

## **Observations made in the Towle Land, June 2019 – August 2020**

### **1. Background**

Claims of severe damage to the understory on town land and loss of biodiversity caused by White-tailed deer were made at Town Meeting in April 2019 as part of the rationale to support bow hunting. The claims were not supported by information about the specific locations of the reported damage or the species affected. This prompted me to take a deeper look at some of the public land surveyed by MassWildlife and document my observations for use by the Land Stewardship Committee (LSC) and the Conservation Commission. A discussion with the LSC resulted in the selection of the Towle Land and the Davis Corridor. This report covers only my observations in Towle. A quick browse survey of Towle had been done in July 2016 by MassWildlife and nothing since then. The GIS tracks of the observers' paths showed that the areas viewed were limited. My goal was to cover more of the territory, visit in different seasons, gather information on vegetation, browsed or not, and in the course of that activity to note other species that share the habitat and thereby to develop an initial understanding of the biodiversity present.

### **2. Process**

I reviewed a variety of existing protocols for understory status and forest health indicators. I found that for the most part, understory protocols are focused on deer browse evidence, with little attention to the extent of un-browsed vegetation, and none about overall diversity. Forest health protocols are the opposite. They cover many factors including topology, geology, and soil analysis (such as that done in the Towle Baseline Assessment of 2006/7) and most are developed by and for foresters with resource extraction as one of the goals.

For this project, I created a worksheet based on a combination of forest health indicators and deer browse indicators. The Deer and Moose Project Leader for MassWildlife, David Stainbrook, who is responsible for the Deer Browse Surveys conducted in Carlisle in 2016, deemed my worksheet "OK." He also arranged for a wildlife biologist, Chalis Bird, to come to Carlisle and show me how to recognize deer browse evidence. That occurred on September 29, 2019 when Warren Lyman and Tom Brownrigg joined us for hands-on learning at Towle.

From June 2019 through August 2020, I visited the Towle Land 25 times, making notes and taking pictures. (I also made a few visits in September 2020 to fill gaps in the worksheets.) The visits covered all seasons of the year, mostly off trail, and accounted for roughly 50 hours of active field time.

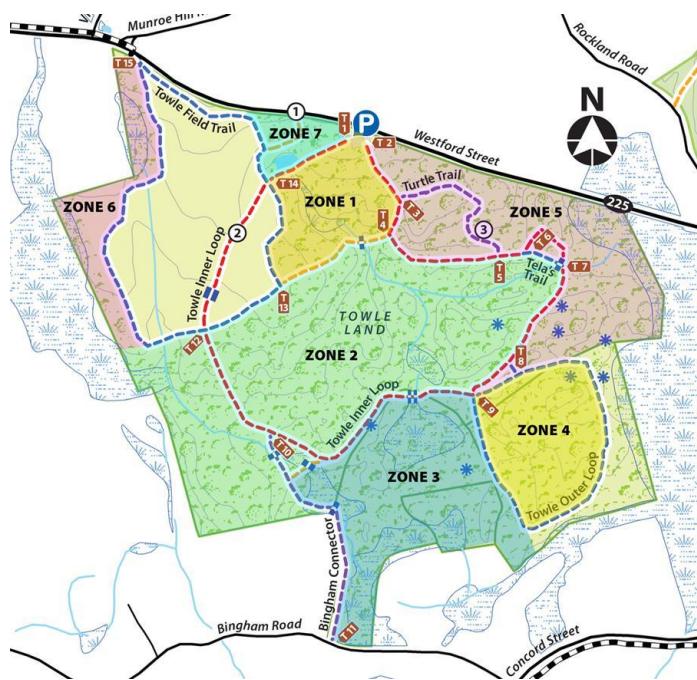
Two things became apparent early on:

- The Towle Land is not a uniform tract, which means that an average assessment of the state of the land as a whole would lead to a distorted understanding of any one of its different habitats. Because of that, and after several visits, I divided the wooded areas into seven "zones" based largely on the nature of the habitat, but also using trails and trail markers as logical delimiters. I chose this method to make it easy for others to follow up on my observations with nothing more than a trail guide to know the area being referenced.
- The extent of Towle biodiversity is far beyond my personal ability to do it justice.

The seven zones I established are described below. I omitted the field since it only marginally relates to

the health of the forest and the diversity of the understory. If it had been included, or is included in later studies, I believe it would need to be considered as two additional zones, the larger upper drier part and the lower wetter part in the area around the boardwalk.

## Map of Habitats in the Towle Land



Zone 1: defined by trail markers T2, T4, T13, T14, T1

Zone 2: inside inner loop (except field and zone 1) plus the area west of T12, T10

Zone 3: defined by T9, T 10, T11 (south of inner loop between Bingham Connector and outer loop,)

Zone 4: inside the outer loop

Zone 5: north-east corner outside of inner loop

Zone 6: western edge - down to southern edge of field

Zone 7: cow tunnel triangle - T1, T14

*The zones merge into one another with no sharp delineation. They are a guide.*

### 3. Observations

For each zone, I completed a 2-page worksheet. They are provided in the Appendix. Observations within each zone are grouped by canopy species, small trees and saplings, understory shrubs (native and invasive), ground cover plants (broken into widespread, occasional, ferns, and wetland species), evidence of browsing, three special deer indicators, and a few notes which didn't fit within any of those groups.

A note on the three special deer indicators, which were chosen from lists published by MassWildlife and by the USDA Forest Service North Eastern Area. Pink Lady's Slippers, Indian Cucumber Root and Mapleleaf Viburnum are among the preferred food or staples for White-tailed deer and they are relatively common in Towle, especially Pink Lady's Slippers. This means there are enough available for monitoring. The protocol for Assessing Vegetative Impact from Deer (AVID) suggests that monitoring a single species of wildflower such as Pink Lady's Slipper could be used as a proxy for all vegetation. In a similar vein, a deer assessment protocol from the USDA North Eastern Area suggests using Mapleleaf Viburnum as the proxy. We have a lot more Pink Lady's Slippers than Mapleleaf Viburnum, but I included them both and added Indian Cucumber Root for good measure.

In the worksheets, Red Oak means any oak in the red oak family; similarly White Oak.

### 4. Assessment

My approach is based on a belief that interpretation of forest health from the point of view of deer

alone makes no sense given the many factors that influence forest health and biodiversity. As John Muir famously wrote, “When we try to pick out anything by itself, we find it hitched to everything else in the universe.” The following sub-sections on key aspects of factors related to forest health provide the context for many of my observations.

#### **4.1 Canopy density, canopy type**

Most of the Towle woods canopy is a mix of hardwoods and conifers with typical canopy density of around 90% for 3 seasons of the year. This means that the understory in Towle is characterized by low-growing shade-loving plants, and that saplings and mid-range trees are less common than in younger more open woods or in woods managed for lumber.



*Both canopy pictures above were taken inside the inner loop in areas dominated by hardwoods. Left hand picture on March 20, 2020 and right hand on August 5, 2020.*

#### **4.2 Forest succession and sapling trees**

The Towle land has been owned by the town for approximately 50 years. During that time, the wooded parts have been untouched except for the creation of trails and associated boardwalks. At the time of acquisition, most of today's wooded parts were already wooded, i.e., the forest is much older than 50 years. It is already showing signs of how succession works in mature forests and is also showing some characteristics of old-growth forest. When a large tree falls and creates a canopy opening, saplings respond with new growth. I found several examples of this. A good one in zone 1 is in an area where white pine is predominant and a large one has fallen and opened space that is being filled with young white pines (expected) but also oak and maple.



Picture to the left shows the hole in the canopy in a pine-dominated area in zone 1. Picture below shows in the foreground the narrow trunks of maple and oak saplings taking advantage of the opening. The canopy hole is relatively new (e.g., the fallen pine still has some of its bark). The maples were over 10 ft and the oak around 8 ft.



### 4.3 Herbaceous plants

The density of herbaceous plants varies considerably as does the distribution of the different species. The main factors seem to be canopy density and natural habitat preferences. I noted as many as I could name in the zone worksheets in the Appendix. Wildflowers like Canada Mayflower and Starflower are widespread and prolific in some wooded areas while Skunk Cabbage, Jewelweed and Jack-in-the-Pulpit are common around wetlands. Club mosses, Pipsissewa, evergreen ferns, common Polypody and Partridgeberry stand out in winter. There are at least 12 species of ferns.

I found the following species not previously documented *anywhere* in Carlisle:

*Chrysosplenium americanum* – Golden Saxifage

*Mimulus ringens* – Allegheny Monkeyflower

*Packera aurea* – Golden Ragwort

*Persicaria virginiana* – Jumpseed

*Platanthera clavellata* – Small Green Wood Orchid

*Rudbeckia laciniata* – Cut-leaf Coneflower

These are note-worthy not because they are additions to the town-wide vascular plant list, but because *I am not a botanist* and simply by wandering in the Towle woods at many different times in the year I was able to spot them when they were flowering. Imagine what a botanist could do! (Approximately 500 vascular plant species are documented in Carlisle's 2020 OS&R report and while I wouldn't expect all of them to be found at Towle, there are many more species than I was able to identify.)

### 4.4 Invasive Species

Non-native woody shrubs are present throughout Towle, with some areas affected more heavily than others and some areas comparatively free. The most abundant is Buckthorn, but Burning Bush, Multiflora Rose, Japanese Barberry, and Oriental Bittersweet are also widespread.

I didn't document the occurrence of non-native herbaceous plants. I lack the expertise.

Jumping worms, introduced from Asia, are capable of reducing the leaf litter layer to a point where they compromise seed germination, tree nourishment, and soil invertebrates. I looked for them particularly near the south and east borders that I thought might be more susceptible. I found none.

The non-native saprophytic fungus, *Radulomyces copelandii*, aka Asian Beauty, is in several places in different zones in the Towle woods. It was first noted in the USA in Ipswich in 2009 and is already quite common in eastern Massachusetts. The rapid spread is concerning some mycologists but so far I have no information about adverse impacts.

#### 4.5 Weather (rainfall/drought, storms, etc.)

For the period of these observations, we had a winter with very little snow, followed by a summer drought that lasted into fall and resulted in all streams, ponds, and wetlands drying up – even the dam pond near T14. This means that some vegetation and especially wetland plants, other species that depend on those plants, as well as certain aquatic animals would have been stressed and may suffer a setback.

#### 4.6 Fungi (mycorrhizal, saprophytic, parasitic, blights)

Relatively recent scientific evidence has shown the expanded role of mycorrhizal fungi in maintaining healthy forests. Because these fungi are underground, we detect their presence when they produce mushrooms, but mushrooms require moisture and we had a drought. This means their occurrence was limited and observations in this time period are not reflective of the actual presence of the fungi. Despite that, I found several different species and they are noted in the spreadsheets. I also found Indian Pipes in many locations. They use mycorrhizal connections in lieu of photosynthesis so they confirm the presence of this type of fungus without one having to see the mushrooms.



Left: Mycorrhizal (Bicolor bolete), zone 2, 8.5.20. Middle: Unknown saprophyte, zone 5, 9.9.20. Right: Chicken of the woods, saprophyte, zone 5, 9.9.20.

Saprophytic fungi are less affected by drought and I found them throughout Towle, doing their job of breaking down woody material and making it available as nutrients for other species. Some of these mushrooms are themselves the habitat for certain species of flies and beetles – furthering the overall biodiversity and extending the food chain.

In prior years I have found mushrooms of the parasitic honey fungus (*Armillaria* sp.) in large numbers on oaks near T7. I found none during this time, but it's all over Carlisle and presumably still in Towle.

Chestnut blight is still present but the trees continue to survive in a couple of places. They put on fresh growth and photosynthesize but remain small. (An optimist might think that given time they will develop resistance and grow tall again.)

I also found two seldom-reported cup fungi (*Phaeohelotium epiphyllum* and *Adelphella babingtonii*), which I had not previously found in Carlisle or anywhere else. I mention them only to indicate our limited knowledge of the full biodiversity of the Towle land.

#### **4.7 Herbivores**

The most obvious signs of herbivory (apart from deer browse on Jewelweed) were from caterpillars and leaf miners. Many oak seedlings (<2 ft tall) were heavily browsed by caterpillars and leaf miners. I found almost no evidence of rabbits. They are less forest creatures and more likely to be found in early disturbed successional habitat, residential (lawn), farm fields/pasture and edge habitat. On August 8, 2020 I saw two adult White-tailed Bucks in zone 3. Deer browse evidence is listed by zone and by species in the worksheets.

#### **4.8 Insects and insect pests**

Insects and particularly their larvae are a very important part of the food chain for wetland creatures and for birds, thereby expanding the biodiversity of the woods. I noted a few caterpillars in the worksheets but I didn't begin to scratch the surface of insect diversity.

I found the Wooly Adelgid on a small area of hemlocks near T13 but none in the lower branches of the larger stand near T7/T8. This doesn't mean they are not there. Robust adelgid populations can be found in mature hemlocks that look excellent from the ground. The Towle hemlocks are isolated from other stands in Carlisle and could be experiencing a delayed response to the spread of the adelgid throughout eastern Massachusetts. A canopy inspection would be needed to confirm their presence/absence.

A note about unintended consequences: I found a caterpillar that might have been a Viceroy or a Red-spotted Purple butterfly on Black Cherry. I brought it home to hatch it for its ID, intending to return it when it hatched. After a few days, two white grubs emerged from the caterpillar and pupated. The caterpillar had been eaten from the inside and died. The grub pupae hatched into non-native Tachinid flies of a type that were introduced to combat the gypsy moth but that now attack native species.

#### **4.9 Dead wood (standing and fallen)**

The Towle woods have many standing dead trees both large and small and much fallen woody debris including large bark-covered logs, bare wood logs, logs covered with fungi, mosses and liverworts and lots of smaller dead brush and twiggy material. Standing dead wood provides resources for many animal species from small insects to birds to large mammals. I observed a Pileated Woodpecker in zone

3 feeding on carpenter ants on a snag for 30 minutes. The fallen dead wood is inhabited by fungi and beetles (and other insects) and eventually becomes moisture-retaining soil. These are all characteristics of healthy mature forests.

## 5. Deer Assessment

### 5.1 Observations

Deer trails criss-cross the land and there is evidence of browsing along their trails. If you were to stay on a deer trail you would notice browse evidence along the way and could be misled into thinking that this was widespread. If you go either side of their trail you find un-browsed species on their “preferred” list. Species browsed are noted zone by zone in the worksheets. The only evidence of heavy browsing across all zones was on Jewelweed and in some zones on invasive Multiflora Rose. There were many broad patches of Jewelweed which showed heavy browsing in late summer and fall of 2019. I monitored these areas in 2020. The Jewelweed returned in abundance and flowered. By the end of July 2020 while some was still flowering, a few had already set seed. Again, much had been browsed. On either side of a browse path, Jewelweed was growing tall and healthy. This is an easy species to recognize and monitor to see if it continues to return.

The rule of thumb that native animals don’t eat non-native plants is not true for all species. Buckthorn and Multiflora Rose are listed as “Preferred” and Oriental Bittersweet is “Moderately Preferred” by native White-tailed deer. Browse evidence in Towle supports those preferences.

There were very few days to spot deer tracks in the snow. On 12.11.19 I walked the whole Towle land except the area west of T10, T12 and T15. I stayed on human trails until I found deer prints crossing the path, which I then followed. I found tracks on the south side of the Inner Loop between T9 and T10, in the field near the road between T1 and T15, and across the boardwalk at T7 heading off to the east. Nowhere did I find track evidence of large groups of deer i.e., more than 3 in a group.

White ash suckers sprouting from the horizontal portion of a trunk that had been completely browsed sometime prior to February 2020 were replaced in the spring with new leafy suckers, which had not been browsed by the end of July 2020. They are near a cluster of un-browsed Mapleleaf Viburnum shrubs, which are a deer-preferred species. This suggests that deer are not revisiting with high frequency an area they know, further suggesting they are finding food in sufficient quantities in other places.

I tagged a group of 10 oak seedlings in zone 5 on 5.26.20 and when checked on 9.9.20, I found that none had been browsed. Oak seedlings are a deer-preferred species.

Pink Lady’s Slippers are defined by MassWildlife as preferred by deer, meaning: “you would expect to see browsing *even at low deer densities*, e.g., 6 to 18 deer per square mile.” Among the dozens spread across different zones through the woods I found only two specimens that had been browsed. I don’t suspect deer and both had flowered. Sarsaparilla, Indian Cucumber Root, and Canada Mayflower, which are either preferred or moderately preferred by deer, are growing throughout Towle. In some areas Canada Mayflower is the *predominant* ground cover plant.



Left: Pink Lady's Slippers, zone 4, 5.26.20 Right: Indian Cucumber Root, both single whorl (young) and double whorl, zone 2, 6.20.20

Most ferns are classified as a low preference food meaning they are “typically avoided by deer or only browsed at very high densities e.g. above 50 deer per square mile.” I didn’t find any evidence of deer browse on ferns. The presence of Hay-scented fern is sometimes mentioned as an indicator of high deer density. In parts of the Towle woods it grows in healthy stands spreading naturally by runners. There are spots, e.g., not far from T6, where it stops rather abruptly at a trail edge suggesting that soil compaction may be the inhibitor. I found other native plants (including deer-preferred oak seedlings and Canada Mayflower) growing among the fern fronds.

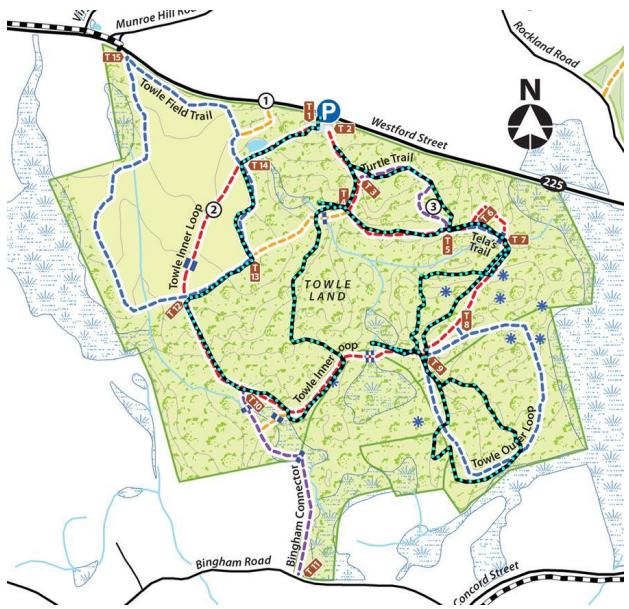
The huge acorn crop in the fall of 2019 meant there was a lot of food for deer (and other animals) in the winter, further aided by very little snow cover. It also meant that in 2020 there were extensive areas of wall-to-wall oak seedlings. Some of these will probably provide deer forage in the upcoming winter.

## 5.2 Browse survey by MassWildlife

The map shows the path (green and black dotted line) taken by MassWildlife personnel for their deer browse survey on July 26, 2016.

The only parts they consider valid per their survey protocol, i.e., off trail, are two tracks into the inner loop, one into the outer loop and a tiny departure off the west side of the outer loop. They did no surveying at all in zones 1, 5, 6 or 7 and next to nothing in zone 3. They went through the middle of a hemlock stand and declared hemlock is “not present” in Towle.

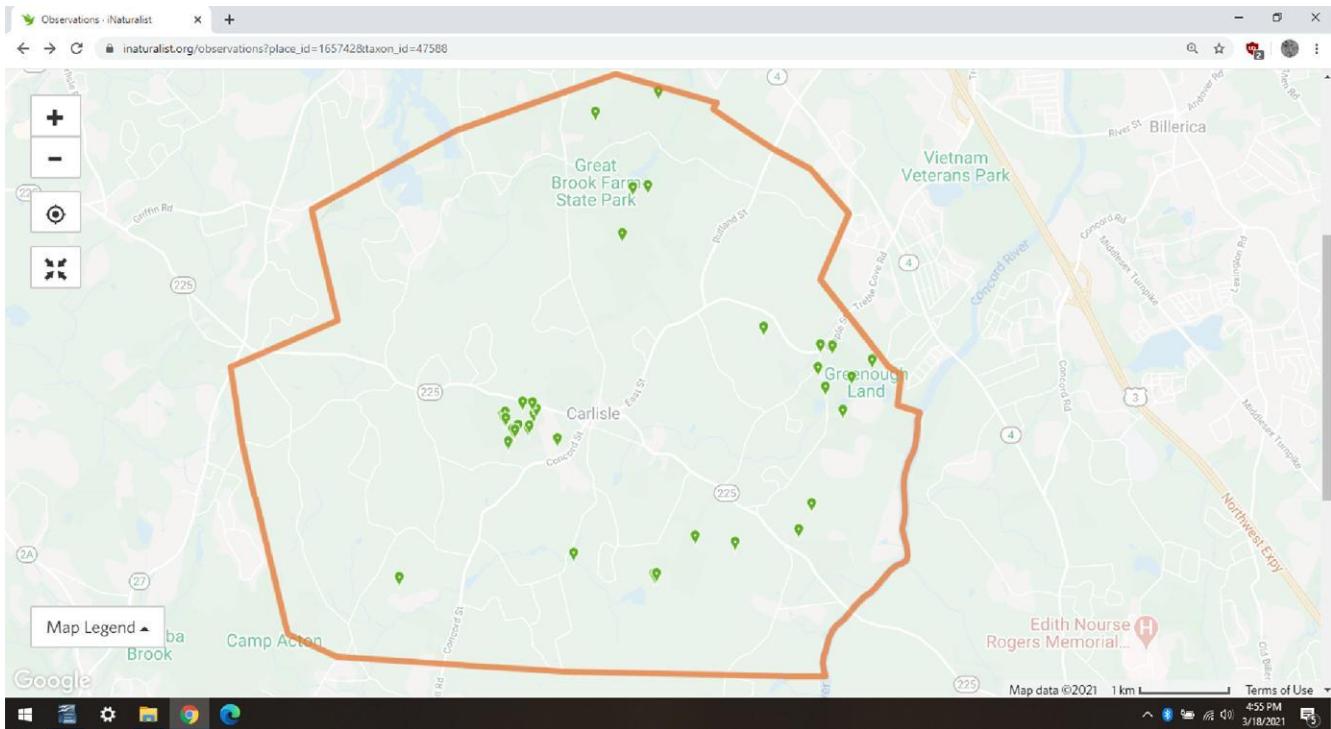
Based on their findings, they reported the Towle woods to be “moderately to negatively impacted.” To come to that conclusion, it’s possible they followed a deer path through the inner loop.



## 6.0 Orchidaceae

Four members of the Orchidaceae family have been found in the past on the Towle land, two species in the field and two in the woods. I found both woodland species (Pink Lady's Slipper and *Goodyera pubsecens*) and Nodding Ladies' Tresses in the field (September 3, 2020) but was not able to find the other field species (Ragged Fringed Orchid). In addition, I found 17 plants of the Small Green Wood Orchid in a wetland location. It was new to Carlisle's vascular plant list. Pink Lady's Slippers were numerous (2019 and 2020) and I found them in almost all areas except the field. Some plants were small and did not produce a flower. This is normal for young plants. Many flowered and the dead flower or flower stalk was still present (late July) indicating they hadn't been browsed. In some cases, I could also see the prior year's flower stalk. Most (estimating around 80 - 90%) of the flowers were not pollinated. The usual pollinator is a bumblebee. Pollination rates are generally low so this could be typical rather than an indication of fewer bumblebees. The plants are also known to have good years and bad years.

The map below shows some of the Pink Lady's Slipper locations in Carlisle, i.e., limited to photos people have loaded into iNaturalist for the period of June 1, 2019 to August 31, 2020. The cluster in Towle is mainly from my photos. The map does not illustrate the actual range or abundance of Pink Lady's Slippers in Carlisle. I include it only to illustrate the possibility of how iNaturalist might be used if we were to make a concerted effort in any or all parts of town to understand the range of any species.



## 7.0 The Field

A decision was made in the past to prevent natural forest succession from reclaiming the field and to maintain it as a meadow so that it could be more readily available in the future for agriculture. In the meantime, various programs have reduced the growth of Buckthorn and Poison Ivy and others have helped encourage Bobolinks and Bluebirds to nest.

While I didn't study the field, I couldn't help noticing that the field suffered three events impacting biodiversity in the past 12 months:

- In 2019 (late summer?) the shrubby edges of the field were ripped out by a large machine not designed to make clean cuts and without consideration for damage to the remaining shrubs and small trees that create a thick cover of edge habitat suitable for many species of birds.
- In the first week of July 2020, before wildflowers had set seed and before many insects had completed their life cycles, the entire field was mowed to a height of 3 or 4 inches. In the month since then, some flowers have returned – most noticeably Queen Anne's Lace. The stand of Virginia Meadow Beauty (*Rhexia virginica*), that I first observed in August 2006, survived the mowing. I was not able to find the Ragged Fringe Orchid, which had been only a very small stand. It may be okay and I missed it. The Nodding Ladies' Tresses grow low and flower late which may have helped them survive the July mowing. By mid-August, the tree swallows had returned.
- On September 24, the partially recovered field and the still flowering Ladies' Tresses were mowed again.

## 8.0 Recommendations

Use these findings as a baseline for further observations.

Encourage people with the appropriate expertise to document their observations and help build an understanding of the extent of the actual biodiversity.

Let shrubbery grow around the field to create a bird-friendly edge habitat.

Restrict field mowing to late in the season after first frost to allow flowers to set seed and insects to complete life cycles. This would avoid the trap of using a single species protocol to govern habitat decisions, e.g., if Bobolink nesting time governs the mowing schedule and if Bobolinks are no longer present then all other species in the habitat are at risk.

Continue the hands-off approach to the wooded areas since they are starting to exhibit some of the characteristics of healthy old-growth forests.

Create policies that incentivise residents to remove a short list of invasive species from private land and persuade the Select Board to adopt them.

## **9.0 Summary**

Overall, I find that the wooded areas show the characteristics of a healthy mature forest. The understory is more dense in some areas than in others, as is the canopy cover. Ash trees are not doing well. Wildflowers abound; many as woodland ground cover plants, others are restricted to swamps and stream sides according to their natural habitat preferences. There is a healthy amount of standing and fallen dead wood. Young trees are growing to fill openings made in the canopy. There is a lot of buckthorn in the shrubby layer, and other non-native plants can be found throughout. I did not find all of the plant species identified in 1979 that are attached to the 2006 Towle Baseline Assessment — partly because there are some I don't know, partly because I didn't know which part of Towle in which to search, and possibly because they are no longer present. I found many others not noted in 1979, but the full extent of the biodiversity remains unknown. My observations provide a limited snapshot in time and are the beginning of what could become a baseline for assessing future changes.

## **Appendices**

Appendix A: Observations for Zone 1

Appendix B: Observations for Zone 2

Appendix C: Observations for Zone 3

Appendix D: Observations for Zone 4

Appendix E: Observations for Zone 5

Appendix F: Observations for Zone 6

Appendix G: Observations for Zone 7

Appendix H: Annotations to Plant List from 1979

## Appendix A: Observations for Zone 1

<b>Zone 1: Area defined by T2, T4, T13, T14, T1</b>	
Date	June 2019 thru August 2020
canopy type	Oak, White Pine, Maple. A few mature Black Locust, a single live cedar
canopy cover (%)	90 - 95% in spring, summer, fall
<b>Saplings and Small Trees</b>	<b>Height range</b>
White pine	1 ft – 12 ft
Red Oak	1 ft, 2 ft, 3 ft, 15 ft, 20 ft
Birch	15 ft
White Oak	6" - 1 ft
Black cherry	3 ft – 10 ft, mostly trailside
Hickory	2 ft, 8 ft, 15 ft+
Maple	1 ft – 20 ft
Elm	2 ft – 3 ft
Sassafras	1 ft, 2 ft, 5 ft – 20 ft, mostly near parking lot, several towards the field
<b>Understory shrubs (native non-invasive)</b>	
Highbush Blueberry	
Black Huckleberry	
Elderberry	
Winterberry	
Viburnum	Unknown kind
Spicebush	
Shrub density	Varied. Sparse in places.
<b>Invasive species</b>	
Buckthorn	1 ft – 10 ft
Oriental Bittersweet	
Multiflora Rose	
Euonymus alatus	5 ft – 8 ft
Euonymus fortunei	One instance
Japanese Barberry	
Cleavers	Theoretically invasive but now naturalized, considered native by some
<b>Ground cover plants</b>	

Widespread	Canada Mayflower and Virginia Creeper (both in many places, including below hay-scented fern fronds), Partridgeberry, Club mosses (two kinds), Starflower, Poison Ivy
Occasional	Grape, brambles, Groundnut (trailside, between T4 and boardwalk)
Ferns	Sensitive fern, Hay-scented (lots), Cinnamon (lots), Evergreen ( <i>Dryopteris intermedia</i> )
Grasses, sedges, reeds	Several kinds, in lower areas
Mosses	Present on ground, on tree bases, and on logs.
Swamp/wetland plants	Jewelweed (lots, wide swaths streamside, in stream beds and swamp), Skunk Cabbage, Goldthread
<b>Signs of browsing</b>	Deer browse unless otherwise stated
Hemlock	Not applicable, none in this area
White pine	Yes, sparse
Birch	One 4 ft tall with modest browse, another heavily browsed, and nearby 3 ft, 4 ft and 5 ft saplings with no browse.
Black cherry	moderate
Buckthorn	moderate
Red Oak	5 ft – no browse on leader
White Oak	3 ft tall, browsed at 1 ft
Maple	Sprouts at base of 10 ft tree browsed, another heavily browsed, and nearby 3 ft, 4 ft and 5 ft saplings with no browse.
Viburnum	Unknown variety, not Mapleleaf
Jewelweed	Heavy in spots
Multiflora rose	Heavy
<b>Other deer indicators</b>	(Some browse protocols rely on these species, if present.)
Pink Lady's Slipper	A few in this area towards southern parts, not browsed
Cucumber root	None noted
Mapleleaf viburnum	None noted
<b>Notes</b>	
Small canopy opening with brambles, poison ivy, multiflora rose.	
Streamside – big canopy hole 40% open with young birch, buckthorn, mid-range maples (trunk diam 4" - 6"), elderberry 8 ft. Big canopy opening over swamp with cleavers, jewelweed, skunk cabbage, multiflora rose (browsed), goldthread.	
Deer scat along a track, in February 2020.	
Ovenbird calling (6.20.20).	
Big canopy hole made by white pine in a mainly pine area – now with numerous little pines, 2 maples over 10 ft, one oak over 8 ft.	
Garter snake in the jewelweed. 8.5.20 Had had a recent meal.	

## Appendix B: Observations for Zone 2

<b>Zone 2: Area inside inner loop (except field and the loop defined by T2, T4, T13, T1) plus area west of T12, T10</b>	
Date	June 2019 thru August 2020
canopy type	Dominated by hardwoods with a few white pine, a few scattered hemlock and a large localized hemlock zone near T7, Maple, Oak, (scarlet, black, red, white), Black Birch, Pignut Hickory. A few White Ash. A very few beech – medium one north of T9. Small group of Tupelos (one medium tree and two saplings.)
canopy cover (%)	90 - 95% in most wooded parts for ¾ of the year, much less over swamps.
<b>Saplings and Small Trees</b>	<b>Height range</b>
White pine	1 ft – 10 ft
Red Oak	2ft, 3 ft – 10 ft – 15 ft, also areas of wall-to-wall seedlings 6" - 8"
Birch	5 ft – 10 ft, this is the predominant small tree in the understory
White Oak	Areas of 1 ft – 3 ft, scattered others 8 ft, 12 ft, 15 ft
Witch hazel	1 ft, 3 ft, 12 ft – 15 ft, bordering the streams and swamps
Hickory	Low ones in the ferns – 3 ft, 4 ft, 8 ft. Bigger ones – 15 ft
Maple	6" - 15 ft
Tupelo	One location with 2 small trees 8 ft – 10 ft beside a larger tree
Sassafras	1 ft - 5 ft
<b>Understory shrubs (native)</b>	
Highbush Blueberry	widespread
Lowbush Blueberry	Nowhere near as much as Highbush
Black Huckleberry	many
Mapleleaf Viburnum	A few scattered clusters, 6" - 4 ft
Swamp Azalea	Only one verified (in flower)
Buttonbush	few
Spicebush	few
Clethra	few
Holly	Few (verticillata or laevigata)
Greenbrier	few
Shrub density	varied. Some areas sparse (especially upland), others dense (especially bordering wetlands)
<b>Invasive species</b>	
Bittersweet	
Buckthorn	
Japanese Barberry	

<b>Ground cover plants</b>	
Widespread	Canada Mayflower, Partridgeberry, Starflower, club mosses (they stand out in winter), Virginia Creeper, Poison Ivy, Pipsissewa maculata (easiest to see it in winter), Indian Pipes, Uvularia
Occasional	Wood Anemone, Cow Wheat, Wintergreen, Rattlesnake Plantain, Roundleaf Pyrola, Pipsissewa umbellata, Goldenrod, Canada Dogwood
Ferns	Sensitive, Cinnamon, Hay-scented, Royal, black-stalked (?), Polypody, Bracken.
Grasses, sedges, reeds	Several kinds
Mosses	Many kinds, on the ground, on rocks, on logs. Sphagnum in the wetlands
Swamp/wetland plants	Skunk Cabbage, Jack-in-pulpit, Jewelweed, Golden Saxifrage, violets, arrow leaf(?), Golden Ragwort, Goldthread, False Hellebore, Small Green Wood Orchid
<b>Signs of browsing</b>	Deer browse unless otherwise stated
Hemlock	No. Lots of mature hemlock with branches 1 - 2 ft from the ground and lots of young hemlocks under 3 ft tall. None browsed. One with trunk about 8" diameter had been scraped 2-3 ft from ground.
White pine	Yes, minimal, on 2 ft to 3 ft seedlings here and there.
White ash	2.16.20 heavy browse on suckers from the horizontal portion of a large single white ash. 8.5.20 suckers had grown back and not re-browsed.
Maple	Modest browse on lower branches of trees 10 ft – 15 ft tall, heavy browse on basal suckers on trees that have them alongside new un-browsed suckers.
Black Huckleberry	some
Buckthorn	some
Red Oak	some
White Oak	some
Highbush blueberry	some
Jewelweed	Widespread heavy browsing
Birch	some
<b>Other deer indicators</b>	(Some browse protocols rely on these species, if present.)
Pink Lady's Slipper (note flower or seed pod)	Many plants throughout. Most flowered. Most not pollinated.
Cucumber root (note 1 or 2 whorls of leaves)	Many clusters, often near Pink Lady's Slippers. Many with double whorl, many flowered in 2020. Two clusters with only single whorl of leaves.
Mapleleaf viburnum	A few patches. None over 5 ft tall. All had flowered and set seed.
<b>Notes</b>	
Magnificent Red Oak and American Elm specimens pointed out on CCF tree walk on Feb 16, 2020.	
Medium size Tupelo noted on north side of trail between T9 and T10, plus a couple of saplings.	
Mycorrhizal fungi present throughout (Russulaceae, Boletaceae, Amanitas).	
Saprophytic fungi were present throughout. A variety of large species, medium, and tiny. Two somewhat rare species found (Adelphella babingtonii, Phaeohelotium epiphyllum). Clavariadelphus truncatus (10.5.20) – not known elsewhere in Carlisle.	
Deer scat observed in dry vernal pool and here and there in other spots on deer trails.	
Wooly Adelgid present on small group of hemlocks south of T4 and T13, no signs of it on large area of hemlocks east and west of trail between T7 and T8	

Lichen accessioned into Harvard Herbaria, *Cetrelia chicitae* (known in a few other spots in Carlisle, not common, possible role as old growth indicator)

Carion beetles observed on remains of a small rodent 6.17.19

## Appendix C: Observations for Zone 3

### **Zone 3: Area defined by T9, T 10, T11 (south of inner loop between Bingham Connector and outer loop)**

Date	June 2019 thru August 2020
canopy type	Mainly maple and birch at south end, some oak; mainly oak, birch, pine in northern part.
canopy cover (%)	90% - except winter
<b>Saplings and Small Trees</b>	<b>Height range</b>
Sassafras	Near Bingham Rd trail head, 2 ft – 10 ft
Witch Hazel	Many, 1 ft – 15 ft
Birch	Many, all sizes
White Pine	Many, 1 ft – 10 ft – 15 ft
White Oak	Scattered, 1 ft – 4 ft
Red Oak	Many, mostly seedlings, < 1 ft
Black Cherry	Few, 6 ft
Maple	6 ft – 8 ft – 15 ft
Hickory	1 ft – 8 ft
<b>Understory shrubs (native non-invasive)</b>	
Highbush Blueberry	many
Lowbush Blueberry	many
Black Huckleberry	many
Grape	few
Elderberry	few
Spicebush	lots
Hawthorn	One location, 2 ft – 3 ft
Greenbrier	few
Shrub density	Extremely varied. Upland more open, low-lying and wetlands more dense
<b>Invasive species</b>	
Burning Bush	few
Buckthorn	many
Japanese Barberry	Scattered throughout the wetland areas

Multiflora Rose	Here and there bordering wetlands

Ground cover plants	
Widespread	Starflower, Canada Mayflower, Partridgeberry, Sarsparilla, Wintergreen,
Occasional	Groundnut, Goldenrod, Indian Pipes, Pyrola
Ferns	Sensitive, Cinnamon, Common Polypody, Hayscented, Lady Fern, Royal Fern
Grasses, sedges, reeds	American Bur-reed, many other kinds I can't ID
Mosses	Sphagnum sp., Ulota crispa (on trees), Leucobrium bryum, Polytrichum, many others on ground, on rocks and on logs
Swamp/wetland plants	Jewelweed, Skunk cabbage, plant with arrow leaves, plant with heart-shaped leaves (1 ft tall), nettle (?), Cut-leaf Coneflower, Cardinal Flower, Allegheny Monkeyflower, Jack-in-the-Pulpit, Rue, Blue flag Iris
Signs of browsing	Deer browse unless otherwise stated
Hemlock	Only one hemlock of note in the area. No signs of browse but lower branches are dead.
White pine	Yes, scarce, on a 2 ft plant which had new growth
White oak	Modest, on single plant
Elderberry	Moderate
Jewelweed	Heavy and fairly widespread
Multi-flora rose	Heavy on the limited number of plants
Witch hazel	Modest
Spicebush	Heavy in spots
Other deer indicators	(Some browse protocols rely on these species, if present.)
Pink Lady's Slipper	Many, some flowered, some didn't
Cucumber root (note 1 or 2 whorls of leaves)	Some, scattered, distribution of single/double approx 50/50
Mapleleaf viburnum	None noted
Notes	
6.4.20	Pileated woodpecker busy on broken pine for 30 mins
6.4.20	Copper Underwing caterpillars on Witch Hazel

7.10.20 Net-winged beetles, <i>Calopteron reticulatum</i> .
8.24.20 Two White-tailed bucks browsing – late afternoon
8.24.20 Russula mushrooms, a mycorrhizal species
Rare lichen, <i>Coenogonium pineti</i> , accessioned into Harvard Herbaria. Not known elsewhere in Carlisle (or Concord).

## Appendix D: Observations for Zone 4

<b>Zone 4: Area inside outer loop</b>	
Date	June 2019 thru August 2020
canopy type	Mainly birch and oak with some white pine. Some hickory, some ash and maple near the south edge
canopy cover (%)	>90% except for holes over vernal pools
<b>Saplings and Small Trees</b>	<b>Height range</b>
Red Oak	many seedlings (< 8"), few 2 ft
White Oak	many 1 ft – 2 ft (un-browsed), 3 ft, 4 ft – 8 ft, 15 ft
Chestnut	3 ft to 8 ft
White Pine	1 ft, 2 ft, plus all heights and many dead ones
Birch	4 ft, 10 ft, all heights
Maple	Few, 8 ft, 20 ft
Hickory	6 ft to 8 ft
Black Cherry	One, 4 ft
Beech	One around 5 ft, another 20 ft
Sassafras	One, 3 ft
<b>Understory shrubs (native non-invasive)</b>	
Highbush Blueberry	
Lowbush Blueberry	
Black Huckleberry	
Grape	
Sheep laurel	Flowering on 6.17.19
Bramble	
Shrub density	
<b>Invasive species</b>	
Burning Bush	Euonymous alatus, a well-established widespread thicket, with shrubs young and old (1 ft – 12 ft), near the south edge and extending over the south side of outer loop trail.
Buckthorn	
Japanese Barberry	Occasional
Multiflora Rose	

<b>Ground cover plants</b>	
Widespread	Club moss, wintergreen, (lowbush blueberry noted in shrub section)
Occasional	Starflower, Canada mayflower, Partridge berry, poison ivy, brambles, Indian pipes. Canada lily just over zone 4 southern border
Ferns	Common Polypody, Bracken, Hay-scented
Grasses, sedges, reeds	
Mosses	Many types on rocks, logs, ground, trees. Liverworts on logs and trees.
Swamp/wetland plants	No streams or swamps. Some vernal pools (3 noted) which when dry were almost bare of vegetation.
<b>Signs of browsing</b>	Deer browse unless otherwise stated
White Oak	Occasional. 2 ft 6" one leader browsed, 4 ft with browse
Maple	Basal shoots of larger trees
Buckthorn	
Hickory	
Burning Bush	
<b>Other deer indicators</b>	(Some browse protocols rely on these species, if present.)
Pink Lady's Slipper (note flower or seed pod)	Numerous. Scattered throughout, most flowered.
Cucumber root (note 1 or 2 whorls of leaves)	None noted
Mapleleaf viburnum	None noted
<b>Notes</b>	
Ground cover very different from most of rest of Towle	
Canopy hole over bare patch (depression as if a vernal pool but dry in May when other pools in this area were not) surrounded by 2 ft blueberries, mid-sized maple and oak, birch and 2 white pine.	
Some of the big rocks have colonies of Smooth Rock Tripe and Toadskin lichen	
Numerous snags and dead wood on the ground	
On one visit I disturbed a Barred Owl.	
Saprophytic fungi – including Poison Pigskin Puffball hosting Parasitic Bolete	
Mycorrhizal fungi present as indicated by Indian Pipes.	

Sheep Laurel with flies on the flowers (pollinators?) and hosting leaf miners.
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## Appendix E: Observations for Zone 5

### Zone 5: Northeast corner, outside of inner loop

Date	June 2019 thru August 2020
canopy type	Largely Birch, White Pine, some Oak, some Ash, some Maple.
canopy cover (%)	80% - 95%
<b>Saplings and Small Trees</b>	<b>Height range</b>
White Pine	all heights
White Oak	2 ft – 8 ft
Birch	none in western end, scattered in rest
Sassafras	up to 15 ft, mostly 3 ft – 4 ft
Witch Hazel	northeast area large grove, 2 ft – 15 ft
Hemlock	across from those inside Inner Loop, 3 ft and up
Black Cherry	2 ft – 10 ft
Maple	lots at 1 ft, others up to 20 ft
Red Oak	<12" seedlings, plus others 4 ft – 8 ft
Hickory	10 ft (up through hay-scented fern), 15 ft
Balsam Fir	3 isolated instances
<b>Understory shrubs (native non-invasive)</b>	
Highbush Blueberry	Lots, widespread
Lowbush Blueberry	Lots, widespread
Viburnum	One specimen, not Mapleleaf, 2 ft
Mapleleaf Viburnum	One location, 3 ft tall, with berries
Black Huckleberry	Lots in one location
Shrub density	<i>Extremely</i> varied. Some areas are impenetrable, others (e.g. near parking lot) are dense, and others (e.g. opposite Turtle Rock) have very few shrubs.
<b>Invasive species</b>	
Buckthorn	Widespread
Burning Bush	One location

Ground cover plants	
Widespread	Canada Mayflower, Wintergreen, Partridge Berry, Virginia Creeper, Club Moss, Starflower
Occasional	Poison Ivy, Pipsissewa, Sarsparilla, Canada dogwood, Whorled Aster, Indian Pipes
Ferns	Bracken, Hay-scented (in patches), Cinnamon, Common Polypody, Royal, Interrupted, Sensitive, other
Grasses, sedges, reeds	Sedges in low spots around Tela's trail, grasses in other low spots

Mosses	on rocks, logs and ground. Sphagnum in the low spots
Swamp/wetland plants	Jewelweed but only in one location alongside T3, T4.
<b>Signs of browsing</b>	Deer browse unless otherwise stated
Jewelweed	along the stream on the east side of trail between T3 and T4, heavily browsed in 2019, returned fully in 2020, repeated heavy browse. Tall ones still flowering 9.9.20
Bramble	
Hickory	3 ft
White Oak	Up to 3 ft, several heavily browsed by caterpillars. 4 ft with deer browse.
Buckthorn	
<b>Other deer indicators</b>	(Some browse protocols rely on these species, if present.)
Pink Lady's Slipper	Scattered throughout, some flowered in 2019, others didn't. Many flowered in 2020, few were pollinated.
Cucumber root	Scattered. Most single whorl.
Mapleleaf viburnum	One location, 3 ft tall, berries, no evidence of browse
<b>Notes</b>	
In a sunny opening: saplings of White Pine, Black Cherry (3 ft – 5 ft), Maple and Oak (1 ft)	
Dark area near road: no shrubs, pine saplings, low maple saplings	
Area with dense birch canopy, no birch saplings, a few small pines, white oak (1 ft – 2 ft)	
Saprophytic fungi (e.g. Chicken of the Woods in several places, Bleeding Mycena, Trichaptum biforme, Daedaleopsis confragosa)	
Mycorrhizal fungi – Russulas – despite drought.	
Vernal pool, dry in August, pool area surrounded by Highbush Blueberry, with one 3 ft oak and nearby 1 ft – 2ft oaks and 3 ft maple.	
Tag placed on 5.26.20 to mark cluster of 10 oak seedlings. Checked on 9.9.20, all seedlings intact.	
3 Net-winged beetles, <i>Calopteron reticulatum</i> , 7.10.20	
Understory shows abrupt changes in several locations, as do the ground cover plants.	

## Appendix F: Observations for Zone 6

### Zone 6: Western Edge - down to southern edge of field

Date	June 2019 thru August 2020
canopy type	Mostly Maple. Some Oak, some Hickory. One Ash. Two large White Pines.

	One small pine grove in the back field with large trees.
canopy cover (%)	70% - 90%

Saplings and Small Trees	Height range
White Pine	3 ft – 8 ft
Black Cherry	1 ft – 8 ft
Sassafras	3 ft – 4 ft
Hickory	3ft, 8 ft, 12 ft
Red oak	1 ft
White Oak	< 1 ft
Elm	2 ft
Juniper	1 ft 6"

<b>Understory shrubs (native non-invasive)</b>	
Grape	Lots, some vines over 1" diameter
Lowbush Blueberry	
Shrub density	Dense except directly over stream. Density largely due to invasives.
<b>Invasive species</b>	
Bittersweet	
Buckthorn	
Multiflora Rose	Lots
Honeysuckle	
Burning Bush	few
Japanese Barberry	single cluster, near the holly
Holly	single plant

Ground cover plants	
Widespread	Goldenrod (edges), Cleavers, Virginia Creeper, Poison Ivy, Brambles

Occasional	Rue, Wild Geranium,
Ferns	Sensitive, Royal, Interrupted, Christmas, others
Grasses, sedges, reeds	Several
Mosses	Many kinds on rocks, trees, ground, logs
Swamp/wetland plants	Jewelweed, Skunk Cabbage, Jack-in-Pulpit, False Hellebore,
<b>Signs of browsing</b>	Deer browse unless otherwise stated
Buckthorn	
Jewelweed	
Honeysuckle	
Burning Bush	
Viburnum (not Mapleleaf)	all instances (3) had heavy caterpillar browse on all leaves.
<b>Other deer indicators</b>	(Some browse protocols rely on these species, if present.)
Pink Lady's Slipper (note[?] flower or seed pod)	Single plant. Did not flower in 2020.
Cucumber root (note 1 or 2 whorls of leaves)	N/A
Mapleleaf viburnum	N/A
<b>Notes</b>	
A lot of the area is a red maple swamp but no maple saplings. Virginia Creeper is covering large areas on ground and up trees.	
Deer scat in the back field under the apple tree. A single windfall apple (9.16.20).	

#### Appendix G: Observations for Zone 7

##### Zone 7: Cow Tunnel Triangle - T1, T 14

Date	June 2019 thru August 2020
canopy type	Oak, Maple, Birch, Black Locust, one giant White Pine. One Black Walnut at entrance to cow path trail
canopy cover (%)	60% and kind of airy
<b>Saplings and Small Trees</b>	<b>Height range</b>
Aspen	trailside
Black Cherry	6 ft – 10 ft
Maple	12 ft – 15 ft
Alder	6 ft – 15 ft
Black Locust	2 ft
<b>Understory shrubs (native non-invasive)</b>	
Highbush Blueberry	
Clematis	Clem. virginiana (I think)
Elderberry	pondside
Shrub density	very thick in parts due to the invasives
<b>Invasive species</b>	<b>Invasive species</b>
Buckthorn	
Multiflora Rose	
Japanese Barberry	
Bittersweet	
Honeysuckle	
<b>Ground cover plants</b>	

Widespread	Virginia Creeper, Poison ivy, Canada Mayflower,
Occasional	Asters, Partridgeberry, Pokeweed (at edge), Goldenrod, Persicaria virginiana, Brambles
Ferns	Cinnamon (3 ft – 4 ft tall), Hay-scented, Sensitive, Intermediate
Grasses, sedges, reeds	Cat tails, American Bur-reed, others in pond and in woods
Mosses	on logs, ground, trees, rocks
Swamp/wetland plants	Jewelweed, Jack-in-Pulpit, Skunk Cabbage

#### Signs of browsing

Jewelweed	heavy browse in places, large stands un-browsed and in flower 9.14.20
<b>Other deer indicators</b>	
Pink Lady's Slipper (note flower or seed pod)	N/A
Cucumber root (note 1 or 2 whorls of leaves)	N/A
Mapleleaf viburnum	N/A

#### Notes

Carolina Wren calling by the pond 5.20.20, pair of them in woods 5.30.20
Red-bellied woodpecker 5.30.20
Bull frogs calling 5.30.20
This triangle is very different from the rest of Towle, much higher density of invasives. Clematis not elsewhere in Towle. Persicaria virginiana not previously noted elsewhere in Carlisle.

## Appendix H: Notes on Plant List in Towle Land Baseline Assessment, Appendix D

### Towle Land Plant List, by Habitat

Source: Niessen, Nancy E., Site Analysis and Land Use Plan – Towle Conservation Land, Carlisle, Massachusetts, prepared for the Radcliffe Seminars Program, February 1979.

First two columns are from the original document; the third column was added by Kay Hurley based on observations from June 2019 through July 2020

Common name	Scientific name	2019/2020 Observation
<b>A. Succession Meadow</b> (I'm not sure which area this is – perhaps near the parking lot due to Black Locust being present. The species I checked off are present at Towle. Sumac wouldn't thrive as the meadow became woods and the canopy filled in but I didn't find any along the edges.)		
Black birch	Betula lenta	✓
Black locust	Robinia pseudoacacia	✓
Blackberry	Rubus sp.	✓
Common field juniper (red cedar)	Juniperus virginiana	✓
Dwarf huckleberry	Gaylussacia dumosa	
Gray Birch	Betula populifolia	✓
Gray dogwood	Cornus racemosa	
Fox grape	Vitis labrusca	✓
Hawthorn	Crataegus sp.	
Multiflora rose	Rosa multiflora	✓
Poison ivy	Toxicodendron radicans	✓
Smooth Sumac	Rhus glabra	
Staghorn Sumac	Rhus copallinaum	
Sweetfern	Comptonia peregrina	✓

Virginia Creeper	Parthenocissus quinquefolia	✓
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### B. Wet Woods

Bitter nightshade (bittersweet)	Solanum dulcamara	
Cinnamon fern	Osmunda cinnamomea	✓
Common buckthorn	Rhamnus cathartica	✓
False Solomon seal	Smilacena racemosa (Maianthemum canadense)	
Greenbrier	Smilax rotundifolia	✓
Hayscented fern	Dicksonia punctilobula (Dennstaedtia punctilobula)	✓
Jack-in-the-pulpit	Arisaema atrorubens (A. triphyllum triphyllum)	✓
Marsh fern	Dryopteris thelypteris (Thelypteris palustris)	
Poison ivy	Rhus toxicodendron (Toxicodendron radicans)	✓
Pokeweed	Phytolacca americana	✓
Red maple	Acer rubrum	✓
Royal fern	Osmunda regalis	✓
Silver maple	Acer saccharinum	
Sphagnum moss	Sphagnum magellanicum	✓
Swamp azalea	Rhododendron viscosum	✓
Swamp (fly) honeysuckle	Lonicera oblongifolia	✓

### C. Upland Woods

American chestnut	Quercus velutina	✓
American elm	Ulmus americana	✓

Black oak	<i>Quercus velutina</i>	✓
Blueberry	<i>Vaccinium</i> sp.	✓
Bracken fern	<i>Pteris latiuscula</i> ( <i>Pteridium aquilinum</i> , <i>P. latiusculum</i> )	✓
Canadian hemlock	<i>Tsuga canadensis</i>	✓
Dwarf rattlesnake plantain	<i>Goodyera repens</i>	✓
Fragrant sumac	<i>Rhus aromatica</i>	
Green ash	<i>Fraxinus pennsylvanica</i>	
Partridgberry	<i>Mitchella repens</i>	✓
Pink lady slipper	<i>Cypripedium acaule</i>	✓
Red maple	<i>Acer rubrum</i>	✓
Red Oak (northern red oak)	<i>Quercus borealis</i> ( <i>Q. rubra</i> )	✓
Round leaved pyrola	<i>Pyrola rotundifolia</i> ( <i>P. americana</i> )	✓
Sassafras	<i>Sassafras albidum</i>	✓
Sheep laurel	<i>Kalmia angustifolia</i>	✓
Spicebush	<i>Lindera benzoin</i>	✓
Wintergreen	<i>Gaultheria procumbens</i>	✓
White oak	<i>Quercus alba</i>	✓
White pine	<i>Pinus strobus</i>	✓
Witch hazel	<i>Hamamelis virginiana</i>	✓

#### D. Open Meadow

27 species listed in original | I didn't record observations in the open meadow

**E. Wetland**

Arrowwood	<i>Viburnum dentatum</i>	
Cardinal flower	<i>Lobelia cardinalis</i>	✓
Common cattail	<i>Typha latifolia</i>	✓
Pickerelweed	<i>Pontederia cordata</i>	
Skunk cabbage	<i>Symplocarpus foetidus</i>	✓
Spotted jewelweed	<i>Impatiens capensis</i>	✓