Banningwood Preserve

102.75 Acres - Natural Resource Survey

May, 2017

Lyme, Connecticut

TABLE OF CONTENTS

	Page
INTRODUCTION AND MANAGEMENT GOALS	3
REGIONAL CONTEXT	6
GLACIAL GEOLOGY AND SOILS	7
LANDSCAPE RESOURCES	10
Insect Pests and Pathogens	14
Woodland Composition	15
Canopy Cover Types	16
Understory Shrubs	19
Non-native Woody Invasives	19
Rare and Endangered Species	21
WILDLIFE RESOURCES	22
Water and Wetlands	23
Edge	25
Snags	26
Cavities	26
Mast	27
Browse	27
Cover	28
Coarse Woody Debris	28
MAPS	
Aerial Photograph from 1934	4
Aerial Photograph from 2016	4
Wetlands and Topographic	23
TABLES	
Table 1 – Trees and Relative Occurrence on Banningwood	18
Table 2 – Shrubs and Relative Occurrence on Banningwood	19
Table 3 – Non-native Shrubs and Relative Occurrence on Banningwood	21
Table 4 – Summary of Wildlife Resources Present on Banningwood	29

INTRODUCTION AND MANAGEMENT GOALS

This Natural Resource Inventory for the 102.75-acre Banningwood Preserve was prepared in conjunction with the Lyme Land Conservation Trust. The property was acquired by the Lyme Land Conservation Trust in 2013 and is open to the public for passive recreation. Roaring Brook defines this preserve with its waters flowing to Whalebone Cove, a near-coastal estuarine system of international significance. The property's diversity between stages of wetlands and uplands and a complex geology highlight this dynamic ecosystem. Such a landscape presents opportunities for study and education, from the geology that everything "sits on" to the tree canopy layer and all that is in between.

Land-use history would indicate that for the first few centuries, after European colonization, the land was used primarily for agriculture. The 1934 aerial photograph seen on page 4 shows the Preserve reverting from pastureland and scattered hayfields back to woodland.

Today, remnants of this agricultural past are documented by stonewalls and scattered red cedar and some openings in woodlands. The glacial meltwater soils that predominate over nearly a third of the property would have lent themselves to pastureland, being mostly stone free, but too acidic and excessively drained for row crops. The floodplain soils along roaring brook may have been in row cropping, but they sit just a little low to the water table with the prospect of stream flooding making tillage unpredictable from year to year.

To the north where the glacial meltwater soils of the lowlands meet the ice-laid glacial tills of the uplands, the land rises quickly with its combination of soil, rock debris, and bedrock outcrops. The wooded uplands may have been in grazing or in timber, as it appears these uplands were never completely cleared. What makes this transition particularly interesting is that it marks the fault zone where two ancient continents came together over 250 million years ago.

Banningwood 1934 Aerial Photograph

Banningwood 2016 Aerial Photograph

In total, the property represents a diverse mix of geological types and habitat ranging from wetlands and floodplain forest to upland forest and rising in places to dry, ridge top woodlands. Management of this system to both protect and enhance the Preserve's ecological values while promoting it for passive, public use and education is the goal of the Lyme Land Conservation Trust. In particular the land trust wishes to

- conserve a diverse and healthy suite of habitats
- provide public access and recreational use
- encourage scientific research
- promote educational opportunities

The first objective of this document is to identify and portray the array of natural resources found and how they contribute individually and in combination to the broad spectrum of vegetative and habitat types that comprise the Banningwood Preserve. These are evaluated in an addendum document in relation to identifying those unique geologic and ecological examples that best represent our understanding of the system as a whole. It is this knowledge of the land's potential to enhance a coming together of people and nature that is at the heart of the planning process.

Field data for this report were collected using a plot transect grid system. Plot transect lines were laid out in an approximately east/west axis with plot sampling taken every 500 feet. Parallel transect lines were 500 feet apart.

REGIONAL CONTEXT

The 103-acre Banningwood Preserve is part of an area of Connecticut known as the Eastern Coastal Ecoregion[1], a seaboard region lying within five to seven miles of Long Island Sound. The topography of this ecoregion is characterized by coastlands that include a level but rolling near-shore landscape and rocky uplands extending to the coastline. Regional elevations vary from sea level to 300-400 feet above sea level. Elevations on Banningwood Preserve range from a high of around 230 feet along the northern border to a low of 55 feet where Roaring Brook exits the property under Route 82.

Soils in this ecoregion are developed on unsorted glacial till in uplands and on deposits of stratified sand, silts and gravels in the river valleys. All of these soils overlay metamorphic bedrock of gneisses and schists folded into belts with various trends. On the Banningwood Preserve glacial till is present on uplands while deposits of layered sands and gravels, a product of glacial meltwater deposition, are found throughout the Roaring Brook valley.

From a watershed perspective, Banningwood Preserve is in the Whalebone Creek drainage basin that in turn is part of the larger Connecticut River watershed. Roaring Brook runs in a westerly direction. After leaving the property it flows about 3600 feet to Whalebone Creek that in turns flows 1500 feet before draining into Whalebone Cove.

Annual mean temperature for the region is 51° F, the highest in the state. Winter temperatures average 32.5° F., the warmest in the state. The average mean temperature in summer is 70° F. The frost-free season averages 195 days, the longest in the state. Mean annual precipitation is 46 inches, which includes snowfall accumulation of about 35 inches. How these statistics change over time due to global climate change is worth tracking in relation to the future ecosystem health and composition.

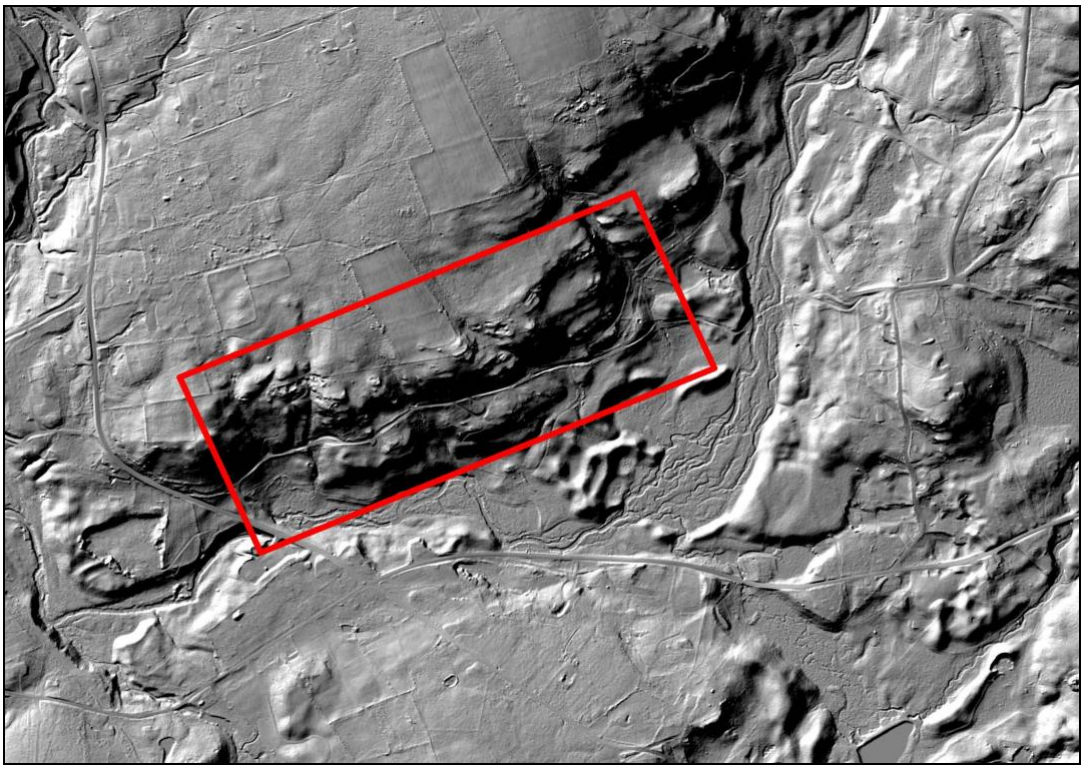
[1] Dowhan, Joseph J., Robert J. Craig, *Rare and Endangered Species of Connecticut and Their Habitats*, State Geological and Natural History Survey of Connecticut, Department of Environmental Protection,1976, p. 35-36.

GEOLOGY, SOILS AND THE LANDSCAPE

Continental collisions that created our east coast mountain ranges, as the super continent of Pangaea was assembled, and the subsequent near tearing apart of New England, as the Atlantic Ocean formed, have become familiar parts of a global-scale geologic scenario with a direct bearing on landscape development in and around the Banningwood Preserve. Although these events took place between 500 million and about 200 million years ago, the distribution of bedrock units and the patterns of faulting and fracturing that they created have controlled regional and local landscape development ever since. As the "collision" of the African and North American tectonic plates played out, bedrock units that were resistant to weathering and erosion were comingled with less resistant rock units, and accompanying faulting created zones of broken rock. This was followed by more faulting and fracturing of the bedrock as the continents moved apart during the birth of the Atlantic Ocean.

For the past 200 million years, the region's various bedrock units, and disrupted fault and fracture zones, have been exposed to the ravages of weathering and erosion. Rock units that were the most resistant to this exposure remained as uplands while bedrock valleys developed where less resistant bedrock units and highly faulted/fractured rocks yielded to the ravages of time. The four glaciations that are known to have advanced across Connecticut in Pleistocene time (~ the last 2.6 million years) smoothed the pre-glacial bedrock surface but did not greatly alter the existing pattern of hills and valleys.

This is clearly illustrated by the topography of the Preserve. Owing to the way that the small continent of Avalonia rotated as it was crushed between the African and North American plates, the resulting Honey Hill fault zone, and the Roaring Brook valley that developed along it, generally trend Northeast-Southwest. The ridges of the upland bordering the fault zone to the north are also aligned Northeast-Southwest. This is an anomaly in Connecticut where most ridges trend North-South. North-South trending fractures cut across the ridges breaking them into a rectangular topographic pattern that is unique to Lyme (Red Rectangle, Banningwood Lidar Image Below).



NE-SW Ridges Cut By 3 N-S Fracture Zones Create Rectangular "Block" Topography

Glaciers Moving From Right To Left Smoothed The North Slope Of This Ridge With Till, And Over Steepened The South Slope (Left) By "Glacial Plucking" Of Boulders

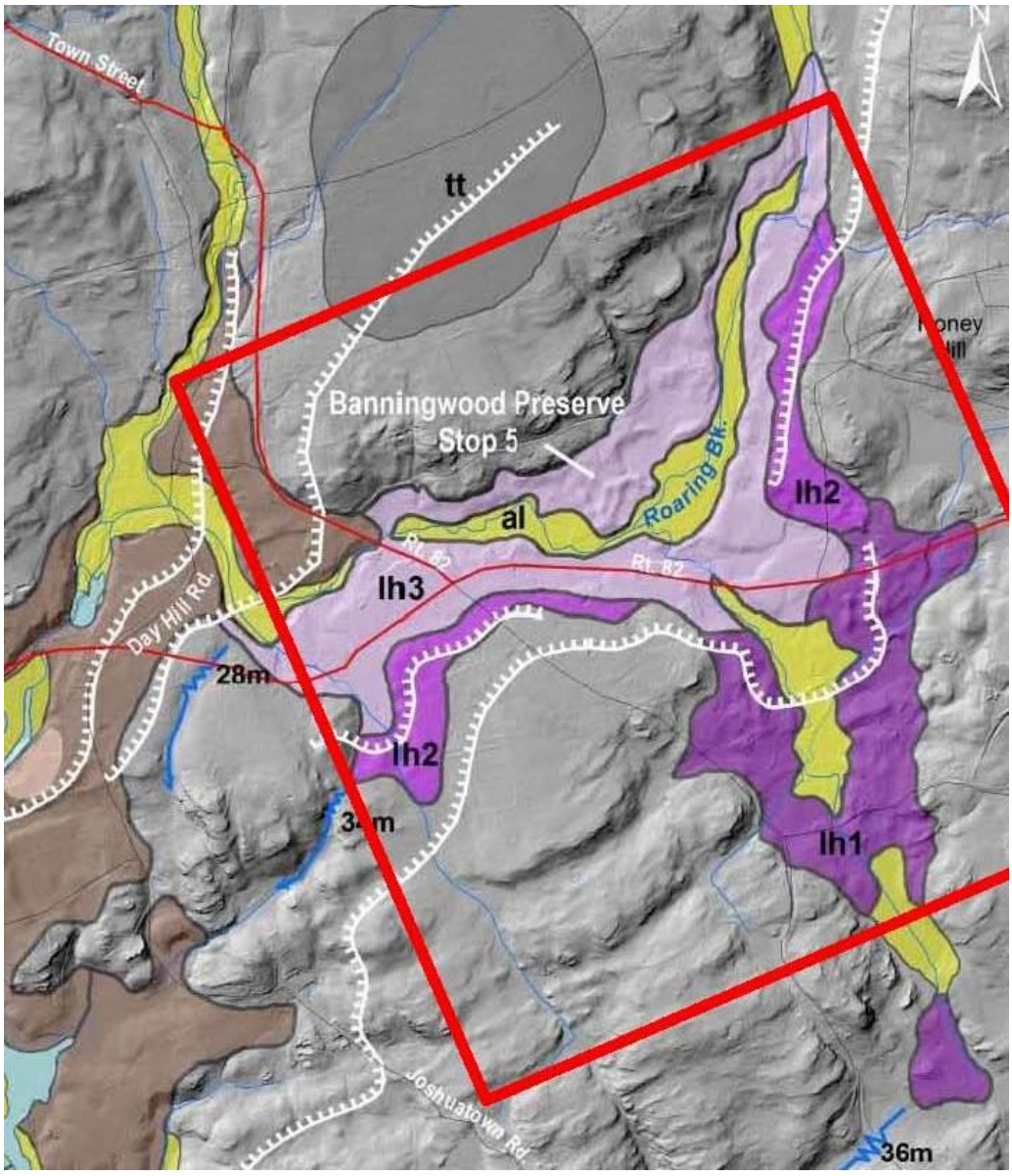
Even though the glaciers that passed over this area were moving southward the pre-existing landscape pattern was not materially altered. In some ways, the glaciations actually enhanced the prominence of the ridges by preferentially plucking boulders from their "glacially over-steepened" south sides (Left in Photo Above).

The upland portion of the preserve also offers an opportunity to see several bedrock features that reflect the tectonic history of the region (Folding, Faulting, Foliation, Fracturing, Etc.).

Folded Metamorphic Bedrock

Mylonite In A Small Fault

As the last (Wisconsinan) glacier melted northward out of Connecticut, the shape of the emerging bedrock surface determined the type of glacial deposition that occurred. In the uplands, whatever the glacier contained was dumped directly onto the land as the glacier melted. Since ice is a poor sorting agent, these "ice laid" till deposits tend to be a variable mixture of everything from boulders to fine silt. True to form, till blankets the northern upland portion of the Banningwood Preserve (Grey on Map Below).



Banningwood Map Showing Till (Grey), Westward Ice Meltback Positions (White Hatched Lines), Associated Meltwater Deltas (lh1, lh2, lh3), And Modern Roaring Brook Deposits (al)

Water from the melting glacier was concentrated in the emerging bedrock valleys where it sorted the sediment it was carrying by size. Large cobbles and boulders that the water could not carry were left behind, and the finest material was carried the farthest. As a result, the "water laid" glacial deposits that fill most of the region's valleys tend to be composed of layered silts, sands, and gravels. The meltwater deposits that fill southern portions of the Roaring Brook valley fit this model to a tee. They consist of three terraced remnants of meltwater deltas that once filled the entire valley and have been partly eroded away. Delta remnant lh1 is the highest on the topography and deltas lh2 and lh3 were deposited in successively lower ponds as the ice dams (White Hatched Lines) holding them in retreated westward, down the Roaring Brook valley. Modern alluvial deposits (al) occupy areas where the delta deposits have been eroded away.

The geology is not only unique in and of itself, but also plays a role in determining soil types. As noted earlier, soils on the preserve are developed on unsorted glacial till in uplands and on glacial meltwater or modern alluvial deposits in the valleys. All of these soils overlay metamorphic bedrock composed of gneisses and schists. These soils tend to be acidic because the bedrock and glacial deposits they are derived from are acidic. On the Banningwood Preserve glacial till is present on uplands and the associated soils are generally thin and sprinkled with boulders. Soils developed on the delta remnant terraces are generally a bit thicker, better drained and boulder free. Alluvial soils often have a higher organic content and can be poorly drained.

LANDSCAPE RESOURCES

The 103-acre Banningwood Preserve is divided into three distinct vegetative zones of approximately equal size: the 35 acres along Roaring Brook with its flat floodplain soils of silts, sands and gravels. These include the associated wetlands, which comprise about one quarter of this type. Adjacent to them on the north side and at the eastern end of the property are 35 acres of mostly meltwater sands and gravels. These mounded, rolling, glacially-derived hummocks are rock free, but quite acidic and excessively drained. The 33 acres of poorly-drained glacial till uplands to the north, with their rock outcrops, stony soils and steep slopes present a different set of growing conditions. Soil type and water availability are two measures of site productivity, but disturbance also plays a major role as to what grows where.

After disturbance, how a forest responds is dictated by several factors:

- what was the kind and intensity of the disturbance,
- what tree species respond best to a particular disturbance type and intensity,
- what seedlings and saplings were growing at the time of disturbance,
- what were the available seed sources and production at the time of disturbance,
- what were the overall site conditions such as soil type, aspect and water availability,
- what were the site micro conditions for seedling growth,
- what species responded best to the change in growing conditions including increased heat, dryness and sunlight due to the overstory removal?

The various combinations of these disturbance factors along with other variables, such as regional climate, as well as chance and the unknown, produce a variety of forest outcomes. Most of the New England forest saw profound change with its settlement by Europeans. Forests were cut and the landscape came to mimic the open agricultural landscape of the Old World. The Banningwood Preserve woodlands reflect these historic land use practices. They have been cleared for agricultural use, going back more than a century. Evidence for this includes remnant red cedar trees, open grown "pasture" trees, stonewalls/fence rows, stone piles, and invasive plants. It was not until around 100 years ago that the Preserve began the successional process from open land to woodland.

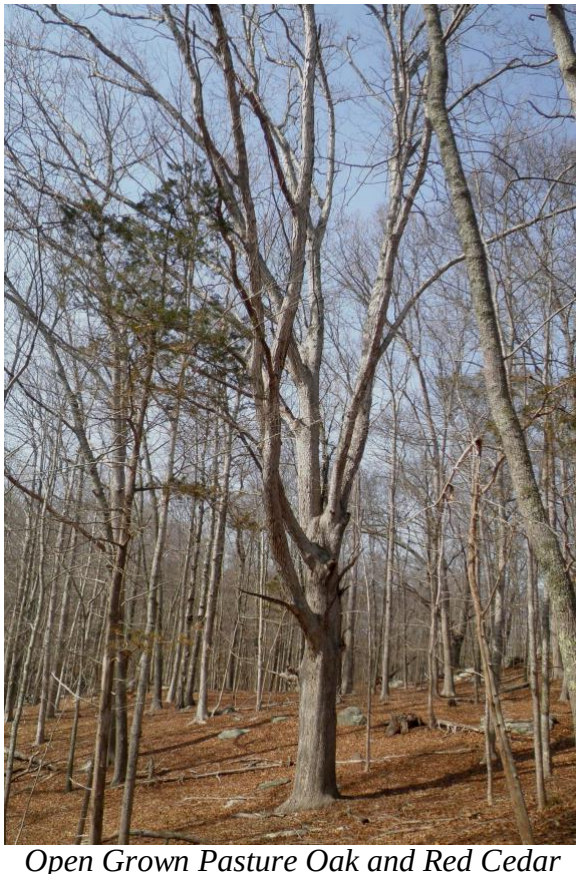
Quarry Stone Remnants

The main disturbance impact to the Banningwood Preserve was the clearing of

land for agriculture. Other disturbance events noted by EECOS were wind damage and blow down from Hurricane Gloria in 1985, and old pit and mound formations, the remnants of previous wind events such as the 1938 hurricane. Insect pests, especially the gypsy moth outbreak in the early 1980's, were responsible for the loss of some trees, especially oak. This could be repeating itself this spring with the buildup of gypsy moths over the past two years. The chestnut blight of the early 1900's killed this major tree component of the New England forests. Interestingly, the Banningwood Preserve shows no sign of the historic presence of American chestnut (*Castanea dentata*), and this may be due to the property's reversion from pastureland after the blight had already become established.

Although a woodlot was a typical component of the colonial homestead, one was not noted, as the entire property appears to have been cleared. Perhaps wood products were harvested from adjacent land that at one time was part of the Banningwood property. This makes for a mostly even-aged woodland that reverted from pastureland to woodland at the same time, around 100 years ago.

Overall, the forested portion of the Banningwood Preserve is single-aged in structure in the 60-80-year-old age class, with a peppering of other trees, some as old as 100+ years. This mostly single-aged structure will persist until senescence and disturbance factors create openings resulting in multiple age class distribution and species composition. With a major disturbance, such as clearing for agriculture, a 1938 style hurricane or an extensive, hot forest fire, the woodland would likely revert to year one on the forest development time scale. How these changes would be manifested will be driven by the variety and combination of revegetation factors described at the beginning of this section. Species-specific disturbances, such as the 1900's chestnut disease outbreak, a future infestation of the Asian long horned beetle (*Anoplophora glabripennis*), or a major infestation by Gypsy moths impose changes that greatly alter species composition and the forest ecology.



Open Grown Pasture Oak and Red Cedar

Disturbance is inevitable, and it cannot be predicted with certainty how the forest seen today will look in the future. That being said, predictions about the future of the Banningwood Preserve forest can be made. As noted previously, the present day

woodland age and composition has primarily been driven by a reversion from pastureland to woodland. These past patterns of use and disturbance will continue to shape the forest well into the future. Although the forest today is composed of mostly oaks and other mixed hardwoods, as the aging of the forest continues, beech will increasingly take over unless disturbance interrupts this progression. Once again disease is playing a role here, as beech bark disease is becoming more prevalent as it spreads south from northern New England. What we can describe with certainty is what we see today will change over time.

Insect Pests and Pathogens

The gypsy moth (*Lymantria diaspora*) invaded the oak hardwood forests of the eastern seaboard after its introduction from Asia to the northeast early in the 20th century. Caterpillars defoliate trees, especially oaks, restricting the tree's ability to photosynthesize. It is unlikely that the Banningwood Preserve was spared the severe outbreak in the early 1980's that defoliated much of southern New England's oak component over a 2–3 year period. The cyclical nature of infestations is seen in its reemergence over the past couple of years. Gypsy moth numbers have been increasing to such an extent that trees weakened by the recent outbreak are more likely to succumb to the cumulative stress if this spring's infestation continues to build. On the Banningwood Preserve egg clusters were observed at 65% of woodland data gathering plots with the heaviest numbers west of Roaring Brook.

Just Hatched Gypsy Moth Caterpillars

It should be noted that in southern Fairfield County in 1989, an outbreak was broken when a pathogenic fungus (*Entomophaga maimaiga*) killed the caterpillars. This fungus, first released in the early 1900's as a way to control gypsy moths, was believed ineffective, but a combination of weather conditions conducive to the fungus's rapid spread led to its sudden and effective appearance. Another fungus, native to Japan and a known natural enemy of gypsy moth, was released at a number of test sites in New York and Virginia in 1991. Its rapid spread and almost complete effectiveness holds great promise for limiting future gypsy moth infestations. However, due to our dry springs over the past two years, neither of these fungi has taken hold under these dry conditions. The weather this spring will have a controlling role in limiting gypsy moth populations. Gypsy moth defoliation poses the greatest threat to forest health at this time.

Beech Bark Scale Disease occurs when bark that has been attacked by the beech scale insect, *Cryptococcus fagisuga,* is invaded and killed by the fungus *Nectria* spp. The beech scale insect provides an entrance point for the fungus that gives the once smooth bark a patchy, scalely look. Although trees survive limited outbreaks, the disease results

in significant mortality and defects to trees, especially the further north in New England one goes. *Nectria* infestation was noted on 14% of those plots containing beech. Its future impact on beech is unknown at this time, but it appears to be increasing throughout our region.

Nectria canker (*Nectria* spp.) is a fungal pathogen affecting black birch and is characterized by a wound that is sunken inward. Enlarged cankers restrict nutrient and water flow and lead to deterioration of the stem. Nectria canker was evidenced at 33% of the data gathering plots where black birch was noted. There is no treatment for the disease except for tree removal and improved growing conditions. Research at the Connecticut Agricultural Experiment Station has found black birch trees that reach 4 inches in diameter at breast height (DBH) without being infected with the Nectria fungus usually manage to avoid infection entirely.

The woolly adelgid (*Adelges tsugae*), which attacks eastern hemlock is an aphid-like sucking insect introduced from Japan and first seen in New York in the late 1960's. Originally, infested and untreated hemlocks were expected to die within four years; however, even heavily infested areas in southern Connecticut are experiencing some improvement on those trees not killed outright. A ride through Devils Hopyard shows areas with complete mortality compared to others where infested trees appear to be making a comeback. According to recent research, site characteristics apparently influence the degree of impact from adlegid infestation with the hotter and drier southern and eastern aspects experiencing the greatest decline. Additionally, hemlocks on ridge tops and upper slopes appear to suffer more damage than do those in adjacent valleys with their moister and richer soils. One hope for arresting the pest lies in biological control using predators and parasites brought in from their native Japan. Field studies being conducted by Dr. Mark McClure and the Connecticut Agricultural Experiment Station are in their early stages and any widespread success is at least a few years away.

The hemlock component on the Banningwood Preserve is somewhat limited, which may account for its relative good health, although adelgid was noted on some trees. As hemlock is lightly represented, this may act as a physical quarantine barrier. Also the stresses outlined above are mostly absent.

Overall, forest tree health is good, although further outbreaks and infestations of pathogens and insects, like the emerald ash borer (*Agrilus planipennis*) and the Asian longhorned beetle (*Anoplophora glabripennis*), could have a significant impact on forest structure.

Woodland Composition

Tree ages throughout the Banningwood Preserve are mostly in the 60-80-year-old age class with over 80% of the plots falling into this category. These are generalized age classes that reflect the average age within each data plot. This young age indicates that most of the former pastureland was already reverting back to woodlands some time after World War I. The 1934 aerial photograph on page 4 shows that two areas still remained open at this time – one at the property's western end, still partly maintained today, and the other just north of Roaring Brook across from Route 82 near the present day

firehouse. There is also evidence of widespread selective timbering some 30+ years ago. This is evidenced by the young sapling layer seen in the understory and why tree density is quite low (basal area averaging 60-80).

26-Inch Diameter Red Oak

Three of the 17 plots, however, had tree ages averaging in excess of 100 years. Two are along the flood plain while the third is just north of the woods road near the newly opened field. Why these contain an older tree class is unknown, but they could have been in use as woodlots or just simply passed over during a timbering operation. Tree diameters on most plots average between 12 and 16 inches diameter at breast height (DBH) while those on the three older plots range from 20-26 inches.

In the seedling layer, American beech is most prevalent, being found on over 50% of the plots, and is in most cases the result of root suckering off of larger beech. The highly shade tolerant beech not only persists in the low light understory, but on many plots, outcompetes all other species by blocking sunlight to seedlings. Other species are represented such as white pine, red oak and red cedar, but to a much lesser extent. Part of the dearth of other species aside from low light conditions has to do with deer browsing. Where the understory is more open, red maple, black birch, oaks, hornbeam and hop hornbeam are part of the mix. The high-shade tolerance of beech is signaling it will be a major forest component in the next century until there is a significant disturbance.

Canopy Cover Types

For this report, similar groupings of tree species are assigned a cover type designation. Identification of these various cover types not only tells us what is growing, but indicates the underlying growing conditions, history and future of the site. In time, as noted previously, site limitations and disturbance affect this makeup. Even within each cover type, species composition and representation varies depending on site-specific conditions and disturbance history. Banningwood Preserve contains five basic cover types representing from 12% to 35% of the sampled plots outside of wetland areas. In all, 23 species of trees were noted.

Cover Type	% Plots
Oak/Mixed Hardwoods	18
Upland Oak	12
Mixed Hardwoods	35
Oak/Hickory	18
Floodplain	18

Oak–Mixed Hardwoods - This canopy type is found on 18% of the surveyed plots on the Banningwood Preserve. It is common on acidic, nutrient-poor soils, and where soil depths are moderate and moisture is not a limiting factor. Red oak is most numerous on all these sites, and is found in combination with white and black oak. Associated hardwoods include black birch and American beech. On moist lowlands, adjacent to wetlands, yellow birch, sugar and red maple, and white ash can be found. Average diameters are in the 12 - 14 inch DBH range. Many of these plots have a high incidence of beech in the understory indicating that in the next hundred years or so these same plots will likely be beech dominated.

Upland Oak - This component makes up 12% of the forested plots and is found on high, mostly south facing slopes and on excessively drained glacial meltwater soils. As soils are either thin to bedrock or excessively drained, moisture availability is the limiting factor. Also, south and west facing sites have higher evapotranspiration rates. On the Banningwood Preserve common upland oak species are black and white oak. Associates include red maple and beech. As moisture is a limiting factor, trees are generally smaller and slower growing than on moist sites. In addition, there is greater spacing of individuals with more light reaching the forest floor. The presence of huckleberry attests to these more open conditions.

Mixed Hardwoods - This cover type accounts for 35% of the data plots. Mixed hardwood sites are located where soil depths are moderate and moisture is less of a limiting factor. On the Banningwood Preserve this component is found on lower slopes and the floodplain adjacent to Roaring Brook. These conditions foster the growth of the greatest variety of species with no one species having clear dominance. Trees on the Banningwood Preserve lands most often associated with this classification are American beech, red and white oak, red and sugar maple, black birch and mockernut, shagbark and pignut hickory.

Oak/Hickory - Although sharing similar site conditions as the oak/mixed hardwoods, it is unclear what, if any, differences are present that favor the development of this cover type. In all probability, chance plays a greater role than any specific site condition. The oak/hickory cover type also develops under conditions of high deer browse, fire, or other disturbance such as timber harvesting that favors its regeneration. Connecticut is known for its oak/hickory forests with the Banningwood Preserve at 18% of the forested plots. In general, red and black oak and shagbark, mockernut and pignut hickory comprise this group.

Floodplain –18% of the Banningwood plots are of this woodland type. These are part of sinuous stream chains found in relation to the Roaring Brook. Species here mimic the mixed hardwood cover type with the addition of more moisture dependent species such as white ash and yellow poplar (*Liriodendron tulipfera*), although on the preserve these species are poorly represented.

Shrubs are well represented by highbush blueberry, winterberry and sweet pepperbush, with witch-hazel sometimes being present around edges. Sphagnum moss (*Sphagnum*

sp.), tussock sedge (*Carex sp*.), skunk cabbage (*Symplocarpus foetidus*), along with cinnamon (*Osmunda cinnamomea*), royal (*O. regalis*), and New York (*Thelypteris noveboracensis*) ferns are also commonly found in the wetland understory.

Aside from their vegetative complexity, these floodplains attenuate flooding, are optimal for water recharge, filter nutrients and sediments and have high value for wildlife.

Table 1: Trees and Their Relative Occurrence on the Banningwood Woodlands

COMMON NAME		COMMON	UNCOMMON
ASH, WHITE	*Fraxinus americana*		X
BEECH, AMERICAN	*Fagus grandifolia*	X	
BIRCH, BLACK	*Betula lenta*	X	
CEDAR, RED	*Juniperus virginiana*	X	
CHERRY, BLACK	*Prunus serotina*		X
DOGWOOD, FLOWERING	*Cornus florida*		X
HEMLOCK, EASTERN	*Tsuga canadensis*		X
HICKORY, MOCKERNUT	*Carya tomentosa*		X
HICKORY, PIGNUT	*Carya glabra*	X	
HICKORY, SHAGBARK	*Carya ovata*	X	
HOPHORNBEAM	*Ostrya virginiana*	X	
HORNBEAM	*Carpinus caroliniana*	X	
MAPLE, RED	*Acer rubrum*	X	
MAPLE, SUGAR	*Acer saccharum*		X
OAK, BLACK	*Quercus velutina*	X	
OAK, PIN	*Quercus palustris*		X
OAK, RED	*Quercus rubrum*	X	
OAK, WHITE	*Quercus alba*	X	
PINE, WHITE	*Pinus strobus*		X
SASSAFRAS	*Sassafras albidum*		X
SHADBUSH	*Amelanchier sp.*		X
SPRUCE, NORWAY	*Picea abies*		X
SYCAMORE	*Platanus occidentalis*		X

Understory shrubs

In woodlands, by necessity, understory shrubs are shade tolerant. Even so, the shadier the landscape the fewer the shrubs found. Another limiting factor for shrubs is water availability, which makes dry, shaded sites even less productive. The understory or shrub layer is poorly developed over much of the forested Banningwood Preserve: 55% of forested plots have one species or no shrubs present. This is likely due to the high incidence of beech in the overstory as well as historic over browsing by deer. Although forest shrubs such as witch hazel, mountain laurel, highbush blueberry, huckleberry, and green briar are present and have a certain shade tolerance, they are poorly represented under the lowlight conditions imposed by beech. The most common shrubs noted were huckleberry on dry sites and spicebush on moist lowlands.

Table 2: Native Shrubs and Their Relative Occurrence on Banningwood Woodlands

COMMON NAME		COMMON	UNCOMMON
BLUEBERRY, HIGHBUSH	*Vaccinium corymbosum*	X*	
BLUEBERRY, EARLY LOW	*Vaccinium vacillans*	X	
BRIAR	*Rubus* spp.	X	
GRAPE	*Vitis* sp.	X	
GREENBRIAR	*Smilax* sp.	X	
HUCKLEBERRY	*Gaylussacia baccata*	X	
MOUNTAIN LAUREL	*Kalmia latifolia*		X
POISON IVY	*Toxicodendron radicans*	X	
SPICEBUSH	*Lindera benzoin*	X*	
SWEET PEPPERBUSH	*Clethra alnifolia*		X*
WINTERBERRY	*Ilex verticillata*		X*
WITCHHAZEL	*Hamamelis virginiana*		X

* Wetlands Associate

Non-Native Woody Invasives

Compared with much of the Connecticut landscape, woody, non-native invasives are mostly missing from the upland woodlands of the Banningwood Preserve. In fact, on the meltwater terraces at the east end of the property invasive shrubs are absent or nearly so. However, along the preserve's southern boundary along Roaring Brook, Japanese barberry is extensive.

Japanese barberry was introduced in the second half of the 19th century. This introduction coincides with the conversion of much of Connecticut's farmland back to forest. Barberry became established in these high-light conditions and persisted as the canopy closed during the ensuing decades. Although nearly 60% of study plots contain barberry, representation was low, except quite extensive along the brook. The 2016 aerial photo on page four shows the extent of the barberry (in light green) along the southern end of the Preserve, and again, it is seen in the 1934 aerial.

Multiflora rose was the second most invasive shrub found, but only on just over one quarter of plots. Multiflora rose is not shade tolerant being more commonly associated with field abandonment and along woodland edges. The presence of the plants found here are likely remnants of field abandonment and as the canopy continues to close, these remnants will die out.

A non-woody invasive previously noted on the property is Japanese stilt grass (*Microstegium vimineum*). This grass is adaptable to lowlight conditions forming dense patches, displacing native wetland and forest vegetation as the patch expands. Because it's an annual, pulling before flowering is effective, although due diligence is required.

Recommendation - Management of invasive shrubs is time consuming and difficult, but necessary in order to keep their spread in check and to restore native plants to the area. An all-out assault on the Banningwood barberry would be quite an undertaking and likely unrealistic. However, tending to the smaller patches throughout the property would be beneficial, as well as keeping an eye on any northward creep up from Roaring Brook.

Diligence is also required for monitoring of invasives not found as yet on the preserve, such as Burningbush (*Euonymus alatus*), Japanese knotweed (*Polygonum cuspidatum*), and mile-a-minute vine (*Polygonum perfoliatum*), notably in fields and along edges. Burningbush is especially invasive as it spreads into the lowlight conditions of the forest understory. Once established, it is persistent and readily spreads.

Table 3: Non-native Shrubs and Their Relative Occurrence on The Banningwood Preserve

COMMON NAME		COMMON	UNCOMMON
BARBERRY	*Berberis thunbergii*	X	
BITTERSWEET	*Celastrus orbiculatus*		X
MULTIFLORA ROSE	*Rosa multiflora*	X	

Endangered, Threatened, and Special Concern Species

Information provided by the State of Connecticut's Department of Environmental Protection indicates that there are no known extant populations of State-listed Endangered, Special Concern or Threatened species on the Banningwood Preserve.

WILDLIFE RESOURCES

Animals have four basic habitat needs: living space, cover, food, and water. The availability of these, in relation to the successional age and composition of the vegetative cover, determines not only population sizes and densities, but what species will likely inhabit a particular area. Many species, though, use a variety of habitat types making it difficult to neatly classify species exactly by location. Even amphibians and reptiles, usually associated with particular habitats, require access to other areas at different life cycle stages: mole salamanders spend most of the year in moist woodlands, but migrate to vernal pools in the spring to lay their eggs. Conversely, painted turtles (*Chrysemys picta*) leave lakes and ponds to lay their eggs in upland areas. Wetlands also provide food, water, and cover for most upland mammals and birds. Generally speaking, the greater the diversity of habitats, the more species found.

The Banningwood Preserve contains an assortment of topographic, hydrologic and vegetative features. It is this combination of site conditions along with the history of natural and man-made disturbances that distinguishes the property seen today. What has and will continue to change is the vegetative component. As a food resource, vegetation abundance, availability and species type are at the heart of the food network. Land use management both on and adjacent to the Banningwood Preserve will shape wildlife makeup in the years to come.

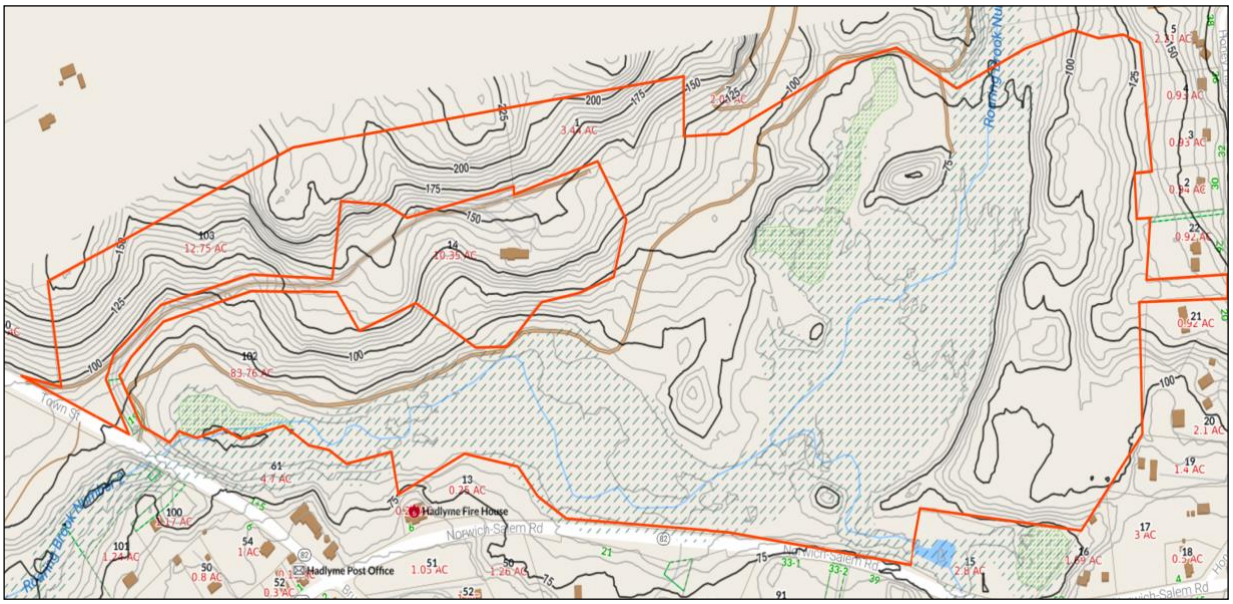
Size of surrounding uplands is another factor affecting habitat viability for wildlife. Although the Banningwood Preserve is a mostly unfragmented block of nearly 100 acres, it is by itself too small to support sustainable populations of top carnivores such as bobcat (*Lynx rufus*), fisher (*Martes pennanti*), and coyote (*Canis latrans*). Even smaller mammals and woodland birds that depend on both wetland and extensive forested upland need not only habitat, but also "room to move about" and migration and dispersal corridors to other habitat blocks. Route 82 to the south and west with its attendant development inhibits such movement; however, north of the preserve into East Haddam, although fragmented, is still rural enough to provide linkages and adequate habitat for the time being. With continued development, however, a tipping point can be reached where Banningwood will no longer contribute to sustaining viable populations of some wildlife species.

As the Banningwood Preserve is not large enough to support minimum viable populations of most mammals other than the smaller species, it is important to look at the larger, connecting landscape. If the Banningwood Preserve is to avoid becoming an isolated island of protection, creating additional corridor linkages to outside blocks of protected properties needs to be accomplished. Working with East Haddam to forge a strategy that recognizes the importance of these open space linkages between the two towns is an important first step.

Wildlife resources on the Banningwood Preserve are evaluated based on the abundance and availability of water, tree cavities and snags, cover and edge, large woody debris, forage, and fruits, seeds and nuts. These are considered in the context of the habitat issues described above. In general, the property contains an inconsistent mix of many of these resources.

Streams and Wetlands

Water availability is the driving force behind the study area's diversity. Water habitats on the Banningwood Preserve are varied from Roaring Brook itself to the network of sinuous streams and pools associated with the system. This "flattening" of Roaring Brook as it spreads out creates a floodplain system in excess of 30 acres on the preserve. During high flow periods, especially in spring, these wetland resources are mostly linked together; however, as water recedes, streamlets are cut off hydrologically from the main branch creating pools and other wet areas. In late summer and during periods of low precipitation these wet areas dry out leaving a patchwork of depressions over the flat floodplain.



Wetlands and Topography

The complexity and diversity of this wetlands system is a dynamic driver behind the abundance and availability of resources for wildlife on the Banningwood Preserve. As wetlands that are cut off from Roaring Brook do not support fish populations, suitable habitat is provided for those species, such as mole salamanders (*Ambystoma spp*.), that are more often associated with vernal pools. Other amphibians such as green (*Rana clamitans*), pickerel (*Rana palustris*), and wood frog (*Rana sylvatica*), as well as spring peeper (*Pseudacris crucifer*) and grey tree frog (*Hyla versicolor*), are likely breeding inhabitants. The wetlands are also well suited to breeding by the spotted turtle (*Clemmys*

guttata), as well as ribbon (*Thamnophis sauritus*) and northern water snakes (*Nerodia sipedon*).

Wood Frog and Spotted Salamander Egg Masses

Where Roaring Brook passes through the preserve it is a perennial third order stream that likely supports numerous cold water fish species such as brook trout (*Salvelinus fontinalis*), blacknose dace (*Rhinichthys atratulus*), white sucker (*Catostomous commersoni*), and American eel (*Anguilla rostrata*). In addition, if there was no physical barrier between the Connecticut River going up stream to the preserve, migratory alewife and blue back herring (*Alosa* spp.) would find suitable spawning and egg laying habitat here. However, a three-foot high dam proximate to where Whalebone Creek enters the cove is a barrier to upstream migration. If a fish ladder were installed over the dam substantial breeding habitat would become available.

A two-acre red maple swamp is located just upland on the west side of Roaring Brook as it enters the property and another of approximately the same size is found in the southwestern side just north of Roaring Brook. Understory shrubs include mostly highbush blueberry with sweet pepperbush found around the edges. These are both typical southern New England systems that not only provide wildlife resources, but also are a prime recharge area for storm and flood waters.

When the value of these wetlands to woodland birds is considered, the significance of the system is even greater. Berry-producing shrubs, such as blueberry, winterberry and spicebush, provide food, nesting and cover. The importance to upland mammals is also high. Not only is water available, but also the rich habitat diversity provides opportunities to both predator and prey. In addition, the organic mucks and their associated plant communities created by flooding are complex systems that support a suite of insects and microorganisms. Because the wetlands system supplies so many resources to many different species there is a concentrated interaction of wildlife not found elsewhere.

Vernal pools are absent, except for three created as a result of the quarrying for stone along the northern border. Only one of these contained salamander eggs – the other two may be too ephemeral to hold water long enough into early summer. This dearth of vernal pools is overshadowed by the overall extent and complexity of the entire Roaring Brook wetlands system. As some of the wetlands associated with the brook become cut off as stream levels recede, they act as cryptic wetlands, providing the same resources and

lifecycle functions as would vernal pools. This is because the habitat components required by mole salamanders as well as wood frogs (*Rana sylvatica*), traditionally reliant on vernal pools for lifecycle success, are found as part of the larger system. These amphibians, other than the fall migrating marble salamanders (*Ambystoma opacum*), travel to wetlands during early spring from wooded uplands, where they mate and produce gelatinous egg masses before returning to their upland habitats. Just like for vernal pools, successful recruitment of juveniles to adults depends on these cryptic wetlands to retain standing water into July to allow tadpoles to develop into young adults. Both wood frog and spotted salamander egg masses were noted.

Route 82 to the south and west is a physical barrier between wetlands and uplands that adversely affects migration to and from surrounding uplands for salamanders and other amphibians and reptiles; however, uplands to the east and north are open to migration.

Recommendation – Any activity, such as forestry or trail building, around streams and wetlands needs to minimize erosion, soil compaction and removal of the forest overstory.

Edge

Edge is the upland vegetative zone between open areas and woodland. It provides not only cover for animal forays into the open, but supports a great variety of sun-loving fruit and seed-bearing plant species not found in the more shaded woodlands, except in large tree-fall gaps, other canopy openings and wetland and river edges. Insects are also more plentiful, increasing the importance of these areas to numerous bird species such as woodcock, ruffed grouse (*Bonasa umbellus*), alder (*Empidonax alnorum*) and willow flycatchers (*Empidonax traillii*), swallows, and a variety of warblers and sparrows. Wild turkey (*Meleagris gallopavo*) and their poults also visit fields and edges for feeding on insects in late springtime. Mammals such as eastern cottontail (*Sylvilagus floridanus*), red fox, and small rodents use these habitat types almost exclusively.

On the Banningwood Preserve, edge is associated with the field opening by the western entrance and the field clearing at the junction of the red and yellow trails in the property's middle. Too much edge can fragment forestland and create access points for predators. Many forest interior birds are area-sensitive because of high densities of nest predators and cowbirds. Not only do forest interior birds need at least 100 acres of continuous forest to nest successfully, but also require a wide buffer of 300 feet or more between edge and forest nesting. Additionally, as noted earlier, the high light edge conditions are conducive to growth of invasive plants and shrubs that effectively outcompete native species. Some of these non-natives, however, such as barberry, multiflora rose and bittersweet provide fruits utilized by a variety of wildlife and, in fact, were originally introduced for this purpose. Other invasives not found on the preserve edges as yet include autumn olive and burning bush. The degrading of the natural vegetative landscape by these invasives, however, requires their removal, especially in lieu of their spreading into adjacent woodlands. All that being said, edge is an important component when assessing habitat resources and on the Banningwood Preserve edge plays a positive role.

Recommendation – Minimize further edge creation and monitor for establishment of invasives. Planting of native shrub species such as highbush blueberry, shadbush and flowering dogwood along field edges will provide berries and have high aesthetic value.

Snags

Snags are dead or dying, standing trees that are an important food and cavity nesting resource. Insectivorous species such as woodpeckers and nuthatch (*Sitta* spp.) depend heavily on snags as a source of food. Using Connecticut Department of Energy and Environmental Protection guidelines to assure that minimum requirements of most wildlife species are being met, three snag trees with a diameter of 12 inches DBH or greater should be available per acre. According to these standards most of the Banningwood Preserve woodlands do not meet this criterion and in fact snag numbers are quite low.

Snag formation is usually related to stand age. Due to mortality through aging, disease and competition, the older the forestland the greater the likelihood that snags are present. The Banningwood Preserve upland woodlands are a maturing forest in the mostly 60-80-year-old range, quite young by woodland standards. Natural snag production at this age will be slow in coming, especially as the woodland has been thinned by timbering, minimizing natural mortality through competition.

Recommendation - Girdling of crowded trees, not only creates snags, but releases adjacent trees for better growth. This technique should only be utilized in areas where it would not conflict with recreational trail use as these trees would constitute a hazard.

Cavities

Cavities in both snag and live trees satisfy essential nesting and denning requirements for birds and certain reptiles, such as northern black racer (*Coluber c. constrictor*) and black rat snake (*Elaphe o. obsoleta*); and mammals such as Virginia opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), and gray (*Sciurus carolinensis*), red (*Tamiasciurus hudsonicus*) and northern flying squirrel (*Glaucomys sabrinus*). As with snags, the size and number of cavities affects whether certain species will inhabit an area and their population levels. Birds, especially (35 in the northeast), use cavities for nesting, including eastern bluebird (*Sialia sialis*), wren (*Thryothorus* spp.), tufted titmouse (*Baeolophus bicolor*), black-capped chickadee (*Poecile atricapillus*), owls, and wood duck (*Aix sponsa*). Woodpeckers are important agents of cavity creation in their quest for insects and creating their own nesting sites, but woodpecker activity seemed especially low at the time of our site visits. This may be due to the young age of the woodland with its lack of dead and diseased trees. Another cause of cavity formation in older trees is the wounding and decay caused by the self-pruning of limbs due to senescence, wind, and heavy snow and ice.

In addition to smaller cavity trees, a minimum of one 15-inch DBH or greater cavity tree per acre is considered desirable for denning purposes. Field observation revealed that the Banningwood Preserve woodlands contain low numbers of cavities. Hopefully, with the

aging of the woodland, or creating snags by girdling live trees, woodpecker activity will increase with a subsequent increase of cavities.

Recommendation – As with snag creation, the girdling of trees promotes woodpecker activity as trees decay. One way of augmenting cavity availability is by installing wooden nesting boxes on poles or attached to older trees. Nest boxes need to be maintained.

Mast

Hard mast, the dry fruit from woody plants, is the primary food in fall and winter for most forest wildlife, except songbirds. These include the nuts of beech, oak and hickory; samaras from ash, tulip poplar, and maple; and seeds from hornbeam and birch, although the small seeds of birch are not a significant food resource for most wildlife. The Banningwood Preserve property woodlands contain excellent numbers of prime mast trees throughout, with nearly two thirds of plots having medium to high numbers.

In much of the northeast, the number one food is the acorn because of the many animals utilizing it, its year round availability and its prominence in diet. Acorns, especially the low tannin white oak, swamp white oak and chestnut oak, can account for up to 50% of the fall diet for deer and are a major food source for turkey, blue jay (*Cyanocitta cristata*) and many mammals. White oak is well represented on the property whereas the others are not. Other oak species found that have higher tannin levels, but are still a primary food resource, include red and black oaks. Hickory is another mast source, and pignut, mockernut and shagbark are present, and are found mostly on the glacial till uplands.

Soft mast is the fruit and berries from trees such as red cedar, black and choke cherry (*Prunus virginiana*), black gum, sassafras and flowering dogwood. Many shrubs produce viable fruit crops, including highbush blueberry, winterberry, dogwoods (*Cornus* spp.), viburnums (*Viburnum* spp.), witchhazel and spicebush in and around wetlands, while huckleberry and lowbush blueberry are more common on dry uplands. Vines, too, such as greenbrier, grape, and poison ivy have berries favored by wildlife, although found in low numbers. Soft mast is especially important in the diet of songbirds in fall and winter. A number of non-native invasives are also a good source of soft mast. Japanese barberry, multiflora rose and bittersweet are all prolific fruit producers with barberry being the most commonly found on Banningwood.

Recommendation – Sources of hard mast are plentiful; however, soft mast is in short supply. The planting of berry-producing native shrubs along field edges would increase cover, nesting and food opportunities.

Browse

Browse, the leaves and twigs of shrubs and tree seedlings and saplings, is a critical food resource for deer and smaller mammals such as New England and eastern cottontail. Overall, browse is low on the Banningwood Preserve. In the same way that creating forest openings increases edge habitat, they also promote growth of tree saplings, shrubs and herbaceous vegetation. The higher the light levels reaching the forest floor the

higher the browse resources. Except on the drier hilltops and wetland edges, beech numbers are generally high in the pole/sapling layer. Beech effectively shades out the understory, leaving it bare of vegetation, and as it is not a favored food, browse resources are limited. Deer are also playing a role in the dearth of browse. Of the sampled plots, 95% contain low browse amounts. Short of clearing the property of beech and excluding deer, it is unlikely that the browse picture on the Banningwood Preserve will change any time soon.

Cover

Cover provides protection from weather and predators. Hard cover, such as the rock outcrops and the boulder fields scattered throughout, offers protection and denning locations for a variety of wildlife like snakes and mammals, including bobcat, coyote, fox, rabbit, *mustelidae* and small rodents. Stonewalls and rock piles from pasture clearing are another cover source, especially for weasels and rodents, such as eastern chipmunk (*Tamias striatus*). Survey plots indicate that cover is generally in the low to medium range with higher amounts along the northern uplands with their rock outcrops and stonewalls and low numbers in the Roaring Brook floodplain.

These Rock Outcrops Afford Cover and Denning Sites for Wildlife

Vegetative, or soft cover, supplies the needs to a greater number of species. Evergreen stands of pine, and particularly eastern hemlock, offer protection from the winter elements for deer, among others, and cover protection from predators for smaller species. A well-developed evergreen shrub layer, especially stands of mountain laurel, is equally important, but is generally missing from the woodlands. Although stands of beech saplings do provide cover opportunities, they do inhibit growth of other vegetation resources. Some cover for birds is found in the wetlands, and when most of these dry out in summer they provide protection for other animals as well.

Coarse Woody Debris

Coarse woody debris, also known as large woody debris, is sound and rotting branches, logs, stumps and tree falls lying on the ground that provide habitat resources for animals, insects, and microorganisms, and a source of nutrients for soil development. Coarse woody debris contributes to the overall biological functioning of the ecosystem. The property is generally lacking in quantities of coarse woody debris, especially in the larger than six-inch category where three quarters of the forested plots are deficient. Much of this is due to the woodland's young age and historic timbering that leaves the tops of cut

trees, but does not contribute to the larger diameter stems that are removed during harvest. Forest management that calls for the girdling of low value timber trees to create snag trees for wildlife would eventually lead to greater woody debris on the forest floor.

Table 4: Summary of Wildlife Resources Present on the Banningwood Preserve

Feature	Incidence
Edge	Low/Medium
Cavities	Low
Snags	Low
Mast	Medium/High
Forage	Low
Cover	Low/Medium
Water	High
Woody Debris <6”	Low
Woody Debris >6”	Low/Medium

Compiled by Anthony Irving, Forest ecologist and Ralph Lewis, former CT State geologist.