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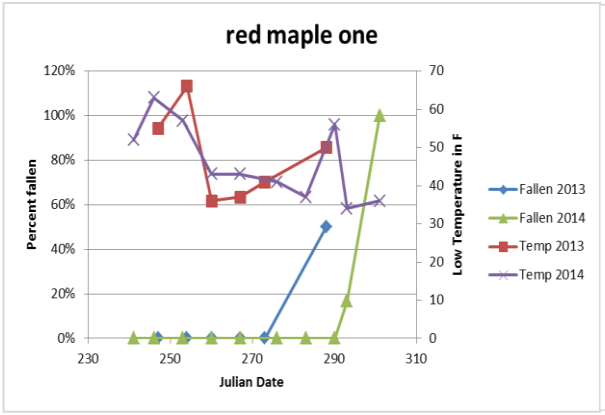
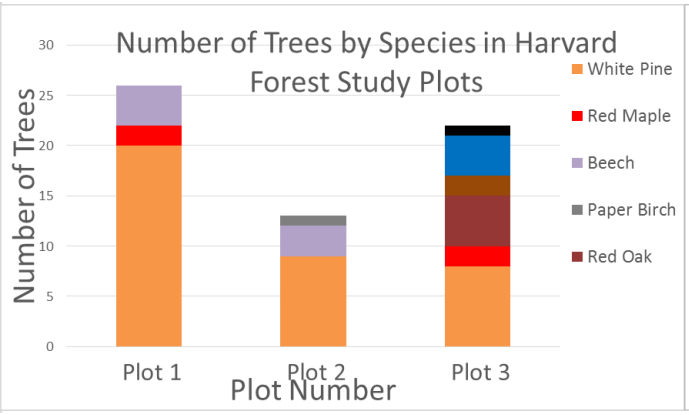
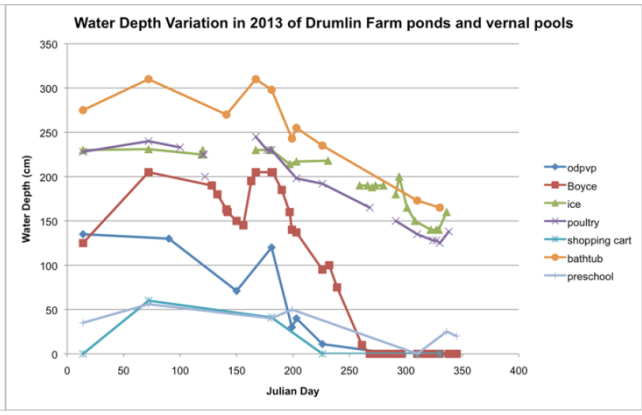
Teacher Developed Graphs and Data Documents
Harvard Forest Schoolyard Ecology
Looking at Data Workshop, 2014

Compiled by Pamela Snow





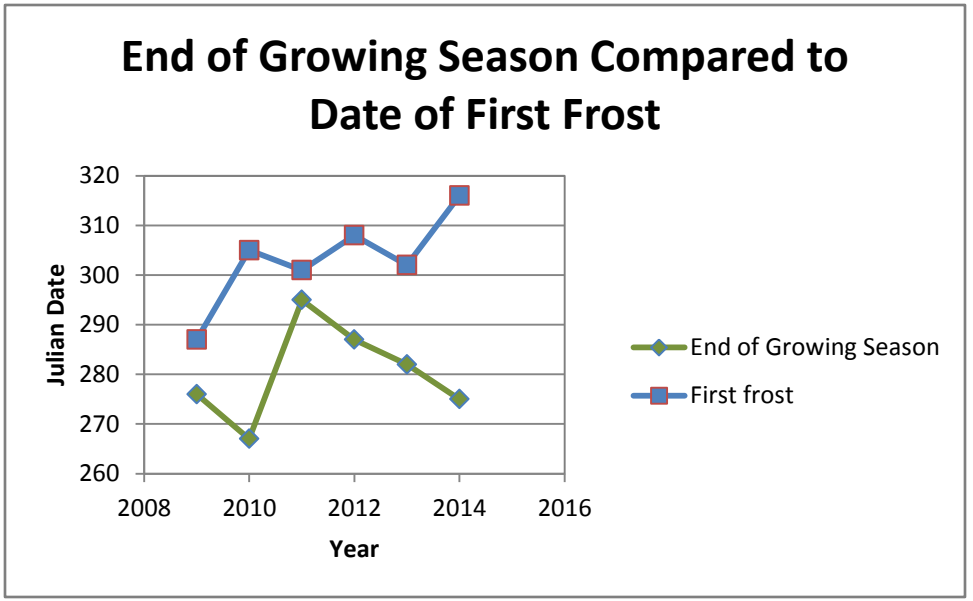


Schoolyard Ecology Teachers: Louise Levy, Nicholas Kostich, Maryanne Rotelli, Sally Farrow, Colleen Casey, Lori Primavera

Harvard Forest Mentors: Betsy Colburn, John O'Keefe, Emery Boose, Audrey Barker-Plotkin, Brian Hall, Merissa Weiss

Graph 1: *End of the Growing Season for Red Maple #2 Versus Date of First Frost* at Belchertown H.S. from 2008 to 2014

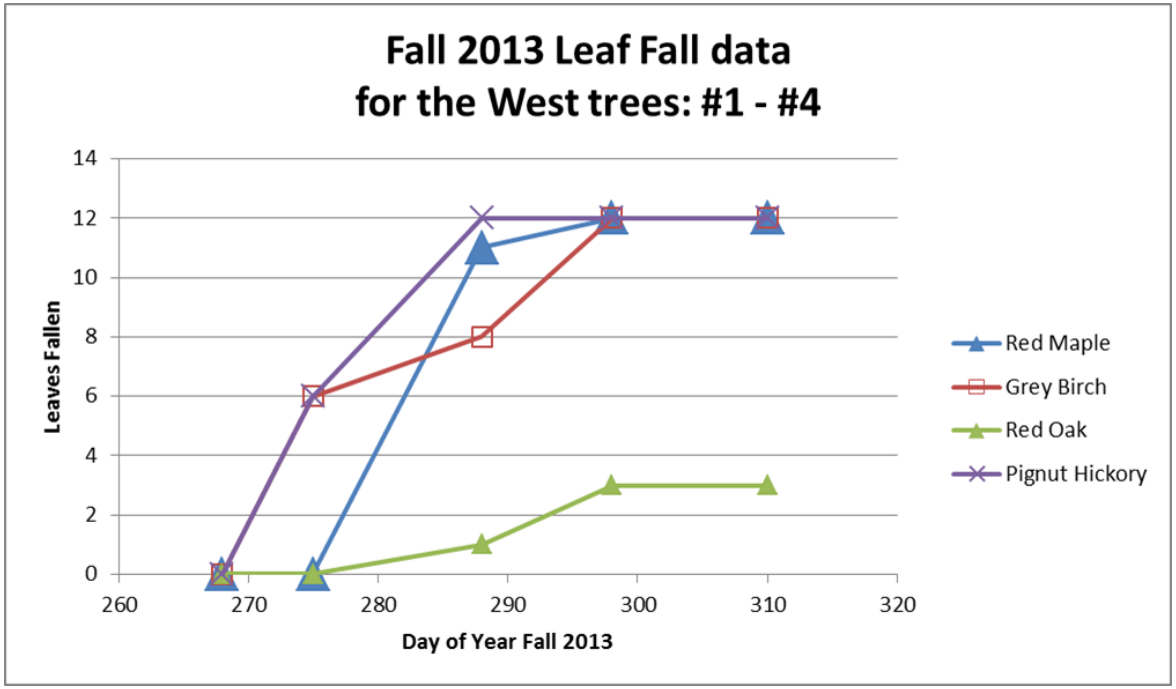
- **Description of graph and related data table:** *Graph #1 sets the end of the growing season for Red Maple #2 against a variable (date of first frost) for analysis.*
- **X Axis:** Year
- **Y Axis:** Day of the Year (Julian Date)
- **Teacher/Author:** Louise Levy
- **School:** Belchertown High School
- **Level:** 12th Grade- Environmental Studies
- **Educational Objectives**. *To have the class examine the data for "their" trees, noting differences in trends for different species and the physiological differences that this reveals. Also, to help students brainstorm ways of making Oak data comparable to the other species.*



Other notes about this graph and/or data table*2- *I provide instructions for the pencil-and-paper part of the process for graphing the data from one year in order to determine the date of the end of the growing season. The students split up the effort graphing the fall data, paired with the instructions for spring, and an additional step of calculating (subtracting) to reach the length of the growing season. This is the level of detail that allows all levels of students in my class to be successful.*
See data tables in Addendum.

Graph 2: Fall 2013 Leaf Fall Timing For the West Trees #1-#4 at Belchertown H.S.

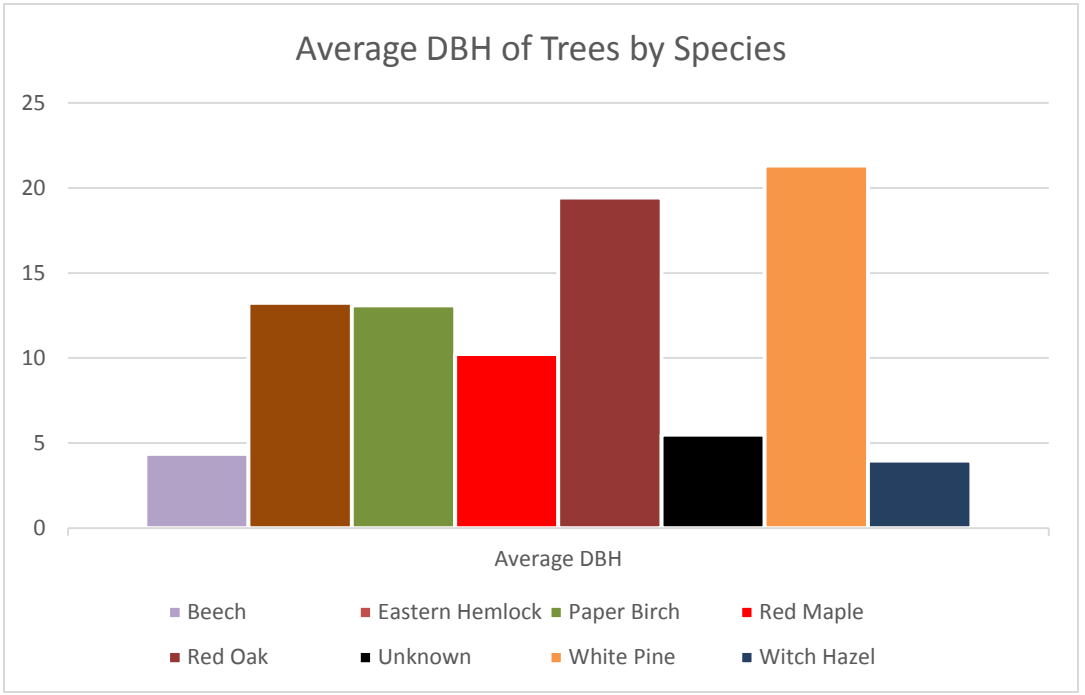
- **Description of graph and related data table:** *Graph #2 shows a comparison of Leaf Fall of different species in the fall of 2013.*
- **X Axis:** Day of the Year
- **Y Axis:** Number of Leaves Fallen
- **Teacher/Author:** Louise Levy
- **School:** Belchertown High School
- **Level:** 12th Grade- Environmental Studies
- **Educational Objectives**: *I would like to further develop micro-procedures for my students to help them succeed in graphing/data analysis of their Buds, Leaves and Global Warming project data.*



Other notes about this graph and/or data table*1- *We discussed an "oak conundrum" at the data workshop. Using leaf fall data didn't work in comparing oaks and beech to other species because all leaves do not drop on Oaks and Beech. This brings up the physiological differences in Oaks/beech vs others, and the crucial issue that how we decide to set up data collection in an experiment can enormously influence the usefulness of that data. I do plan to go back through the Fall data for the Oaks to generate a "hindsight" data set, with the 2nd day of 100% color defining "fallen"*. Going forward in the future, "fallen" will be defined as brown and curled.
See data tables in Addendum.

Graph 3: Average Diameter At Breast Height (DBH) of Study Trees in Plot One By Species

- **Description of graph and related data table:** *Graph #3 shows a comparison of DBH by species using data from all 3 plots.*
- **X Axis:** Tree Species
- **Y Axis:** Diameter at Breast Height (DBH)
- **Teacher/Author:** Nicholas Kostich
- **School:** Oakmont High School
- **Level:** 9th Grade- Biology
- **Educational Objectives:** *I would like to teach students how to use Excel to graph large data sets.*
- **Other notes about this graph and/or data table*** - See data tables 3 and 4 in Addendum



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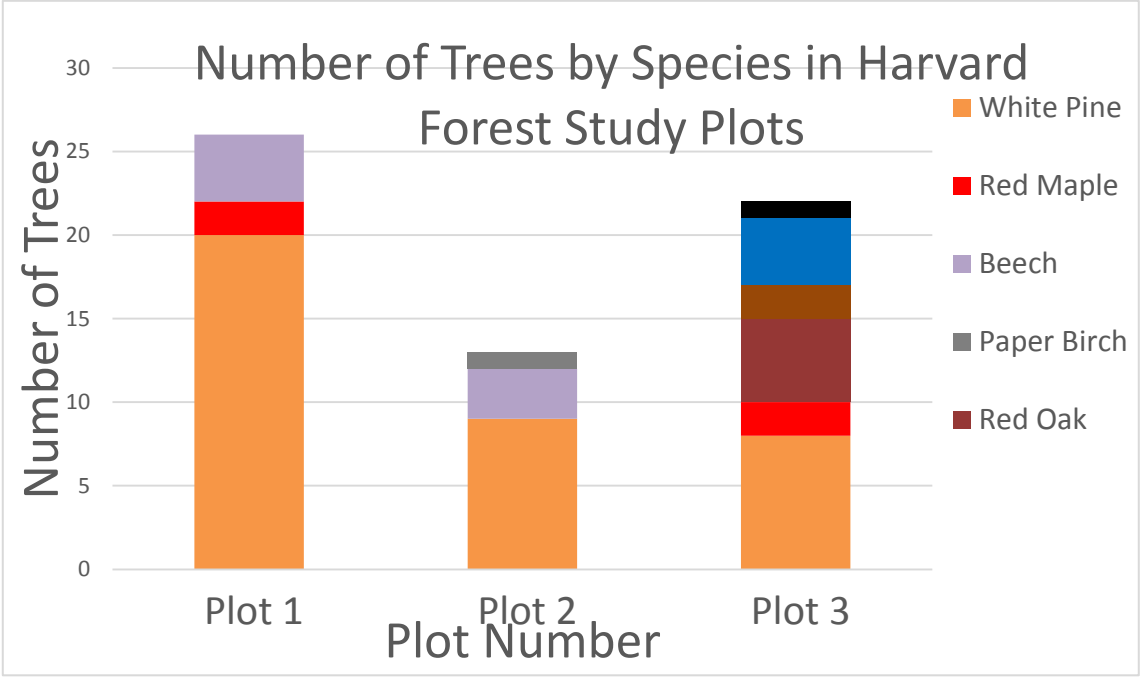
Graph 4 : Number of Trees by Species in each of Oakmont High School's Three Study Plots

- **Description of graph and related data table:** *Graph #4 shows the diversity and abundance of tree species in each plot.*
- **X Axis**: Plot Number
- **Y Axis**: Number of Trees
- **Teacher/Author:** Nicholas Kostich
- **School:** Oakmont High School
- **Level:** 9th Grade- Biology
- **Educational Objectives:** *I would like students to work with more complex graphing techniques as well as show the students how they can expand a simple bar graph.*
- **Other notes about this graph and/or data table***- See data tables 5 and 6 in Addendum



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Graph 5: Leaf Fall and Temperature for Red Maple One at Hollis-Brookline H.S. Over 2 Years

- **Description of graph and related data table:** *Graph shows timing of leaf fall for Red Maple Tree #1 and its relationship to temperature.*

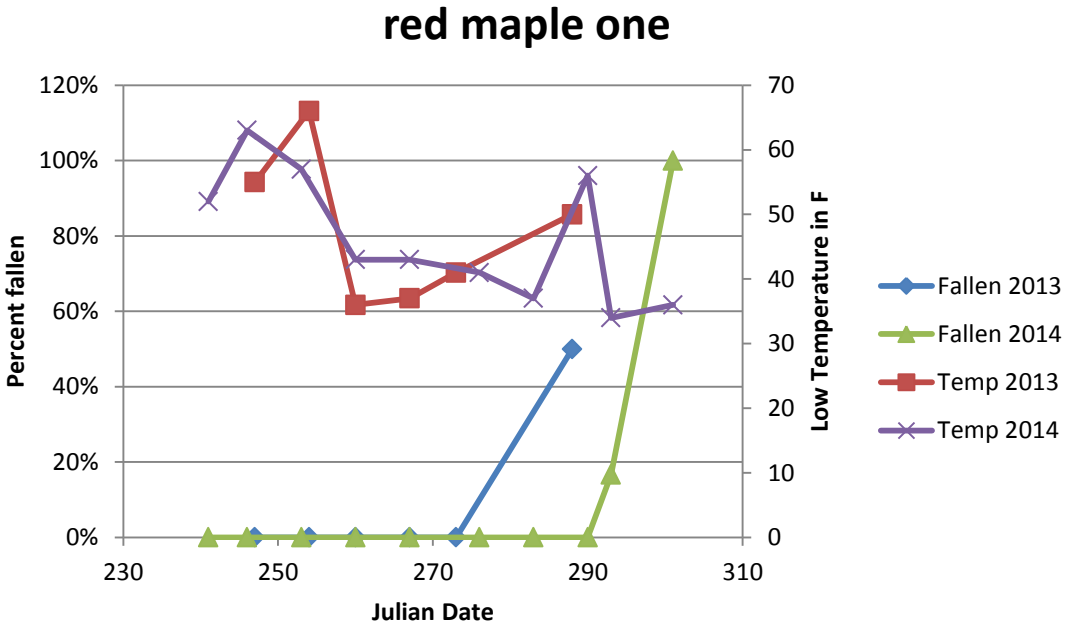
- **X Axis:** Day of the Year (Julian Date)
- **Primary Y Axis**: Percent fallen
- **Secondary Y Axis**: Low temperature for the date of data collection

- **Teacher/Author:** Maryanne Rotelli

- **School:** Brookline-Hollis High School

- **Level:** 12th Grade- Ecology

- **Educational Objectives**: *I want students to look at whether or not low temperatures impact leaf drop rate from one year to another. From personal observation, the fall of 2014 seemed warmer than 2013. Did the leaves drop later? It does appear that some trees' leaves fell later than 2013. However, we had a late spring in 2014 did that impact the leaf drop rate? Goal is for students to generate questions for which they can use their data to analyze and answer.*

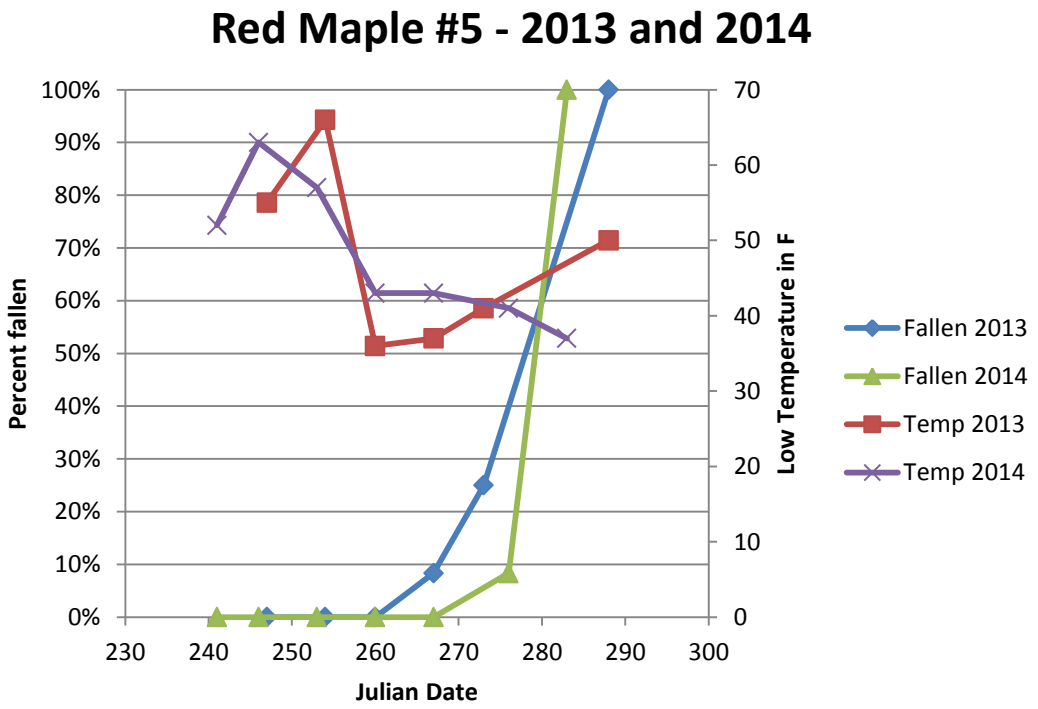


Other notes about this graph and/or data:

Unfortunately our school does not have spring data for 2013 for comparison as we only started this study in fall of 2013. Future work could see the students plotting the color change compared to temperature and see if there was any differences between the years. Additionally the students can compare rates of leaf drop and color change between the different tree species. The other challenge for students is to learn how to graph two different types of data that requires use two y-axes.

Graph 6: Timing of Leaf Fall and Temperature for Red Maple 5 at Hollis Brookline H.S. Over 2 Years

- **Description of graph and related data table: :** *Graph 6 shows timing of leaf fall for Red Maple Tree #5 and its relationship to temperature in 2013 and 2014.*
- **X Axis:** Day of the Year (Julian Date)
- **Primary Y Axis**: Percent fallen
- **Secondary Y Axis**: Low temperature for the date of data collection
- **Teacher/Author:** Maryanne Rotelli
- **School:** Brookline-Hollis High School
- **Level:** 12th Grade-Ecology
- **Educational Objectives:** See notes for Graph #5.



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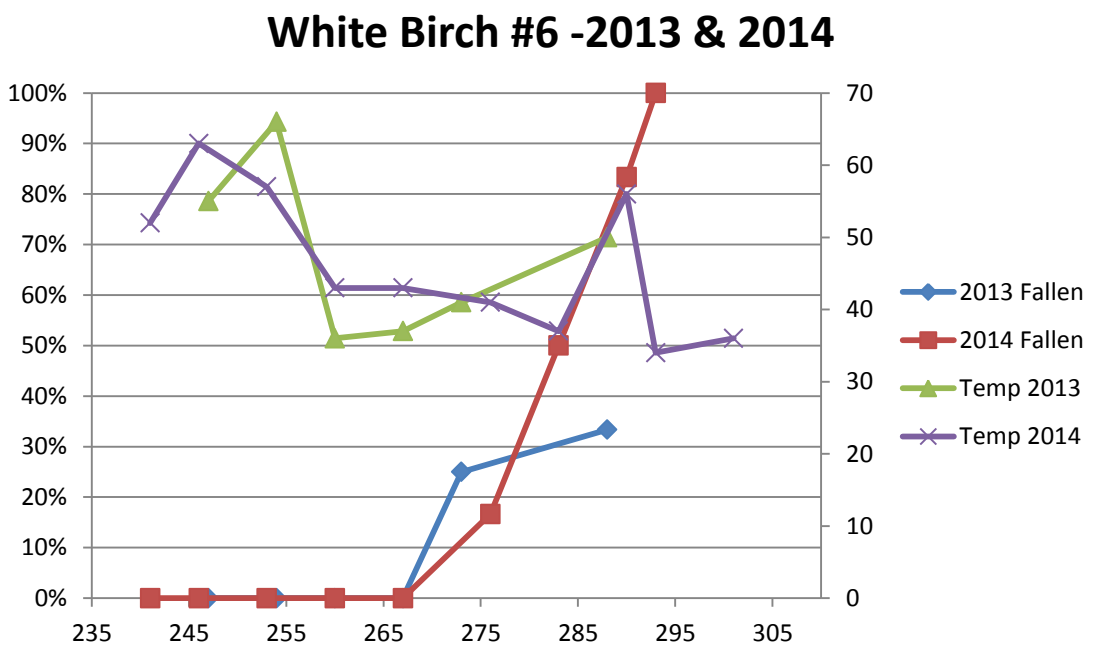
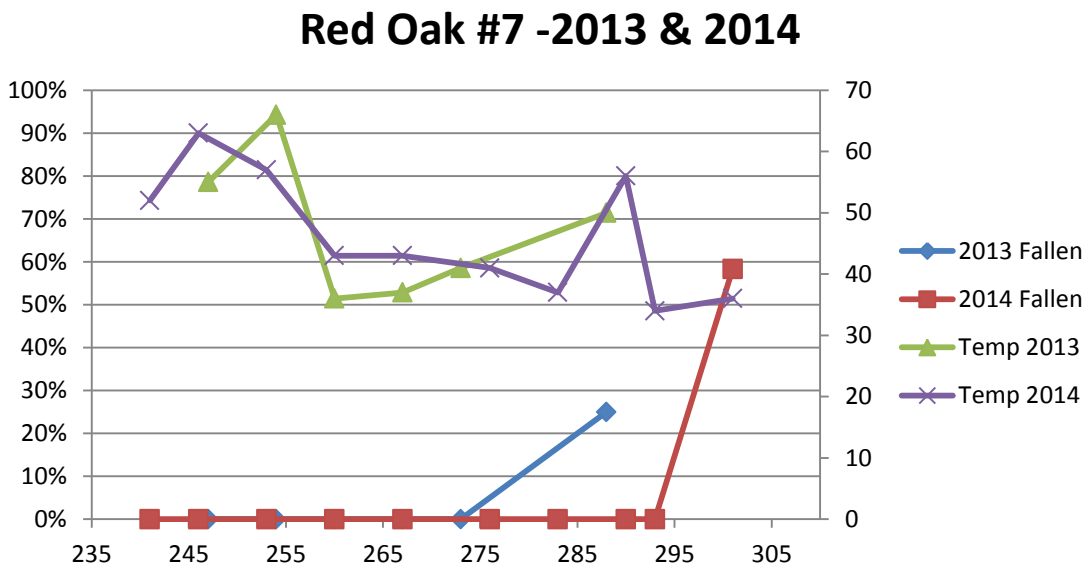
Graph 7: Timing of Leaf Fall and Temperature on White Birch 6 at Hollis Brookline H.S. Over 2 Years

- **Description of graph and related data table:** *Graph 7 shows timing of leaf fall for White Birch# 6 and its relationship to temperature in 2013 and 2014.*
- **X Axis:** Day of the Year (Julian Date)
- **Primary Y Axis**: Percent fallen
- **Secondary Y Axis**: Low temperature for the date of data collection
- **Teacher/Author:** Maryanne Rotelli
- **School:** Brookline-Hollis High School
- **Level:** 12th Grade- Ecology
- **Educational Objectives:** See notes from Graph #5.



Graph 8: Timing of Leaf Fall and Temperature for Red Oak Seven at Hollis Brookline H.S. Over 2 Years

- **Description of graph and related data table:** *Graph 8 shows timing of leaf fall for Red Oak #7 and its relationship to temperature in 2013 and 2014.*
- **X Axis:** Day of the Year (Julian Date)
- **Primary Y Axis**: Percent fallen
- **Secondary Y Axis**: Low temperature for the date of data collection
- **Teacher/Author:** Maryanne Rotelli
- **School:** Brookline-Hollis High School
- **Level:** 12th Grade- Ecology
- **Educational Objectives:** See notes on Graph #5 above.



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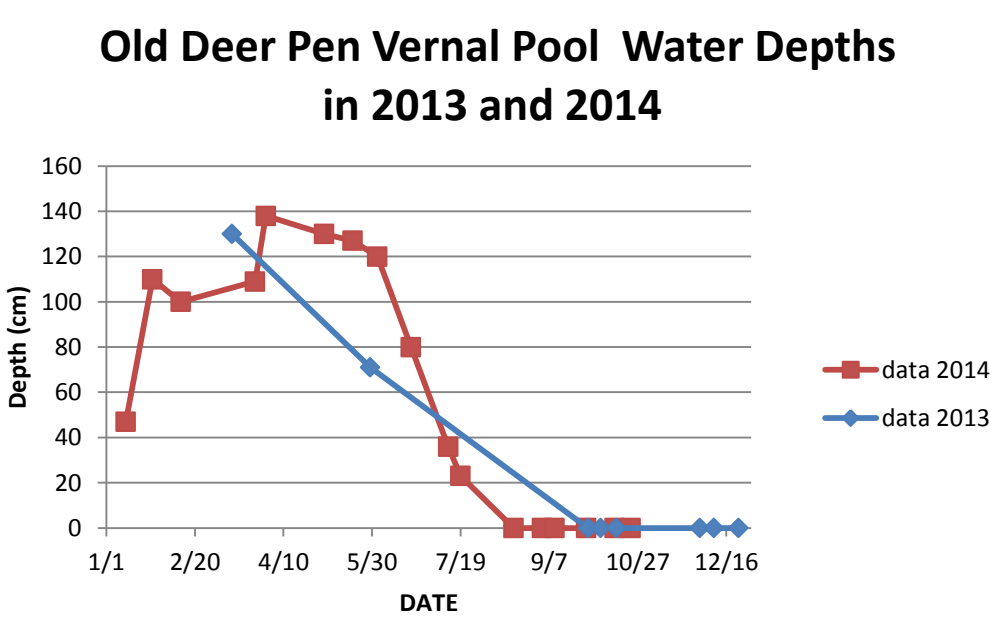
Graph 9: Old Deer Pen Vernal Pool Depths in 2013 and 2014

- **Description of graph and related data table:** Graph 9 shows the variation in water depth in the Old Deer pen vernal pool for 2 years, 2013 and 2014.
- **X Axis:** Date
- **Y Axis:** Vernal Pool Water Depth
- **Teacher/Author:** Sally Farrow
- **Field Site Location**: Drumlin Farm
- **Level:** 3rd Grade through 12th Grade
- **Educational Objectives**: *I would like the students to understand that the water depth in the vernal pool is variable and related to other environmental factors such as air and water temperature, trees and shrubs (bud burst and leaf drop) and* precipitation.



Other notes about this graph: *We have been following this pond for 6 years and are monitoring changes over time which may be related to climate change.* See data table# 7 in Addendum below.

Graph 10: Water Depth in 7 ponds and Vernal pools at Drumlin Farm throughout 2013.

- **Description of graph and related data table:** Graph 10 shows the variation in water depth in the 7 ponds and vernal pools at Drumlin Farm though out the year 2013.

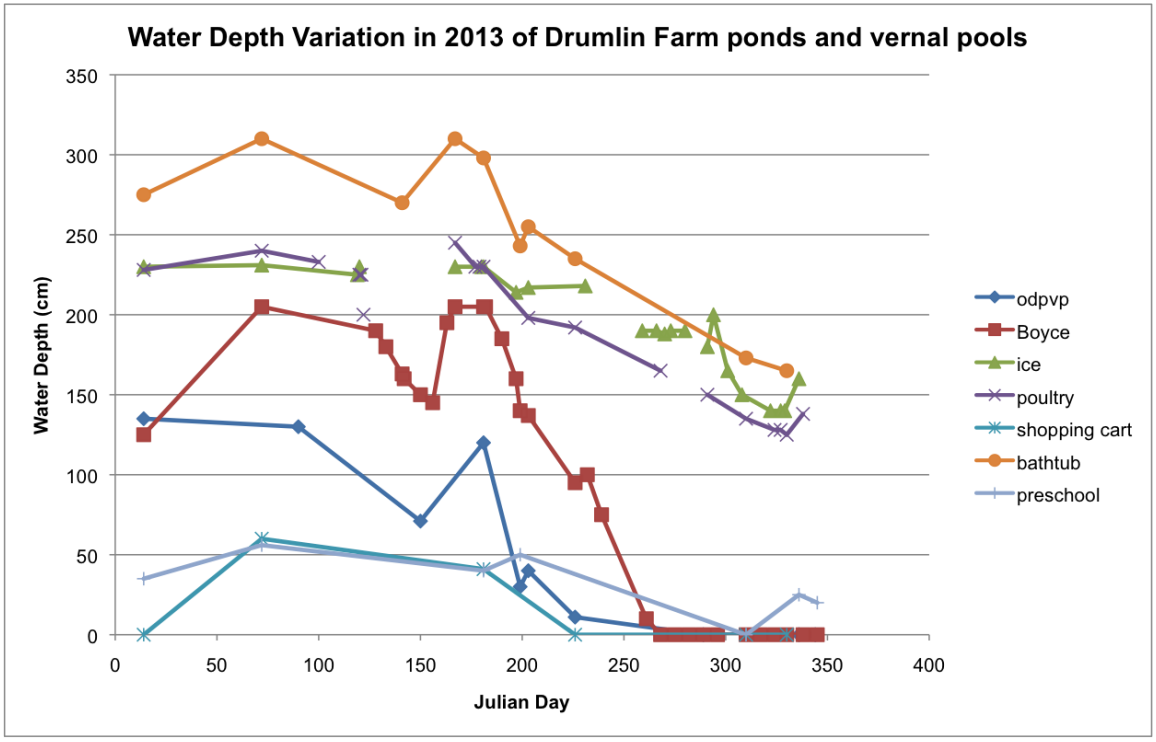
- **X Axis:** Julian Date
- **Y Axis:** Vernal Pool Depth

- **Teacher/Author:** Sally Farrow

- **Field Site Location**: Drumlin Farm

- **Level:** 3rd Grade-12th Grade

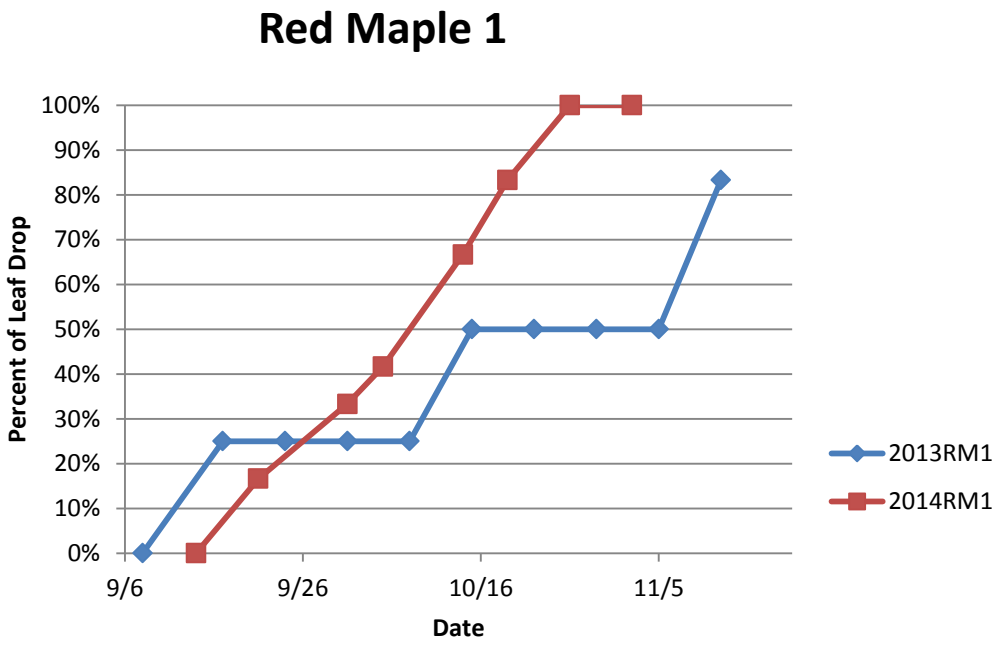
- **Educational Objectives:** *I would like to have the students follow these 7 ponds and vernal pools over a number of years to see if climate change affects the hydrology of the Drumlin Farm ponds and vernal pools.*



Other notes about this graph: *We also follow the variation in water depth for each pond and vernal pool over a number of years. It is interesting to note that 5 of these water bodies are connected: Old Deer pen vernal pool, Boyce vernal pool, Deer pen (not on graph. We have just started to follow this pond)) Ice pond and Poultry pond are connected and part of a flood control network. We currently follow bud burst and leaf drop for a black birch next to Old Deer pen vernal pool and a sugar maple in the sheep pasture near Poultry pond as well a beech tree near Poultry pond. We hope to start monitoring more trees in relation to the other ponds.*

Graph 11: Timing of Leaf Fall on Red Maple One at Trinity Catholic Academy

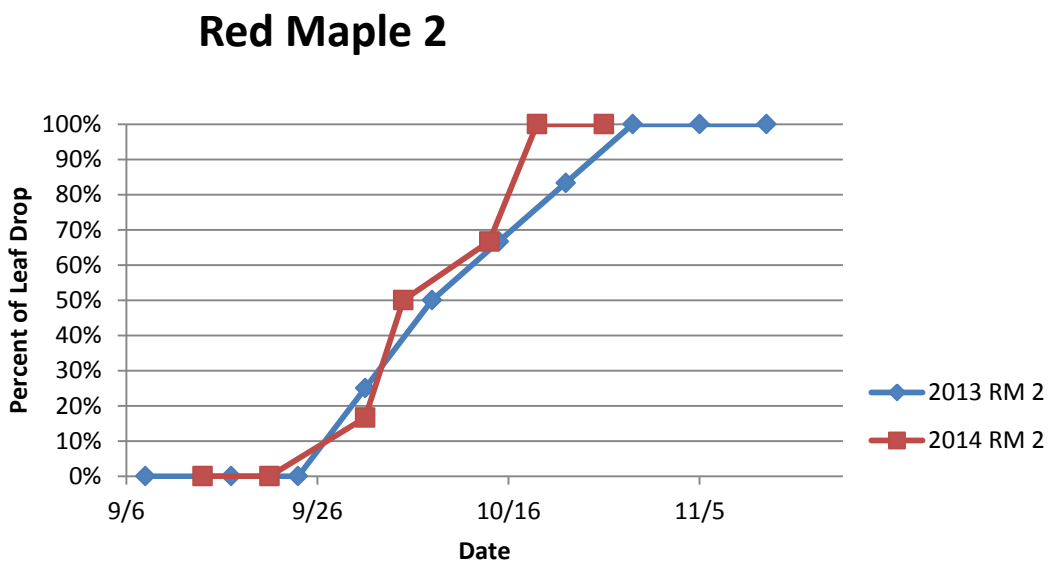
- **Description of graph and related data table:** *Graph 11 compares the timing of leaf fall on red maple tree#1 at Trinity Catholic Academy in 2013 and 2014.*
- ***X Axis:*** Date
- ***Y Axis:*** Percent of Leaves Fallen
- **Teachers/Authors:** Colleen Casey and Lori Primavera
- **School:** Trinity Catholic Academy
- **Level:** 4th Grade General Science
- **Educational Objectives:** *Our primary objective is to understand the importance of accurate data collection which leads to our secondary objective to graph and analyze the data.*



- **Other notes about this graph:** See Data Table #8 In Addendum.

Graph 12: Timing of Leaf Fall on Red Maple Two at Trinity Catholic Academy

- **Description of graph and related data table:** *Graph 12 compares the timing of leaf fall on red maple tree #2 at Trinity Catholic Academy in 2013 and 2014.*
- **X Axis:** Date
- **Y Axis:** Percent of Leaves Fallen
- **Teacher/Author:** Colleen Casey and Lori Primavera
- **School:** Trinity Catholic Academy
- **Level:** 4th Grade General Science
- **Educational Objectives:** *Our primary objective is to understand the importance of accurate data collection which leads to our secondary objective to graph and analyze the data.*



Other notes about this graph: See data table # 9 in Addendum.

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Addendum to Looking at Data Graphs, 2014

Data Tables 1-9

Data Tables 1 and 2: Belchertown H.S.

Louise Levy

Data Table 1

year	End	first frost*
2009	276	287
2010	267	305
2011	295	301
2012	287	308
2013	282	302
2014	275	316

*first frost from Amherst College website

Data Table 2

Date	Tree ID	pecies Cod	Total Leaves	Fallen Leaves			Tree	day of year	leaves fallen
9/25/2013	6	RM	12	0			RM	268	0
10/2/2013	6	RM	12	0			RM	275	0
10/15/2013	6	RM	12	2			RM	288	2
10/25/2013	6	RM	12	12			RM	298	12
11/6/2013	6	RM	12	12			RM	310	12
9/25/2013	7	RO	12	0			RO	268	0
10/2/2013	7	RO	12	0			RO	275	0
10/15/2013	7	RO	12	1			RO	288	1
10/25/2013	7	RO	12	1			RO	298	1
11/6/2013	7	RO	12	1			RO	310	1

Data Table 3: Oakmont H.S.

Nicholas Kostich

Plot Number	Tree Species	Tree ID	DBH cm
1	Beech	23	4.5
1	Beech	24	4.4
1	Beech	25	3.8
1	Beech	26	4.4
2	Beech	30	5.9
2	Beech	32	3.4
2	Beech	36	4.2
3	Eastern Hemlock	50	10.6
3	Eastern Hemlock	59	15.9
2	Paper Birch	34	13.1
1	Red Maple	11	26.1
1	Red Maple	22	3.2
3	Red Maple	49	3.5
3	Red Maple	58	8.1
3	Red Oak	40	12.3
3	Red Oak	42	20
3	Red Oak	51	29.8
3	Red Oak	56	30.7
3	Red Oak	57	4.4
3	Unknown	53	5.5
1	White Pine	1	16.1
1	White Pine	2	18.6
1	White Pine	18	22.2
1	White Pine	19	9.2
1	White Pine	20	39.5
1	White Pine	21	22.8
1	White Pine	3	10.6
1	White Pine	4	12.3
1	White Pine	5	8.3
1	White Pine	6	16.4
1	White Pine	7	10.1
1	White Pine	8	27.1
1	White Pine	9	17.5
1	White Pine	10	18.9
1	White Pine	12	24.2
1	White Pine	13	9.3
1	White Pine	14	19.4
1	White Pine	15	32.6
1	White Pine	16	18.7
1	White Pine	17	24.5
1	White Pine	18	22.2
1	White Pine	19	9.2
1	White Pine	20	39.5
1	White Pine	21	22.8
2	White Pine	27	31.1
2	White Pine	28	9.1
2	White Pine	29	51.8
2	White Pine	31	16.9
2	White Pine	33	8.3
2	White Pine	35	68.2
2	White Pine	37	7.5
2	White Pine	38	48.5
2	White Pine	39	4.4
3	White Pine	41	21.7
3	White Pine	43	49.2

Data Table 4: Oakmont H.S.

Nicholas Kostich

Tree Species	Average DBH
Beech	4.37
Eastern Hemlock	13.25
Paper Birch	13.1
Red Maple	10.23
Red Oak	19.44
Unknown	5.5
White Pine	21.31
Witch Hazel	3.975

Data Table 5: Oakmont H.S.

Nicholas Kostich

Plot Number	Tree Species	Tree ID
1	White Pine	1
1	White Pine	2
1	White Pine	3
1	White Pine	4
1	White Pine	5
1	White Pine	6
1	White Pine	7
1	White Pine	8
1	White Pine	9
1	White Pine	10
1	Red Maple	11
1	White Pine	12
1	White Pine	13
1	White Pine	14
1	White Pine	15
1	White Pine	16
1	White Pine	17
1	White Pine	18
1	White Pine	19
1	White Pine	20
1	White Pine	21
1	Red Maple	22
1	Beech	23
1	Beech	24
1	Beech	25
1	Beech	26
2	White Pine	27
2	White Pine	28
2	White Pine	29
2	Beech	30
2	White Pine	31
2	Beech	32
2	White Pine	33
2	Paper Birch	34
2	White Pine	35
2	Beech	36
2	White Pine	37
2	White Pine	38
2	White Pine	39
3	Red Oak	40
3	White Pine	41
3	Red Oak	42
3	White Pine	43
3	White Pine	44
3	Witch Hazel	45
3	Witch Hazel	46
3	White Pine	47
3	White Pine	48
3	Red Maple	49
3	Eastern Hemlock	50
3	Red Oak	51
3	White Pine	52
3	Unknown	53
3	White Pine	54
3	White Pine	55
3	Red Oak	56
3	Red Oak	57
3	Red Maple	58
3	Eastern Hemlock	59
3	Witch Hazel	60
3	Witch Hazel	61

Data Table 6: Oakmont H.S.

Nicholas Kostich

Tree Species	Plot 1	Plot 2	Plot 3
White Pine	20	9	8
Red Maple	2	0	2
Beech	4	3	0
Paper Birch	0	1	0

Data Table 7: Drumlin Farm

Sally Farrow

School Code	Teacher	Date	Pool	Julian	Max Diameter (m)	Diameter (m)	Depth (cm)	Air Temp (c)	Water Temp (c)
DFA	Farrow	3/13/2013	1	72	18.6	17.9	130	8	5
DFA	Farrow	5/30/2013	1	150	18.6	12.8	71	28	18
DFA	Farrow	9/30/2013	1	273	18.6	0	0	20	NA
DFA	Farrow	10/7/2013	1	280	18.6	0	0	22	NA
DFA	Farrow	10/16/2013	1	289	18.6	0	0	19	NA
DFA	Farrow	12/2/2013	1	336	18.6	0	0	3.5	NA
DFA	Farrow	12/10/2013	1	344	18.6	0	0	0	NA
DFA	Farrow	12/24/2013	1	358	18.6	0	0	2	NA
DFA	Farrow	1/12/2014	1	12	18.6	NA	47	NA	NA
DFA	Farrow	1/27/2014	1	27	18.6	15.8	110	-5.5	0
DFA	Farrow	2/12/2014	1	43	18.6	NA	100	NA	NA
DFA	Farrow	3/26/2014	1	85	18.6	15.8	109	-2	0
DFA	Farrow	4/1/2014	1	91	18.6	18.6	138	8.5	1
DFA	Farrow	5/4/2014	1	124	18.6	18.4	130	15	20
DFA	Farrow	5/20/2014	1	140	18.6	18.1	127	22.5	18
DFA	Farrow	6/3/2014	1	154	18.6	16.9	120	25.5	18.8
DFA	Farrow	6/22/2014	1	173	18.6	16.45	80	23	18
DFA	Farrow	7/13/2014	1	194	18.6	13.1	36	26	21.5
DFA	Farrow	7/20/2014	1	201	18.6	8.9	23	23.5	21
DFA	Farrow	8/19/2014	1	231	18.6	0	0	26	NA
DFA	Farrow	9/4/2014	1	247	18.6	0	0	26.5	NA
DFA	Farrow	9/11/2014	1	254	18.6	0	0	25	NA
DFA	Farrow	9/29/2014	1	272	18.6	0	0	22	NA
DFA	Farrow	10/15/2014	1	288	18.6	0	0	22.8	NA
DFA	Farrow	10/24/2014	1	297	18.6	0	0	NA	NA
DFA	Farrow	11/18/2014	1	322	18.6	2.8	9	4	NA
DFA	Farrow	11/25/2014	1	329	18.6	6.97	18	16	8.5
DFA	Farrow	12/7/2014	1	341	18.6	15.1	107	3	2.5

Data Table 8: Trinity Catholic

Colleen Casey and Lori Primavera

School Code	Teacher	Date	Julian	Tree ID	Species Code	Total Leaves	Fallen Leaves	% Fallen	Tree Color
TCA	Casey	9/9/2013	252	1	RM	12	0	0%	1
TCA	Casey	9/18/2013	261	1	RM	12	3	25%	1
TCA	Casey	9/25/2013	268	1	RM	12	3	25%	1
TCA	Casey	10/2/2013	275	1	RM	12	3	25%	2
TCA	Casey	10/9/2013	282	1	RM	12	3	25%	3
TCA	Casey	10/16/2013	289	1	RM	12	6	50%	3
TCA	Casey	10/23/2013	296	1	RM	12	6	50%	3
TCA	Casey	10/30/2013	303	1	RM	12	6	50%	4
TCA	Casey	11/6/2013	310	1	RM	12	6	50%	4
TCA	Casey	11/13/2013	317	1	RM	12	10	83%	4
TCA	Casey	9/15/2014	258	1	RM	12	0	0%	1
TCA	Casey	9/22/2014	265	1	RM	12	2	17%	1
TCA	Casey	10/2/2014	275	1	RM	12	4	33%	2
TCA	Casey	10/6/2014	279	1	RM	12	5	42%	3
TCA	Casey	10/15/2014	288	1	RM	12	8	67%	3
TCA	Casey	10/20/2014	293	1	RM	12	10	83%	3
TCA	Casey	10/27/2014	300	1	RM	12	12	100%	4
TCA	Casey	11/3/2014	307	1	RM	12	12	100%	4

Data Table 9: Trinity Catholic

Colleen Casey

Casey	9/9/2013	252	2	RM	12	0	0%	1
Casey	9/18/2013	261	2	RM	12	0	0%	2
Casey	9/25/2013	268	2	RM	12	0	0%	3
Casey	10/2/2013	275	2	RM	12	3	25%	3
Casey	10/9/2013	282	2	RM	12	6	50%	3
Casey	10/16/2013	289	2	RM	12	8	67%	3
Casey	10/23/2013	296	2	RM	12	10	83%	3
Casey	10/30/2013	303	2	RM	12	12	100%	4
Casey	11/6/2013	310	2	RM	12	12	100%	4
Casey	11/13/2013	317	2	RM	12	12	100%	4
Casey	9/15/2014	258	2	RM	12	0	0%	1
Casey	9/22/2014	265	2	RM	12	0	0%	1
Casey	10/2/2014	275	2	RM	12	2	17%	3
Casey	10/6/2014	279	2	RM	6	3	50%	3
Casey	10/15/2014	288	2	RM	6	4	67%	3
Casey	10/20/2014	293	2	RM	6	6	100%	3
Casey	10/27/2014	300	2	RM	6	6	100%	3
Casey	11/3/2014	307	2	RM	6	6	100%	4