



## Forest Health Monitoring Update for Marsh-Billings-Rockefeller NHP: 2006 - 2018

### The Story so Far...

The Northeast Temperate Network (NETN) has been monitoring forest health in Marsh-Billings-Rockefeller NHP for 12 years. Data collected over this period indicate that the park's forest is doing well overall, especially when compared to some other network parks further to the south. There are still areas of concern, however, including growing deer feeding pressure, forest pests/pathogens, and some invasive species becoming more common.

### Talkin' Bout Regeneration

Tree regeneration is mixed across the park. Some areas of the forest have seen a sharp increase between when NETN first started monitoring (2006) and this year's survey, and some have decreased (Map 1). Much of the forest has seen stable, but low regeneration densities in recent years.

Healthy forests typically have tree seedlings and saplings of varying sizes, whereas forests with a lot of deer tend to have mostly tiny seedlings less than a foot tall. The park forest appears to have a good range of seedling/sapling sizes, though there are some areas lacking any saplings at all (Map 2).

### Oh Deer

Some forests, including those of several NETN parks, have so many deer that the understory no longer has deer-preferred plants (like sugar maple seedlings and many wildflowers) and is instead dominated by deer-resistant species (beech trees, ferns and many invasive species). NETN monitoring in 2018 showed moderate impacts from deer in the park, though pressure does appear to be increasing - especially near park boundaries (Map 3).

### Today's Tiny Trees are Tomorrow's Forest

NETN forest crews keep track of whether seedlings and saplings in a forest are enough to replace the current canopy in the future, a measure called "stocking index" (Map 4). The more deer there are in an area, the more young trees are needed to accomplish this. Recent monitoring suggests that about one-third of the park's forest has enough young trees for areas with high deer impacts, while over 70% of the park's forest is good for low deer

impacts. There are some areas of the forest that appear to be severely under stocked, but closer inspection shows they are dominated by mature hemlock trees which naturally have low regeneration rates.

NETN has also noted that timber harvesting appears to be influencing these trends. Areas that had a high stocking index before a harvest decreased, and those with a low one generally increased - especially 6+ years after a harvest.

### Give me Some Sugar (Maples)

As one might expect for a Vermont park, sugar maple trees make up a significant proportion, about one-third, of all seedling and saplings (Map 5). They also make up a similar proportion of canopy trees (Map 6) and are likely to remain a



dominant part of the park forest into the near future. Together, ash and beech make up nearly another third of tree regeneration. This is concerning only because both of these species are under threat - ash by emerald ash

borer and beech by beech bark disease, limiting their ability to become full-fledged canopy trees. Eastern hemlock and oak each make up about 2% of seedlings and saplings, even though hemlock is the second most common canopy tree in the park. Low regeneration rates and the likelihood of a hemlock woolly adelgid infestation portends that hemlock may decline in importance over time. Native pines are also relatively abundant in the canopy and not well represented in the regeneration layer.

On the other hand ash and beech currently occupy less than 10% of the canopy, but make up almost a third of total regeneration. Low canopy species (mostly hophornbeam and striped maple) are another 25% of the regeneration layer.

Low canopy trees help contribute to overall forest diversity and structure, but these deer-resistant species can sometimes dominate an area so much that the regeneration of other native tree species is held back.

Blackberries and raspberries thickets are common in disturbed areas with lots of light. Their percent cover has increased dramatically in some areas after forestry

**Bottom Line:**  
Park Forests are Doing Well But There is Reason for Concern





In some of the park's tree plantations, raspberry/blackberry thickets may be inhibiting tree regeneration. NPS photo.

operations in the park (Map 10). Most of these species are native and are a natural part of the landscape, but they have become so dense in several plantations that tree regeneration may be suppressed.

Putting all these factors together indicates that the future forest could potentially look quite different than the current one.

### The Brutish Invasion

NETN monitoring found very few priority invasive species in the park forest (Maps 7 and 8), detecting only four species in the spring of 2018: common buckthorn, exotic bush honeysuckle, garlic mustard, and Japanese barberry. Though few in numbers, they were relatively widespread across the park, and somewhat alarmingly exotic bush honeysuckle and common buckthorn numbers doubled over one 4-year stretch of monitoring.



Though most people don't realize it, earthworms that escape to the forest are considered to be invasive. Since at least the end of the most recent ice age, these slimy critters are not native to the northeast - having been scoured away by tons of ice. Along with overabundant deer and invasive plant species, they have been linked to losses in native plant diversity when found in forested areas. Earthworm presence is widespread across the park (Map 9), though oddly, none were detected in the vicinity of the mansion and grounds. The aggressive "crazy

snake-worm" was not detected during 2018, which is the first survey after their initial detection in the park. This may only be because the timing of sampling was not ideal for distinguishing snake worms from the more common European earthworms, however.

### Par for the Coarse

Coarse woody debris (CWD) is an important component of a healthy forest ecosystem. NETN monitoring shows it has been increasing in the park over time (Maps 11 and 12). Most of the park's forest now meets or exceeds the minimum CWD requirements to support a broad suite of forest species dependent on this habitat type. This no doubt is a reflection of the park's continued commitment to retain and/or enhance CWD during forestry operations. Very large CWD pieces, however, (important habitat for species like American marten and black bears), may still be lacking.

### Monitoring Maps and More Detailed Information

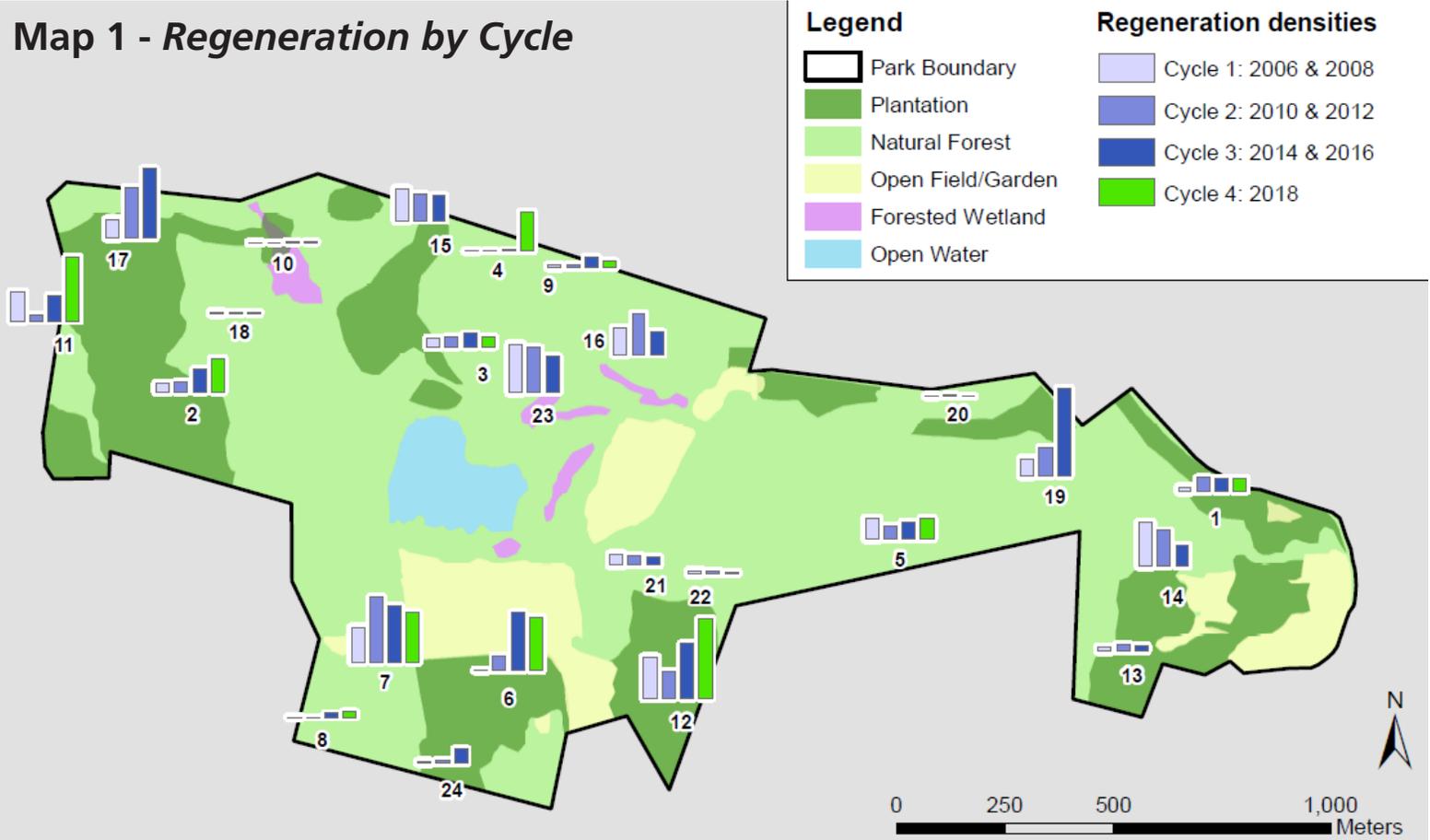
A brief explanation of the following monitoring maps: the number next to the pie/bar charts is the NETN forest monitoring plot number. Each plot is monitored once every 4 years. Pie chart size relates to the overall abundance of vegetation per plot. Bar chart length represents density over time per plot. See NETN's Forest Health Monitoring webpage for access to the full monitoring summary. Also view or download other forest health related materials. <https://www.nps.gov/im/netn/forest-health.htm>



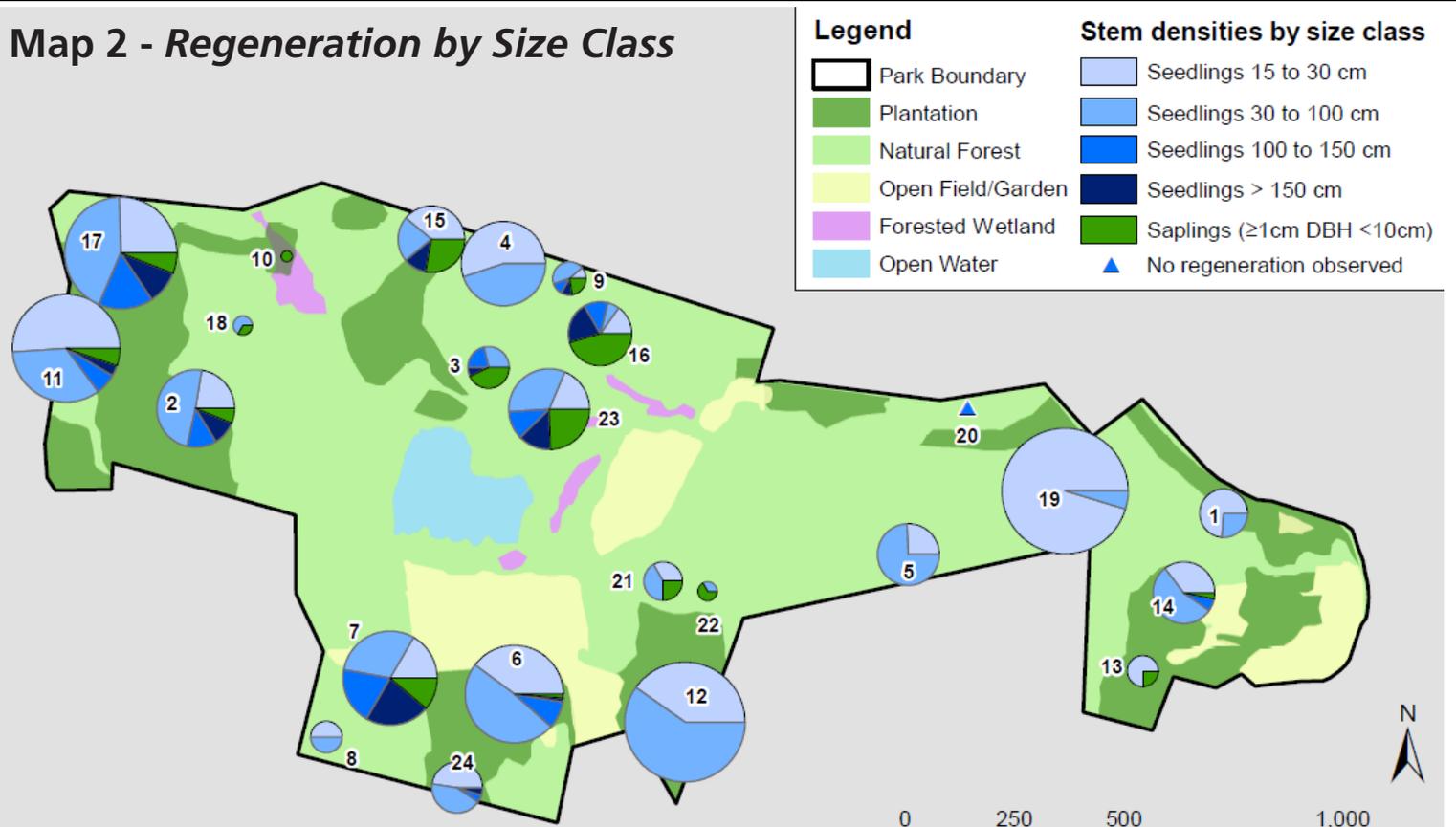


# Forest Health Monitoring Maps for Marsh-Billings-Rockefeller NHP: 2006 to 2018

## Map 1 - Regeneration by Cycle



## Map 2 - Regeneration by Size Class



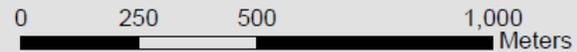
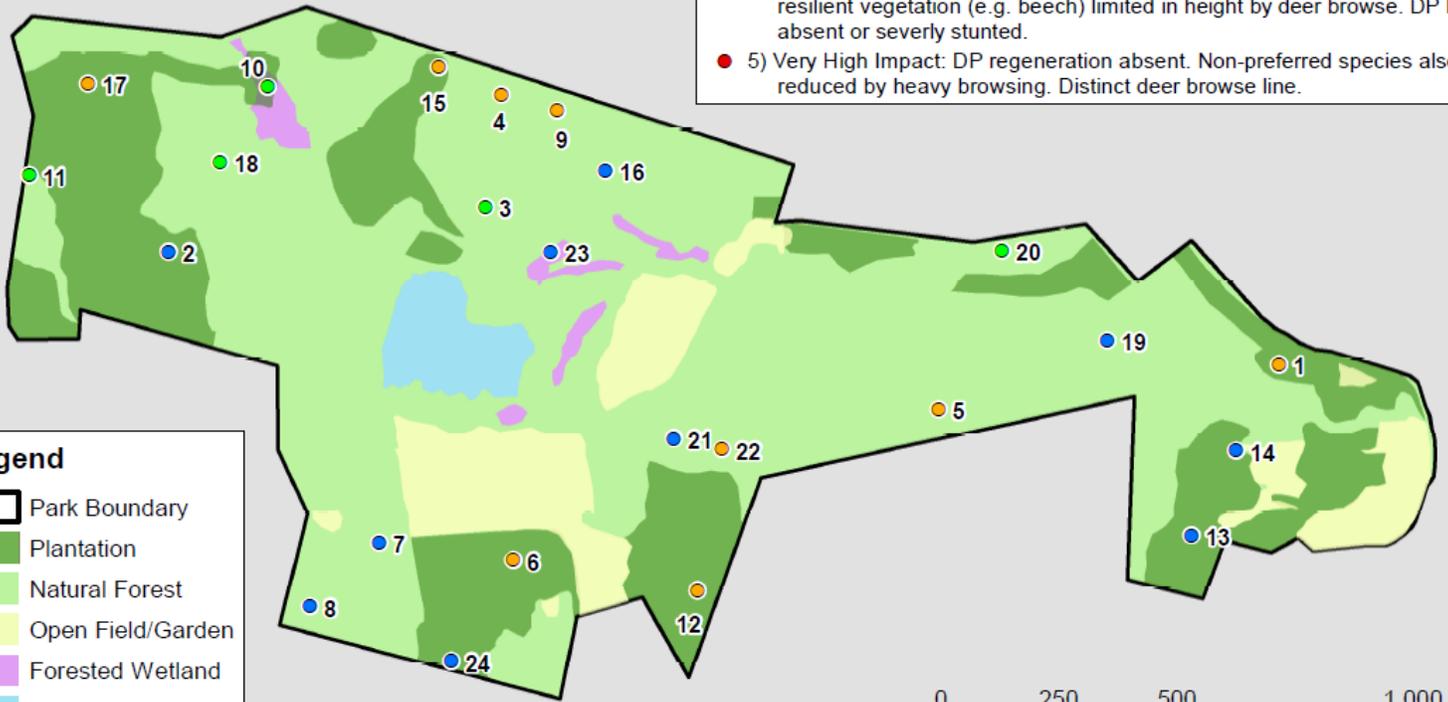
### Map 3 - Deer Browse Impacts

#### Deer Browse Index

- 1) No Impact: found only in well-maintained deer exclosures.
- 2) Low Impact: deer preferred (DP) species abundant and of varying heights.
- 3) Medium impact: DP species present, but mostly under 30 cm tall. DP herbs present but stunted and flowering is uncommon.
- 4) High Impact: DP species are rare to absent. Non-preferred and browse-resilient vegetation (e.g. beech) limited in height by deer browse. DP herbs absent or severely stunted.
- 5) Very High Impact: DP regeneration absent. Non-preferred species also reduced by heavy browsing. Distinct deer browse line.

#### Legend

- ▭ Park Boundary
- ▭ Plantation
- ▭ Natural Forest
- ▭ Open Field/Garden
- ▭ Forested Wetland
- ▭ Open Water



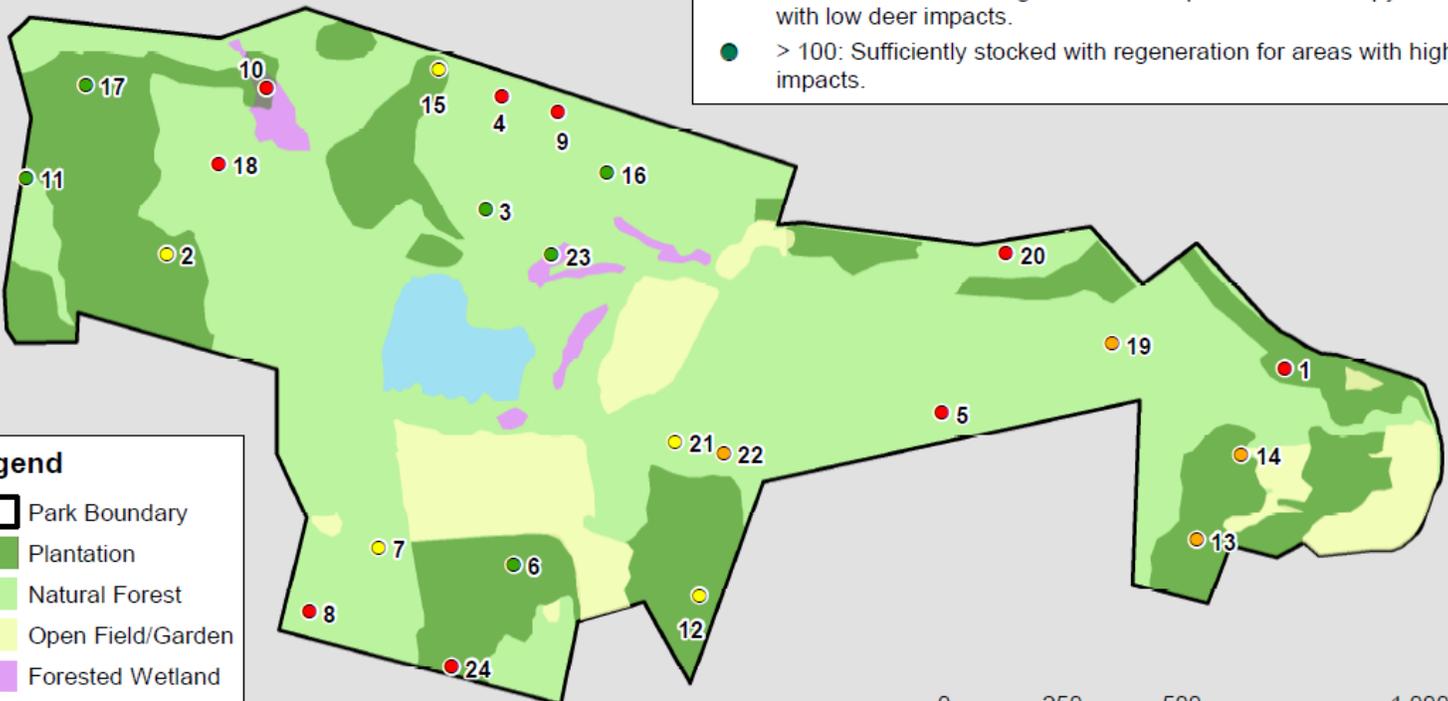
### Map 4 - Regeneration Stocking Index

#### Stocking Index Ranges

- < 25: Severely understocked. Regeneration is insufficient to replace the forest canopy.
- 25 to 50: Moderately stocked regeneration for areas with low deer impacts.
- 50 to 100: Sufficient regeneration to replace forest canopy in areas with low deer impacts.
- > 100: Sufficiently stocked with regeneration for areas with high deer impacts.

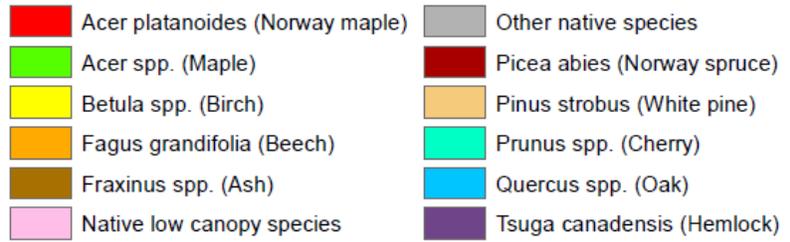
#### Legend

- ▭ Park Boundary
- ▭ Plantation
- ▭ Natural Forest
- ▭ Open Field/Garden
- ▭ Forested Wetland
- ▭ Open Water

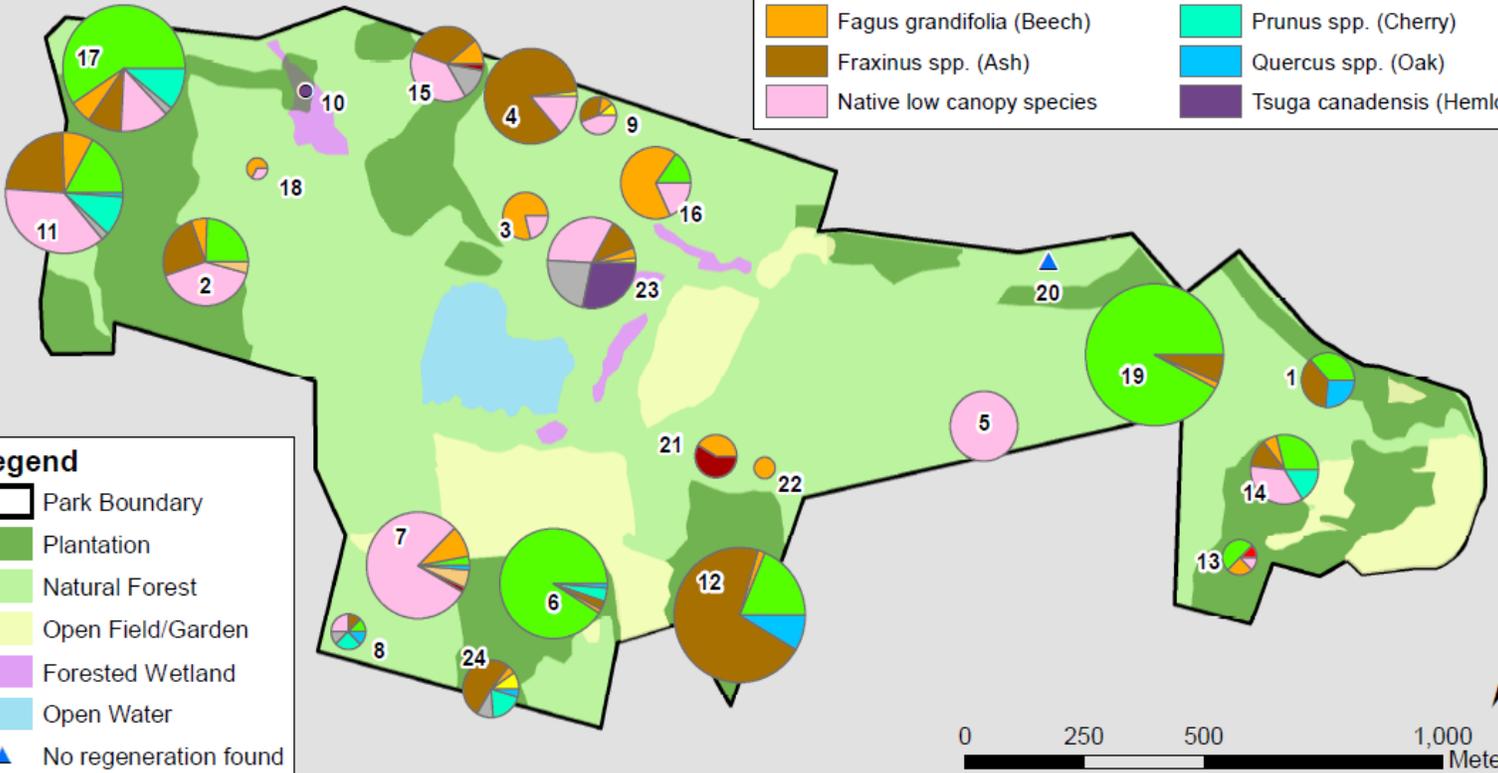


# Map 5 - Regeneration Composition

## Species in Pie Charts

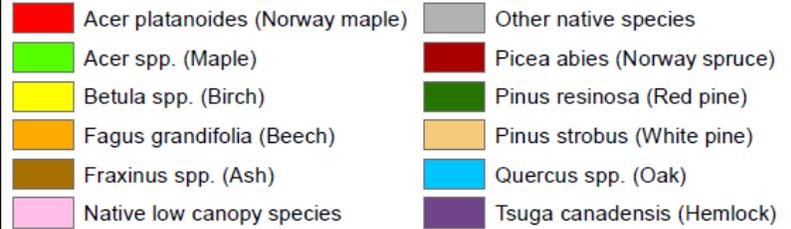


## Legend

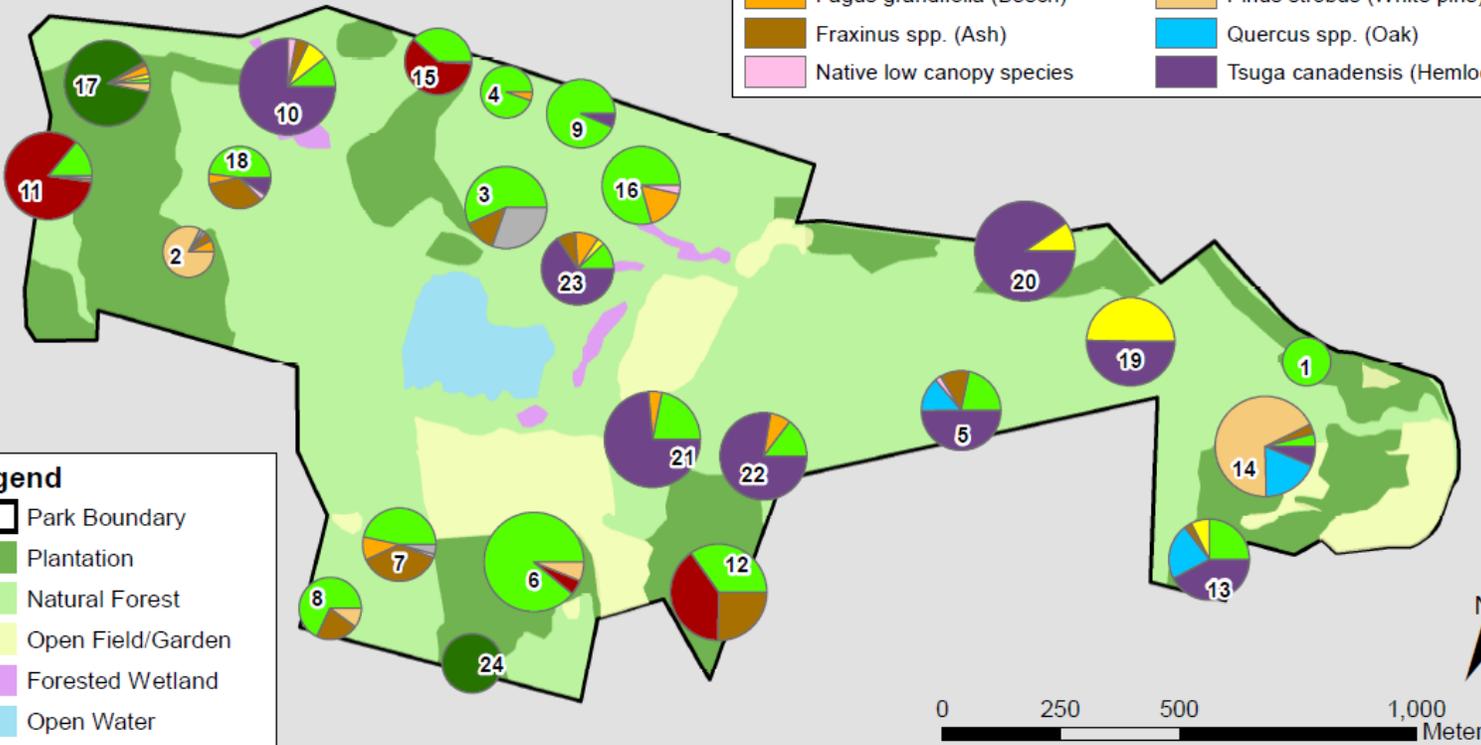


# Map 6 - Canopy Tree Composition

## Species in Pie Charts



## Legend



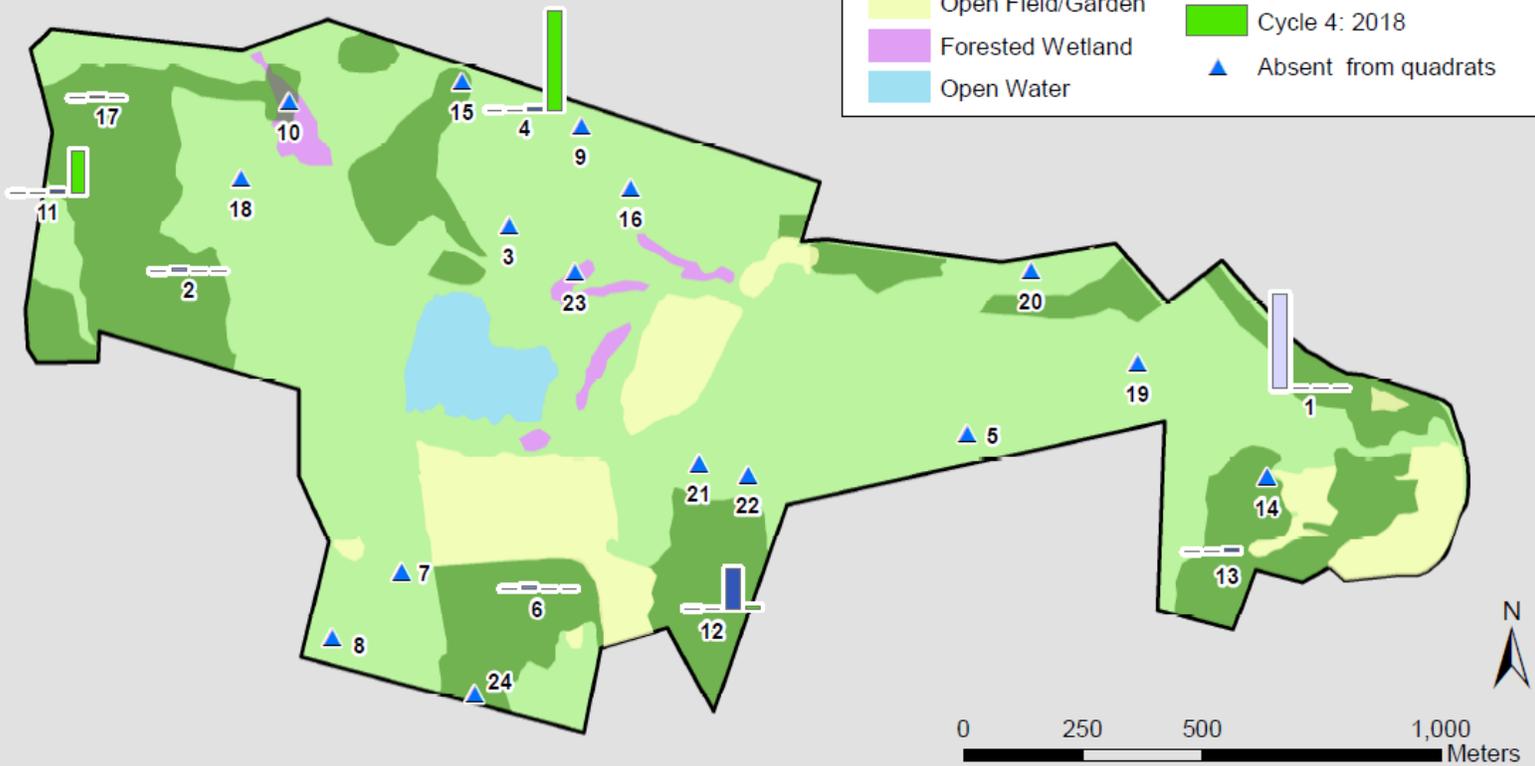
### Map 7 - Priority Invasive Species Cover

#### Legend

- Park Boundary
- Plantation
- Natural Forest
- Open Field/Garden
- Forested Wetland
- Open Water

#### Average Quadrat % Cover

- Cycle 1: 2006 & 2008
- Cycle 2: 2010 & 2012
- Cycle 3: 2014 & 2016
- Cycle 4: 2018
- Absent from quadrats

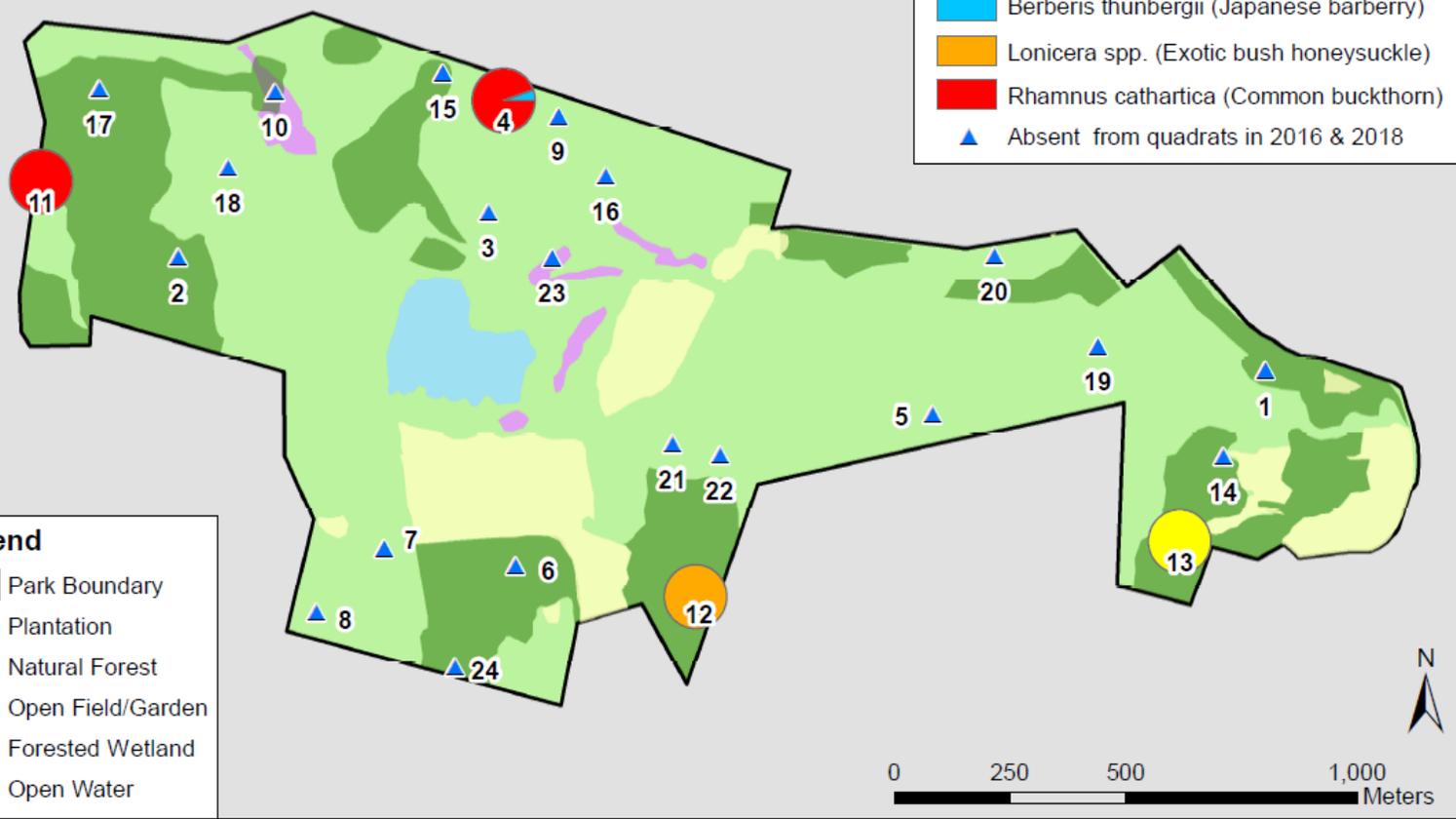


### Map 8 - Priority Invasive Species

#### Species in Pie Charts

- Alliaria petiolata* (Garlic mustard)
- Berberis thunbergii* (Japanese barberry)
- Lonicera* spp. (Exotic bush honeysuckle)
- Rhamnus cathartica* (Common buckthorn)
- Absent from quadrats in 2016 & 2018

- #### Legend
- Park Boundary
  - Plantation
  - Natural Forest
  - Open Field/Garden
  - Forested Wetland
  - Open Water



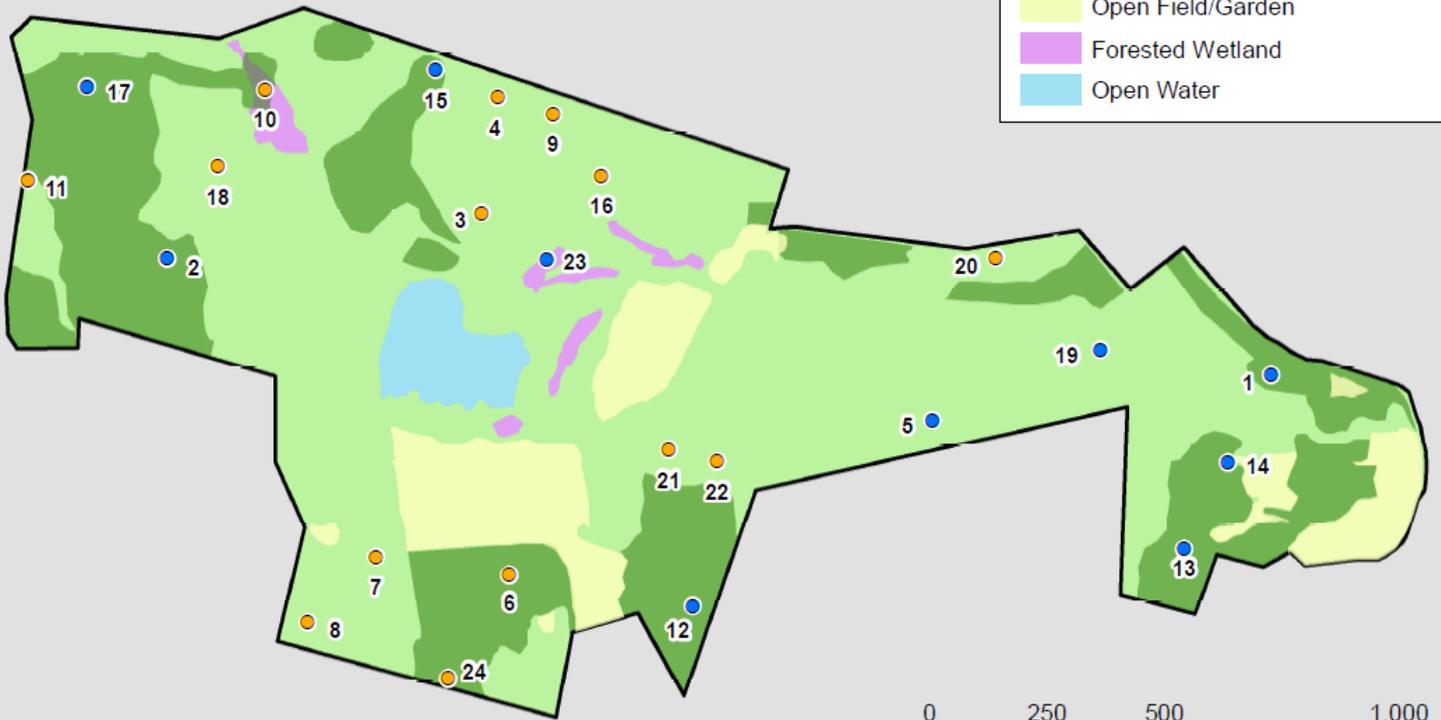
**Map 9 - Earthworm Presence**

**Legend**

- Park Boundary
- Plantation
- Natural Forest
- Open Field/Garden
- Forested Wetland
- Open Water

**Earthworms**

- Absent
- Present



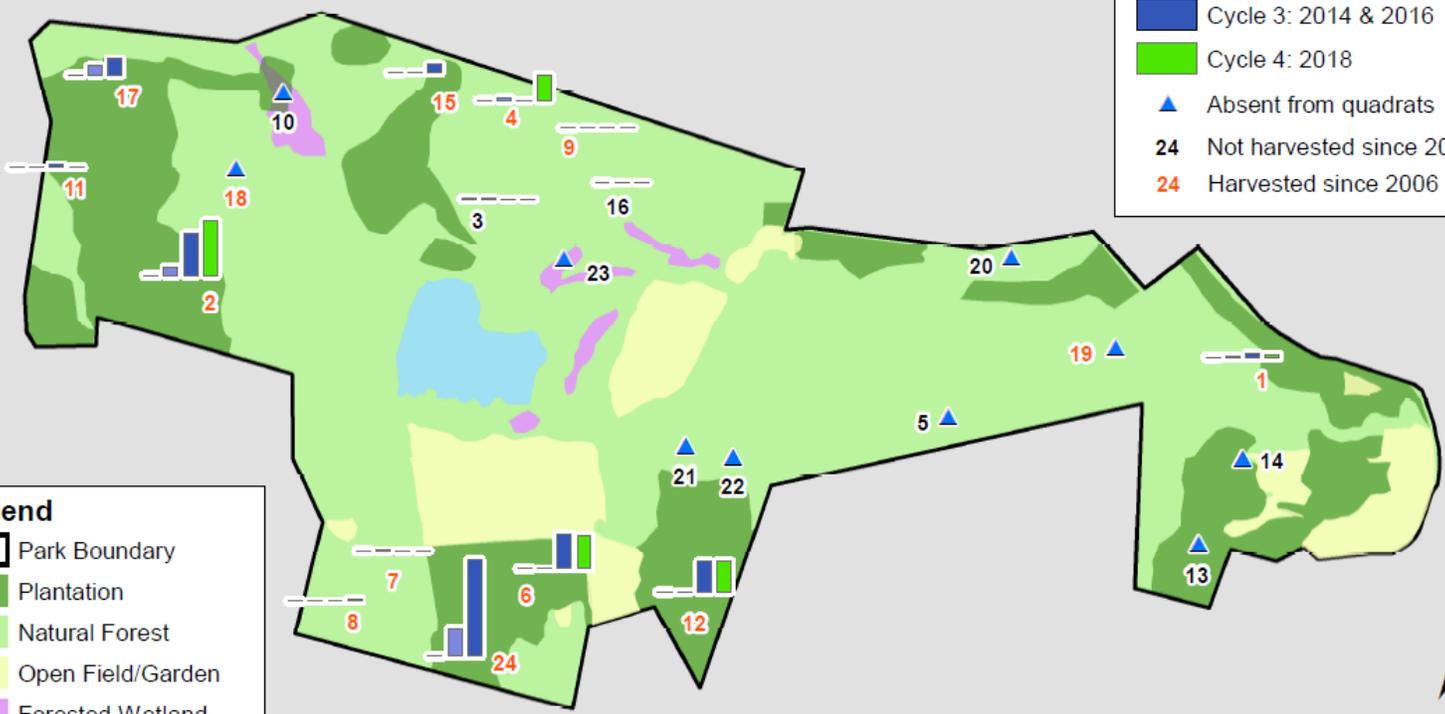
**Map 10 - Raspberry/Blackberry Cover**

**Average Quadrat % Cover**

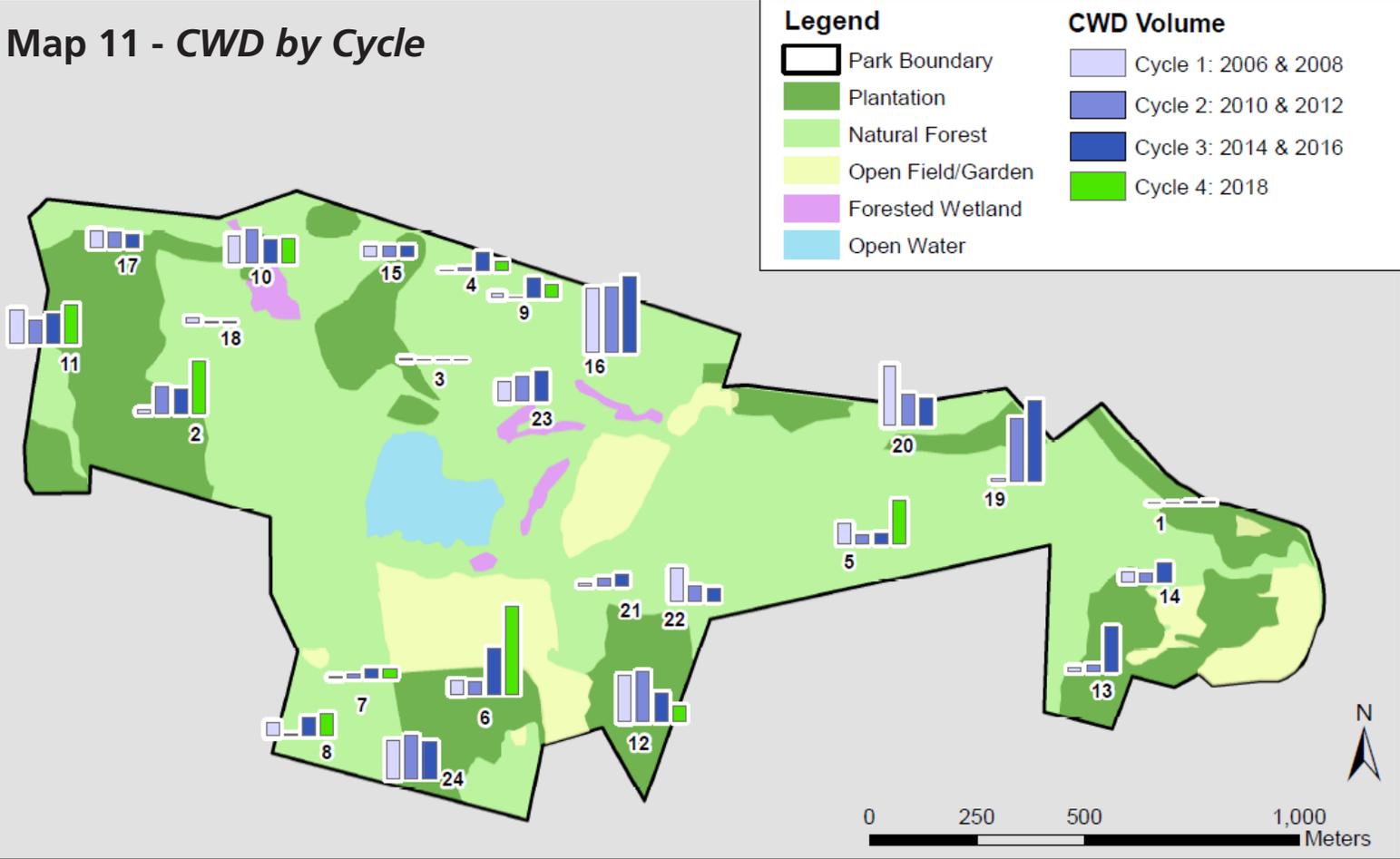
- Cycle 1: 2006 & 2008
- Cycle 2: 2010 & 2012
- Cycle 3: 2014 & 2016
- Cycle 4: 2018
- ▲ Absent from quadrats
- 24 Not harvested since 2006
- 24 Harvested since 2006

**Legend**

- Park Boundary
- Plantation
- Natural Forest
- Open Field/Garden
- Forested Wetland
- Open Water



### Map 11 - CWD by Cycle



### Map 12 - CWD Levels: 2016 and 2018

