

Harvard Forest Schoolyard LTER



Data Workshop

23 Feb 2021

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Photos contributed by program staff & teachers

Level 1 Breakout Group

- Scientific data
- How to enter data
- Online graphing tool
- Graphing exercises



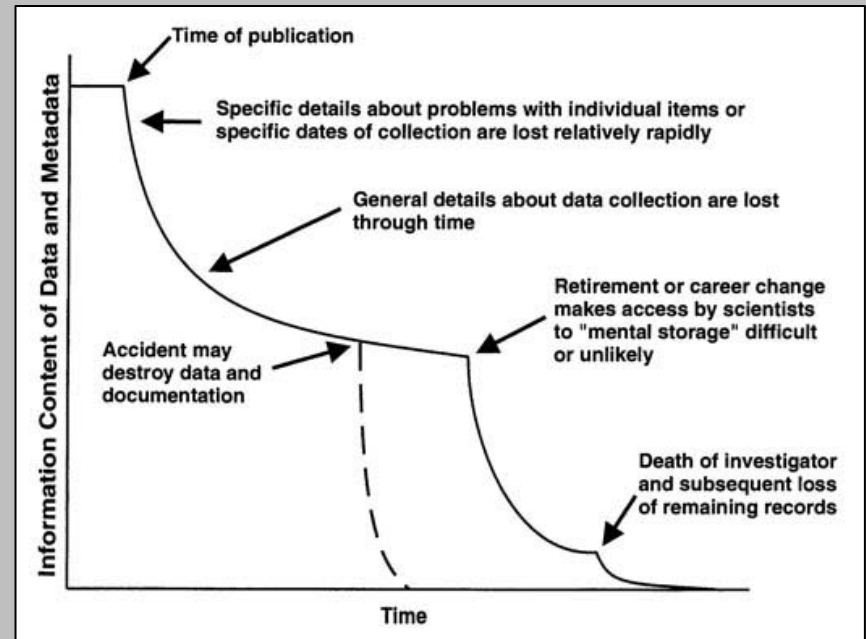
Why Manage Data?

- Scientists build on the work of others
- Data must be accessible & understandable



The New Yorker

Data may disappear



Michener et al. 1997

Information content may disappear

Data & Metadata

Metadata provide the information needed to locate, access, and correctly interpret a dataset

METADATA

datetime = Date and time at end of sampling period (YYYY-MM-DDThh:mm)

jd = Julian day (DDD)

airt = Air temperature. Average of 1-second measurements. (celsius)

rh = Relative humidity. Average of 1-second measurements. (percent)

dewp = Dew point. Average of 1-second values calculated from air temperature and relative humidity. (celsius)

prec = Precipitation. Includes water equivalent of snow. Total value for 15-minute period. Measured in increments of 0.01 inch. (millimeter)

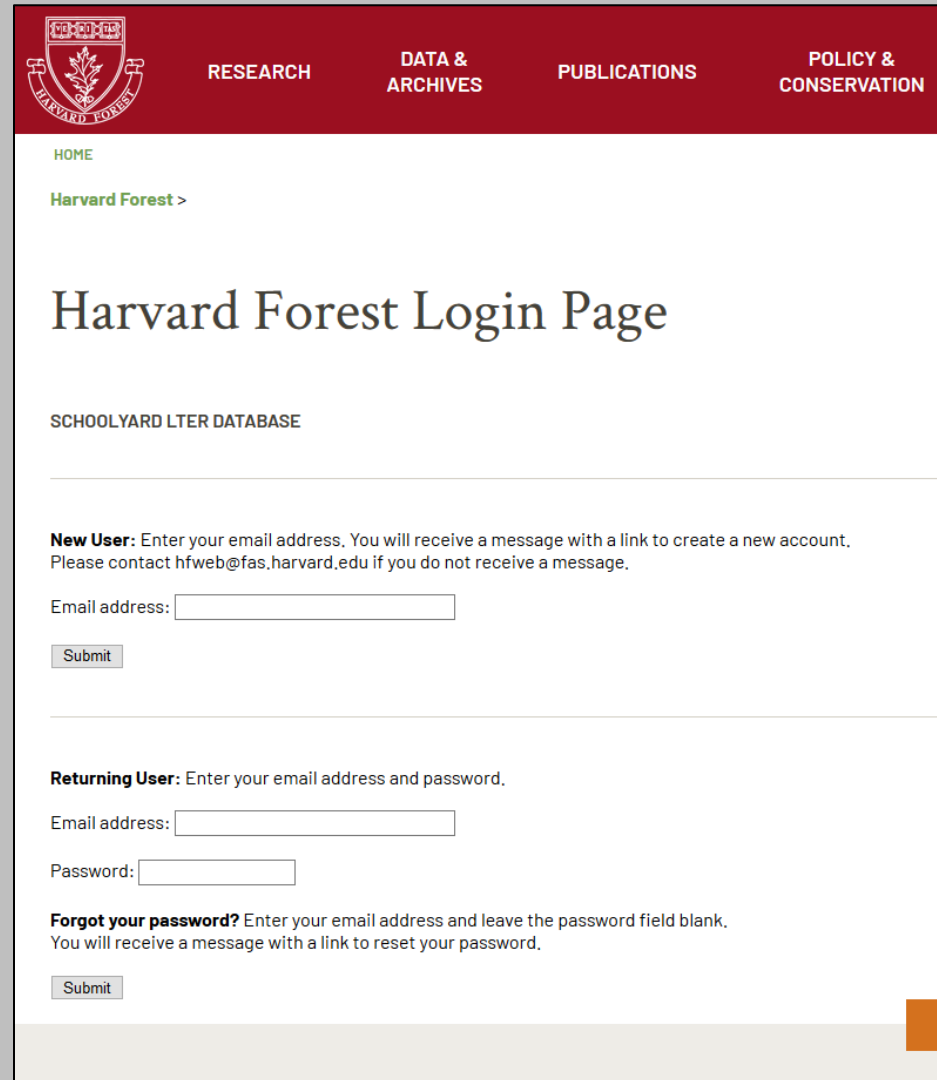


DATA

```
datetime,jd,airt,rh,dewp,prec
2005-01-01T00:15,1,5.1,84,2.5,0.0
2005-01-01T00:30,1,5.0,84,2.5,0.0
2005-01-01T00:45,1,4.9,85,2.6,0.0
2005-01-01T01:00,1,4.7,86,2.6,0.0
```

Step 1

- **New User:** Enter your email address. You will receive a message with a link to create a new account.
- **Returning User (< 2021):** Enter your email address. You will receive a message with a link to reset your password.
- **Returning User (2021):** Enter your email address & password.
- **Note:** Your email address is your user ID. If you enter a different email address, the system will think you are a different person.

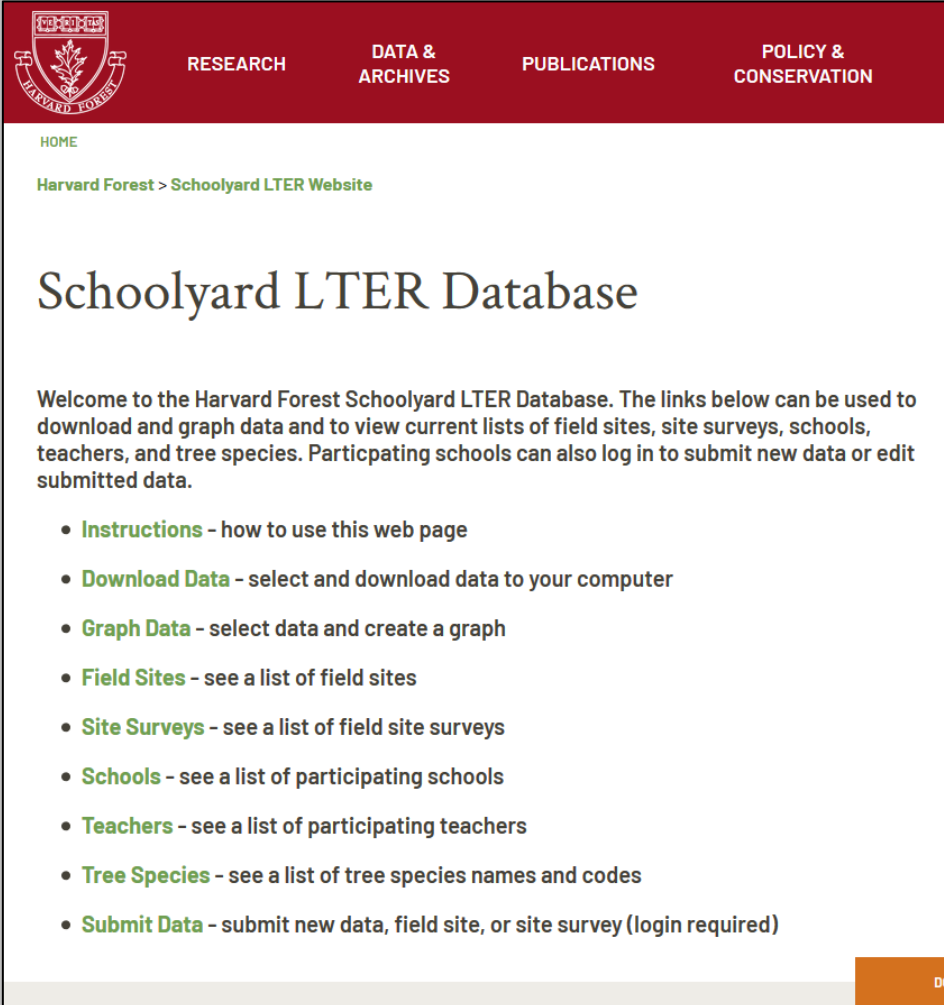


The screenshot shows the Harvard Forest website header with navigation links: RESEARCH, DATA & ARCHIVES, PUBLICATIONS, and POLICY & CONSERVATION. Below the header, there is a 'HOME' link and a 'Harvard Forest >' link. The main heading is 'Harvard Forest Login Page'. Underneath, it says 'SCHOOLYARD LTER DATABASE'. There are three login sections: 1. 'New User' section with an instruction to enter an email address and a 'Submit' button. 2. 'Returning User (< 2021)' section with instructions to enter email and password, and a 'Submit' button. 3. 'Returning User (2021)' section with instructions to enter email and password, and a 'Submit' button. A 'Forgot your password?' link is also present with instructions to enter an email address and leave the password field blank.

<https://harvardforest2.fas.harvard.edu/asp/hf/php/login.php?context=schoolyard>

Step 2

- 1. Add school**
Contact Pam
- 2. Add teacher**
Contact Pam
- 3. Create a field site**
Use Submit Data
- 4. Enter & check data**
Use Submit Data
- 5. Let us know it's ready**
Contact Pam & Emery



HOME

Harvard Forest > Schoolyard LTER Website

Schoolyard LTER Database

Welcome to the Harvard Forest Schoolyard LTER Database. The links below can be used to download and graph data and to view current lists of field sites, site surveys, schools, teachers, and tree species. Participating schools can also log in to submit new data or edit submitted data.

- **Instructions** - how to use this web page
- **Download Data** - select and download data to your computer
- **Graph Data** - select data and create a graph
- **Field Sites** - see a list of field sites
- **Site Surveys** - see a list of field site surveys
- **Schools** - see a list of participating schools
- **Teachers** - see a list of participating teachers
- **Tree Species** - see a list of tree species names and codes
- **Submit Data** - submit new data, field site, or site survey (login required)

https://harvardforest2.fas.harvard.edu/asp/hf/php/k12/k12_project.php

Data Entry

RECOMMENDATIONS

- If you have more than one email address, pick one address to use as your login
- Check your data in the online form and again in Review Submissions
- Read the Instructions section



Fall Phenology / JRB-buds-001 / Bennett

[Review Submissions](#)

To add a new observation complete this form and press Submit. If a data value is missing, please leave the text box empty or select 'Missing Value' from the pull-down list.

NOTE Please enter data for each tree (not each branch). A [worksheet](#) is available to help you calculate tree values from branch values.

>>>>

Date (m/d/yyyy)	<input type="text" value="10/1/2018"/>
Tree ID (number)	<input type="text" value="3"/>
Species Code	<input type="text" value="SM (Sugar Maple)"/>
Total Leaves	<input type="text" value="12"/>
Fallen Leaves	<input type="text" value="4"/>
Tree Color	<input type="text" value="2 (color 26-50%)"/>
Delete This Record	<input checked="" type="radio"/> no <input type="radio"/> yes

Edit	Person ID	Site	Teacher	Date	Tree ID	Species Code	Total Leaves	Fallen Leaves	Tree Color
11298	6859	JRB-buds-001	Bennett	10/4/2018	31	RM	12	0	1
11304	6859	JRB-buds-001	Bennett	10/10/2018	31	RM	12	0	2
11321	6859	JRB-buds-001	Bennett	10/16/2018	31	RM	12	4	2
11405	6859	JRB-buds-001	Bennett	10/22/2018	31	RM	12	4	2
11430	6859	JRB-buds-001	Bennett	10/26/2018	31	RM	12	9	4
11436	6859	JRB-buds-001	Bennett	10/30/2018	31	RM	12	12	4
11295	6859	JRB-buds-001	Bennett	10/4/2018	32	BE	12	0	1
11301	6859	JRB-buds-001	Bennett	10/10/2018	32	BE	12	0	1
11314	6859	JRB-buds-001	Bennett	10/16/2018	32	BE	12	0	1
11402	6859	JRB-buds-001	Bennett	10/22/2018	32	BE	12	0	2
11427	6859	JRB-buds-001	Bennett	10/26/2018	32	BE	12	0	2
11433	6859	JRB-buds-001	Bennett	10/30/2018	32	BE	12	2	3
11297	6859	JRB-buds-001	Bennett	10/4/2018	33	WH	12	0	1
11303	6859	JRB-buds-001	Bennett	10/10/2018	33	WH	12	0	2
11319	6859	JRB-buds-001	Bennett	10/16/2018	33	WH	12	5	3
11404	6859	JRB-buds-001	Bennett	10/22/2018	33	WH	12	8	4

Missing Values



source: sendaiben.org

PROBLEMS

- Different software packages handle missing values differently
- Never use zero! Zero could be a measured value (0 degrees or 0 leaves fallen) or a code (0 = dead)

SCHOOLYARD DATABASE

- When entering data, leave text box empty or select “Missing Data” from pull-down list
- When data are downloaded, missing values are represented by NA



Field Site Coordinates

Latitude = $42^{\circ} 31' 55''$ N

Longitude = $72^{\circ} 11' 24''$ W

1 degree = 60 minutes

1 minute = 60 seconds

Latitude = $42 + 31/60 + 55/3600$

Longitude = $72 + 11/60 + 24/3600$

Latitude = 42.53194 degrees

Longitude = -72.19000 degrees



Site Photo

Applewild School



Greater Lowell
Technical
High School



Woodstock Middle School



South Hadley
High School

Calculating Growing Season

Growing Season Calculation:

- Determine 50% bud burst and 50% leaf-fall dates for each tree, or Alternatively, you could calculate the average for each species, or average for all trees at a site, depending on your analysis goals.
- Subtract budburst date from leaf-fall date; this gives the number of days in the growing season for the selected tree(s)
- This approach could also be used to estimate average duration of flooding in some vernal pools, if data are available on both the increase in water depth in spring, and the decline in water levels as the hydrologic year progresses

Calculating Julian Date from Standard Date: use the Excel formula below

Date	Julian
4/8/1992	99
5/7/1999	127
6/4/1998	155
2/2/2002	33
5/5/1988	126

Julian Date: $=K6-DATE(YEAR(K6),1,0)$

NOTE: "K6" refers to the cell with the standard date

REPLACE "DATE" IN COLUMN A WITH AN ACTUAL DATE, AND THE JULIAN DAY WILL BE CALCULATED IN COLUMN B

Estimating date of 50% leaf fall, bud burst, pool filling or drying, or other event

Use data measuring change in factor of interest -- water depth, growth, leaf fall, etc. Look at the data, and choose two points bracketing the 50% level -- the formula below finds the 50% point between them

$d1$ and $d2$ are the Julian days when measurements were made before and after the 50% level was reached

$p1$ and $p2$ are the percent of leaf-fall estimated for measurement dates $d1$ and $d2$, respectively

Plug the values for $d1$, $d2$, $p1$, and $p2$ into the following formula:

50% Leaf-fall or bud-burst Julian Date: $d1 + [(d2-d1)(50-p1)/(p2-p1)]$

NOTE: For measurements of water depth, growth, etc., plug in the comparable Julian days

EXAMPLE: Spring $d1 = 95$ $d2 = 122$ 50% bud burst = $95 + ((122-95)(50-47))/(62-47) = 100.4$

Fall $p1 = 47$ $p2 = 62$

$d1 = 277$ $d2 = 284$ 50% leaf fall = $277 + ((284-277)(50-46)/(67-46) = 278.3$

$p1 = 46$ $p2 = 67$

If 50% bud-burst was at day 100 (April 10 in a non-leap year), and if 50% leaf-fall was day 278, then $278-100 = 178$: the growing season was 178 days long for this particular tree or group of trees

INSERT YOUR SPRING AND FALL DATA:

	d1	p1	d2	p2	50%
Spring					#DIV/0!
Fall					#DIV/0!

Growing season length (number of days) #DIV/0!

temp-5.csv [Read-Only] - Microsoft Excel

	A	B	C	D	E	F
	Site Code	Year	Tree ID	Species Code	Growing Season	
1						
2	JRB-buds-001	2007	1	RM	160	
3	JRB-buds-001	2007	2	BB	122	
4	JRB-buds-001	2007	6	SM	161	
5	JRB-buds-001	2011	31	RM	166	
6	JRB-buds-001	2011	33	WH	160	
7	JRB-buds-001	2012	42	AP	176	
8	JRB-buds-001	2012	43	RM	180	
9	JRB-buds-001	2012	44	RM	155	
10	JRB-buds-001	2012	45	RM	166	
11	JRB-buds-001	2012	47	SM	159	
12	JRB-buds-001	2014	32	BE	162	
13	JRB-buds-001	2014	33	WH	155	
14	JRB-buds-001	2014	34	WO	169	
15	JRB-buds-001	2014	52	SM	144	
16	JRB-buds-001	2015	32	BE	166	
17	JRB-buds-001	2015	33	WH	168	
18	JRB-buds-001	2015	34	WO	175	
19	JRB-buds-001	2015	51	BB	182	
20	JRB-buds-001	2015	52	SM	163	
21	JRB-buds-001	2016	31	RM	159	
22	JRB-buds-001	2016	32	BE	158	
23	JRB-buds-001	2016	33	WH	158	
24	JRB-buds-001	2016	34	WO	177	
25	JRB-buds-001	2016	51	BB	186	
26	JRB-buds-001	2016	52	SM	159	
27						

Teacher Resources / Data Analysis

Colburn, E. 2014. Calculating Growing Season Active Worksheet

Schoolyard LTER Database / Download Data

Length of growing season by tree

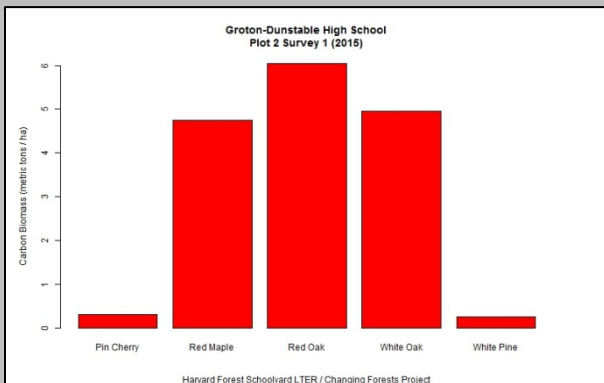
Calculating Carbon Biomass

Schoolyard LTER Database

Tree Biomass Equations
13-Nov-2013

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 dentata (CH)	biomass = $2.204*(\exp(0.95595+2.4264*\log(\text{dbh}/2.54)))$
Fagus grandifolia (BE)	biomass = $0.1967*(\text{dbh}^2.3916)$
Fraxinus Americana (WA)	biomass = $(\exp(7.1148+1.3707*\log(\text{dbh}/2.54)))/1000$
Nyssa sylvatica (BG)	biomass = $(10^{(1.1468+1.4806*\log_{10}(\text{dbh}^2))})/1000$
Pinus resinosa (RP)	biomass = $0.1003*(\text{dbh}^2.3865)$
Picea rubens (RS)	biomass = $(10^{(2.1735+2.1936*\log_{10}(\text{dbh}))})/1000$
Picea spp. (BS, NS, WS)	biomass = $(10^{(2.1735+2.1936*\log_{10}(\text{dbh}))})/1000$
Pinus strobus (WP)	biomass = $0.0696*(\text{dbh}^2.4490)$
Populus grandidentata (LA)	biomass = $0.0785*(\text{dbh}^2.4981)$
Populus tremuloides (TA)	biomass = $0.0637*(\text{dbh}^2.6087)$
Populus spp. (CW)	biomass = $0.0785*(\text{dbh}^2.4981)$
Prunus pensylvanica (PC)	biomass = $0.1556*(\text{dbh}^2.1948)$
Prunus serotina (BC)	biomass = $0.0716*(\text{dbh}^2.6174)$
Quercus alba (WO)	biomass = $0.0579*(\text{dbh}^2.6887)$
Quercus rubrum (RO)	biomass = $0.1130*(\text{dbh}^2.4572)$
Tsuga Canadensis (TS)	biomass = $0.0991*(\text{dbh}^2.3617)$



	A	B	C	D	E	F	G	H	I	J
	Site Code	Teacher	Date	Julian	Survey	Tree ID	Species Code	Health	Dbh	Carbon Biomass
1	GDH-forest-001	McCracken	9/18/2013	261	1	85	RM	1	4.7	2.51
2	GDH-forest-001	McCracken	9/18/2013	261	1	86	RM	1	6.3	5.04
3	GDH-forest-001	McCracken	9/18/2013	261	1	87	SC	1	8.6	10.58
4	GDH-forest-001	McCracken	9/18/2013	261	1	88	RM	1	58.1	998.79
5	GDH-forest-001	McCracken	9/18/2013	261	1	89	SC	1	6.8	6.05
6	GDH-forest-001	McCracken	9/18/2013	261	1	90	RM	1	4.5	2.26
7	GDH-forest-001	McCracken	9/18/2013	261	1	91	RM	1	11.5	21.13
8	GDH-forest-001	McCracken	9/18/2013	261	1	93	TS	1	9.7	10.6
9	GDH-forest-001	McCracken	9/18/2013	261	1	94	WP	1	9.1	7.77
10	GDH-forest-001	McCracken	9/18/2013	261	1	95	WP	1	21.5	63.79
11	GDH-forest-001	McCracken	9/18/2013	261	1	96	RM	1	8.9	11.48
12	GDH-forest-001	McCracken	9/18/2013	261	1	97	RM	1	9.3	12.75
13	GDH-forest-001	McCracken	9/18/2013	261	1	98	RM	1	11.9	22.92
14	GDH-forest-001	McCracken	9/18/2013	261	1	99	SC	1	10.5	17.02
15	GDH-forest-001	McCracken	9/18/2013	261	1	100	SC	1	3.5	1.24
16	GDH-forest-001	McCracken	10/29/2015	302	2	85	RM	1	4.7	2.51
17	GDH-forest-001	McCracken	10/29/2015	302	2	86	RM	1	6.4	5.24
18	GDH-forest-001	McCracken	10/29/2015	302	2	87	SC	1	8.8	11.18
19	GDH-forest-001	McCracken	10/29/2015	302	2	88	RM	1	59.8	1069.77
20	GDH-forest-001	McCracken	10/29/2015	302	2	89	SC	1	7	6.48
21	GDH-forest-001	McCracken	10/29/2015	302	2	90	RM	1	4.9	2.77
22	GDH-forest-001	McCracken	10/29/2015	302	2	91	RM	1	12	23.38
23	GDH-forest-001	McCracken	10/29/2015	302	2	93	TS	1	10	11.4
24	GDH-forest-001	McCracken	10/29/2015	302	2	94	WP	1	9.2	7.98
25	GDH-forest-001	McCracken	10/29/2015	302	2	95	WP	1	21.9	66.73
26	GDH-forest-001	McCracken	10/29/2015	302	2	96	RM	1	9	11.79
27	GDH-forest-001	McCracken	10/29/2015	302	2	97	RM	1	9.5	13.41
28	GDH-forest-001	McCracken	10/29/2015	302	2	98	RM	1	12.2	24.32
29	GDH-forest-001	McCracken	10/29/2015	302	2	99	SC	1	10.5	17.02
30	GDH-forest-001	McCracken	10/29/2015	302	2	100	SC	1	3.8	1.51
31										
32										
33										

Schoolyard LTER Database / Download Data

Carbon biomass by tree

Summary Data by Site



temp-10.csv [Read-Only] - Microsoft Excel

	A	B	C	D
1	Site Code	Year	Growing Season	
2	AHE-buds-001	2011	166	
3	AHE-buds-001	2012	185	
4	AHE-buds-001	2013	170	
5	AHE-buds-001	2014	167	
6	AHE-buds-001	2015	172	
7	AHE-buds-001	2016	181	
8	AHS-buds-001	2011	202	
9	APS-buds-001	2007	175	
10	APS-buds-001	2011	184	
11	APS-buds-001	2012	185	
12	ARM-buds-001	2005	170	
13	ARM-buds-001	2006	164	
14	ARM-buds-001	2007	163	
15	ARM-buds-001	2008	163	
16	ARM-buds-001	2009	170	
17	AWM-buds-001	2014	160	
18	AWM-buds-001	2015	172	
19	BES-buds-001	2010	140	
20	BES-buds-001	2011	159	
21	BHS-buds-001	2009	166	
22	BHS-buds-001	2010	180	
23	BHS-buds-001	2011	169	
24	BHS-buds-001	2013	167	
25	BHS-buds-001	2014	154	
26	BHS-buds-001	2015	174	
27	BHS-buds-001	2016	175	
28	BTH-buds-001	2016	192	
29	CCE-buds-001	2009	160	
30	CCE-buds-001	2010	170	
31	CCE-buds-001	2011	162	
32	CCE-buds-001	2012	169	
33	CCE-buds-001	2013	157	
34	CCE-buds-001	2014	156	
35	CCH-buds-001	2010	172	
36	CCH-buds-001	2011	155	
37	CCH-buds-001	2012	172	

Scholyard LTER Database / Download Data

Length of growing season by site

temp-11.csv [Read-Only] - Microsoft Excel

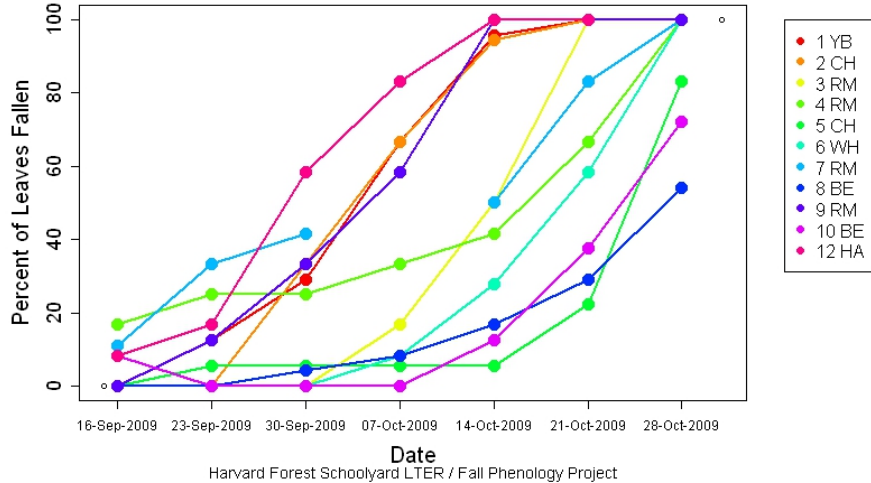
	A	B	C	D	E	F	G
1	Site Code	Survey	Year	Stand Density	Basal Area	Carbon Biomass	
2	APS-forest-001	1	2014	2600	79.18	241.64	
3	ATH-forest-001	1	2013	2400	116.62	409.75	
4	ATH-forest-002	1	2014	2000	169.32	423.33	
5	ATH-forest-003	1	2014	1300	33.82	89.75	
6	AWH-forest-001	1	2016	1000	70.59	212.23	
7	BCE-forest-001	1	2016	900	89.73	239.77	
8	BHS-forest-001	1	2015	2100	71.09	168.06	
9	BRH-forest-001	1	2013	1000	8.84	20.61	
10	DFA-forest-002	1	2014	900	31.06	74.69	
11	DFA-forest-002	2	2016	900	31.23	75.26	
12	EBM-forest-001	1	2014	2000	44.32	138.01	
13	EBM-forest-002	1	2014	4600	22.4	40.87	
14	EBM-forest-003	1	2014	1600	88.07	421.78	
15	EBM-forest-004	1	2014	600	58	150.5	
16	FPC-forest-001	1	2015	1400	89.58	402.59	
17	FPC-forest-002	1	2015	1000	34.27	120.11	
18	FPC-forest-003	1	2015	1000	64.09	238.41	
19	FPC-forest-004	1	2015	1500	64.03	212.92	
20	FPC-forest-009	1	2014	800	22.95	56.57	
21	FPC-forest-010	1	2014	1800	31.38	78.92	
22	FPC-forest-011	1	2014	1600	37.89	89.32	
23	FPC-forest-012	1	2014	1100	20.42	47.02	
24	GDH-forest-001	1	2013	1500	37.53	119.39	
25	GDH-forest-001	2	2015	1500	39.6	127.55	
26	GDH-forest-001	3	2017	1400	40.38	130.93	

Scholyard LTER Database / Download Data

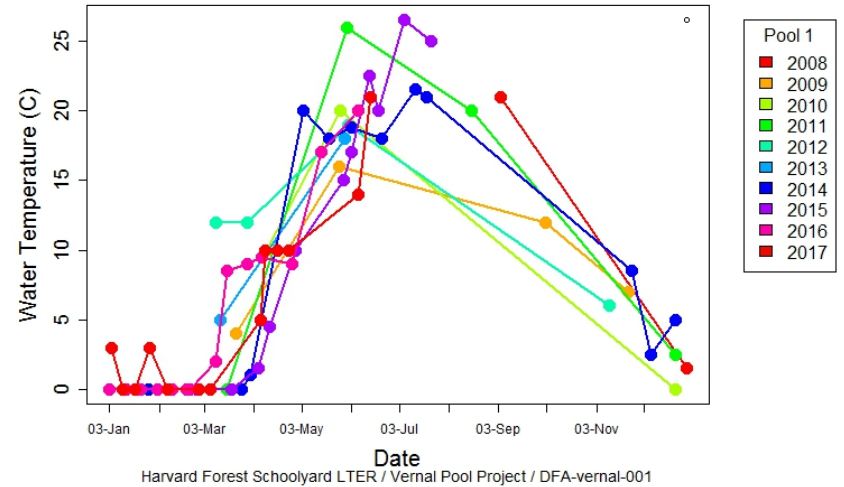
Carbon biomass by site

Detailed Data from a Single Site

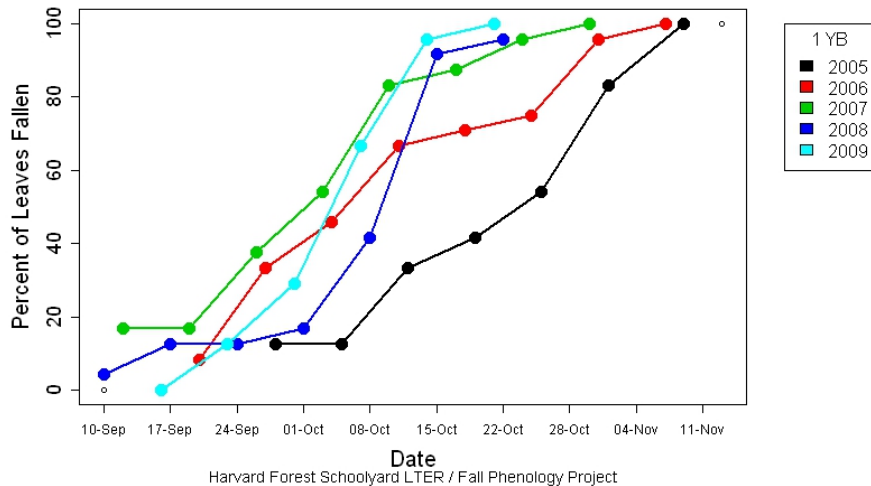
Athol-Royalston Middle School



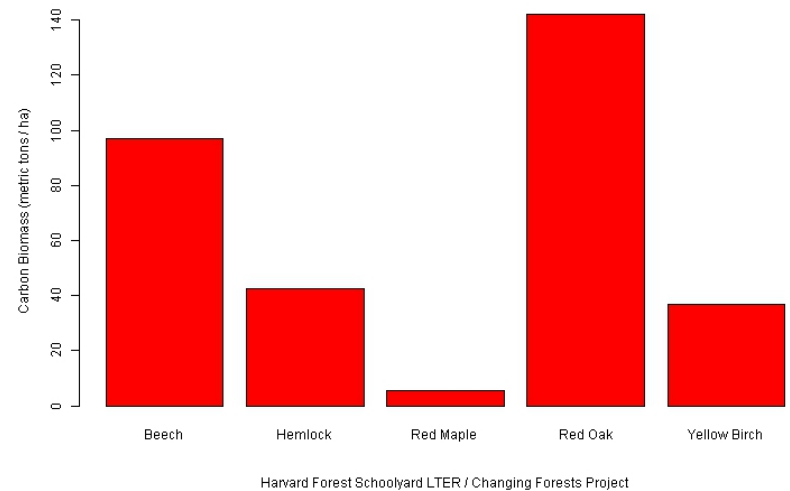
Drumlin Farm Mass Audubon



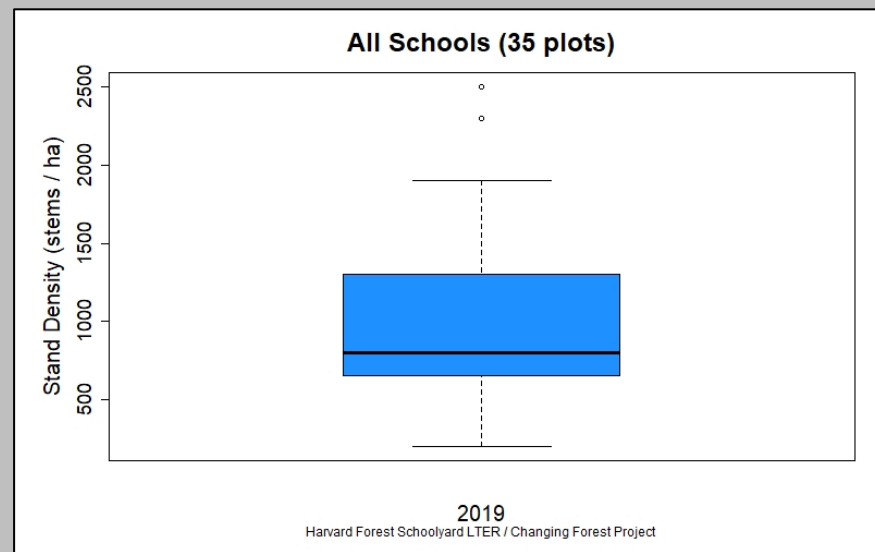
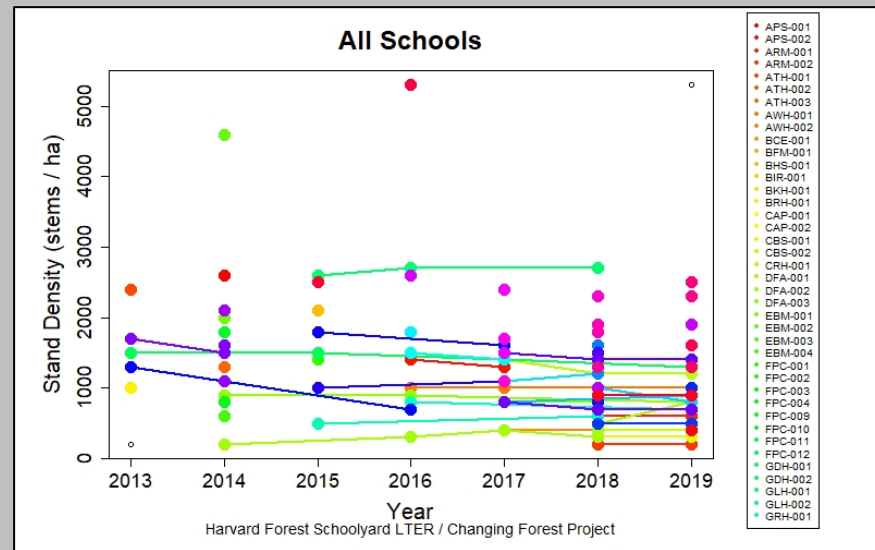
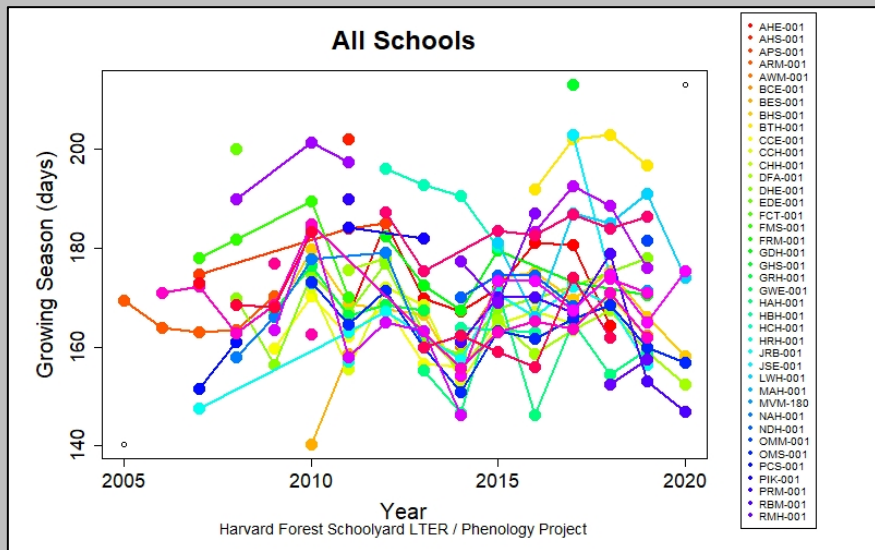
Athol-Royalston Middle School



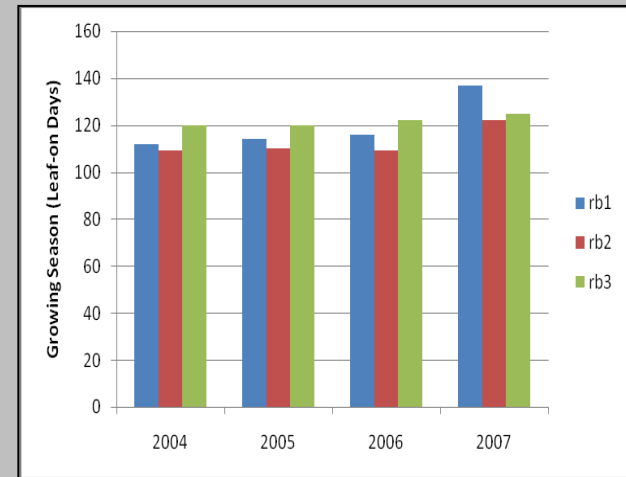
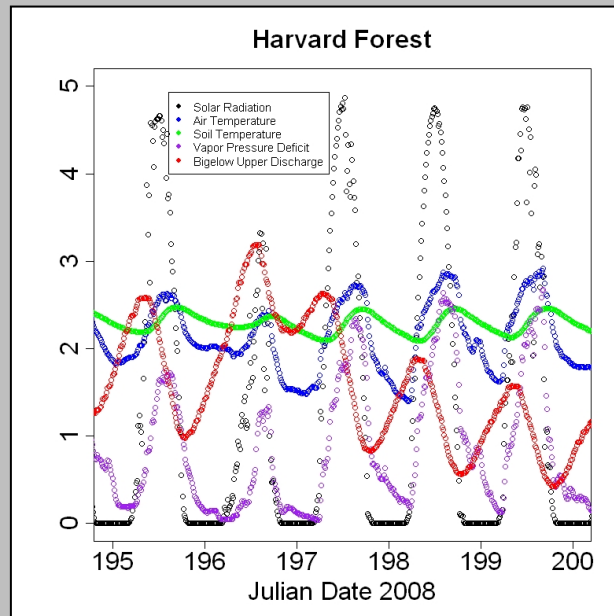
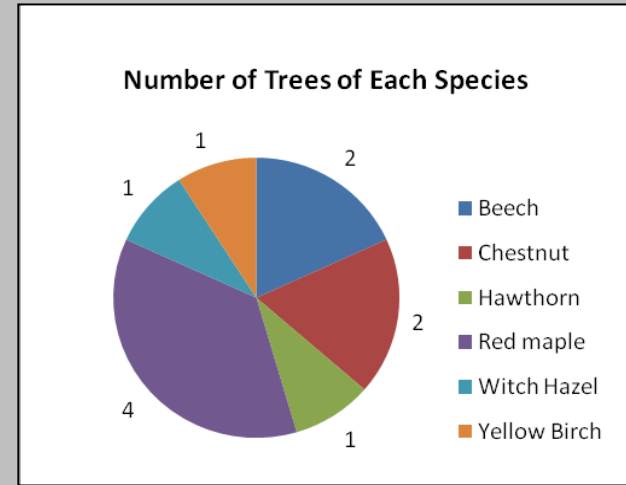
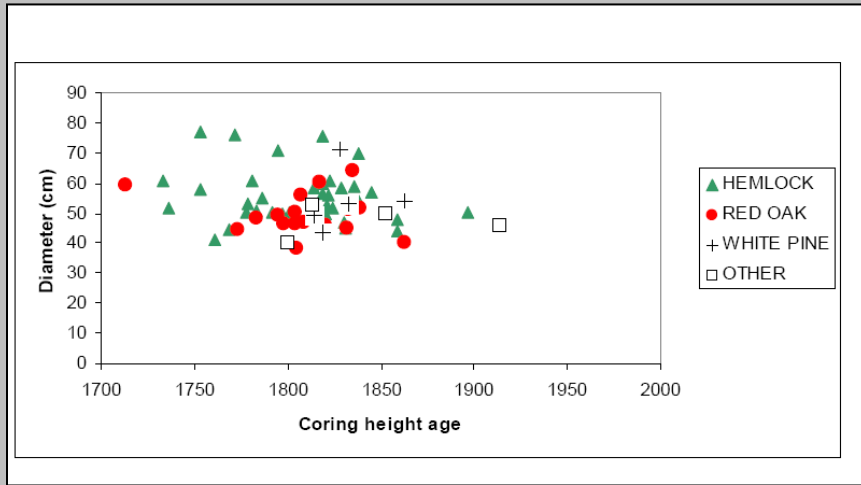
Gardner High School Plot 1 Survey 1 (2013)



Summary Data from One or More Sites



Data Visualization



Graphs from Colburn, Orwig & Boose