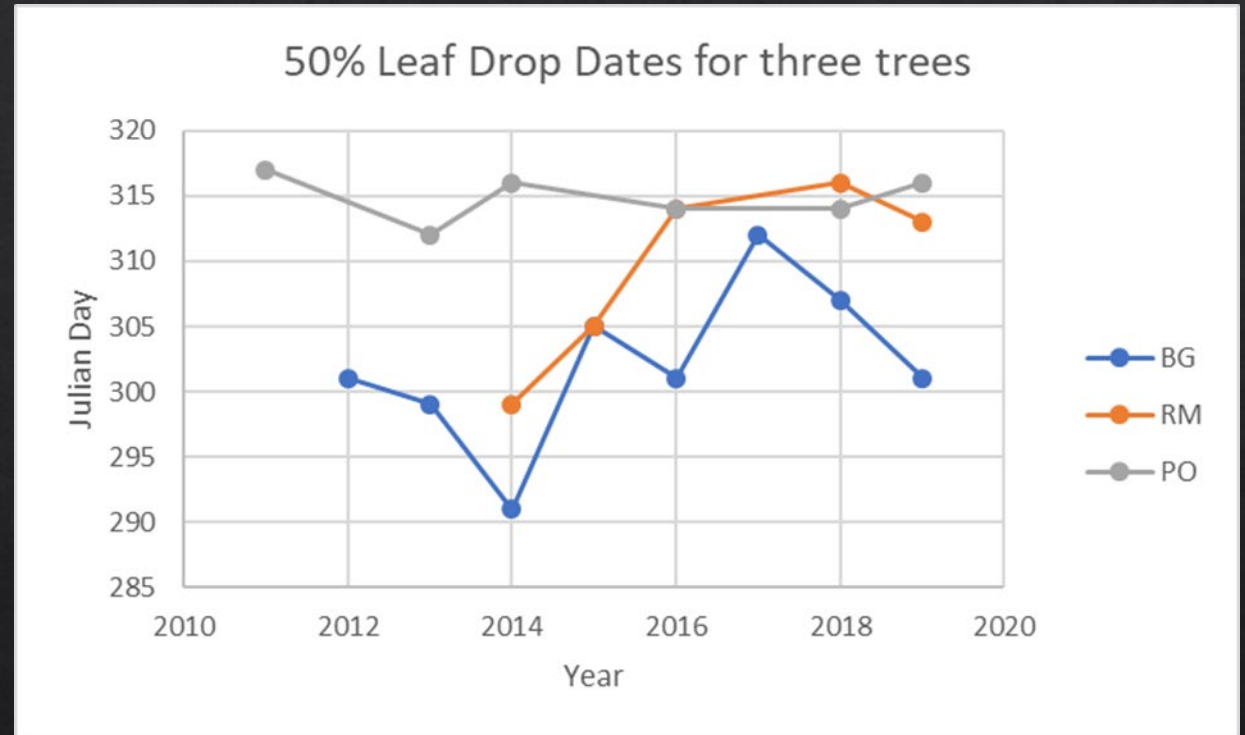


Figure 20: Timing of 50% Leaf Drop in Fall 2019



◆ Description of graph and related data table:

This graph allows for the comparison of the timing of 50% leaf drop on six of the study trees at the O'Maley Innovation Middle School in the fall of 2019.

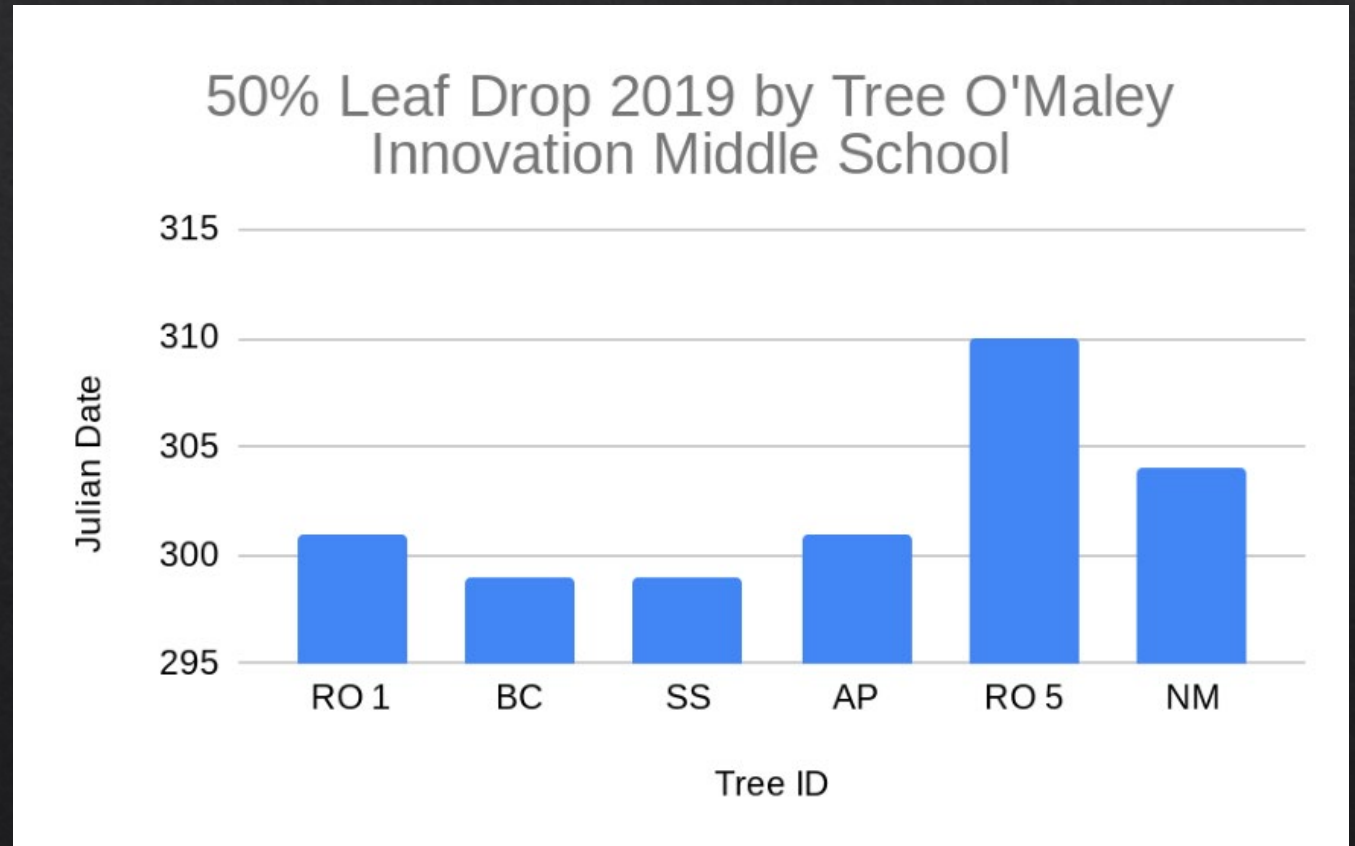
◆ Created using: Google Sheets

◆ Teacher/Author: Dan Thomases

◆ School: O'Maley Innovation School

◆ Grade Level: 8

◆ Harvard Forest Mentor: JoAnn Mossman



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Section Three: Representing Woolly Bully and the Hemlock Tree Project Data

Schoolyard Ecology Teachers: Tara Alcorn, Elicia Andrews

Harvard Forest Staff: David Orwig

Figure 21: Growth of Hemlock Trees Vs. Number of Woolly Adelgid Egg Sacs



◆ Description of graph and related data table:

This graph shows the relationship between growth of Hemlock trees and the number of egg sacs of the Hemlock Woolly Adelgid at the Harvard Forest HWA demonstration field site. The trend line shows a decrease in growth related to the presence of more ovisacs.

◆ Created using: Excel

◆ Teacher/Author: Tara Alcorn

◆ School: Greater Lowell Technical High School

◆ Grade Level: 10,11,12

◆ Harvard Forest Mentor: David Orwig

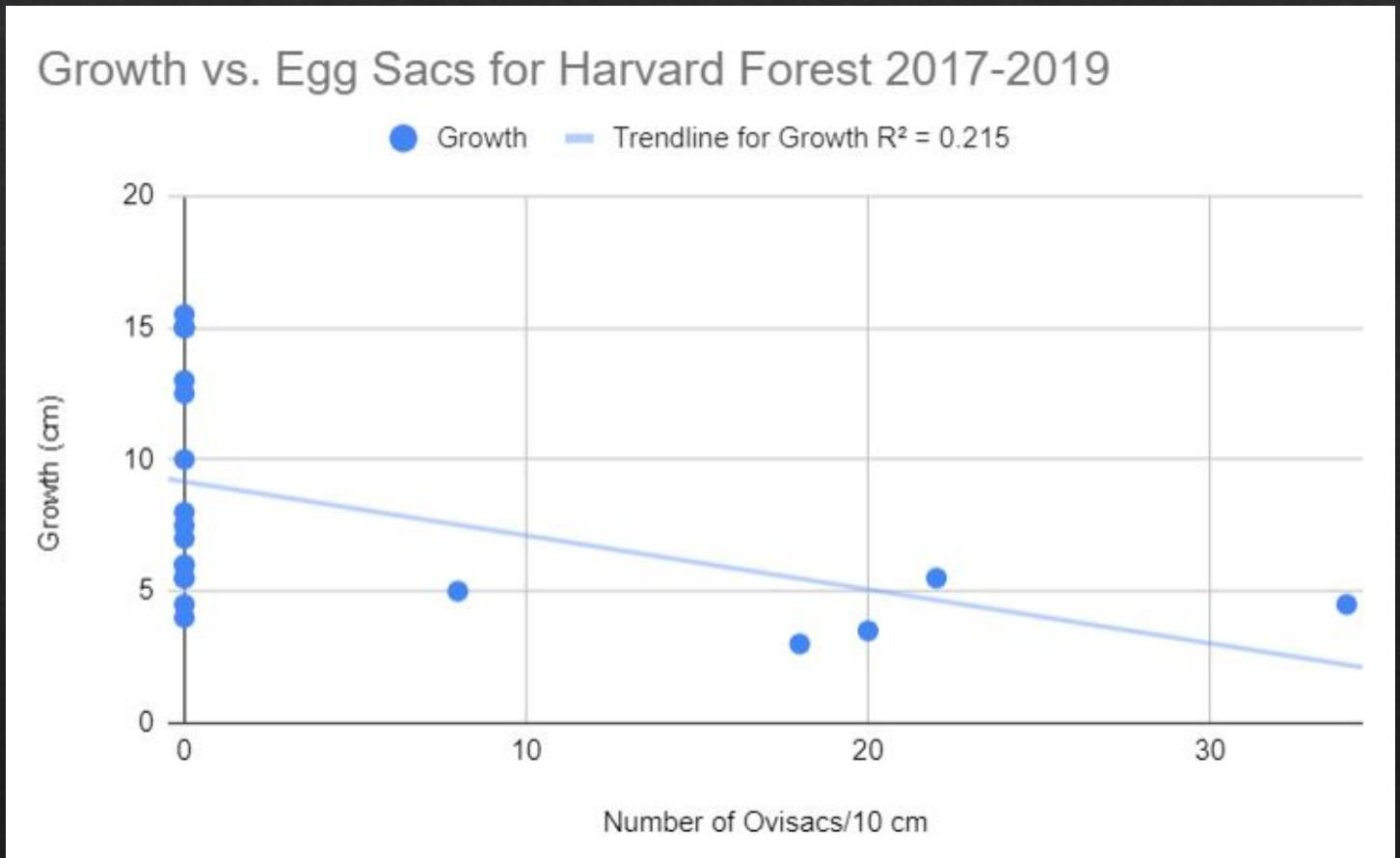




Figure 22: Growth of Hemlock Trees Vs. Number of Woolly Adelgid Egg Sacs

◇ Description of graph and related data table:

This graph shows the relationship between Growth of Hemlock Trees and the Number of Egg Sacs of the Hemlock Woolly Adelgid at the Harvard Forest HWA demonstration field site. The Trend line shows a decrease in growth related to the presence of more ovisacs.

◇ Created using: Excel

◇ Teacher/Author: Tara Alcorn

◇ School:
Greater Lowell Technical High School

◇ Grade Level: 9-12

◇ Harvard Forest Mentor: David Orwig

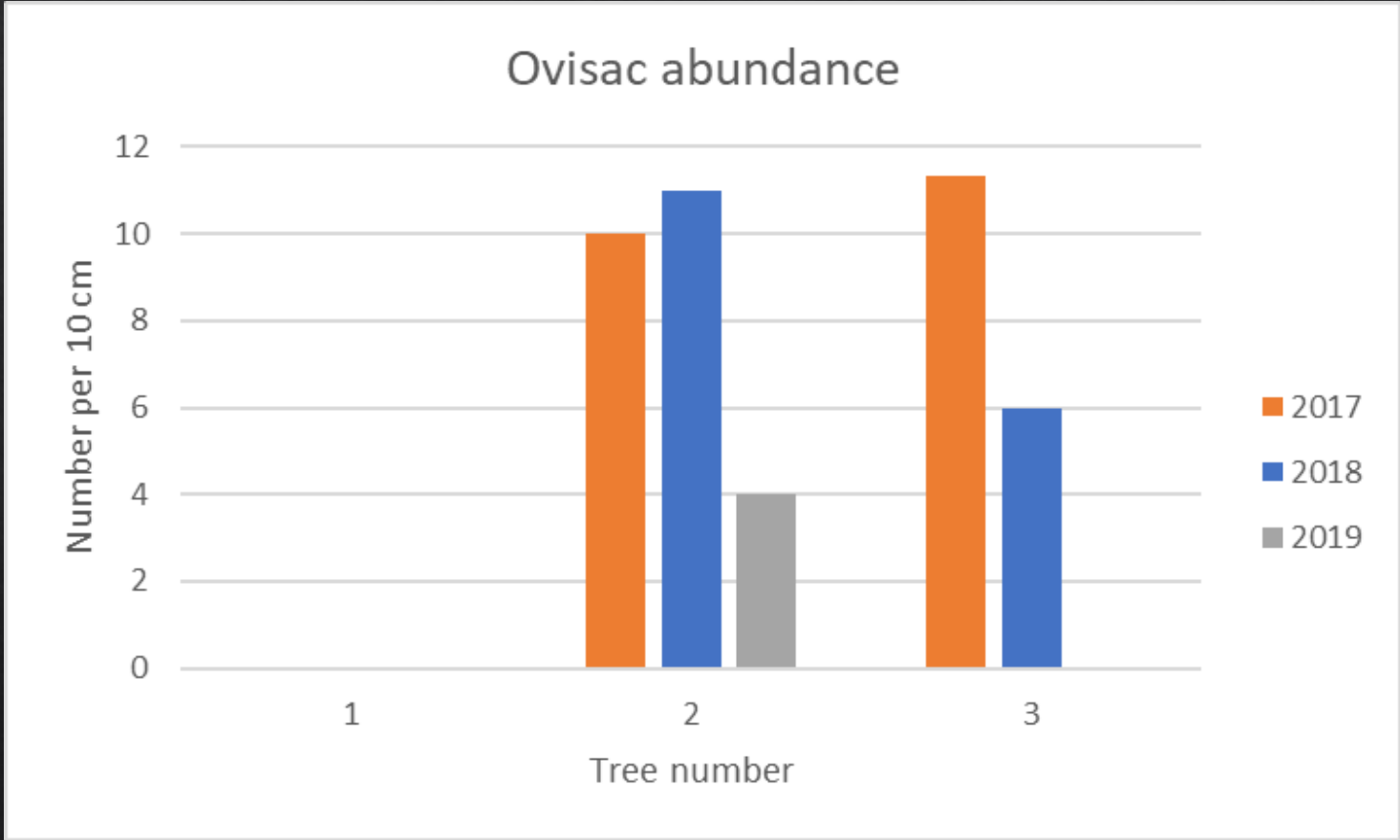


Figure 23: Growth of Hemlock Trees Vs. Number of Woolly Adelgid Egg Sacs



◆ Description of graph and related data table:

This graph shows the relationship between growth of Hemlock trees and the number of egg sacs of the Hemlock Woolly Adelgid at the Harvard Forest HWA demonstration field site. The Trend line shows a decrease in growth related to the presence of more ovisacs.

◆ Created using: Excel

◆ Teacher/Author: Tara Alcorn

◆ School: Greater Lowell Technical High School

◆ Grade Level: 9-12

◆ Harvard Forest Mentor: David Orwig

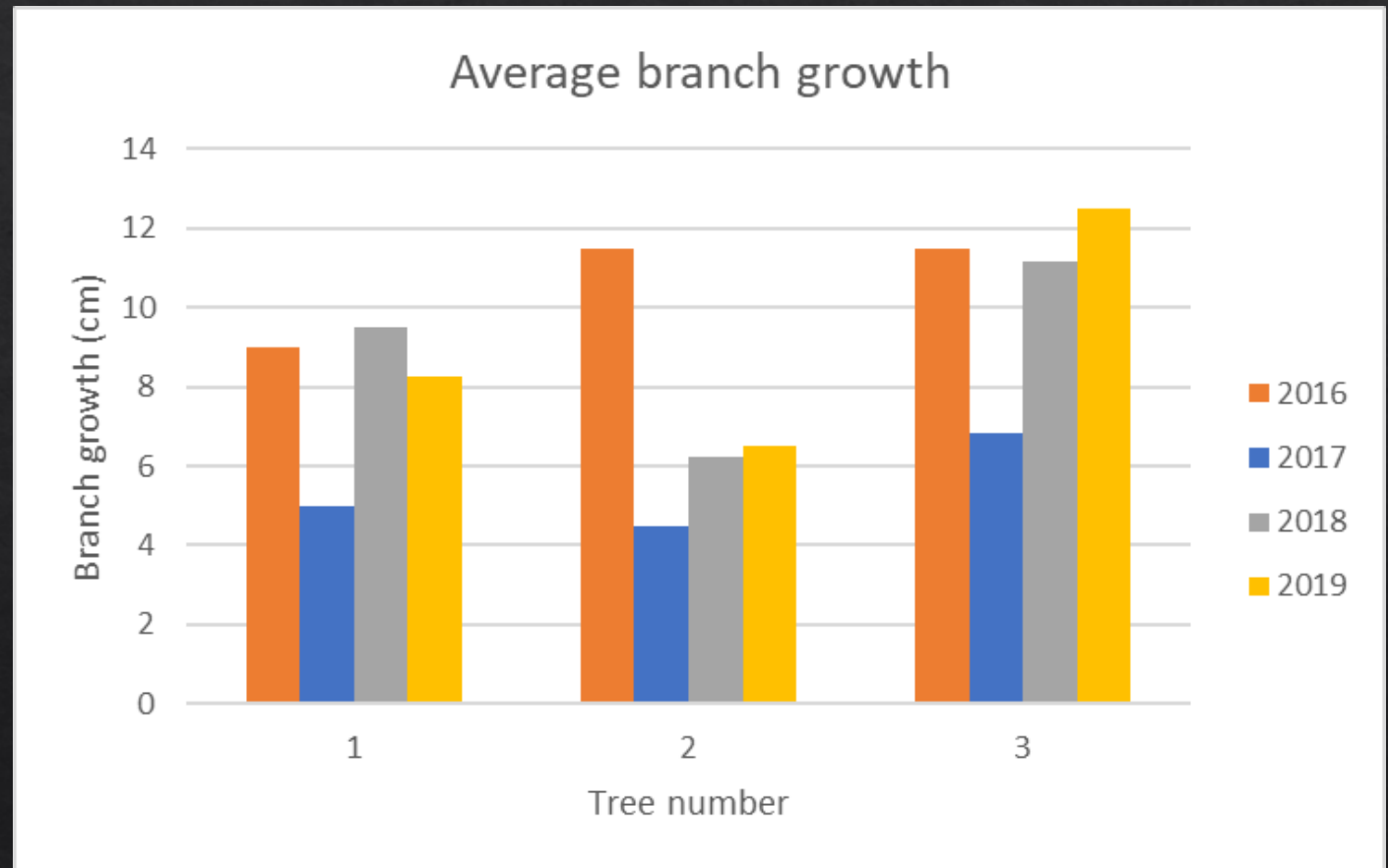


Figure 24: Growth of Hemlock Trees Vs. Number of Woolly Adelgid Egg Sacs



◆ Description of graph and related data table:

This graph shows the relationship between Growth of Hemlock Trees and the Number of Egg Sacs of the Hemlock Woolly Adelgid at the Harvard Forest HWA demonstration field site. The Trend line shows a decrease in growth related to the presence of more ovisacs.

◆ Created using: Excel

◆ Teacher/Author: Tara Alcorn

◆ School: Greater Lowell Technical High School

◆ Grade Level: 9-12

◆ Harvard Forest Mentor: David Orwig



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Section Four: Representing Vernal Pool Project Data

Schoolyard Ecology Teacher: Sally Farrow

Harvard Forest Staff : Betsy Colburn

Figure 25: Water Depths of Drumlin Farm Pool #1 Over 11 years



◆ Description of graph and related data table:

This line graph shows the pattern of water depth seasonal change over 11 years of monitoring a vernal pool at Drumlin Farm.

◆ Created using: Excel

◆ Teacher/Author: Sally Farrow

◆ Site: Drumlin Farm

◆ Grade Level: 4-12

◆ Harvard Forest Mentor: Betsy Colburn and Teachers: Lori Primavera, Colleen Casey

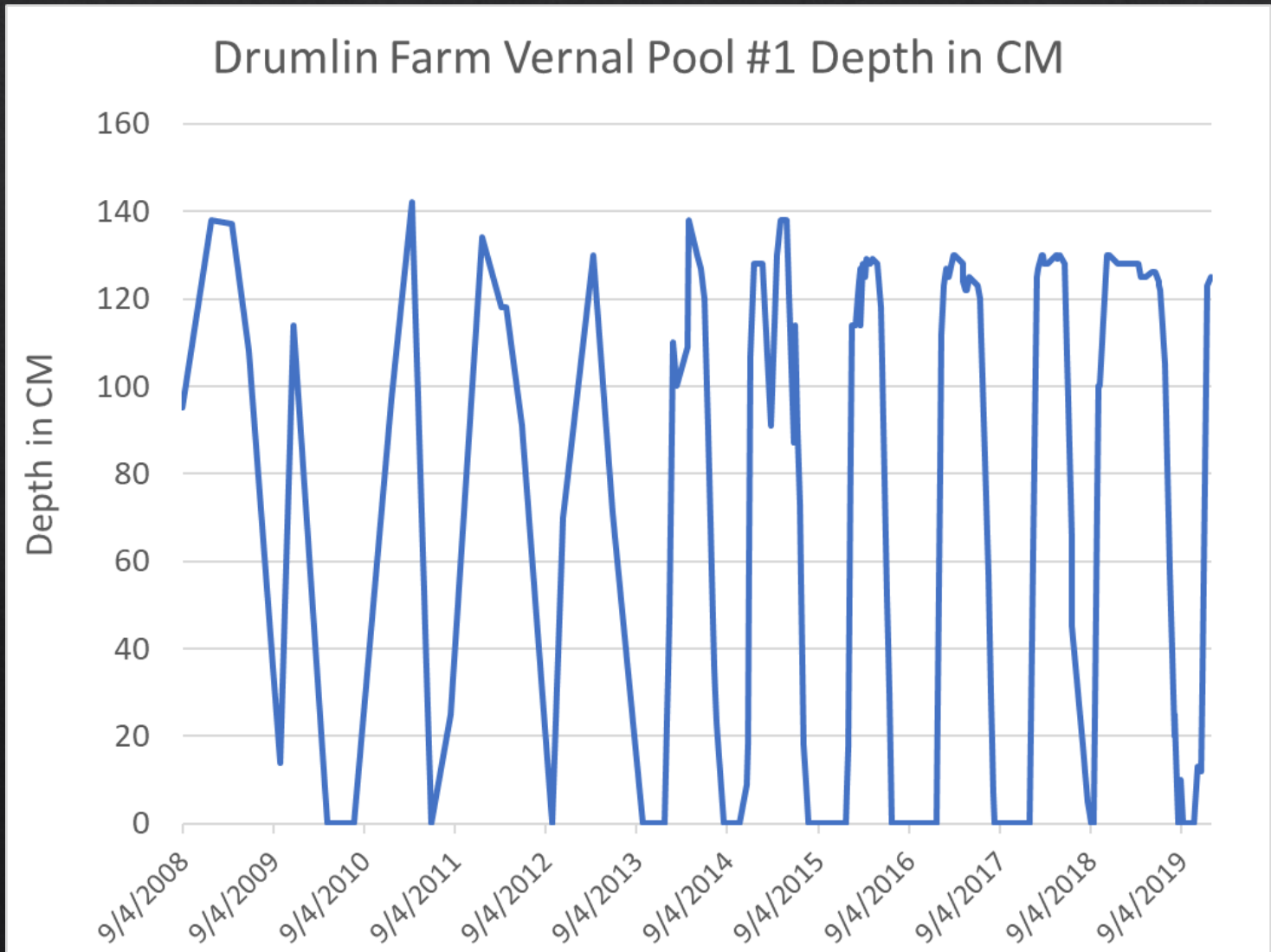


Figure 26: Water Depths of Concord Middle School Vernal Pool Over 9 Years



Description of graph and related data table:

This bar graph shows the pattern of water depth seasonal change over 9 years of monitoring a vernal pool at Concord Middle School. A bar graph was chosen in order to avoid misrepresenting seasonal patterns for 3 years of missing data.

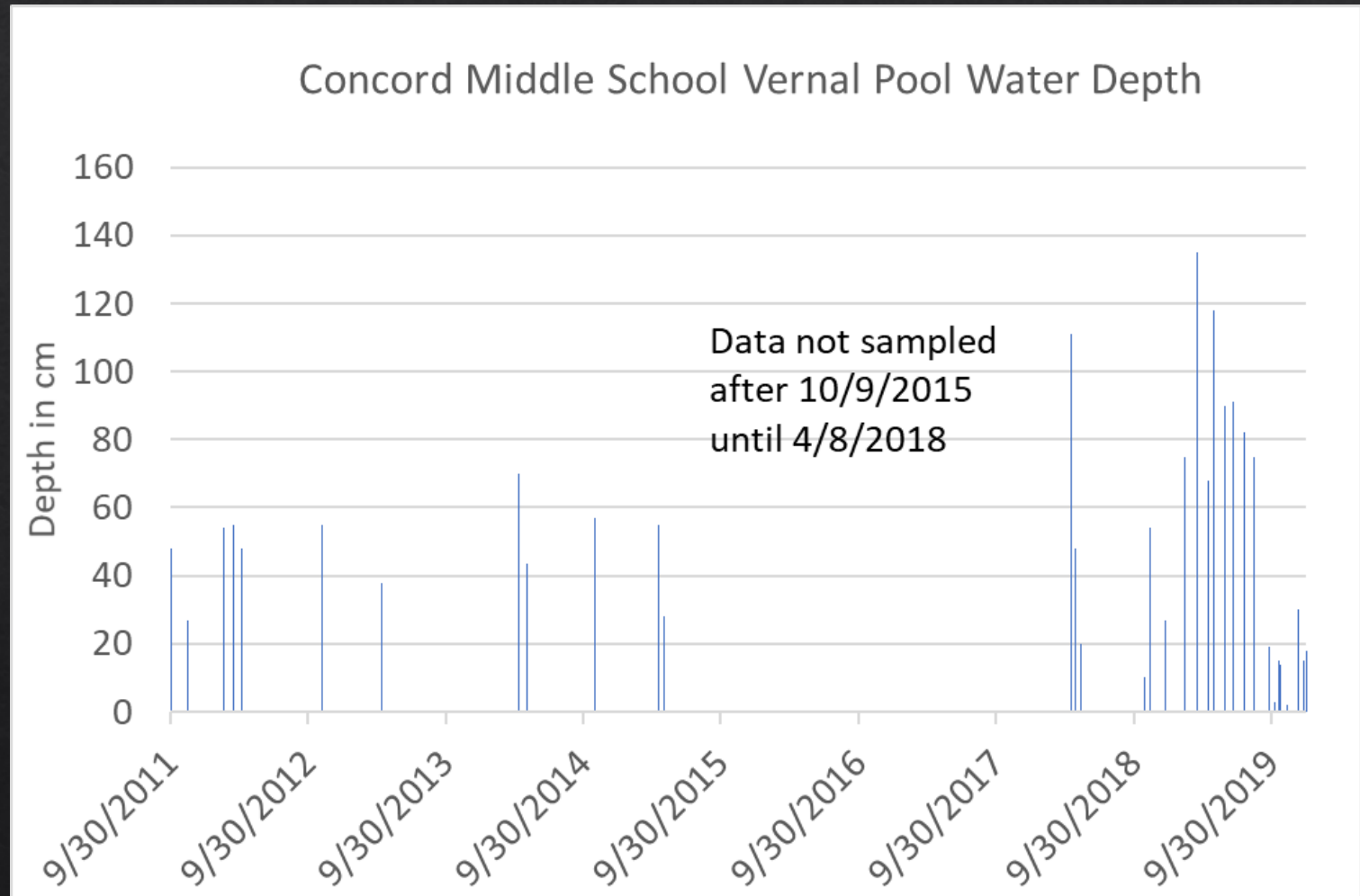
Created using: Excel

Teacher/Author: Sally Farrow

Site: Drumlin Farm

Grade Level: 4-12

Harvard Forest Mentor: Betsy Colburn,
Teachers: Lori Primavera, Colleen Casey



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Section Five: Notes and Tables

Representing Harvard Forest Schoolyard Ecology Data

General Notes on Teacher-Created Data Visualizations 2020:

Each of these graphs were created by teachers to represent Harvard Forest Schoolyard Ecology data collected by students. Most of these graphs were created at the *Looking at Data Workshop* hosted at Harvard Forest on January 9, 2020. Some of the graphs by Joseph Scanio were prepared in advance to be used for instructional purposes in the workshop. Teachers in Levels 2 and 3 of the workshop, spent approximately 3 hours of the day creating visual representations of Schoolyard Ecology data collected by their students. These teachers were asked to develop educational goals for themselves prior to the workshop so that they could spend their time with Harvard Forest mentors most effectively. Each teacher chose their own priorities and educational objectives in working with project data collected by students in the Harvard Forest Schoolyard Ecology program.

After Ecologist, Betsy Colburn, shared her *Looking at Data* presentation to help orient teachers in representing project data, 13 teachers worked with 7 Harvard Forest staff and 2 Mentor Teachers supporting teachers in achieving their preset goals, and or helping them focus their goals in a way that would allow some completion in this brief time. Two teachers from level 1 also contributed graphs to this document. They were able to transition from data submission into level 2 graphing by the end of the workshop.

Some specific notes on the process and outcome of each of the data representations that were shared at the end of that Data Workshop are outlined below.

Figures 1-3 Notes:

Melanie McCracken and Joseph Scanio

Groton Dunstable HS Teacher, Melanie McCracken has developed graphing skills over several years of participation in the Harvard Forest Schoolyard Ecology program. This year, she bravely tackled a new graphing software, called Tableau with the help of mentor, Joseph Scanio.

While these data visualizations clearly offer many advantages over Excel and Google Sheets, she is concerned that the limitations of her students' hardware (Chromebooks) will prevent her students from having access to Tableau. Hopefully, she will be able to use the data visualizations created in Tableau as instructional tools/references for her students.

Mentor Teacher Joe Scanio notes that *Sheet 4 has lots of info in it, not because it was necessarily a good idea to put all of that in there, but because it was a good way to see what one could do with Tableau.* This was part of a learning experience for Melanie and could be used as such by students who can access Tableau as Joe's students have. The software is available to educators for free. Those schools who have computers that allow for this download may find it a worthwhile free resource.

Figures 9-11 Notes:

Colleen Casey and Lori Primavera

- Graphs 10-13 were created by Trinity Catholic School teachers, Lori Primavera and Colleen Casey, who are Elementary teachers working as part of the Buds, Leaves and Global Warming project. These teachers work closely as a team. Their goals were to update bar graphs that they had created in previous Harvard Forest workshops. They had previously worked primarily with bar graph format, largely based on the developmental level of their students. This team tends to work quite independently at Harvard Forest for the past few years, and have developed a comfort level in creating graphs using Excel.
- Note that in figure 9, Colleen chose to graph 50% Leaf Fall. This is a common way of showing timing of leaf drop because the rate of leaf drop is usually highest at the 50% mark.
- Figure 10 : Colleen's line graph shows the length of the growing season over time with trend lines to help see the pattern over time for each study tree.
- Figure 11: Lori's line graph of the growing season focusses specifically on Red Maples at their school, and does not include trend lines.

Figure 15 Data Tables:

by Laura Schofield using Excel

Site Code	Year	Tree ID	Species Code	50% Bud Burst
BCE-buds-001	2019	1	SO	152
BCE-buds-001	2019	2	TA	116
BCE-buds-001	2019	3	RM	117
BCE-buds-001	2019	4	WA	145

	Scarlet Oak	Aspen	Red Maple	White Ash
2019	152	116	117	145

Figure 16-19 Notes:

Jane Lucia

An interesting part of the story told in these graphs is how much more meaning can be made from the multiple line graph in which each tree's data is plotted on the same y-axis (same range and intervals) than when each tree is plotted separately.

If I stay on track, I plan to have my students make similar graphs the first week in March. Josh and John may be interested in knowing that I played around with making excel graphs with other data the class collected, and after a few tries, was successful!

Figure 20 Notes:

Dan Thomases

Mentor Teacher, JoAnn Mossman, discussed some ways of approaching representing one-three years of data for the *Buds, Leaves and Global Warming* study. Dan conferred with some other teachers and how they were approaching this as well.

While red oak #1 and red oak #5 are located very close together receiving southern sun, red oak # 5 is more densely surrounded by other trees. I am not sure why there is such a big discrepancy between the number of days in their growing season. I am curious if this data will be reflected in future years, or if it is a mistake.

Figure 22-24 Data Tables:

David Orwig and Elicia Andrews

Site	treeid	16.growth	17.wool	17.sacs	17.growth	18.wool	18.sacs	18.growth	19.wool	19.sacs	19.growth
HF	1a	10	0	0	4.5	0	0	13	0	0	12.5
HF	1b	8	0	0	5.5	0	0	6	0	0	4
HF	2a	10	0	0	5.5	0	0	7	0	0	8
HF	2b	13	1	20	3.5	1	22	5.5	1	8	5
HF	3a	12	0	0	10	0	0	15.5	0	0	15
HF	3b	15	0	0	6	0	0	15	0	0	15
HF	3c	7.5	1	34	4.5	1	18	3	0	0	7.5
Averaged Data											
HF	Tree	16.growth	17.wool	17.sacs	17.growth	18.wool	18.sacs	18.growth	19.wool	19.sacs	19.growth
HF	1	9	0	0	5	0	0	9.5	0	0	8.25
HF	2	11.5	0.5	10	4.5	0.5	11	6.25	0.5	4	6.5
HF	3	11.5	0.333333	11.33333	6.833333	0.333333	6	11.16667	0	0	12.5
		10.66667	0.277778	7.111111	5.444444	0.277778	5.666667	8.972222	0.166667	1.333333	9.083333

Figure 22-24 Data Tables:

David Orwig and Elicia Andrews

	growth	eggs
2016	10.67	
2017	5.44	7.11
2018	8.97	5.67
2019	9.08	1.33