



Harvard LTER Schoolyard Program

Teacher Developed Lessons and Documents that integrate
Harvard Forest Schoolyard Ecology Themes into curriculum.

- **Presentation Title:** Enhancing 'The Woolly Bully' Schoolyard Project
- **Teacher/Author:** Shirley Griffin
- **School:** Oakmont High School
- **Level:** 12th Grade- Environmental Planning-
Environmental Science-Global Ecology
- **Date:** April 13, 2011



*Harvard University
Harvard Forest*

***Enhancing
“The Woolly Bully”
School yard Project***

S.L.Griffin 4-2011
Oakmont Regional High School
Ashburnham, MA

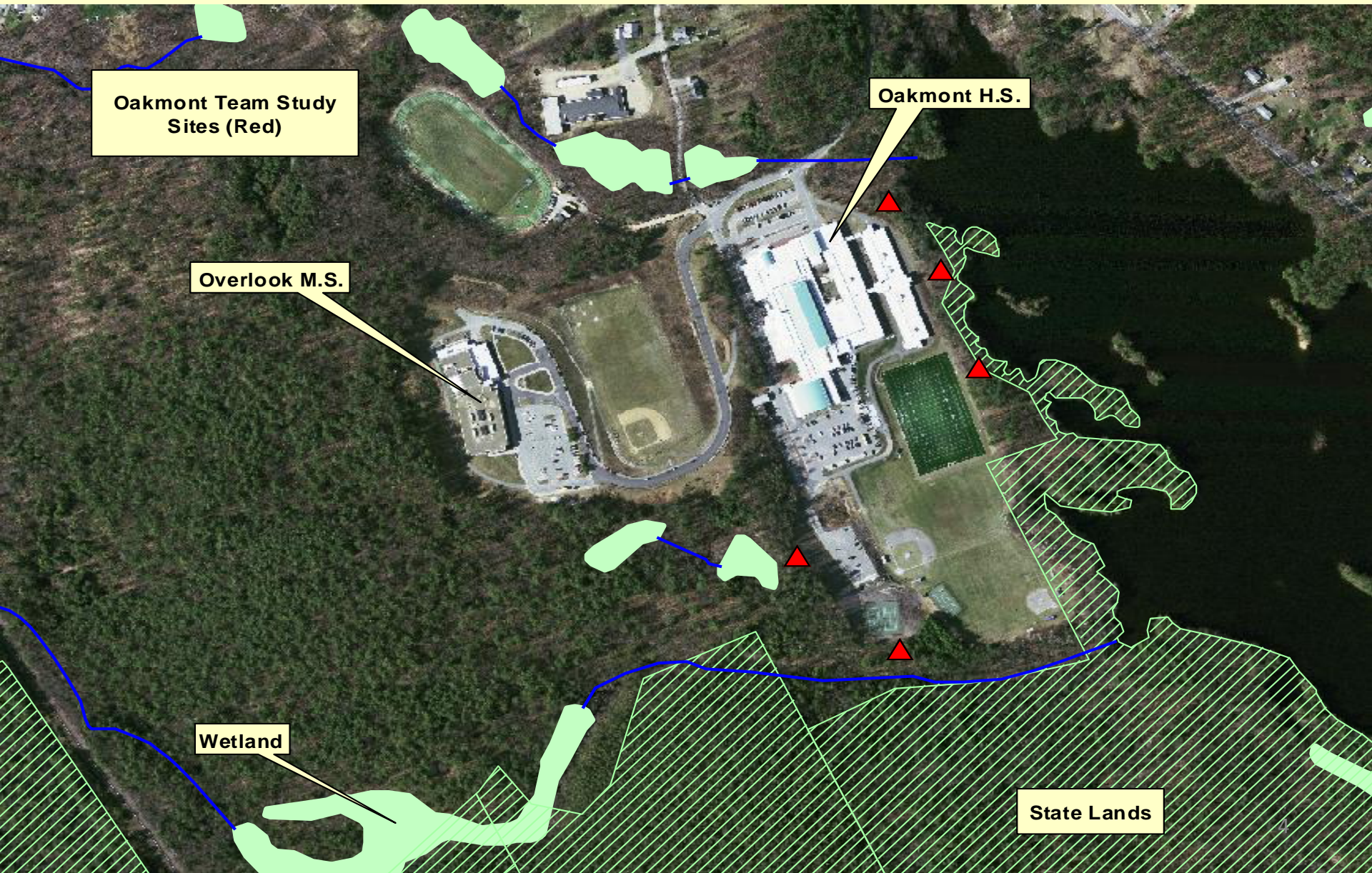
Overview

Introduction:

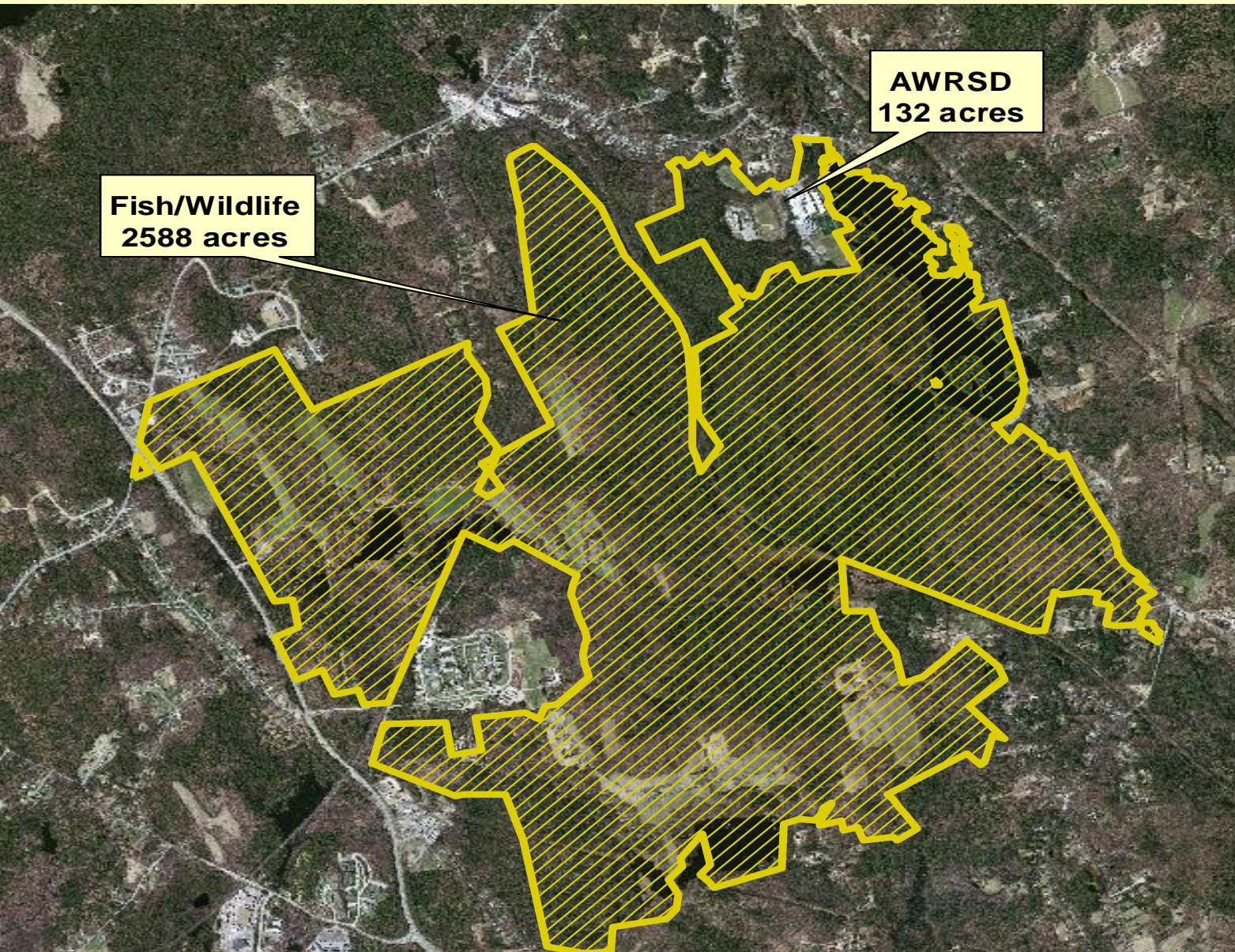
Schoolyard Project – Harvard Forest *“Woolly Bully”*

Hemlock Woolly Adelgid

Project Goals: If the HWA infests Oakmont – What changes can we expect?



Project Goals: If the HWA infests FWL abutting lands – What changes could we expect?



Total
Acres:

Almost
3,000
acres –
hemlocks
are in
clusters in
mixed
forest

Teacher Goals:



1. To expand student ecological knowledge about Transitional Forests,

2. To incorporate Harvard Forest Scientists' research findings about HWA in classroom activities,



Teacher Goals:



3. To Involve students in local scientific surveys of HWA infestation at Oakmont, on FWL lands, and on their home property/communities.

4. To stimulate student critical thinking through spatial data analysis (GIS Tools)



Implementing

Teacher Goal #1:

To expand student ecological knowledge about Transitional Forests and Invasive Insects in order to understand the impact of Woolly Adelgid on Hemlocks.

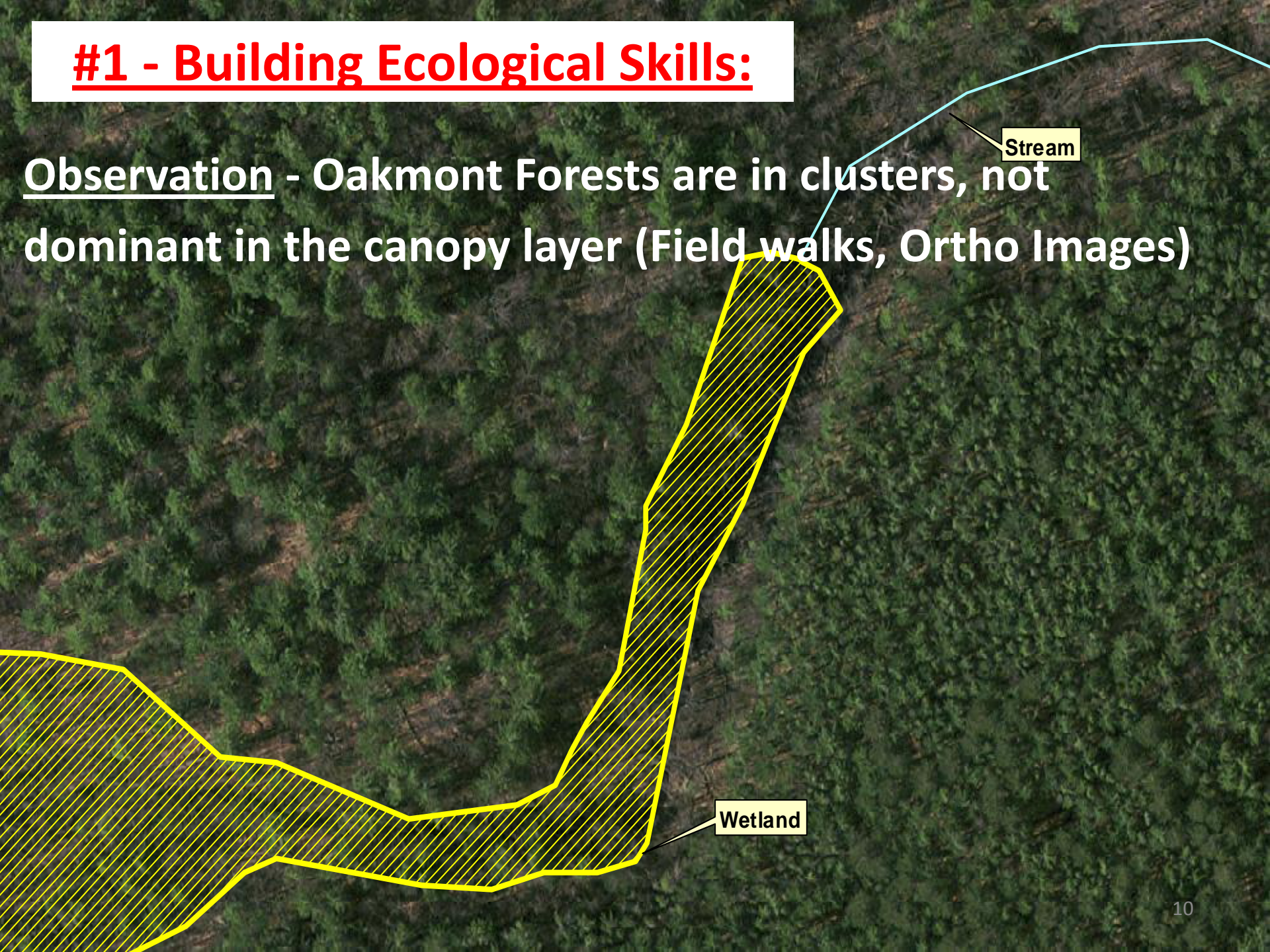
#1 - Building Ecological Content

A photograph of three people standing in a forest. They are all wearing bright orange safety vests. The person on the left is a woman with brown hair, wearing a grey long-sleeved shirt and blue jeans. The person in the center is seen from the back, with long dark hair, wearing a black long-sleeved shirt. The person on the right is a woman with long brown hair, wearing a blue jacket. They are standing on a forest floor covered with dry leaves and moss. In the background, there are several tall trees, including birches with white bark, and a body of water is visible through the trees. The sky is clear and blue.

Types of Forests
(Coniferous, Mixed, Deciduous)

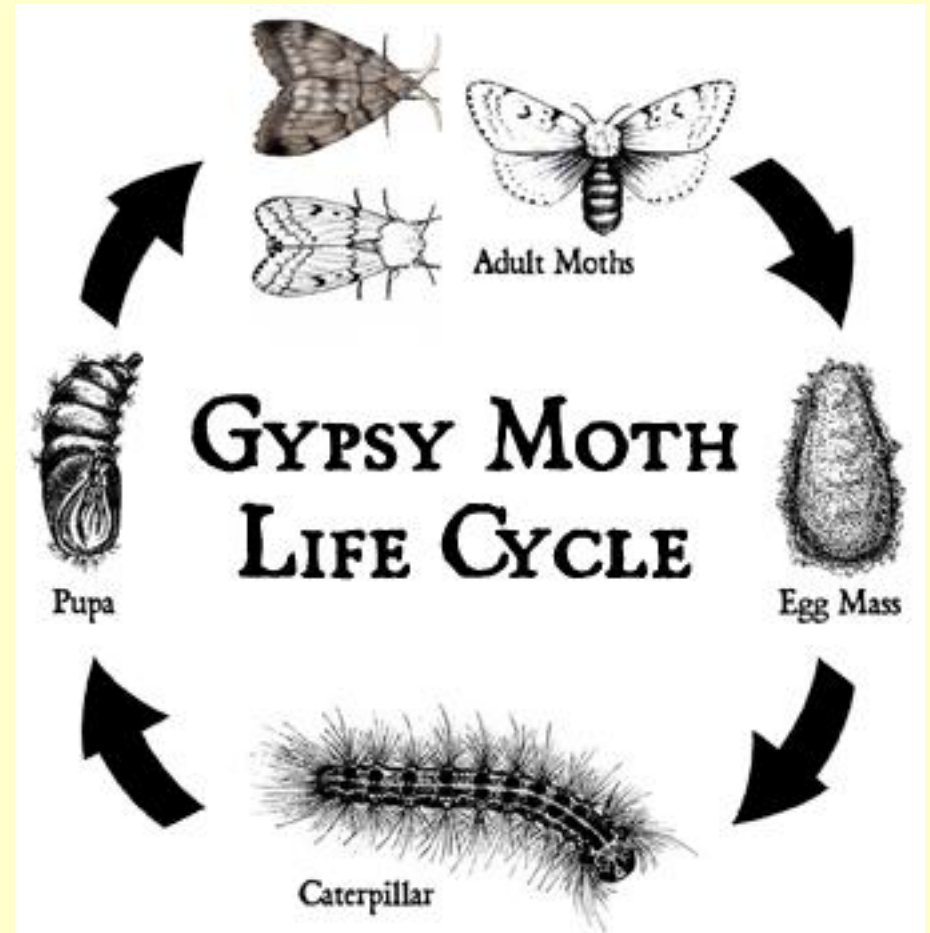
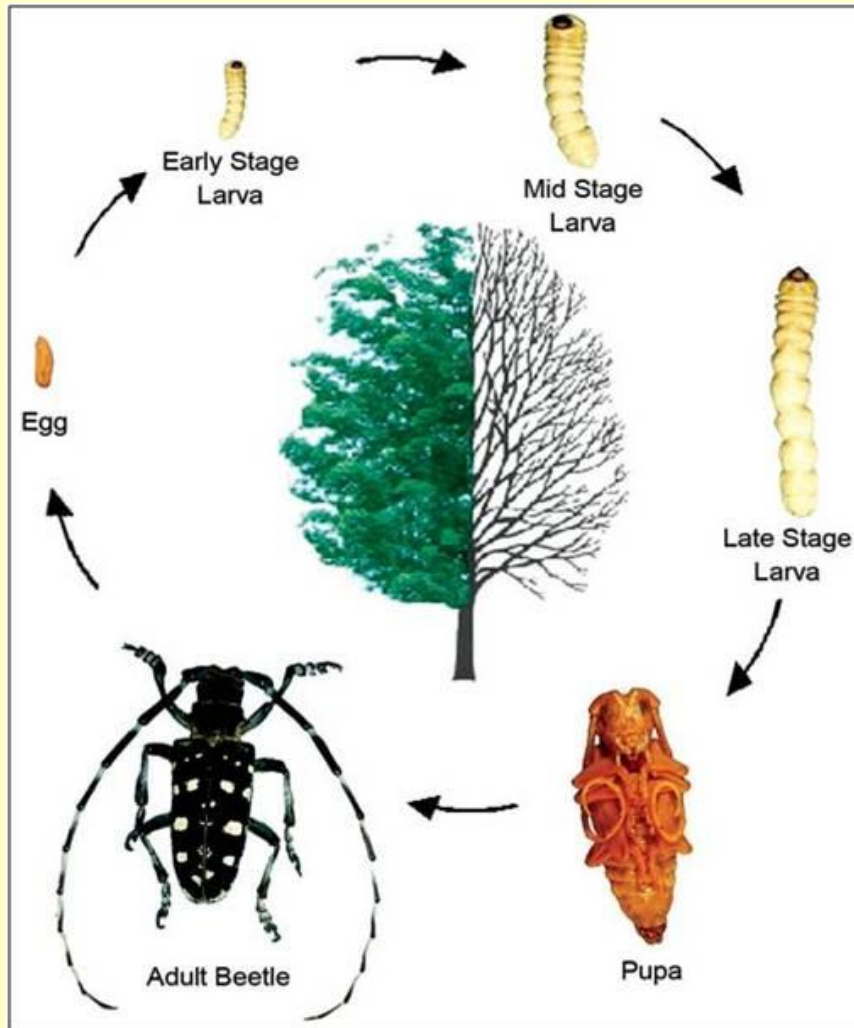
#1 - Building Ecological Skills:

Observation - Oakmont Forests are in clusters, not dominant in the canopy layer (Field walks, Ortho Images)



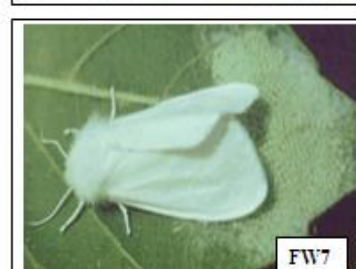
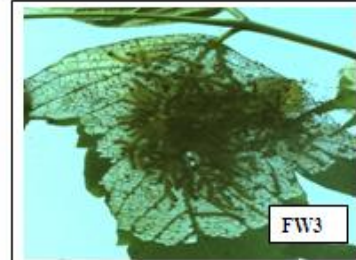
#2 - Invasive Species Vs. Pest Species

Activity #1: What is a Life Cycle?



Made and Compared Diagrams/Charts

Activity #1: Students arranged “life cycle cards” in a circular pattern on tables



#2 - Invasive Species Vs. Pest Species

Activity #2: Native, Invasive, Pest or both?



- Fall Webworm
- Asian Longhorn beetle
- Hemlock Woolly Adelgid
- Eastern Tent Caterpillar
- Japanese Beetle
- Gypsy Moth



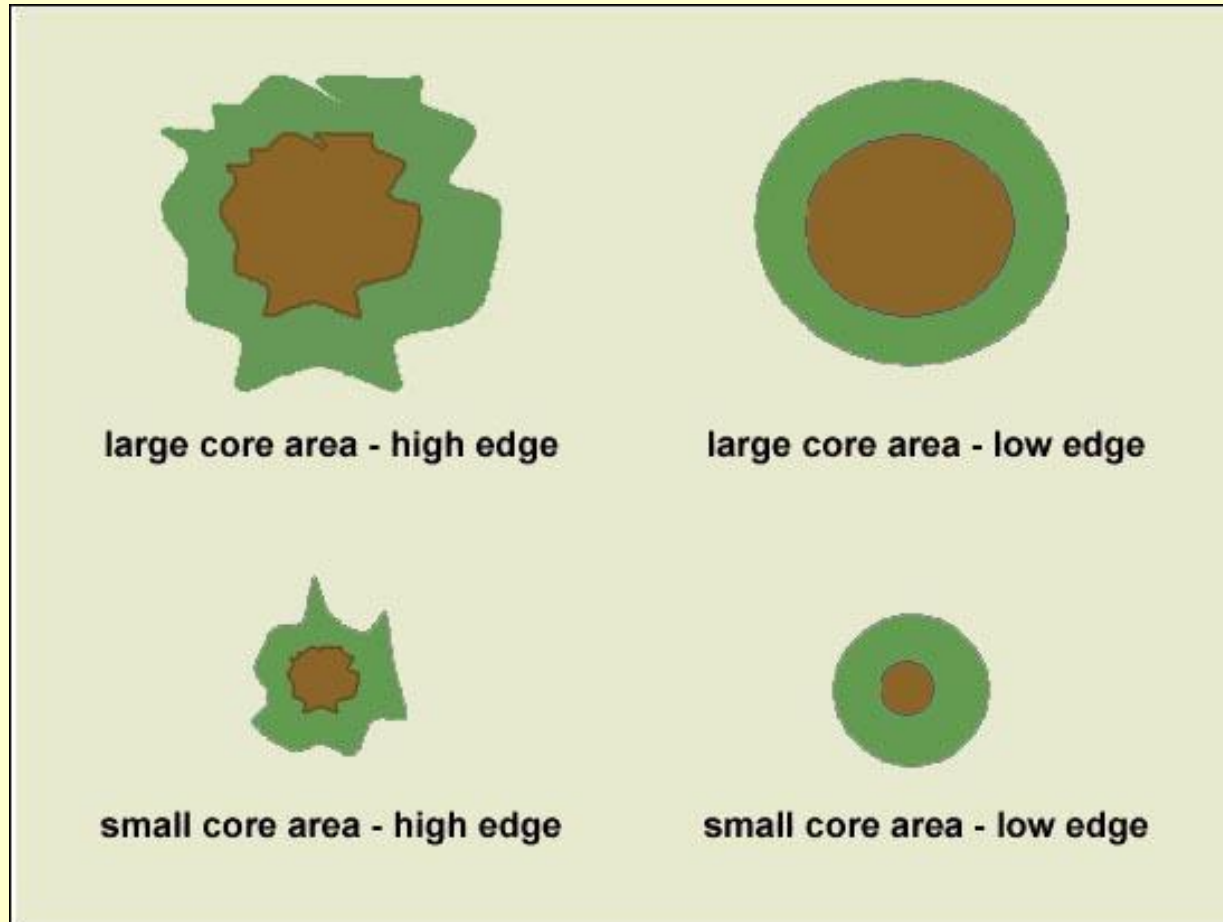
Implementing

Teacher Goal #2:

To incorporate Harvard Forest Scientists' research findings about HWA in classroom activities, to facilitate “student research” at Oakmont and beyond.

#3 – Exploring Forest Habitat

Power Point: What is Edge and Core Habitat?



- Explored the importance of Hemlock in supporting “Core Habitat”
- Began a discussion of types of wildlife that need edge/core habitat
- Walked Grounds

#3 – Exploring The Value of Forest Habitat

Activity #3: “Eastern Hemlock – Irreplaceable Habitat” (Dr. David Orwig)

Eastern Hemlock: Irreplaceable Habitat

by David Orwig

The eastern hemlock is a tree species widely distributed across Massachusetts. Most of the state's known old-growth forest is comprised of hemlock, which often live for 300 to 350 years. However, it is much more than just an old-growth specimen. For any of you who have ventured into the midst of an eastern hemlock-dominated forest, you may sense that you entered a special place. The stately, long-lived conifers with drooping, dark green branches aligned in a pyramidal shape, create an environment that is deeply shaded and cooler than surrounding woodlands. These conditions strongly influence wildlife and nearby streams.

Hemlock forests often feel spongy underfoot, due to a thick accumulation of needles that are slow to decompose. Red-backed salamanders and red eft (juvenile red-spotted newts) thrive under fallen wood where they feed on mites, beetles, and other insects. Visit a hemlock forest after a summer rain, and you may see dozens of red efts crawling about. Soil invertebrates are often overlooked, yet many dwell here; while looking for salamanders, you may see several varieties of ants scurrying around the soil surface, going in and out of ground nests.

The same aromatic boughs that cast the deep shade under hemlock trees also harbor many arthropods, including a broad variety of spiders, mites, and moths. Unfortunately, hemlock branches also provide excellent food for two harmful exotic insects introduced into the eastern US in the mid-20th century: the hemlock woolly adelgid and the elongate hemlock scale. These two unwanted pests feed on hemlock at the same time, threatening this species throughout most of its range in eastern North America and creating uncertainty about the future of hemlock in the coming decades.

Many different birds spend at least part of their life cycle in hemlock forests, often feeding on the insects dispersed throughout the dense tree crowns. During late May and early June, the hemlock forest is alive with a chorus of neotropical songbirds, many recently arriving from their winter homes in the south. Black-

throated green warblers are extremely common in the upper branches of the tree, where they feed and nest. Once you get acquainted with its “zoo zee zoo zoo zee” call, you will rarely be within reach of hemlock forest and not hear this species sing to you. Other avian species such as Acadian flycatchers, Blackburnian warblers, Canada warblers and hermit thrushes also are strongly associated with the hemlock habitat. You might also see black-capped chickadees, winter wrens, and red-breasted nuthatches in hemlock stands. Finally, barred owls, northern goshawks and red-shouldered hawks frequently nest in mature to old-growth hemlock forests.



Photo by Don Mahl

Herds of white-tailed deer congregate under hemlock for precious winter food and cover. The dense branches intercept more snow and ease winter temperatures, reducing the deer's energy requirements, an especially important benefit during harsh winters with deep snow packs. During the winter red squirrels and mice commonly feed on hemlock seeds and snowshoe hares frequently eat hemlock

Hemlocks in
Bernardston, MA

continued on page 5

Read the article - Make a list of information in a bullet format that provides possible answers to the general question (Why are Hemlock forests important and irreplaceable habitats?)

After reading, students agreed on the following major bullet facts:

Hemlocks create unique types of habitat:

- Provide shade, cool temperatures
- Ground is spongy/wet/thick needle layer
- Soil organisms are plentiful
- Favored habitat for HWA/Elongate hemlock Scale
- Many birds spend “life cycle” here (neotropical)
- Influence streams and create fish habitat

“Eastern Hemlock – Irreplaceable Habitat” – for who?



Specific Questions by students (some):

- **Kinds of animals in older “Hemlock Clusters”?**
- **Are Green Throated Warblers in the upper layers of the Hemlocks?**
- **Are wetlands near the Oakmont “Hemlock Clusters”?**
- **Is there evidence of Porcupines?**
- **Are there Red-backed salamanders in the ground cover?**
- **Do hemlocks provide cover for White-tailed deer?**
- **Why do only some birds live in the “hemlock clusters”?**
- **Does the temperature vary under hemlocks?**

Wildlife Habitat Associations in Eastern Hemlock — Birds, Smaller Mammals, and Forest Carnivores

Mariko Yamasaki¹, Richard M. DeGraaf², and John W. Lanier³

Abstract

Ninety-six bird and forty-seven mammal species are associated with the hemlock type in the northeastern United States. Of these species eight bird and ten mammal species are strongly associated with the hemlock type though none of these species are limited to it. Hemlock species richness appears to be lower than in other conifer or hardwood types. Avian habitat considerations include the distribution and variety of structural habitat features throughout managed and unmanaged stands in sustainable patterns. Sawtimber hemlock stands support significantly higher bird communities than young stands. Smaller mammal habitat considerations include dense patches of coniferous regeneration, hard mast-producing inclusions, cavity trees, coarse woody debris, and wetland seeps and inclusions. Forest carnivore habitat considerations include the availability and distribution of predictable prey and suitable cover opportunities (cavity trees, coarse woody debris, wetland seeps and inclusions, and rocky ledge and well-drained den sites). Differences of ten or more inches of annual precipitation distinguish most northern New England landscapes from the majority of landscapes in the western Great Lakes region. Northern New England landscape level habitat elements include lower slope positions and imperfectly drained, excessively drained, or shallow to bedrock sites.

Introduction

Though eastern hemlock (*Tsuga canadensis*) is a well-documented habitat element in winter deer range management throughout the northeastern United States and eastern Canada (Mattfeld 1984; Huot et al. 1984; Blouch 1984; Crawford 1984; Reay et al. 1990), limited research has been conducted specifically on bird and mammal communities in hemlock stands. Roughly 96 avian and 47 mammalian species have been documented using the hemlock type in New England (DeGraaf and Rudis 1986; DeGraaf et al. 1992). Appendix 1 lists eight bird and 10 mammal species strongly associated with the hemlock type.

We review some of the more important landscape and habitat considerations regarding the hemlock type and provide some examples of avian and mammalian habitat associations in the northeastern United States and eastern Canada for birds, small mammals, and forest carnivores.

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³New Hampshire Fish and Game Department, 2 Hazen Drive, Concord, NH 03301

Landscape Level Habitat Elements

Eastern hemlock occurs from the Maritime Provinces in eastern Canada to northern Georgia and west into northeastern Minnesota (Godman and Lancaster 1990). Average annual precipitation in New England ranges from 30-50 inches compared to 21-36 inches in the upper Lakes States (McNab and Avers 1994). Average annual snowfall in New England ranges from 40 to 160 inches compared to 40 to 70 inches and in some sections upwards of 250 to 400 inches along the Lake Superior shoreline (McNab and Avers 1994). This has tended to generally produce abundant hemlock regeneration on coniferous sites in New England in contrast to the difficulties faced by forest managers in the upper Lakes States to regenerate hemlock in the face of significant deer densities (Anderson and Loucks 1979; Alverson et al. 1988; Godman and Lancaster 1990; Mladenoff and Stearns 1993).

Hemlock grows on both imperfectly drained and shallow to bedrock sites as well as excessively drained sites as described by Leak (1982). Secondary successional processes on the Bartlett Experimental Forest in the White Mountains of New Hampshire continue to increase the percentage of hemlock basal area on both managed and unmanaged stands on deciduous as well as coniferous land types occurring on lower slope positions (Figure 1) (Leak and Smith 1996). Extrapolating this information across northern New England land types means there are more opportunities to manage hemlock in distinct stands, mixedwood stands, and coniferous inclusions than in the western Great Lakes region.

Hemlock volume in the northeastern United States is considerably greater in New England than the western Great Lakes region (Table 1) (Powell et al. 1993). New Hampshire timberland acreage in hemlock has increased slightly over the last 25 years from 3.2 to 3.7 percent of the total timberland acreage or 148.3 to 165.7 M acres (Cullen, personal communication). Current size-class distribution of hemlock timberland acreage is concentrated in the sawtimber size-class (120.1 M acres) and pole size-class (45.6 M acres), with almost no discernible seedling-sapling size-class acreage. New Hampshire sawtimber volume has increased over the last 25 years from 1508.3 to 2534.1 MMBF, as has growing stock volume from 596.7 to 832.9 MMCF. These numbers suggest that the hemlock resource is distributed across the New England landscape in much different patterns compared to the patterns seen in the western Great Lakes region.

Potential impacts of an expanding hemlock woolly adelgid (*Adelges tsugae*) population concern forest and wildlife managers over the possible loss of significant sources of winter thermal cover in a variety of site types and slope positions (Evans et al. 1995).

#4 – Taking the Challenge - Real Research : Homework

“Hemlock as Critical Forest Wildlife”

Wildlife Habitat Associations in Eastern Hemlock – Birds, Smaller Mammals, and Forest Carnivores

Mariko Yamasaki
Richard M. DeGraaf
John W. Lanier

#4 – Taking the Challenge - Real Research

Activity #4: Pulling out the Key Information for understanding

- Students Read the Article, answered “study guide” questions (homework)
- Generated a list of wildlife “strongly associated” with Hemlock forests

BIRDS

- Great Horned Owl
- Long-eared Owl
- Northern Saw-whet Owl
- Blue Headed Vireo
- Red-breasted Nuthatch
- Hermit Thrush
- Black-throated Green Warbler

MAMMALS

- Snowshoe Hare
- Red Squirrel
- Deer Mouse
- Southern Red-backed Vole
- Porcupine
- Red Fox
- Black Bear
- Marten
- Bobcat
- White-tailed Deer

#4 – Taking the Challenge - Real Research

Activity #5: Adopting a Species – Who is Your Animal?

- Students used “info” sheets from New England Wildlife (DeGraaf, Yamaski)
- Filling in a chart, they simplified the facts
- Using Google Images and Power Point produced an image view, and a factual sheet.

Porcupine (*Erethizon dorsatum*)



RANGE: Nova Scotia and Quebec w. across boreal Canada to Alaska, s. in the Appalachian to n. Virginia; in the Midwest to n. Minnesota and Wisconsin, and in the West to nw. Texas, Arizona, and e. California.

RELATIVE ABUNDANCE IN NEW ENGLAND: Common to uncommon.

HABITAT: Mixed or coniferous forests especially northern hardwood-hemlock, with adequate denning sites. Not restricted to any plant or edaphic community (Dodge 1982).

SPECIAL HABITAT REQUIREMENTS: Den sites in rock ledges, trees or other protected places.

REPRODUCTION: Age at sexual maturity: 15 to 16 months. Breeding period: October through December, occasionally later. Gestation period: 205 to 217 days, average 210 days (Shadle 1961). Young born: April to June. Litter size: 1, rarely more. Litters per year: 1.

HOME RANGE: Winter ranges averaged 6 acres (2.4 ha) in New Hampshire (Faulkner and Dodge 1962) and 13.3 acres (5.4 ha) in the Adirondacks of New York (Shapiro 1949). Spring and summer ranges ranged from 32 to 36 acres (13.0 to 14.6 ha) in conifer-hardwood forest in Minnesota (Marshall et al. 1962). Varies with climate and habitat (Dodge 1982).

FOOD HABITS: Herbaceous and woody vegetation. Eats large quantities of grasses, leaves, twigs, buds, mast, and bark. Hemlock is a major winter food in the Northeast (Dodge 1967).

COMMENTS: Mainly nocturnal, remaining active throughout the year. Den may be in rocky cavern of ledge, in hollow log, abandoned building, or abandoned fox or beaver den; winter denning may be in groups (Dodge 1982). Generally is solitary throughout the year, may spend the winter in a “station tree,” usually a hemlock or white spruce. May damage commercially grown trees or buildings.

KEY REFERENCES: Costello 1966, Curtis and Kozicky 1944, Dodge 1967, Shapiro 1949.

MATRIX: HABITAT PREFERENCE "PREFERRED"

Local occurrence	SPECIES	Special habitat needs	Seasonal use	Aspen	Paper birch	Northern hardwoods	Red maple	Northern red oak	White pine— Northern red oak— Red maple	Balsam fir	Eastern white pine	Red spruce-Balsam fir	Red spruce	Eastern hemlock
				S Sp St L	S Sp St L	S Sp St L U	S Sp St L	S Sp St L	S Sp St L	S Sp St L	S Sp St L	S Sp St L	S Sp St L	S Sp St L
	Snowshoe Hare <i>Lepus americanus</i>	Dense brushy or softwood cover.	B BF W WF											
	European Hare <i>Lepus capensis</i>	Fields, meadows.	S BF W WF											
	Eastern Chipmunk <i>Tamias striatus</i>	Forest edge or shrub cover, elevated perches, logs.	S BF W WF											
	Woodchuck <i>Marmota monax</i>	Open land.	B BF W WF											
	Gray Squirrel <i>Sciurus carolinensis</i>	Tall trees for dens or leafnests.	S BF W WF					••	••					
	Red Squirrel <i>Tamiasciurus hudsonicus</i>	Woodlands with mature trees, conifers preferred.	S BF W WF							••	••	••	••	••
	Southern Flying Squirrel <i>Glaucomys volans</i>	Mature woodland with cavity trees; favors cavities with entrance diameters of 1.6 to 2 in.	B BF W WF			••		••	••					
	Northern Flying Squirrel <i>Glaucomys sabrinus</i>	Mature trees, cavities for winter dens; arboreal lichens.	S BF W WF			••		••	••			••		
	Beaver <i>Castor canadensis</i>	Woodland streams, lack of disturbance.	B BF W WF	••••	••••		••••							
	Deer Mouse <i>Peromyscus maniculatus</i>	Northern hardwoods or northern coniferous forests.	B BF W WF							••	••	••	••	••
	White-footed Mouse <i>Peromyscus leucopus</i>		B BF W WF			••		••	••					

RED SQUIRREL

American Marten

(Martes americana)



Habitat

- Coniferous forests of fir, spruce, cedar and hemlock
- Swampy areas, dense mixed hardwood-conifer forests

Special Habitat

- Den sites- Lrg. Hollow or logs and subterranean dens
- Summer resting sites in tree canopies ex. Balsams

Reproduction

- Females: 2-3 years
- Males 1 yr.
- Breeding period: late June early Sept. Born mid march to late April
- Litter size-1-5

Home Range

- Summer/Fall ranges, harvested in Maine 5.2km males
- 2.8 km Females

Samples Densities

- Algonquin park –Adult densities 0.6 - 1.2
- Maine ranged from 0.1-1.2

Food

- Masked shrew
- Snowshoe hare
- Passerine birds and ruffed grouse
- Vegetation (fruits, berries, nuts)

Comments

- Commonly called the pine marten- easily trapped
- Pop. is susceptible to over harvesting

Source of Information

New England Wildlife(Habitat Natural History, and Distribution)



Northern Saw-Whet Owl

Aegolius acadicus





- **Habitat:**
- Moist mature woods
- Dense forested wetlands
- Common at forest edges

- **Special habitat:**
- Large trees with large
- woodpecker holes or
- natural cavities

- **Reproduction:**
- Egg dates – April 1 to May 31
- Incubation period – 21 to 28 days

- **Home range:**
- Breeds from s. Alaska, central British Columbia and central Alberta to s. Quebec and n. new Brunswick to s. California, central Mexico, extreme w. Texas, central Missouri, s. Wisconsin, central Ohio, w. Virginia and new York.

- **Sample densities**
- 1 bird per 1.86 miles

- **Food:**
- Mostly small mammals, also insects and small birds

- **Comments:**
- - Smallest owl, males weigh as much as the American robin. Females 25% more. Hunt and roost close to the ground

Source of
Information:
New England
Wildlife (Habitat,
Natural history,
and distribution)

Courtney Blood
Block C
Ecology 1/14/11



Red Breasted Nuthatch

Sitta canadensis

HABITAT

- Breeding: coniferous forest, mixed woodlands
- Coniferous forest wetlands
- Winter: coniferous forest
- Mixed woodland with cone-bearing trees

SPECIAL HABITAT

- Decaying trees or live trees with natural cavities

REPRODUCTION

- Egg dates: May-June
- Nesting period:18-21
- Broods per year: 1 year

HOME RANGE

- S. New Jersey and S. New York
- Winters breeding areas except at the higher latitudes and elevations

SAMPLE DENSITIES

- 0.4 territorial males per 100 acres.

FOOD

- Seeds from spruce, fir, and pine
- Spiders some insects, and spruce budworms
- Summer- seen eating moths

COMMENTS

Red breasted nuthatches are far more common in coniferous forests than in mixed forests.



Source of Information:

*New England Wildlife
(Habitat, Natural History,
and Distribution)*

Danielle Smith

Block C

Ecology 1-14-2011

#4 – Taking the Challenge - Real Research

Activity #6: Building a Hemlock Forest Food Web

Task – Collecting the food data:

- Students studied Food Chains and Webs (Content)

- Students drew out “what eats what” (Skill)

- Students used food habits from “New England Wildlife”

1. Students given “animal cards image/food”
2. Ask to list the animals in a chart , and the foods they consume.
3. Draw a food web using the “Producers” below:

Eastern Hemlock
Northern Red Oak
Sugar Maple
Teaberry
Princess Pine
Partridge Berry



PORCUPINE



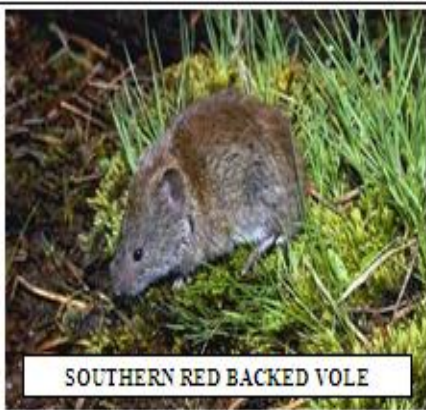
WHITE FOOTED MOUSE

WHITE FOOTED MOUSE

- Seeds
- Acorns
- Nuts
- Fruits
- Tender Green Plants
- Insects
- Carrion

PORCUPINE

- Herbaceous Plants
- Woody Vegetation
- Grasses
- Leaves
- Twigs
- Mast (nuts)
- Bark
- Hemlock (Winter)



SOUTHERN RED BACKED VOLE



FISHER CAT

FISHER CAT

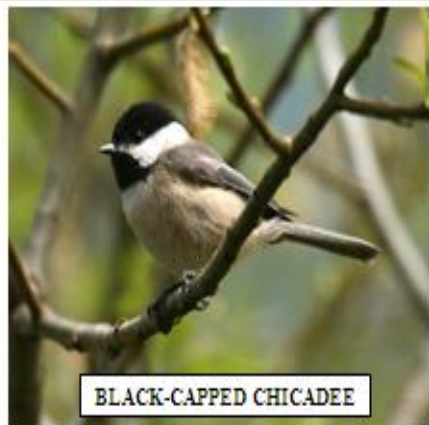
- Mammals
- Shrews
- Mice
- Birds
- Squirrels
- Insects
- Toads
- Berries
- Nuts
- Carrion
- Porcupine

SOUTHERN RED BACKED VOLE

- Green Vegetation
- Seeds
- Nuts
- Fungi
- Bark
- Insects
- Carrion



RUFFED GROUSE



BLACK-CAPPED CHICADEE

BLACK-CAPPED CHICADEE

- Insects
- Spiders
- Seeds
- Fruit

RUFFED GROUSE

- Seeds
- Insects
- Fruits
- Leaves
- Buds of Birch, Aspen, Cherry, Hazel, Hophornbeam

#4 – Taking the Challenge - Real Research

Activity #7: How Crowded is your Species? Will It Survive?

- Students used maps of FWL lands plus Oakmont – Acres = 2,720

- Students used “range” and “habitat” size from data sources

- Students calculated approximate possible density

Porcupine
(*Erethizon dorsatum*)

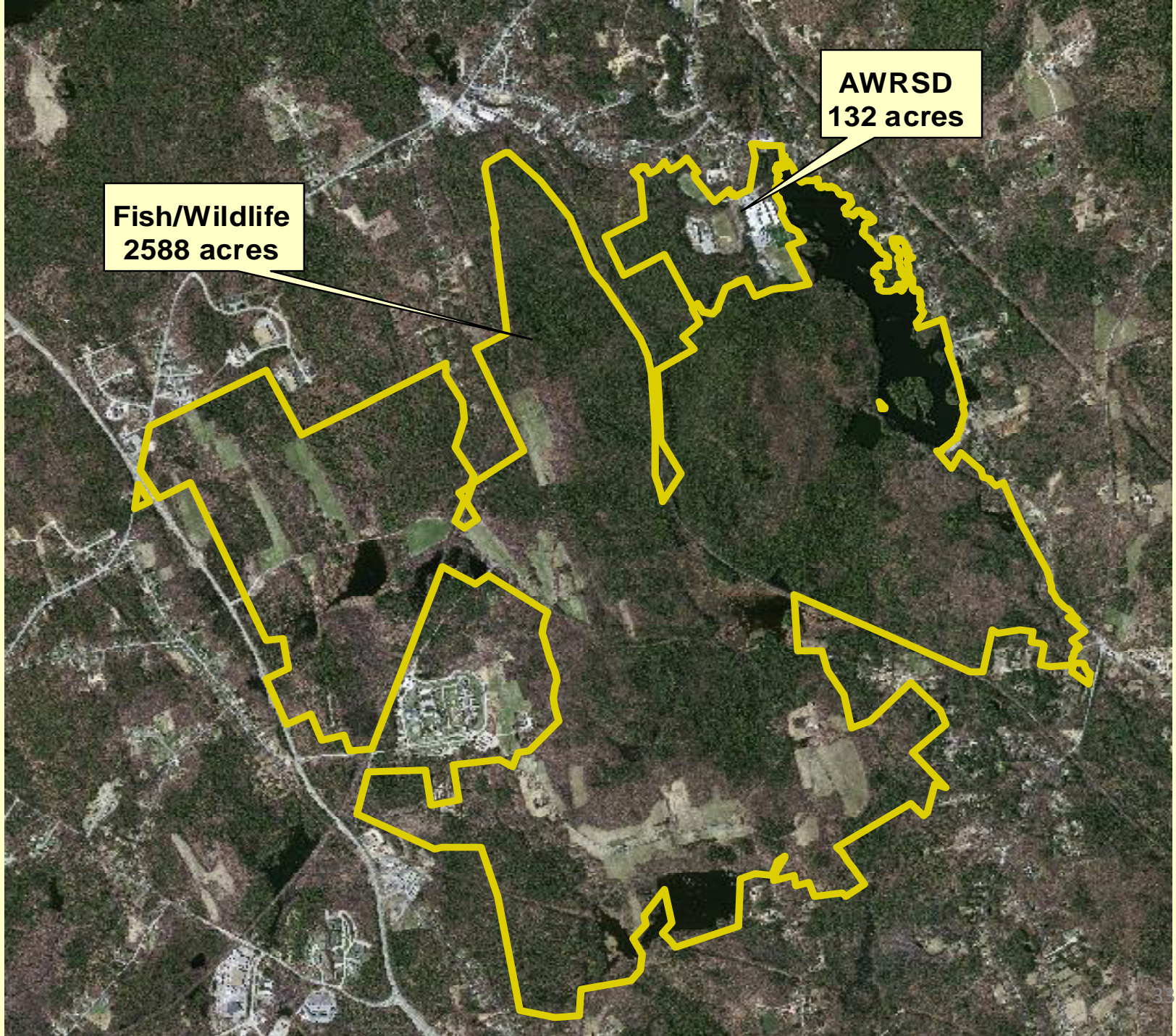


HOME RANGE: Winter ranges averaged 6 acres (2.4 ha) in New Hampshire (Faulkner and Dodge 1962) and 13.3 acres (5.4 ha) in the Adirondacks of New York (Shapiro 1949). Spring and summer ranges ranged from 32 to 36 acres (13.0 to 14.6 ha) in conifer-hardwood forest in Minnesota (Marshall et al. 1962). Varies with climate and habitat (Dodge 1982).

Bobcat
(*Felis rufus*)



HOME RANGE: 2 to 5 linear miles (3.2 to 8 km) for nightly travel in Massachusetts (Pollack 1951). McCord (1977) estimated 26 to 31 acres (10.5 to 12.5 ha) in Massachusetts. In Maine, mean annual home range was 23 km² (8.9 square miles), winter ranges were 30 percent larger than summer ranges (May 1982). In the Catskills, home range was approximately 36 km² (14 square miles) for males and 31.0 km² (12 square miles) for females; Adirondack ranges were estimated to be 325 km² (125 square miles) for males and 86 km² (33 square miles) for females (Fox and Brocke 1983). Ranges farther to find mates or follow prey. In Minnesota, Bobcats traveled 3 to 7 miles (4.8 to 11.2 km) while hunting (Rollings 1945).



**Fish/Wildlife
2588 acres**

**AWRSD
132 acres**

Implementing

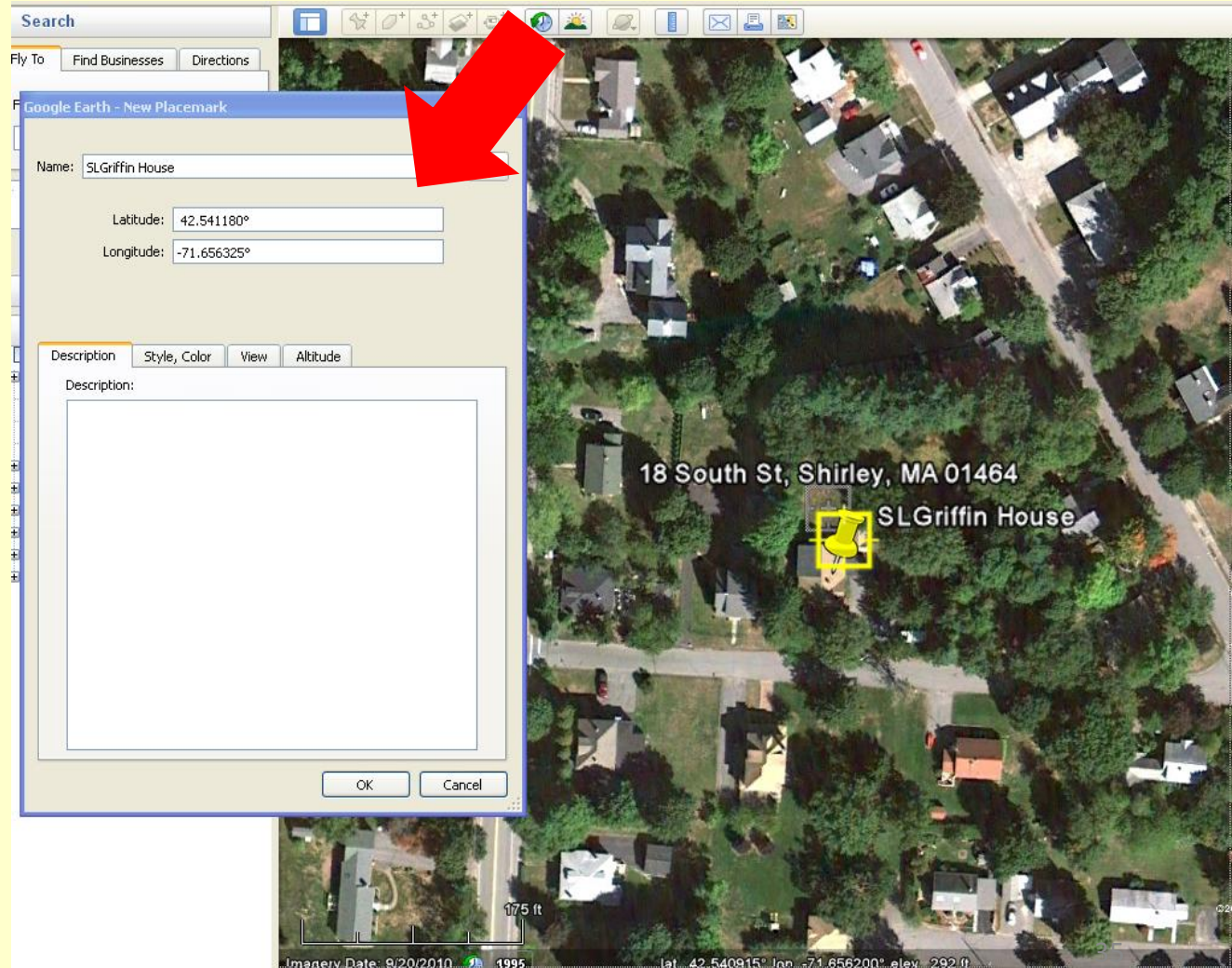
Teacher Goal #3:

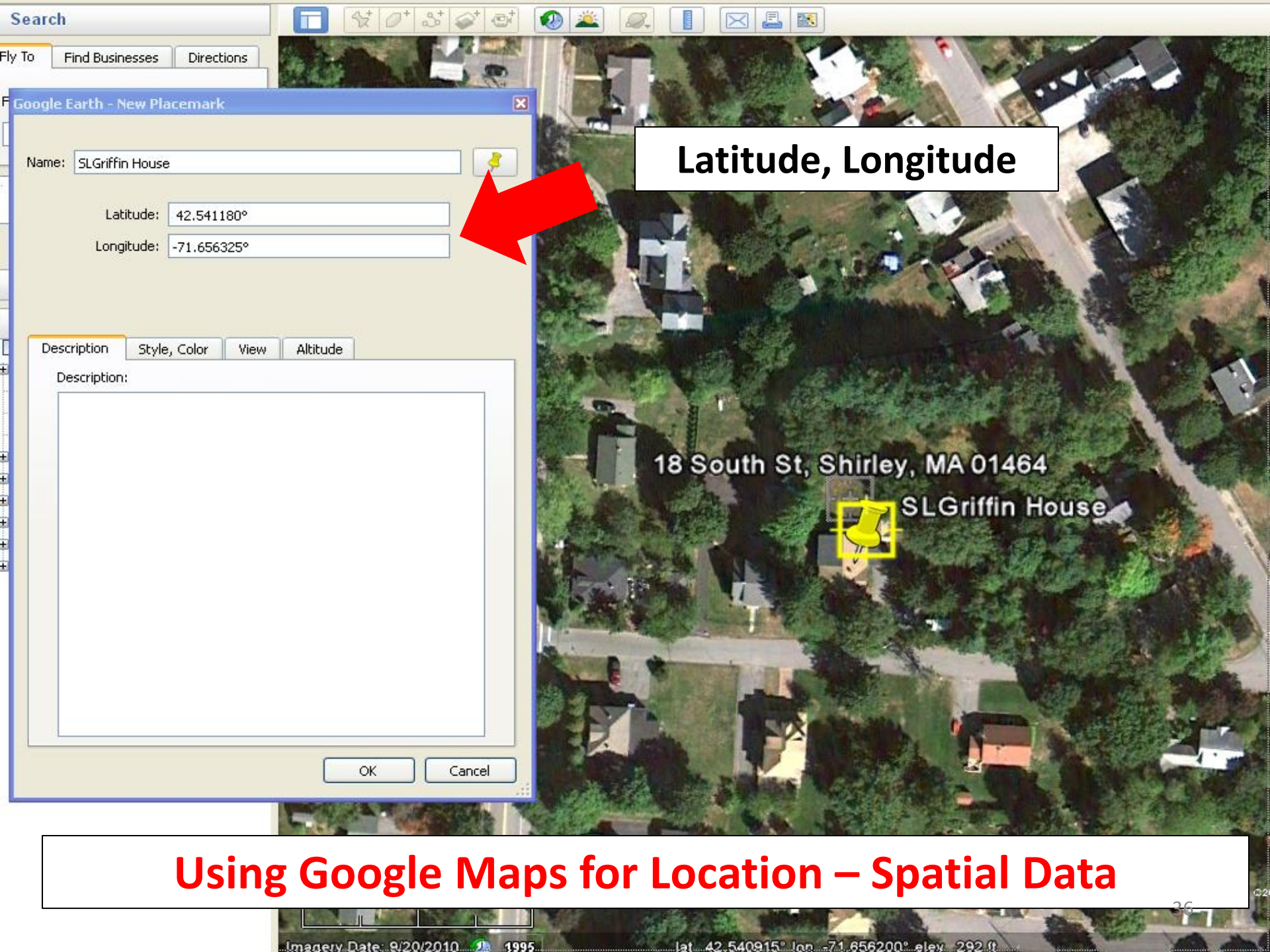
To Involve students in local scientific surveys of HWA infestation at Oakmont, on FWL lands, and on their home property/communities.

#5 – Looking Ahead - Using Spatial Tools: (GIS) to Assess HWA Impact

Activity #8 – Are You Infested? - Surveying Your Home

- Students locate homes (GPS) Google
- Aerial Map generated for each student using GIS
- Students survey home for hemlocks and infestation - use map and GPS



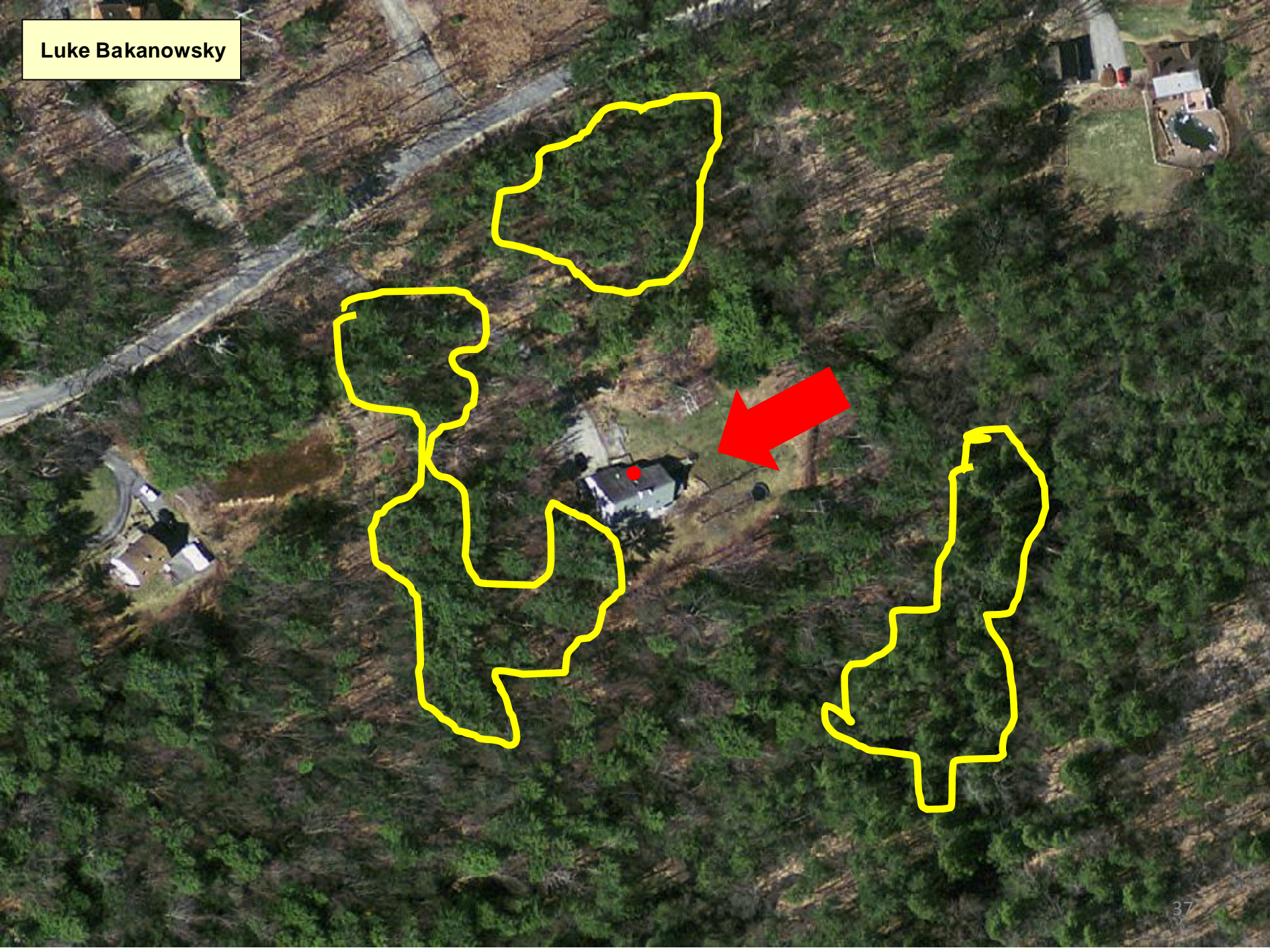


Latitude, Longitude

18 South St, Shirley, MA 01464

SLGriffin House

Using Google Maps for Location – Spatial Data



Implementing

Teacher Goal #4:

**To stimulate student critical
thinking through spatial data
analysis (GIS Tools)**

#5 – Looking Ahead - Using Spatial Tools: (GIS) to Assess HWA Impact

Activity #9 – Infested Neighbors, but How? (*The Abstract*)

- Students read an article about how HWA is spread
- Students answer questions about abstract, discuss and make class list of various hypotheses

Role of Wind, Birds, Deer, and Humans in the Dispersal of
Hemlock Woolly Adelgid (Homoptera: Adelgidae)

Author: McCLURE, MARK S.

Source: Environmental Entomology, Volume 19, Number 1, February 1990, pp. 36-43(8)

Publisher: Entomological Society of America

Abstract:

Activity #9 – Infested Neighbors, but How? (*Potential Hyptheses*)

- Students given pre-made “GIS Maps” representing reported data
- Students use the spatial representation of survey data to prove or disprove a hypotheses.

Studies in Connecticut revealed the following may disperse Hemlock Woolly Adelgid:

- Wind (sticky tape)



- Birds (?)



- Deer (browsing)



- Humans (logging)



Activity #9 – Infested Neighbors, but How?

(Examining “Simulated Data” – Is your team’s hypotheses true or false?)

Dr. Griffin_Sample

Home/Hemlocks

Dr. Griffin_Sample

Sampled Hemlocks 1-10

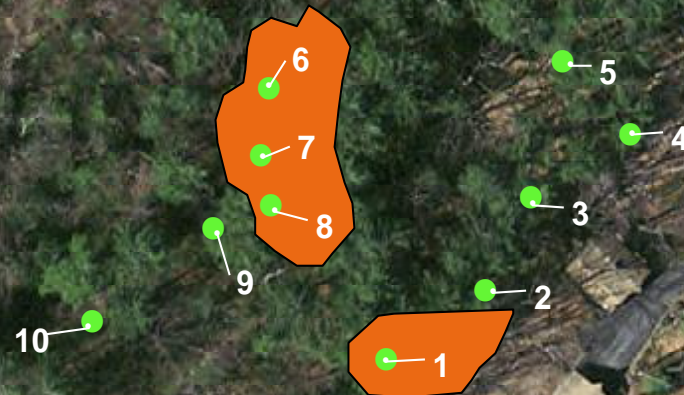


Number of Ovisacs Observed: Small (1-5) = 1, Medium (6-10) = 2, Large (11-15+) = 3

Code	Branch 1	Branch 2	Branch 3	Branch 4	Branch 5	Average Per Tree	Percent of Area Infestation	Comments
G1	1	1	1	2	2	1.4	14%	Infestation on middle branches, not near ground or top
G2	0	1	2	0	1	0.8	8%	Infestation on middle branches, not near ground or top
G3	1	0	0	0	0	0.2	2%	Infestation on middle branches, not near ground or top
G4	0	0	0	0	0	0	0%	
G5	1	1	1	1	0	0.8	8%	
G6	2	3	2	2	2	2.2	22%	Heavy infestation, mostly on branches touching ground
G7	2	1	1	2	3	1.8	18%	Heavy infestation, mostly on branches touching ground
G8	2	2	0	3	2	1.8	18%	Heavy infestation, mostly on branches touching ground
G9	2	1	1	1	0	1.0	10%	
G10	0	0	0	0	0	0	0%	

Dr. Griffin_Sample

Hemlock Clusters – greatest infestation HWA



Dr. Griffin_Sample

Wetland

Land-uses on Site

Deer Run

Evidence of Deer Droppings

Bird
Feeders

Streams

10

9

8

7

6

2

3

4

5



Through our participation in the “Schoolyard Project...” Our Students:

- participated in real field-based ecological research at Oakmont, Fish and Wildlife lands and their homes;**
- had access to Harvard ecologists for assistance;**
- were involved in current environmental issues (Insect invasion/infestation in New England)**

Our students...leaving high school with spatial analysis and research skills...Harvard Schoolyard Project 2011

***S. L. Griffin, Ed. D.
Oakmont Regional High School
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Environmental Planning Class 10-11

Hemlock Woolly Adelgid Survey

Spring Team

