Final Report of Completed Recent Forest Management in Response to the Gypsy Moth at Ludlow Reservoir

Compiled by Michael Mauri, Consulting Forester for the Springfield Water and Sewer Commission, December, 2020

What would you do if you were responsible for a large area of forest that was experiencing a significant decline in tree health and a sharp rise in tree death? What if that forest played an important role in water quality protection? What if that forest also had significant recreational value to the public? And what if that forest also provided other important benefits such as diverse wildlife habitat for both common and rare species, an appreciable timber resource, and a range of other ecosystem services related to quality of life such as improving air quality and absorbing atmospheric carbon? And, finally, what if the significant decline in tree health was impacting the forest's ability to adapt to stresses including other pests and pathogens and climate change?

This was just the problem faced by the Springfield Water and Sewer Commission in its Ludlow Reservoir forest (see Figure A) as it became apparent that a regional infestation of destructive gypsy moth caterpillars had found its way Ludlow Reservoir (formerly known as Springfield Reservoir) (see Figure B). Many local residents may be familiar with the gypsy moth infestation that began little noticed in the years leading up to 2016 and peaked in the growing seasons of 2017-2018 before finally crashing in 2019. Perhaps some local residents will have dealt with the gypsy moth directly in their yards or as officials within their town.

The gypsy moths reached outbreak levels in Ludlow and fed voraciously on the leaves of trees and shrubs over successive years, particularly on the leaves of oak trees, causing a very noticeable and rapid decline in the health and widespread death of a vast number of oak trees throughout the forest. This raised concerns about the safety of the forest along the public walking path as well as the forest's ability to sustain the other important values it provides, such as protecting water quality. By August, 2018, there was still no end in sight to the outbreak.

In response, the Springfield Water and Sewer Commission decided to implement a three-part strategy to ensure that important values provided by the forest will be sustained. This response consisted of the following:

• Using a tree service and logging to remove hazardous trees from the immediate vicinity of the path,

• Using logging in selected areas to establish free-to-grow young forest habitat and widely-spaced areas of thinned trees, and

• Continuing to let most of the forest develop on its own

As a backup surface water supply, the overarching objective of forest management in the Ludlow forest is to ensure continued water quality protection in part by establishing a diverse mix of young trees in some of the most heavily impacted areas. Another primary objective was to improve public safety in heavily-used areas. A secondary objective was to improve spacing around healthy mature trees in some parts of the forest. Indirect benefits of the forest management included capturing some of the resource value of the timber and firewood before deterioration set in, as well as providing areas of young forest habitat that is beneficial to many wildlife species, including species in decline. Active management (such as intervening through logging) and passive management (letting nature run its course) bring different kinds of benefits at different times. The intention in Ludlow was to find a combination that optimizes both of those benefits.

Visitors to the Ludlow path and those previously familiar with the Ludlow forest will notice both the gypsy moth impacts and some aspects of the Commission's response.

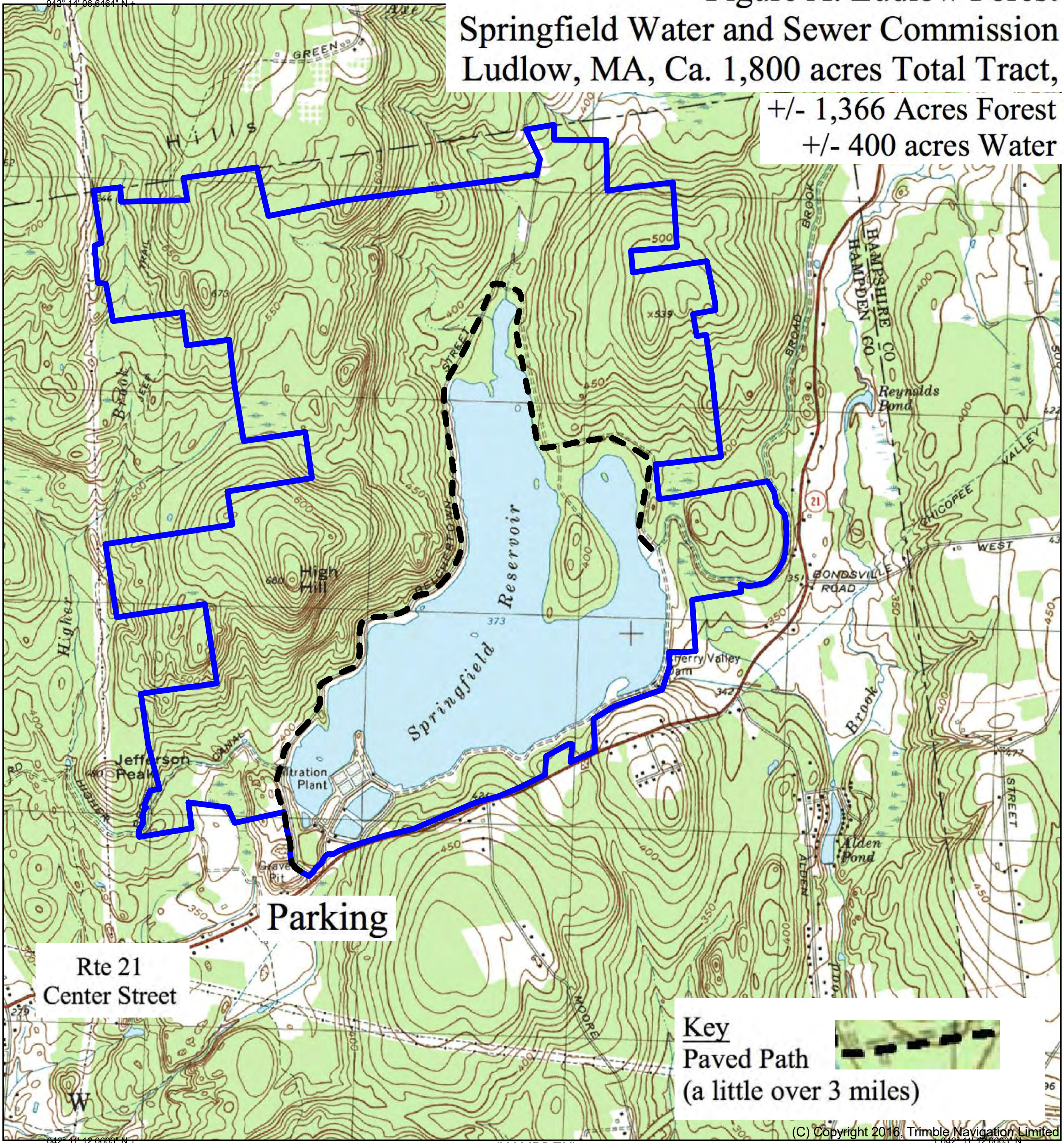
The following pages of maps and photographs will provide further background into the Ludlow forest, the gypsy moth outbreak that impacted it, the Commission's response to date, and thoughts about what to expect going forward.

Contents

Figure A: Ludlow Forest
Springfield Water and Sewer Commission
Ludlow, MA, Ca. 1,800 acres Total Tract,
+/- 1,366 Acres Forest
+/- 400 acres Water

(MT HOLYOKE)

072° 27' 07.9006" W



042° 11' 12.0003" N

072° 27' 07.9006" W

(HAMPDEN)

Printed: Fri Sep 25, 2020

072° 23' 28.4545" W

(SPRINGFIELD SOUTH)

Produced by Trimble Terrain Navigator Pro
Topography based on USGS 1:25,000 Maps

North American 1983 Datum (NAD83)

To place on the predicted North American 1927 move the projection lines 10M N and 39M E

Declination

GN 1.73° E
MN 13.81° W

SCALE 1:25000

Mile | Yards | Kilometer

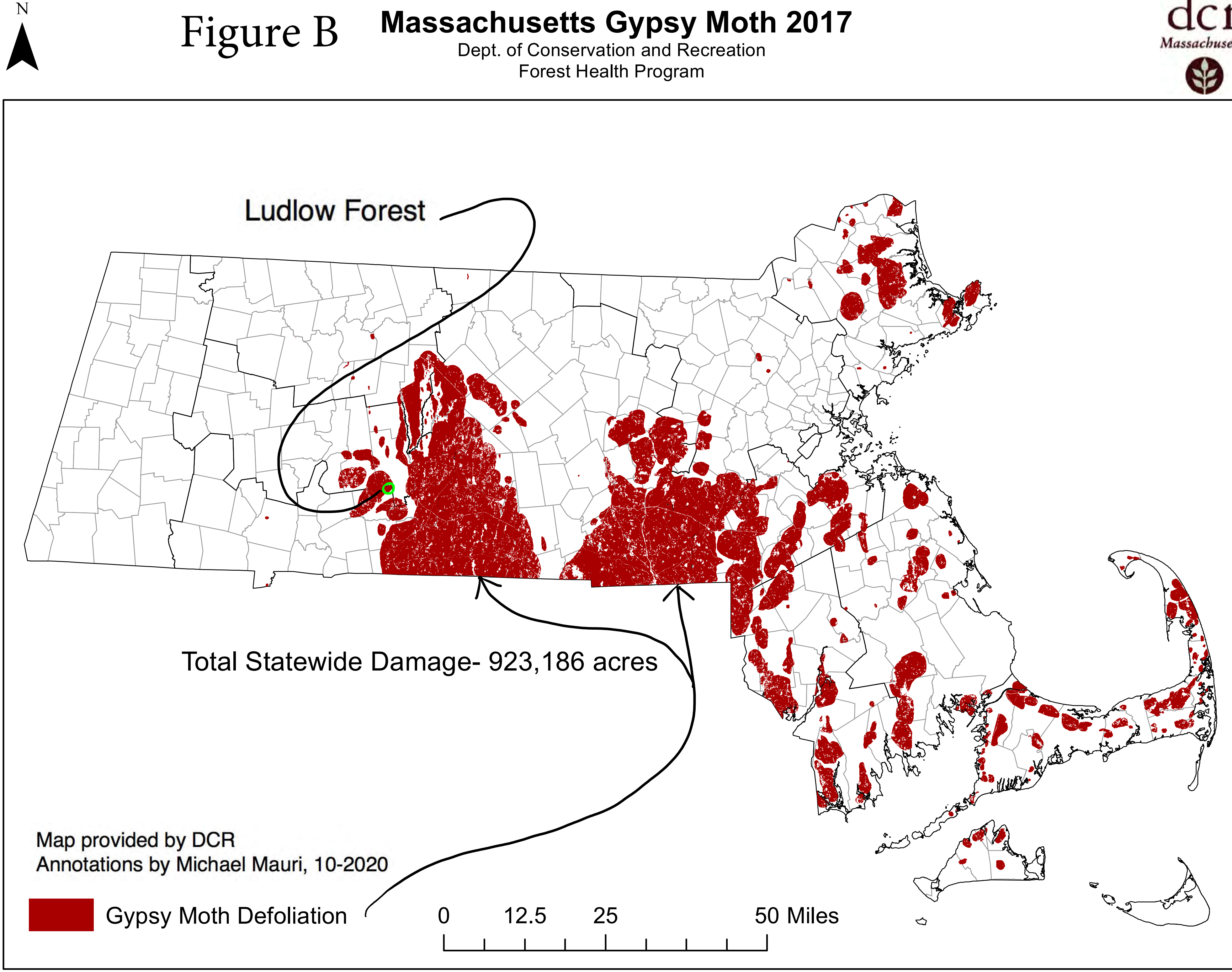
CONTOUR INTERVAL 10 FT

Map by Michael Mauri; LF #161
20 West Street,
S. Deerfield, MA 01373
(413) 665-6829
based on USGS topographic map and boundary information provided by SWSC
Sept, 2020

Figure B

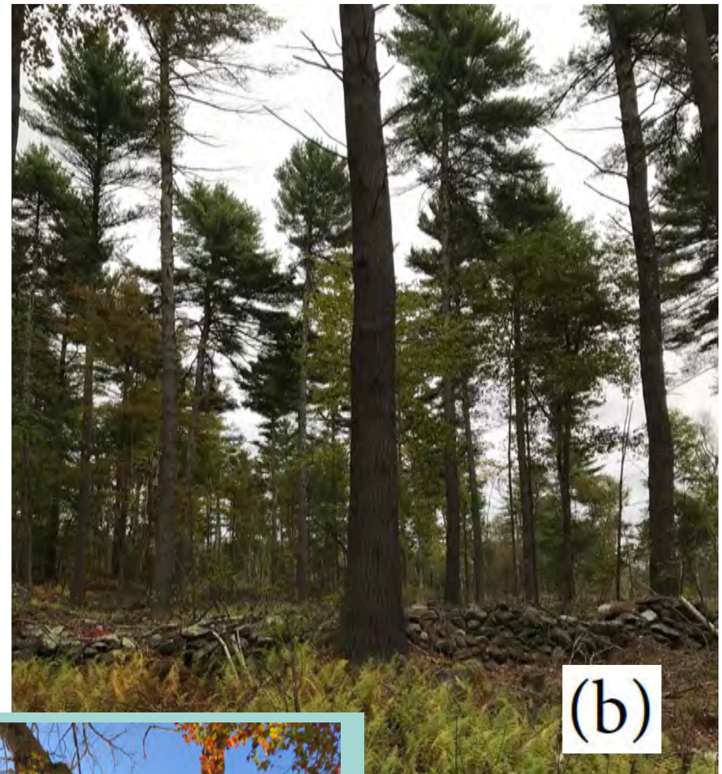
Massachusetts Gypsy Moth 2017

Dept. of Conservation and Recreation
Forest Health Program

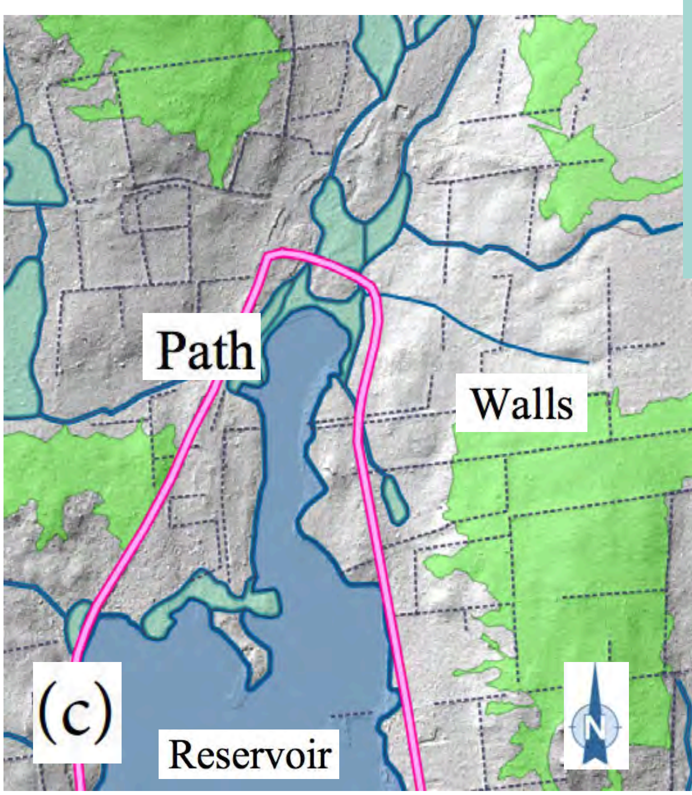


Map Created by N Keleher DCR Forest Health 10/23/2017

Figure 1-1: Ludlow Forest History

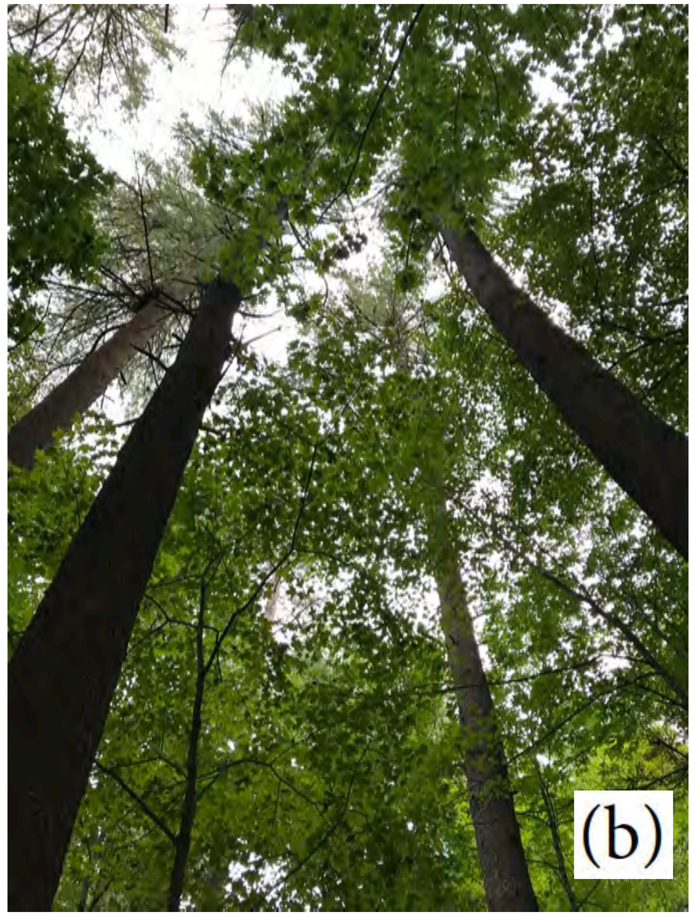


The forest we see in Ludlow today has been shaped by a long and interesting history.



View of the water from the paved walking path around Springfield Reservoir (a). Prior to its construction in the 1870s, the land that is now underwater and much of the forest surrounding it were open farmland. Roughly 14 miles of stone walls such as this one in a recently-thinned pine grove run through the forest (b). A sample of the remarkable network of stone walls is provided by the dashed lines on the adjacent map showing the north end of the reservoir (c). An old oak tree that originally grew in an open field next to a wall (d).

Figure 2-1: Ludlow Core Forest Types



The Ludlow forest contains about 140,000 large trees (trees ≥ 8” diameter). Of these, about 2/3 are either red oak, white pine or red maple.

Red oak, seen here after a recent thinning, is the single most abundant tree in Ludlow (a). White pines reach great heights (seen here with a hardwood midstory) (b). Red maple is most abundant in the lower slopes and wetter areas, often in a mix with tall ferns and shrubs. The dominant tree species occur in diverse mixes with other trees, including other oaks, sugar maple, birches, ash, hickory and hemlock. These core forest types produce a diverse mix of fruits important to wildlife including acorns, prickly dewberries and winterberries (d).

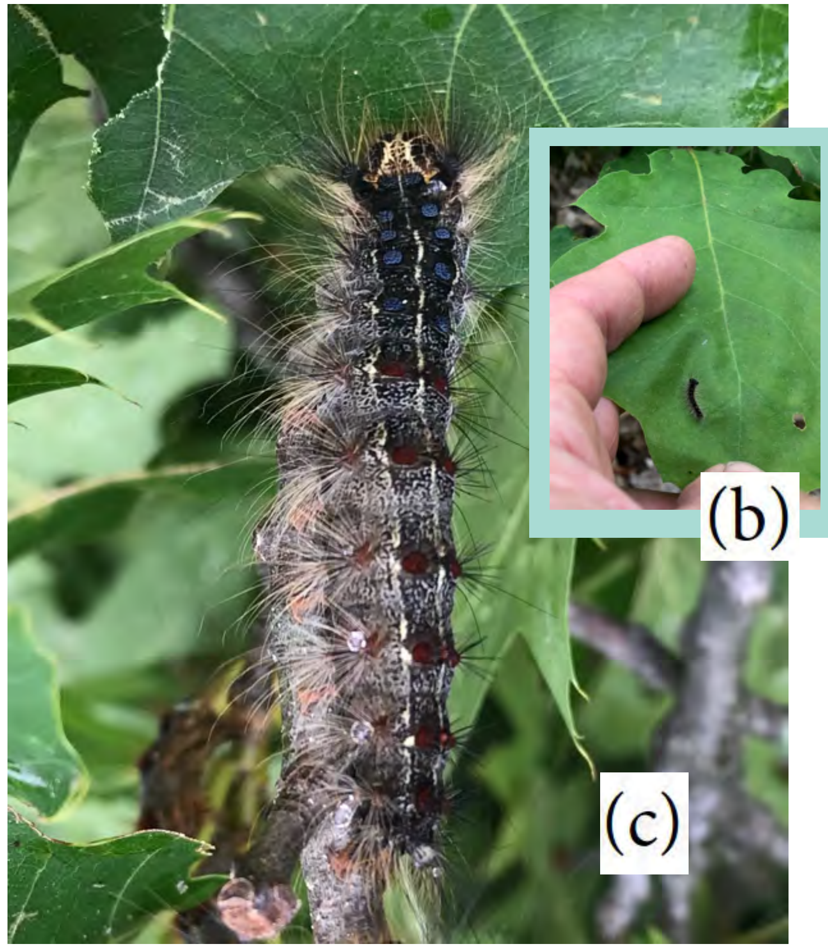
(d)

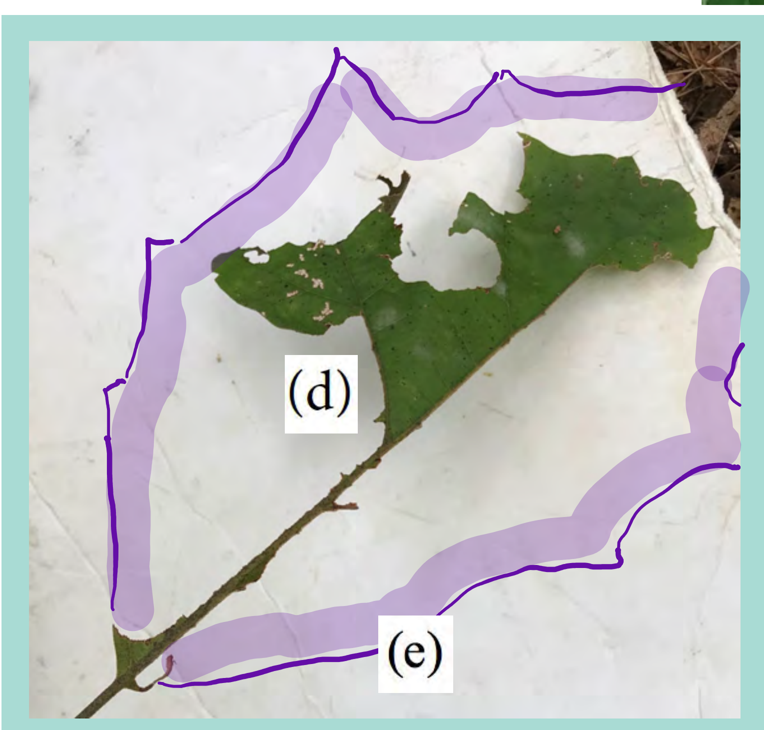
Figure 2-2: Forest Tree and Shrub Diversity

Diversity contributed by non-dominant tree and shrub species makes a forest richer, helping support a greater diversity of wildlife and helping the forest stay resilient in the face of ever-evolving challenges including climate change.

In addition to dominant red oak, there is also scarlet oak, black oak, white oak and, to a very minor extent, chestnut oak such as this one on High Hill (a). There are minor trees and tree-like shrubs including this sassafrass (b), as well as ironwood and musclewood. Shrubs in the Ludlow forest include winterberry, spicebush, beaked hazel, maple-leaved viburnum, lowbush- and highbush blueberry, black huckleberry and its taller cousin known as blue huckleberry (C).

Figure 3-1: Gypsy Moths in Ludlow

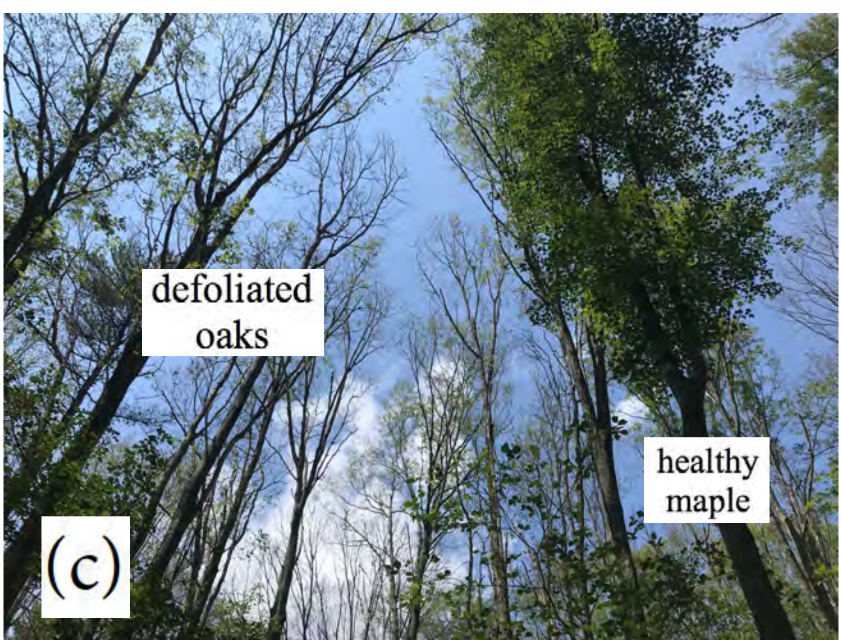




Though becoming a moth in its mature life stage, it is as a voracious caterpillar that the gypsy moth defoliates trees. Oaks are a preferred species.

Gypsy moths hatching in Ludlow on May 7, 2019, after overwintering in their light-brown fuzzy egg masses (a). Defoliation begins early on with small caterpillars taking small bites of leaves (b). The caterpillars grow larger and feed more heavily through the early summer (June 21, 2019) (c). By the end of the growing season, oaks, in particular, may have no remaining leaves or may have what appear from the ground to be “shredded” remains of leaves such as this leaf as seen on September 17, 2018, greatly compromising growth (d). The purple line shows an estimate of the original leaf size (e).

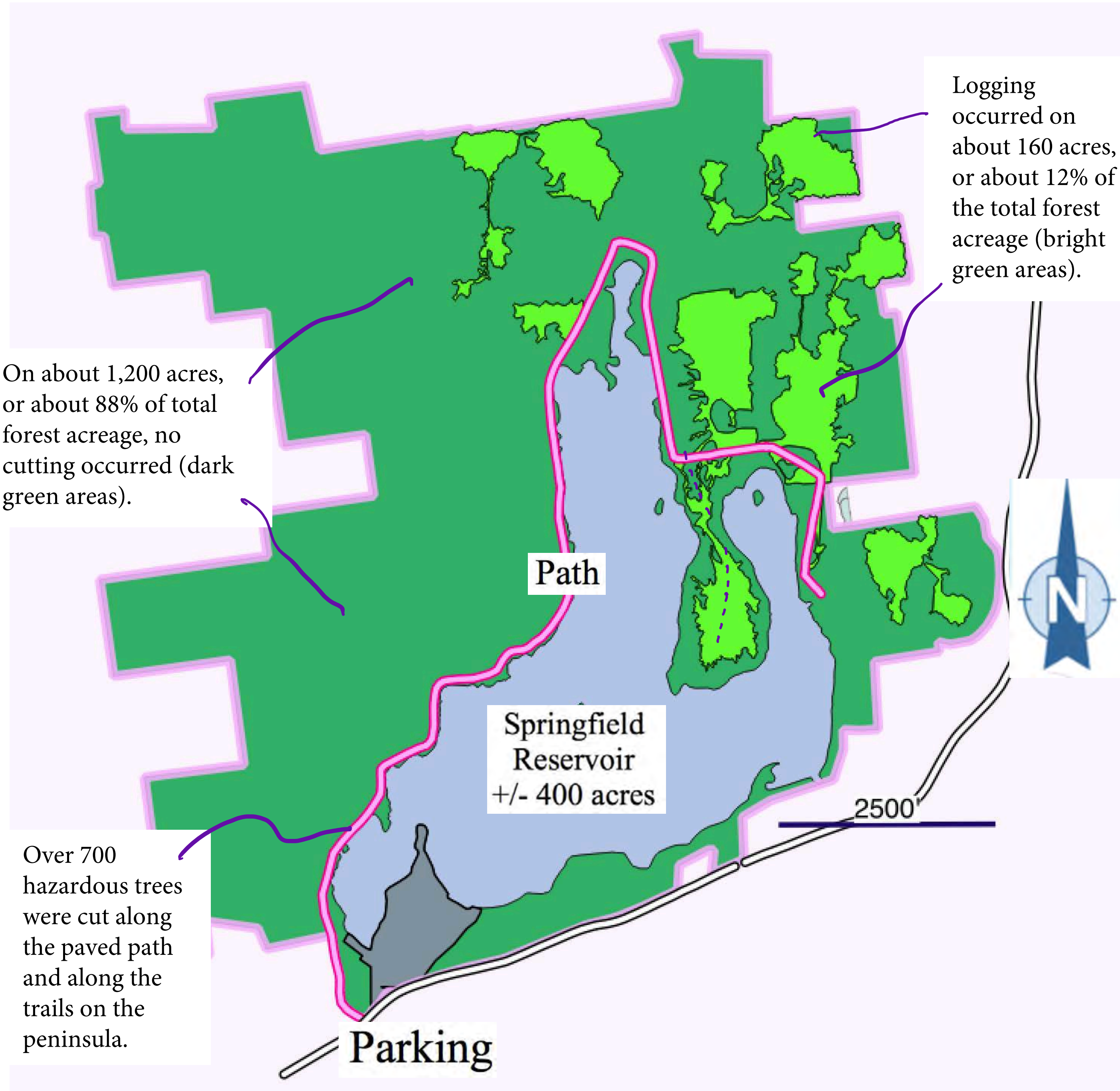
Figure 3-2: Gypsy Moth Impacts in Ludlow



About 1/3 of all large oaks, totaling more than 25,000 trees, were directly or indirectly killed by gypsy moths in the recent outbreak (ca. 2016 – 2019).

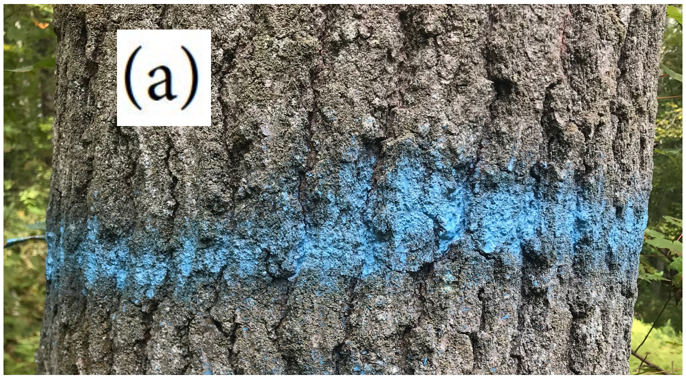
Even large, apparently very healthy oaks died as a direct or indirect result of successive defoliations over several years. Large dead oaks seen in September 2020 (a) & (b). Group of large oaks either totally defoliated or with shredded leaves seen on August 8, 2018. A red maple in the foreground shows what a healthy tree normally looks like at this stage of the growing season (c).

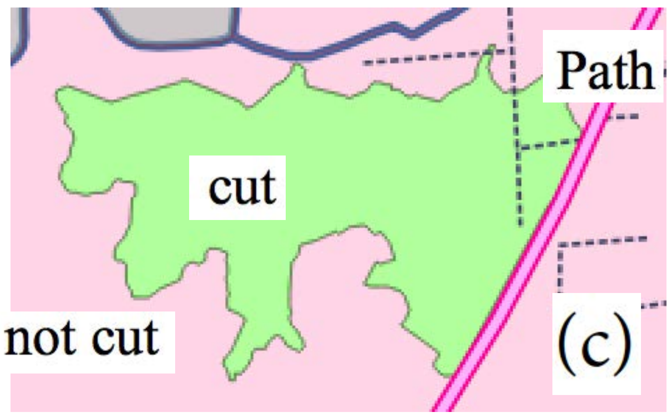
Figure 4-1: Forest Management in Ludlow in Response to the Gypsy Moth

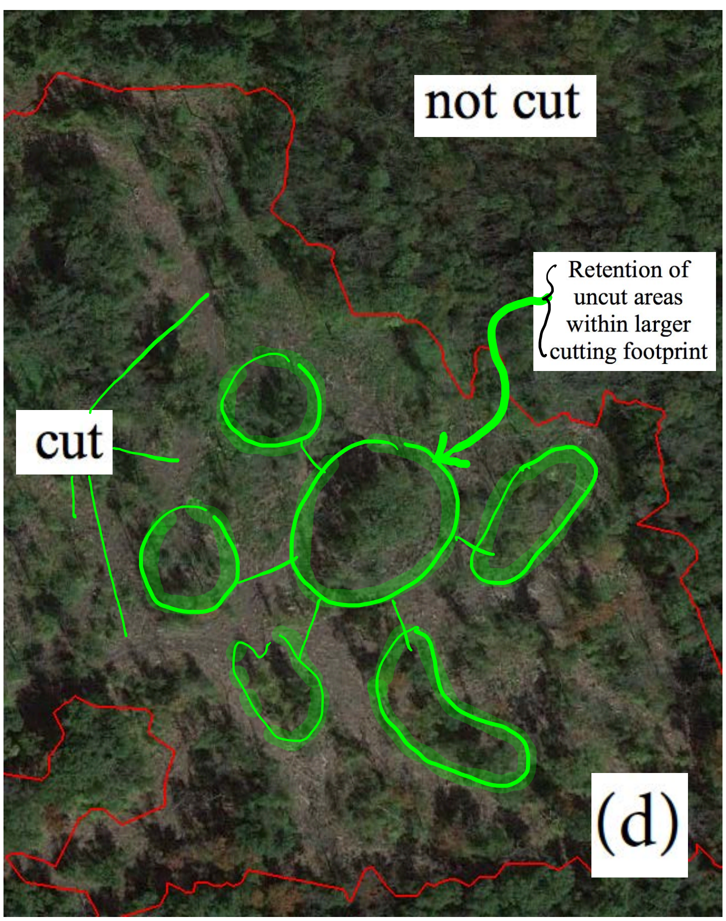


In designing a comprehensive response to the gypsy moth infestation, the Commission decided to take a variable approach that included removing hazard trees along the paved path *and* logging in selected areas in order to establish new trees or to improve spacing around existing trees, while leaving most areas alone to continue to develop and change naturally.

Figure 4-2: Forestry Methods used in Ludlow







A variety of forestry methods were used to direct the logging process and create the conditions for the next stage of forest growth.

Each tree to be cut was marked in blue paint, providing the loggers with a clear set of on-the-ground instructions (a). Pink flagging was hung on selected trees to provide additional clarity about important features to protect, such as these yellow birch stems (b). The area marked for logging was irregular in shape (see green area), following natural patterns that allowed the retention of desirable forest features around the edges, such as large, healthy trees (c). Even within the heaviest areas of cutting, a significant component of the pre-existing forest was retained to provide continuity (Google aerial image showing portion of Ludlow forest post-logging, 9-18-2019).

Figure 4-3: Logging in Ludlow 2019-2020

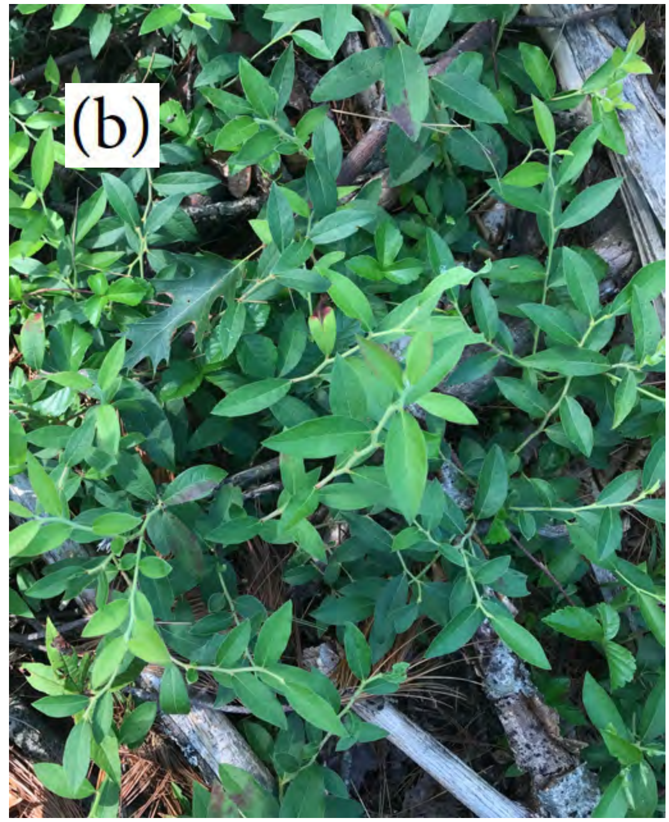
In the multi-step logging process, the loggers cut standing trees that had been previously marked in blue paint by the forester, and then turned them into logs, firewood, pulpwood and in some cases chips.

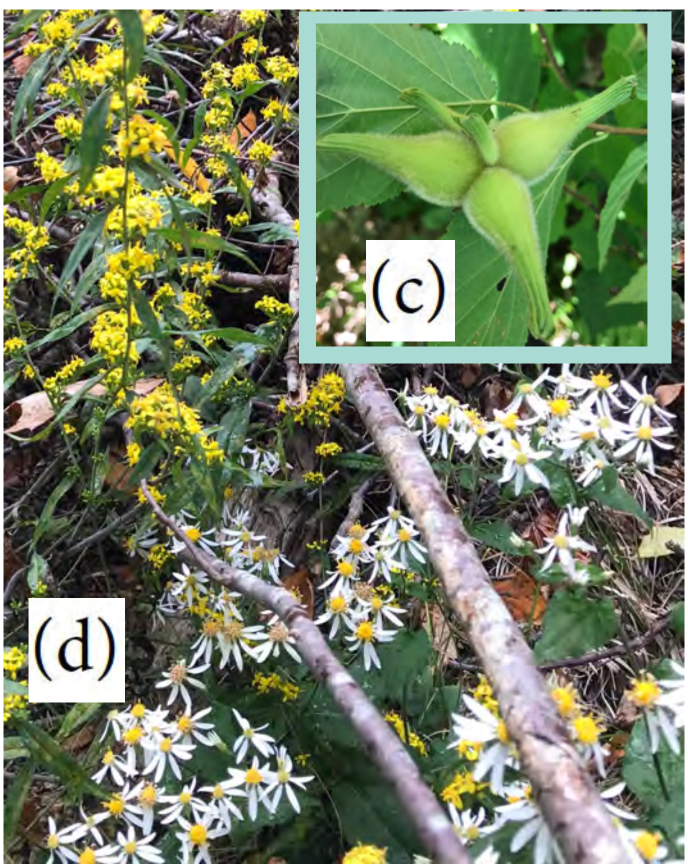
A number of logging systems were used. Ultimately, all forest products to be sold were taken out to a log landing where they could be loaded onto trucks. Selected pictures show oak stems in the forest ready to be pulled out to the landing (a), a grapple skidder for pulling logs (b), a logging trail (c) and a log landing with log piles on either side (d).

Figure 4-4A: Intriguing Conditions for Young Forest Establishment

Openings were created in designated areas to let in ample light for the establishment and growth of a diverse mix of trees, including oaks, while also retaining a significant component of pre-existing features such as tall trees (both live and dead) and unusable tops from logging (known as "slash") and shrubs such as lowbush blueberry. Though messy in appearance, this starting point for young forest is ecologically more complex and diverse than if an even greater level of cutting and a lot of "clean up" had occurred.

Figure 4-4B: Young Forest Details





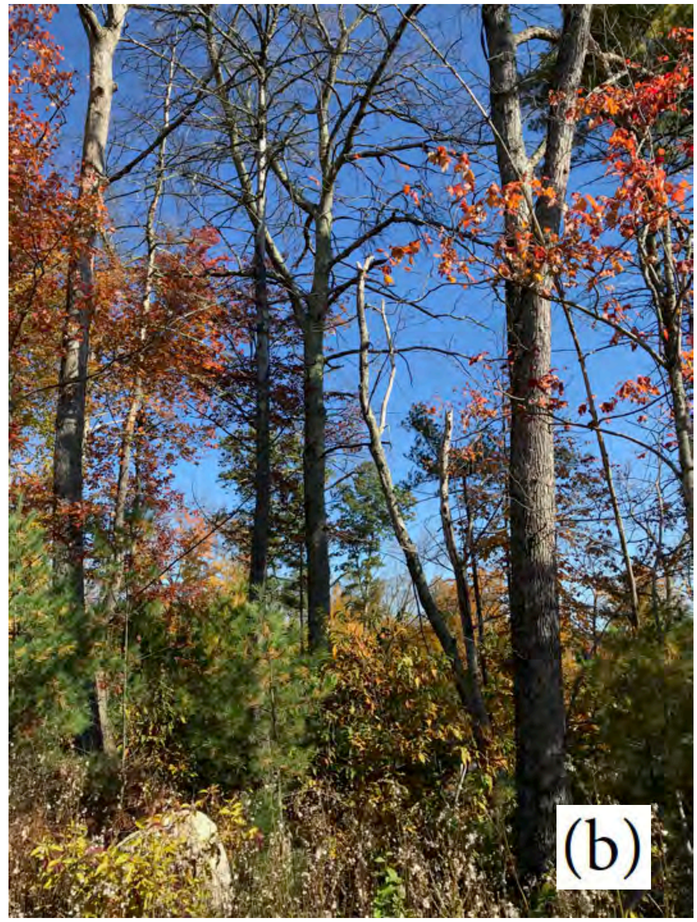
Without the shading canopies of tall trees, sunlight can reach the forest floor, stimulating the growth of a wide variety of plants, including a diversity of desirable trees and shrubs.

A top forest management objective in Ludlow is to ensure that a new generation of oak trees can thrive. Though acorns sprout in shaded forest floor environments, the seedlings often do not persist or thrive there due to the shade of taller plants and feeding by deer. This white oak seedling is in nearly full sun and should be able to grow rapidly (a). Full sun increases the abundance, flowering and fruiting of many plants that benefit wildlife such as this lowbush blueberry (b), this nut-bearing beaked hazel (c) or these pollen-rich goldenrods and asters (d).

Figure 4-4C: Retention of Complex Structure Within and Near Logged Areas

Shown here: a tall healthy white pine and red oak in a complex, layered canopy including tall dead oaks. A silvicultural approach based on an irregularly-shaped cutting footprint, thinning in pine-dominated sections, and the inclusion of no-cut patches within larger openings allowed for a significant amount of pre-existing forest features to be retained both within and around the logged areas.

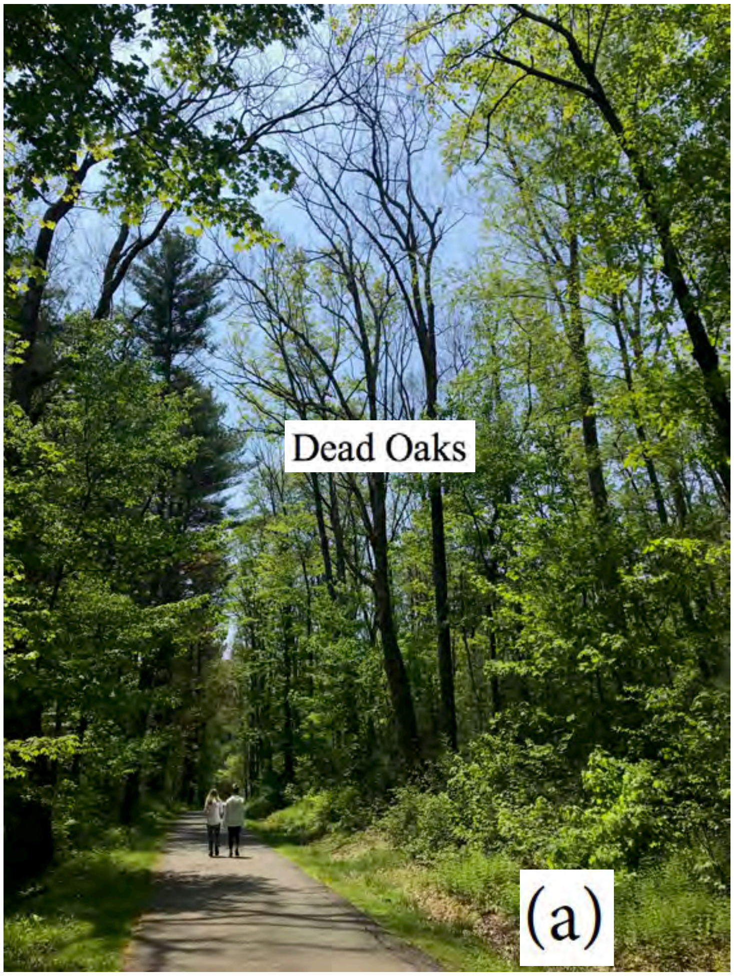
Figure 4-4D: Complex Retention Details



The logging was intended to create conditions for young forest, improve spacing around healthy trees, and improve safety. The intention was not to "clean up" the forest. Within the footprint of the cutting there was significant retention of ecologically beneficial, pre-existing forest components.

Live healthy oak trees in background and tops of logged oak trees in the foreground creating a diverse forest floor environment (a). An uncut patch of diverse, layered forest with both live and dead trees retained within the cutting footprint (b). Standing dead trees or "snags" (in this case oaks) such as those retained within this opening are a favorite of woodpeckers.

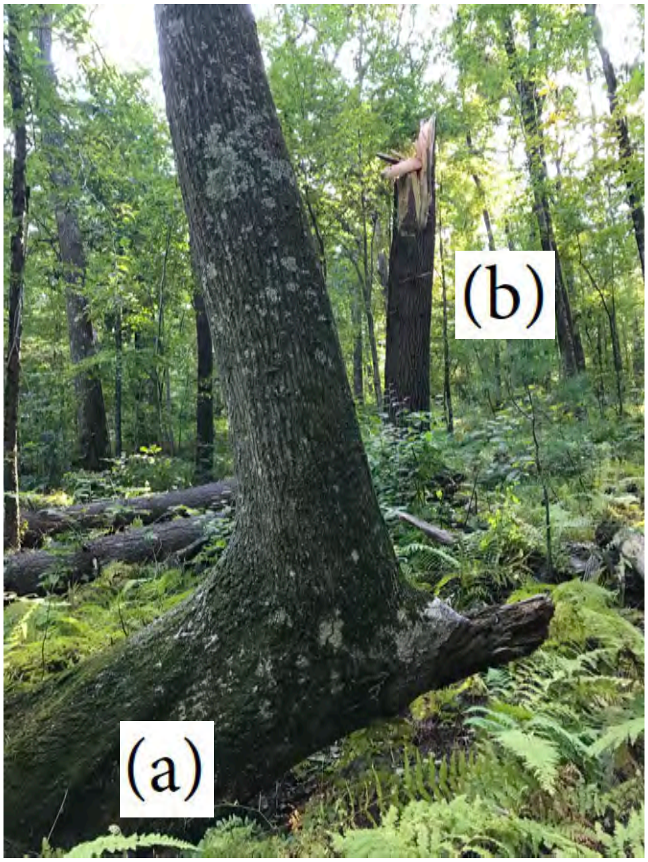
Figure 4-5: Hazard Tree Removal

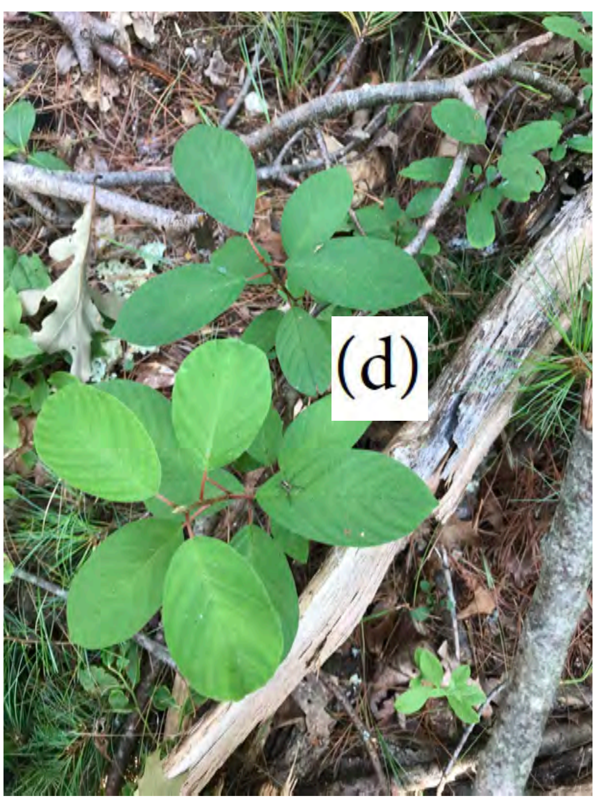


Dead, rotten and overcrowded trees alongside the path were identified for removal. Most of these were oaks, but there were pines and other species as well.

Prior to cutting, tall, dead oaks like these stretched over the path in May, 2019 (a); a tree service using a bucket truck to remove dead oaks in December, 2019 (b); a dead oak that was cut near the path is no longer a threat (c); many dead oaks were removed from near the path by adjacent logging (d).

Figure 5-1: Other Impacts on the Forest

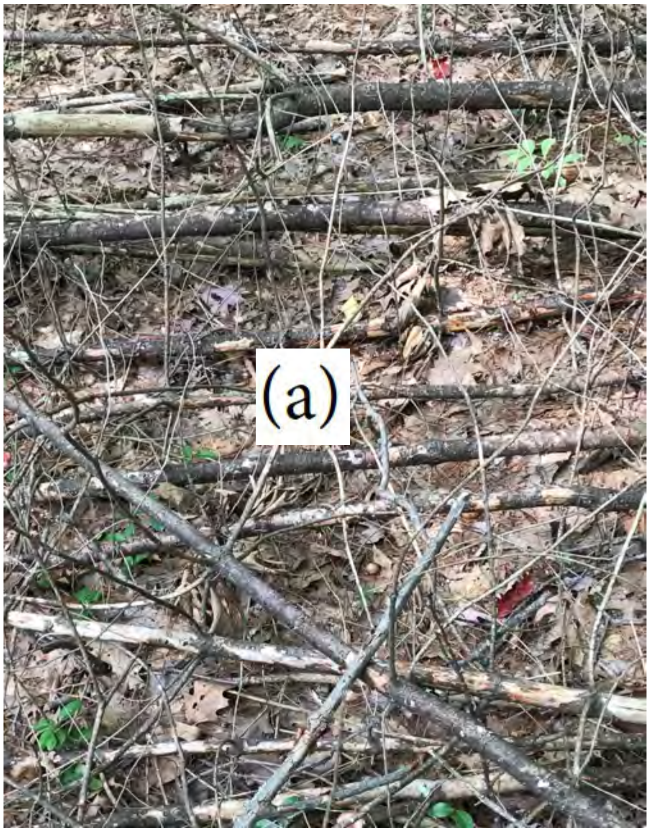




In addition to gypsy moths, many other factors are at work shaping the forest; some add beneficial complexity and diversity, while others detract from it. Forest management must deal with all of these factors. A sample is given below.

A large red oak that was bent by the 1938 hurricane, only to be killed by gypsy moths around 2018 (a), and a large white pine that was snapped off by winds in summer 2020 (b) . Main stem of a red oak seedling chewed off by deer – when occurring at excessive levels, the feeding habits of deer have a profound and negative impact on the diversity and growth of the forest (c). Appearing harmless and perhaps attractive, these seedlings of glossy buckthorn belong to a group of non-native invasive plants that can spread quickly, grow prolifically and ultimately outcompete native vegetation (d).

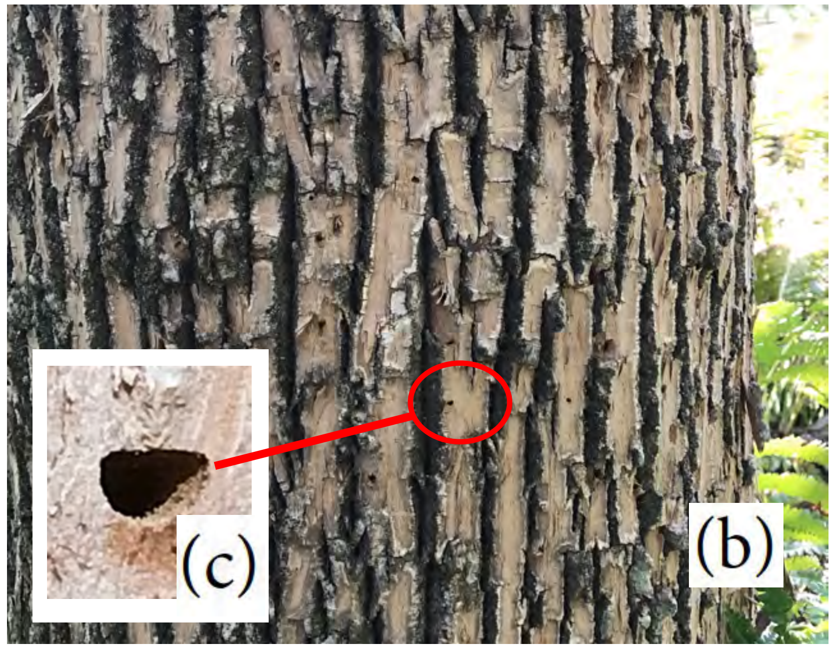
Figure 5-2: Climate Change and Forest Resilience

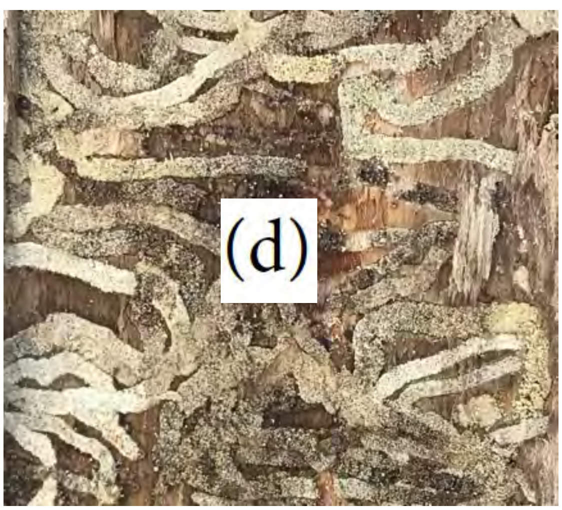


Forests already face many challenges. If the climate of Southern New England continues to become warmer and wetter, stressful impacts on the forest will likely increase. A forest with its full range of diversity and complexity will be best able to adapt and thereby to protect water quality. Forestry will be called upon to sustain diverse and complex forests and thwart factors that interfere with essential forest capacities.

These dead white pine saplings, once growing vigorously, were impacted by a combination of drought prior to 2018, a recently identified fungal pathogen (Caliciopsis) and persistent overstory shade (a). Introduced pests, pathogens, and invasive plants may increase or become more virulent with climate change, intensifying stress on the forest. American chestnut, once an important canopy tree, has been reduced to shrub-like sprouts ever since the chestnut blight, a fungal pathogen, was introduced in the early 20th Century (b). Maintaining a diversity of native trees including those whose natural range extends far to the south of New England, such as these hickories - pignut (c) and shagbark (d) - may help ensure that the forest can adapt to a changing climate.

Figure 5-3: Emerald Ash Borer Detected at Springfield Reservoir 9-21-2020





Comprising only about 1% of all overstory trees in the Ludlow forest, white ash is one of a group of less-abundant but nonetheless important species that add diversity and potential adaptive resilience to the forest. Emerald ash borer (EAB) is an invasive insect that has been slowly spreading through Massachusetts and killing ash trees. Unlike oaks in the recent gypsy moth infestation, *most* ash trees are expected to die. The impact - a loss of functional and adaptive capacities that help protect water quality - will be strongest in the wetter areas where most of the larger ash trees occur. And though other species (e.g. red maple, yellow birch) can substitute some of the benefits ash provides, this comes with the risk of greater reliance on this smaller set of species, increasing future vulnerability to other pests or pathogens,

Tall, dead ash tree (a)" blonding" of ash caused by woodpeckers looking for EAB larvae, and D-shaped exit holes made by emerging adults; (b) enlarged view of D-shaped exit hole of an EAB adult; (c) feeding galleries of EAB larvae under the bark; (d) epicormic sprouting by an ash making a last effort to stay alive (e). Note: at the time of the 2018 Ludlow inventory, half of the ash were already dead due to other factors. Due to its low abundance, ash comprised only 6 out of 410 trees 8" in diameter or larger observed in a non-biased systematic sample. All pictures at Ludlow 9-21-2020 by M.M.