## LANDSCAPE RESOURCES

The 583-acre East River Preserve is divided into three distinct vegetative zones: the 25 acres along the East River with its tidal wetlands and woodland ecotone, the 25 acres of farm fields and the approximately 530-acre forested interior. Of the 530 acres of woodland about 125 acres are inland wetlands[2].

### Forested Uplands and Inland Wetlands

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 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 East River Preserve woodlands do not reflect these historic land use practices, however. They have been timbered over the centuries and do not appear to have ever been cleared for agricultural use. Evidence for this is seen in what was not found during our site investigation, including remnant red cedar trees or old field pines, open grown trees, stonewalls/fence rows, stone piles, cellar holes, charcoal hearths, and invasive plants. Also, in places tree age goes back 150 years or more, indicating that if the Preserve was ever cleared it would have begun to revert to forest prior to 1850.

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[2] From: *Coastal and Estuarine Land Conservation Program – Proposed East River Corridor Protection Project Nomination, Guilford, Connecticut.* Submitted by State of Connecticut Department of Environmental Protection, December 29, 2005

The main disturbance impact to the East River Preserve has been timbering. In *A Short History of the Goss Property*[3] Joel Helander supports this notion that the property "...has been largely unused for over three centuries. The principal value and utility of the woodland has been for woodlots i.e. timber harvest." Other disturbance events noted by EECOS were wind damage and blowdown 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. The chestnut blight of the early 1900's killed this major tree component of the New England forests. Interestingly, the East River Preserve shows no sign of the historic presence of American chestnut (*Castenea dentata*), and we cannot account for this absence.

Although a woodlot was a typical component of the colonial homestead, retaining one of over 500 acres was most unusual for coastal New England. Even on soils too poor or difficult to farm, woodlands were cutover and put into pastureland. Perhaps on the East River Preserve it is the many wetlands that fragment the landscape and the dry uplands that made 'tree farming' the only viable, economic use of the land.

Overall, the forested portion of East River Preserve is two-aged in structure, 21 – 40 years and 81 – 100 years, with a peppering of other age trees, some as old as150 years. This diversity of age structures is due to varying timbering rotations where not all trees were taken during any one rotation. This mostly two-aged structure will persist until age and disturbance factors create different conditions resulting in a change in age class distribution and species composition. With a major disturbance, such as clearing for agriculture, 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. Lesser species-specific disturbances, such as the 1900's chestnut disease outbreak or a future infestation of the Asian longhorned beetle (*Anoplophora glabripennis*), impose changes that greatly alter species composition and the forest ecology.

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 East River Preserve forest can be made. As noted previously, the present day woodland age and composition has primarily been driven by timbering practices. The parameters governing timber management over the centuries, such as tree size, species type and intensity of tree removal, are not

[3] Helander, Joel E., *A Short History of the Goss Property, a/k/a East River Preserve, Guilford, Connecticut, 1641-1927,* 2010, page 2

Chestnut Oaks

Microburst northeast of Plot 13

Upland oak community near Plot 12

Sand and gravel borrow pit near Plot 18

Denning site on upland knoll

Heavy beech understory

known except for the most recent cut some 30 years ago. These past patterns of use and disturbance will continue to shape the forest well into the future. Beech is becoming a dominant presence, although the forest overstory is still 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. 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 this century. Caterpillars defoliate trees, especially oaks, restricting their ability to photosynthesize. It is unlikely that the East River 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 suggests that future outbreaks could occur. On the East River Preserve no egg clusters were observed. 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. Whether the fungus will reappear in the future is unknown.

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.

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 over 50% of those plots containing beech. Its future impact on beech is unknown at this time.

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 40% of the data gathering plots where black birch was noted. This pathogen not only impacts black birch health, but also the overall timber value on the East River Preserve, as black birch is an intermediate forest com-

ponent. There is no treatment for the disease except for tree removal and improved growing conditions. Recent 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.

**Woodland Composition**

As previously noted, the age of forested plots east of the fields include two general age classes. For nearly two thirds of the plots, high canopy trees are in the 81-100+ year old age class, with varying ages for low canopy trees, anywhere from 20 to 100 years. The high canopy trees in the other third of the forested plots are in the 61-80 year old age class. These are generalized age classes that reflect the median age within each canopy class. For instance, a plot in the East River Preserve with a high canopy age class of 80-100+ may include individuals in excess of 150 years. Diameters for high canopy trees average 18 inches. Oaks are dominant, especially red, white and chestnut.

There are three plots containing an emergent layer, trees that are higher than the overall high canopy. This emergent layer consists of trees that, due to their growth characteristics, 'pop' above the high canopy layer. Red oak and tulip poplar are two examples of species with this growth characteristic. These trees are quite large with DBH (diameter at breast height) averaging about 28 inches. As the oaks in the high canopy layer continue to mature they will likely form a more substantial emergent layer than seen today.

On most plots there is a low canopy layer representing trees that are in various age classes. The youngest are in the 21-40 year old age class up to 81-100 years, with most in the 41-60 year old age class. Whether these represent truly separate age classes or are simply suppressed individuals competing poorly in the understory is unclear without coring trees. In the low canopy layer the species composition resembles that found in the high canopy, although beech is more highly represented. The DBH of this group averages eight inches. The high-shade tolerance of beech is signaling the forest composition of the future unless there is a significant disturbance.

In the pole and sapling layer (trees less than four inches DBH), species are represented that go across the shade tolerance spectrum. American beech is most prevalent, being found on nearly 80% of the plots, and in fact dominates on over 40% of plots. The highly shade tolerant beech not only persists in the low light understory, but on many plots outcompetes all other species. Where the understory is more open, red maple, black birch, oaks, hornbeam and hophornbeam are part of the mix.

The high percentage of beech in the understory also has an impact on the presence of seedlings and advanced regeneration. As in the pole and sapling

layer, beech dominates, being found alone or in combination with other species on nearly 50% of the forested plots. Red maple was the second most represented species on just under a quarter of the plots, closely followed by the oaks. A little over 20% of the plots contained no seedlings or advanced regeneration.

In all, 33 species of trees were noted in the upland woodlands. How this will play out in terms of future forest composition would indicate that beech will become a significantly greater component of the forest overstory with the possible reduction of other tree species. Of course, a disturbance incident could reshape forest structure, but it appears more likely that beech will come to dominate the overstory in the next century.

**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. The upland forested property east of the fields of the East River Preserve contains four basic cover types representing from 5% to 74% of the sampled plots outside of wetland areas. The map following indicates where these cover types are found.

| Cover Type | % Plots |
|---|---|
| Oak/Mixed Hardwoods | 73 |
| Mixed Upland Oak | 17 |
| Hardwoods | 5 |
| Oak/Hickory | 5 |

Oak–Mixed Hardwoods - This canopy type is found on 73% of the surveyed plots on the East River 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, black, chestnut and scarlet oak. Associated hardwoods include black birch and American beech. On moist lowlands, adjacent to wetlands, yellow birch, sugar maple, red maple, pin oak, blackgum, swamp white oak and tulip poplar mix in. Average diameters are in the 18-20 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 17% of the forested plots and is found on high, mostly southerly slopes. As soils are thin and well to excessively drained, and as they receive little upland runoff, moisture availability is the limiting factor. Also, south and west facing sites have higher evapotranspiration rates. On the East River Preserve common upland oak species are chestnut, black, scarlet, and white oak. Associates include black birch and pin oak. As moisture is a limiting factor, trees are generally smaller and slower growing than on lowland sites. In addition, there is greater spacing of individuals with more light reaching the forest floor. The abundance of huckleberry attests to these more open conditions.

On nearly 80% of this stand type, chestnut oak is the dominant species with scarlet, red and white oak mixed in along with American beech. Although the chestnut oak appears to share the same site conditions as the other upland oaks, its high concentration on some upland oak sites is unclear, although soil moisture may be higher. The chestnut oak is concentrated in the middle of the Preserve.

Mixed Hardwoods - This cover type accounts for 5% of the data plots. Mixed hardwood sites are located where soil depths are moderate and moisture is less of a limiting factor. On the East River Preserve this component is found on lower slopes, adjacent to wetlands. These conditions foster the growth of the greatest variety of species with no one species having clear dominance. Trees on the East River Preserve lands most often associated with this classification are American beech, red and white oak, red and sugar maple and black birch.

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 forest 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; however, the East River Preserve, at 5% of the forested plots, has relatively little of this cover type, as hickory occurrences are low throughout the property. In general, red and black oak and shagbark, mockernut and pignut hickory comprise this group.

Although not classified as cover types, the power line right-of-way (ROW) and the inland wetlands play significant roles in East River Preserve forest ecology and vegetation composition.

Power Line Right-Of-Way - According to Connecticut Light and Power (CL&P), the powerline ROW is maintained in an early successional stage, through the use of herbicides and cutting. Their goal is to remove invasive shrubs while maintaining native grasses, forbs and shrubs. The ROW is managed every four

years with a selective treatment of foliar sprays. Every ten years invading edge branches are cut, as are saplings that are then treated with a systemic application of herbicide. Mowing is considered too impactful and is likely difficult from an access perspective.

The ROW, although important to wildlife species requiring old-field and edge habitats, fragments the surrounding woodlands for those species needing large, uninterrupted forest blocks, especially interior nesting birds. ROW's also can act as transit vectors for opportunistic mammals such as raccoon (*Procyon lotor*) and the genus *Mustela*, as well as the nest parasitizer, brown-headed cowbird *(Molothrus ater*). For deep woods nesting birds, these species can pose a particular problem during nesting season.

Invasive plant species, although limited, were noted, including multiflora rose and autumn olive. Soils are acidic and this is reflected by the presence of mostly ericaceous (heath family) shrubs including bayberry, highbush and lowbush blueberry, and sweet fern. Mountain laurel is another shrub that competes well under these conditions. Herbaceous plants noted include milkweed (*Asclepias spp.*), Indian hemp (*Apocynum cannabinum*) the non-native common mullein (*Verbascum thapsus*), bracken fern (*Pteridium aquilinum*) and hayscented fern (*Dennstaedtia punctilobula*). Outside of the power line footprint, early successional habitat is mostly lacking on the Preserve, except along the East River.

Given that the ROW is a fact of life, its management should concentrate on maximizing habitat potential. Elimination of tree saplings and poles is central to maintenance of power line ROWS. While judicious applications of foliar and systemic herbicides are cost effective and relatively safe, other types of control should be considered. Encouraging the growth of shrub species to effectively discourage tree growth was part of experiments conducted by the late Bill Niering of Connecticut College. Such an approach would be part of an overall strategy to keep the ROW open while minimizing herbicide use.

In addition, encouraging management to favor the growth of native shrubs while minimizing herbicide use will provide valuable habitat for bird species that prefer shrubby habitat. Another benefactor would be interior forest nesting birds that will use these areas after the breeding season and during migration. If the area is managed to minimize any areas of short grass, then brown-headed cowbird parasitism will not be an issue. On-going discussion with CL&P as to best management practices would be beneficial in terms of understanding how different management approaches will affect surrounding woodlands and the future vegetation composition of the ROW.

Inland Wetlands/Streams – Over 20% of the wooded uplands are comprised of wetlands. Most of these are part of sinuous chains of mostly intermittent and some perennial streams draining the three local watersheds that divide the property approximately into equal thirds, each draining to the East River. In addition to these connected wetlands, ephemeral or vernal pools are present, although in low numbers

What makes these wooded wetlands particularly significant, other than their extent, is that they have experienced little human disturbance over the centuries. As noted earlier, the uplands are likely to have never been cleared for pastureland and thus have not suffered the impacts of livestock intrusion or the influx of silts and sediments that were a typical byproduct of colonial agricultural practices. In other words, this natural system of wetlands may be one of only a few remaining in coastal Connecticut that reflect the natural successional processes on the post glacial landscape.

Most of the wetland understories are shaded to various degrees due to the surrounding woodlands or that they themselves are wooded. The larger ones are more open, as they tend to remain seasonally flooded into the summer and may have greater water depth, thus inhibiting tree growth. Although difficult to access, none of these appear to retain standing water under dry conditions. Most are a combination of a red maple overstory and shrub understory. Blackgum is found just up gradient of the red maple, although in places it is mixed in, and in at least one wetland near plot 54 a wetland stand of dozens of blackgum is found, including at least one with a 22-inch diameter stem. Trees right around the wetland edges typically include yellow birch, tulip poplar, white ash and swamp white oak. More rarely seen are pin oak and black ash. 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 commonly found in the wetland understory. One of the more impressive of these relic wetlands is located to the southeast of plot 54.

Aside from their vegetative complexity, these inland wetlands attenuate flooding, are optimal for water recharge, filter nutrients and sediments and have high value for wildlife. For a comprehensive wetlands description, reference is made to a report prepared for Russell Waldo & Associates by CLA Engineers titled *Goss Site, East Bearhouse Hill Road, Podunk Road, Guilford, CT*, dated 11/08/05, pages 8-16.

A small 5-10 acre stand of floodplain forest is found at the northern end of the Preserve adjacent to the East River. High tide brings the water table close to the surface creating conditions that are seasonally productive for woodland

growth. Unlike the red maple swamps of the forested uplands, inundation is generally for short periods twice each day. The periodicity of soil saturation means that root systems are constantly moistened without leading to the hypoxic conditions associated with the standing water of red maple swamps. River flooding provides a steady source of nutrient-rich silts and sediments. As conditions are optimum for tree growth, species composition is high. Shrub species are representative of those associated with inland wetlands

Red maple/black-gum wetland

Wetland swamp east of Plot 15

Black ash on swamp edge near Plot 54

24 inch DBH blackgum

Red maple shrub swamp

Vernal pool 450 feet south of Plot 39

**Non-Native Woody Invasives**

Compared with much of the Connecticut landscape, woody, non-native invasives are remarkably absent from the upland woodlands of the East River Preserve. Even along the power line ROW invasives are found only in scattered locations, except for a patch of multiflora rose at the ROW's western end. Invasives are prevalent along the hedgerows and the eastern and northern field and particularly where the land is reverting to woodland, between the River and managed fields to the north and south of Foote's Bridge. In total about 15 acres of non-native woody invasives are found on the East River Preserve. Both burning bush and Japanese barberry were 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, especially, became established in these high-light conditions and persisted as the canopy closed during the ensuing decades. Because the East River Preserve woodlands were not cleared for agriculture, establishment of barberry was thwarted. Today, the woodlands remain barberry free, although a small eighth-acre patch near plot 42 was noted. Burning bush, on the other hand, can become established under the forest canopy, but to date it has not made it out of the forest edges.

Invasives along the hedgerows and eastern and northern field edges comprise an area of a little over three acres. Density of invasives on the eastern field edges is in the low to medium range whereas the northern field edge is medium to high. Of the two hedgerows south of Foote's Bridge one is high in density and the other quite low. The two major blocks of invasives adjacent to the river to the north and south of Foote's Bridge are about 11 acres in area. Here density levels are in the medium to high range and are comprised of the greatest diversity of invasives.

Many invasives, except for barberry and burning bush, require light levels higher than found in the forested understory. In the high-light environment adjacent to the fields and river, autumn olive, bittersweet, honeysuckle, multiflora rose and barberry are all present. Overall, invasives on the East River Preserve are not found in discreet concentrations by species, but are generally mixed together. For this reason the best approach to invasives control is to target all invasives in a particular area.

Recommendation - Managing for 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. It is recommended that invasives be either uprooted mechanically or mowed down, initially using track driven machines with "masticating" or mulching mower heads wherever possible. Follow up targeted treatment with herbicides often has the best control effects on resprouting vegetation. Without the aid of herbicides, the next best control method for barberry is the use of propane torches that heat and kill the root systems and remaining cambial tissue in the cut stems. Reference is also made to a pamphlet issued by the Connecticut Agricultural Experiment Station, *Japanese Barberry Control Overview*.

Diligence is also required for monitoring for invasives not found as yet on the Preserve, such as Japanese knotweed (*Polygonum cuspidatum*), Japanese stilt grass (*Microstegium vimineum*), and mile-a-minute vine (*Polygonum perfoliatum*), especially in fields and along edges. Further discussion on invasives is found in the field and East River Marsh Complex management sections.

**Table 3**: Non-native Shrubs and Their Relative Occurrence on The East River Preserve

| COMMON NAME | | WOODLAND | OPEN/EDGES |
|---|---|---|---|
| BARBERRY | *Berberis thunbergii* | X | X |
| BITTERSWEET | *Celastrus orbiculatus* | | X |
| BURNINGBUSH | *Euonymus atropurpureus* | X | X |
| HONEYSUCKLE | *Lonicera*, spp. | | X |
| MULTIFLORA ROSE | *Rosa multiflora* | | X |
| OLIVE, AUTUMN | *Elaeagnus umbellata* | | X |
| WINEBERRY | *Rubus phoenicolasius* | X | X |