



Harvard Forest LTER Schoolyard Ecology

***Hemlock Trees and the Pesky Pest, The Woolly Adelgid Data Analysis Lesson Plan:
Using data to look for trends in the infestation of Hemlock Woolly Adelgid
among hemlock stands in Massachusetts***

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Acknowledgements:

Dr. David Orwig and Dr. Betsy Colburn, Harvard Forest Ecologists
Pamela Snow, Harvard Forest Schoolyard Coordinator

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Curricular areas: Math: Data analysis/ Graphing and Science: Ecology/Invasive species

Grade Level: 5 -6

Enduring understanding: Students will gain experience in the use of Microsoft Excel to graph data on the abundance of Hemlock Woolly Adelgid. Students will learn how to recognize patterns (or lack of) and draw conclusions from these data.

Essential questions:

1. How are bar graphs useful for analyzing and understanding project data? (They make the numbers into a picture that is easy to interpret)
2. What do the data teach us about the spread of the invasive pest the Hemlock Woolly Adelgid?
 - a. What effects do elevation and latitude have on the spread of the Woolly Adelgid? (HWA abundance generally decreases at sites further north. There is no indication that elevation had an effect on HWA in this particular data set.)

Assessments:

- Students will create two graphs in Excel, one showing the average number of woolly adelgid egg sacks on the outer 15 cm of hemlock branch at sites sorted by latitude, then one sorted by elevation.
- Students will state one conclusion per graph based on the data

Curriculum Standards:

Mathematics: 5.D.2 Construct and interpret bar graphs

Science: Life Science Grades 3 to 5

Learning Standard 3: Recognize that plants and animals go through predictable life cycles that include birth, growth, development, reproduction, and death.

Learning Standard 7: Give examples of how changes in the environment have caused some plants and animals to die or move to new locations

Instructional Strategies or goals	Activities
Students will enter data onto an Excel worksheet	Students will use an Excel worksheet and enter data from 10 sites being checked for the abundance of HWA. This data set will include their own hemlock site on the nature trail.
Students will create two bar graphs from the data	Students will create a bar graph sorting the data according to latitude. They will then re-sort according to elevation and create a second bar graph.
Students will interpret their graphs	Students will state a conclusion for each graph recognizing trends, if any, in their data.

Tools and Resources:

- Harvard LTER Schoolyard Program -Protocols and Data, suggested reading, related research
- <http://harvardforest.fas.harvard.edu/museum/hwa.html>
- *Hemlock Woolly Adelgid Data Analysis: Student Worksheet 1* –Microsoft Excel worksheet- Abundance of HWA South to North Data Set* Data Set on Abundance of HWA
- *Hemlock Woolly Adelgid Data Analysis Student Worksheet 2: Graphing directions*
- *Hemlock Woolly Adelgid Data Analysis: Student Worksheet 3: Conclusions*
- *Teacher Key to Student Worksheet 3: Conclusions*
- *Hemlock Woolly Adelgid Data Analysis: Teacher Key/Sample Graphs*
- Hemlock Woolly Adelgid Schoolyard Ecology project data
- School computers with access to Microsoft Excel

*South-North data set was adapted from a larger data set provided by Dr. David Orwig, Harvard Forest, which documents the average abundance of Hemlock Woolly Adelgid egg sacs in Hemlock stands at various study sites.

Teacher notes:

- Students should have basic knowledge of the invasive pest, the Hemlock Woolly Adelgid. They should understand what the Key to the Average Abundance of HWA Per Stand means ~This is a stand-level rating of how abundant HWA was throughout the area.
0 = HWA absent; 1 = light; 2 = light to moderate; 3 = moderate; 4 = moderate to heavy; 5 = heavy (sacs found at the base of most needles on most if not all branches examined).
- Students should be introduced to Excel in a previous lesson. They should also have a basic knowledge of latitude and elevation.
- Lesson should be done in two parts:
 - Part One: Inputting project data in Excel worksheet
 - Part Two: Creating and Interpreting Graphs
- The teacher should go through the steps of the lesson with the students with a projector if possible.
- This is a challenging lesson. It would be helpful to have another person with some Excel experience to help ~ a good opportunity to get a parent involved!
- If a computer lab is not available, the lesson can be modified to include hand graphing. Excel graph can be done as a demonstration.

Name: _____



Date _____ □

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Hemlock Woolly Adelgid Data Analysis: Student Worksheet 1

Enter Data on the Excel worksheet as follows:

1. Title the columns **A** through **C** on the Excel worksheet with the titles on the chart below.
2. Enter the data from the chart.

Latitude ° N	Elevation (meters)	Adelgid*
42.74 Ashburnham	311 Ashburnham	0
42.54 Athol	220 Athol	1
42.42 Barre	316 Barre	1
42.11 Monson	189 Monson	3
42.37 N. Brookfield	223 N. Brookfield	0
42.61 Orange	236 Orange	0
42.04 Southbridge	290 Southbridge	4
42.08 Springfield	051 Springfield	4
42.15 Warren	247 Warren	1
42. 63 Winchendon	311 Winchendon	0

3. Save as Name (yours!) HWA data 2004

*Key to the Average Abundance of HWA Per Stand: This is a stand-level rating of how abundant HWA was throughout the area.

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Name _____

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Harvard Forest LTER Schoolyard Ecology
Hemlock Woolly Adelgid Data Analysis Student Worksheet 2

1. Open a Word document. Type your name and save as HWA GRAPHS. Minimize (-) the document.

2. Open your Excel document

3. Sort data in ascending order (from lowest to highest) latitude as follows. This will put the data in order from South to North as follows:

- a. Holding down the Control key, highlight all the cells **A1** to **C11** (It also works to hold down the shift key, if you are sorting data from all of the cells).
- b. Go to **Data** on the toolbar at the top. Scroll down to **Sort**. Sort by **Latitude/Ascending order**.

Note: Sometimes there may be a problem sorting. Be sure there is a checkmark in the box that says the data have a header row.

4. Create a graph of the data

- a. Highlight all the cells in the **Latitude** and the **Adelgid** column that have data ~ **A2** to **A11** and **C2** to **C11**. You have to hold the Control key to do this.
- b. Click on the chart wizard on the toolbar. Click on the bar column graph. Click Next
- c. You should see the graph. Click Next
- d. Fill in the: Chart Title ~ **Abundance of HWA South to North**

X axis(bottom of graph) ~ **Latitude of Study Site**

Y axis (side of graph) ~ **Average Abundance of HWA Per Stand**

- e. Click Next. Place as an object in Sheet 1
- f. Make sure the chart is highlighted. Click on Cut (the little scissors) on the toolbar. Maximize () your Word document. Click on **Paste** (little clipboard) on the **Word** toolbar. Minimize (-) your document.

5. In your Excel file, sort the data in ascending order by elevation (lowest to highest from sea level).

6. Create a graph based on site elevation:

- a. Click on the chart wizard on the toolbar. Click on the bar graph. Click Next
- b. You should see the graph. Click Next
- c. Fill in the: Chart Title ~ **Average Abundance of HWA by Elevation**

X axis (bottom of graph) ~ **Elevation of Study Site**

Y axis (side of graph) ~ **Average Abundance of HWA Per Stand.**

- d. Click Next. Place as an object in Sheet 1
- e. Make sure the chart is highlighted. Click on Cut (the little scissors) on the toolbar. Maximize () your Word document. Click on **Paste** (little clipboard) on the **Word** toolbar.

7. It is important to explain what the adelgid scale means.

Type in below the graphs :

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8. Save the file. Print and exit the file.

Name: _____



Date _____

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Hemlock Woolly Adelgid Data Analysis: Student Worksheet 3: Conclusions

Answer the following questions in complete sentences.

1. Look at your graph with the towns organized from south to north. What is the trend in the data of the towns as you go further north?

2. Look at your graph with the towns organized from lowest to highest elevation. Can you see any trends in the data here?

3. What else might be related to latitude or elevation that may be important to trends in HWA abundance?



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Hemlock Woolly Adelgid Data Analysis:

Teacher Key to Student Worksheet 3: Conclusions

Answer the following questions in complete sentences.

1. Look at your graph with the towns organized from south to north. What is the trend in the data of the towns as you go further north?

HWA abundance generally decreases at sites further north.

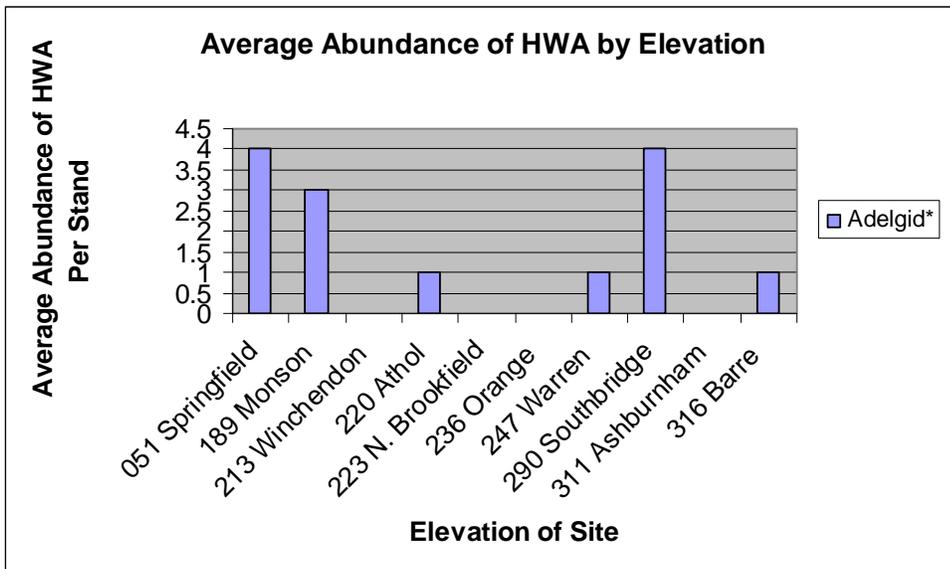
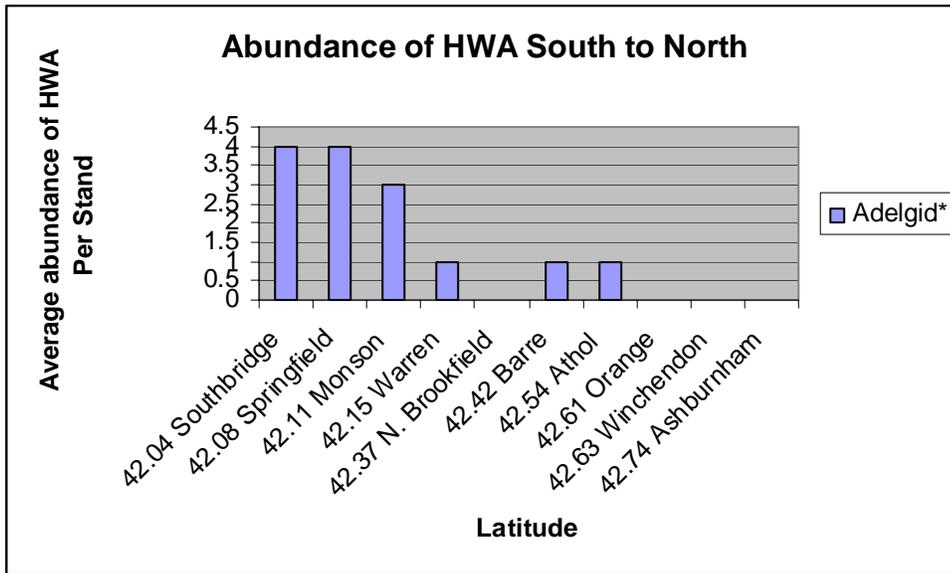
2. Look at your graph with the towns organized from lowest to highest elevation. Can you see any trends in the data here?

Elevation does not seem to make any difference.

3. What else might be related to latitude or elevation that may be important to trends in HWA abundance?

The key seems to be related to temperature. Sites further north are typically colder and also HWA has been moving south to N in New England, so HWA has been in the south longer. Sometimes elevation may play a role, lower elevations are often warmer, and HWA abundance may be higher. In this case lower elevation also corresponds with the CT River, so that is also a potential vector.

Hemlock Woolly Adelgid Data Analysis: Teacher Key/Sample Graphs



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