

Forest Data Summaries for Weir Farm National Historic Site: 2007-2017.

Background

Data summaries are based on data collected in Northeast Temperate Network (NETN) long-term forest monitoring plots. There are 10 NETN forest plots in WEFA. Each plot is sampled on an alternating 4-year cycle, where plots 1-5 are sampled were sampled in 2007, 2011, and 2015, and plots 6-10 were sampled in 2009, 2013, and 2017.

Within each forest plot, tree and stand measurements, including an assessment of deer browse impact, are made within 20x20 m square plots. Tree regeneration is tallied by size class within three 2-m radius circular microplots within each square plot. Coarse woody debris (CWD) is assessed using line intersect sampling along three 15-m transects originating at plot center. Understory diversity is monitored within eight 1-m² quadrats, and soil samples are obtained from a location adjacent to the plot. Plots are permanently marked and measured at the same location every cycle. For a more detailed description of the forest monitoring protocol, including background information, field methods, and sample design, refer to the [NETN forest monitoring protocol](#).

This document provides data summaries and brief interpretations of tree regeneration and invasive species data to help inform resource management staff of any potential forest issues detected by NETN forest monitoring. Note that summaries are considered preliminary until after the 2017 forest data are thoroughly quality checked and certified at the end of the field season.

Interpretation of Maps

Regeneration Stocking Index

The regeneration stocking index quantifies whether current seedling and sapling densities are sufficient to restock a forest canopy. The index is a weighted sum of native seedling and sapling densities where larger size classes get higher weights in the calculation. Based on the most recent survey cycle (2015 and 2017), 6 of 10 (60%) of forest plots are severely understocked in WEFA. Four plots are moderately to sufficiently stocked; however, this level of stocking may not be sufficient if white-tailed deer impacts continue to be high throughout the park.

Index of Deer Browse Impacts

Deer browse impacts (DBI) were high (deer browse index: 4) in 7 out of 10 plots (70%) in cycle 3. DBI scores have remained consistently high since DBI assessments began in 2009, which was half-way through the first cycle (average DBI scores were: 3.8 in cycle 1, 4.0 in cycle 2, and 3.8 in cycle 3). Mean DBI scores above 3.5 indicate that forest plots have sustained such heavy browse that the understory composition has shifted from browse-preferred woody and herbaceous species (e.g., sugar maple and liliaceous herbs) to browse-resistant or non-preferred species (e.g., beech, ferns and invasive species).

Regeneration by Size Class

Healthy forests typically have tree seedlings of varying sizes, whereas forests with impacts from deer browse tend to be dominated by seedlings less than 30cm (~1 ft) tall. Where regeneration is moderately abundant, such plots 1, 2, 7, and 9, seedlings are present in a range of size classes, including saplings. Where regeneration is sparse, seedlings tend to only be in the 15-30cm (~6-12 inches tall) size class.

Regeneration Composition

While regeneration in plot 7 is fairly abundant, the regeneration layer is dominated by ash seedlings, which is not ideal given the imminent threat of emerald ash borer. Remaining plots with moderate

Forest Data Summaries for Roosevelt-Vanderbilt National Historic Sites: 2007-2017.

regeneration (e.g., plots 1, 2 and 9) have a decent mix of native species in the seedling layer, although based on the stocking index, regeneration abundance is still largely below levels needed to restock the future forest.

Tree Composition by Basal Area

Basal area, which is a common metric to assess tree abundance, is the cross-sectional area occupied by each species (based on the diameter at breast height) on a plot, converted to m²/ha. Based on the basal area by species in WEFA plots, forests are dominated by species of maple (*Acer* spp.), especially red maple (*A. rubrum*) and sugar maple (*A. saccharum*). However, the canopy layer is also fairly diverse in WEFA, with species of birch (*Betula* spp.), oak (*Quercus* spp.), and hickory (*Carya* spp.) common. While ash (*Fraxinus* spp.) trees are present in half of the plots in WEFA, ash is a minor component of the canopy in all but plot 10. With emerald ash borer (EAB) present in the same county as the park, the forest canopy in WEFA is not as vulnerable to EAB as other NETN parks (e.g. MABI and SARA).

Invasive Plant % Cover by Cycle

While invasive plants are present in the quadrats for all but one plot in WEFA (90% of plots), quadrats remain dominated by native species and cover has remained relatively steady since monitoring began in 2007 in all but 3 plots. Invasive cover in plot 9 decreased by 3-4% between each of the three cycles, but the declines were not driven by a single species. Invasive cover in plot 4 increased by roughly 10% between the 2nd and 3rd cycle (1.35% to 11.7%), and this was primarily due to a 9.5% increase in burningbush (*Euonymus alatus*) between cycle 2 and 3. Average invasive cover in plot 8 increased from 4.7 to 20.5% between cycle 2 and 3, due to 7-8% increases in cover of Japanese barberry (*Berberis thunbergii*) and wineberry (*Rubus phoenicolasius*).

Summary

Impacts from deer overabundance, including reduced tree regeneration and understory diversity, are widespread throughout WEFA. Deer management may be necessary to ensure sufficient regeneration and maintain understory native diversity. While invasive plant species are present in the majority of forest plots, invasive abundance has remained fairly constant since monitoring began in 2007. Managing deer densities where impacts are most severe will help ensure invasives remain at relatively low levels, as deer tend to facilitate expansion of invasive species by preferentially browsing native species. Impacts from invasive shrubs, such as Japanese barberry, burningbush and wineberry, have been documented on forest regeneration and understory diversity across the northeastern US, including NETN parks, and keeping these at relatively low levels is important to ensure impacts are minimal to WEFA forests.

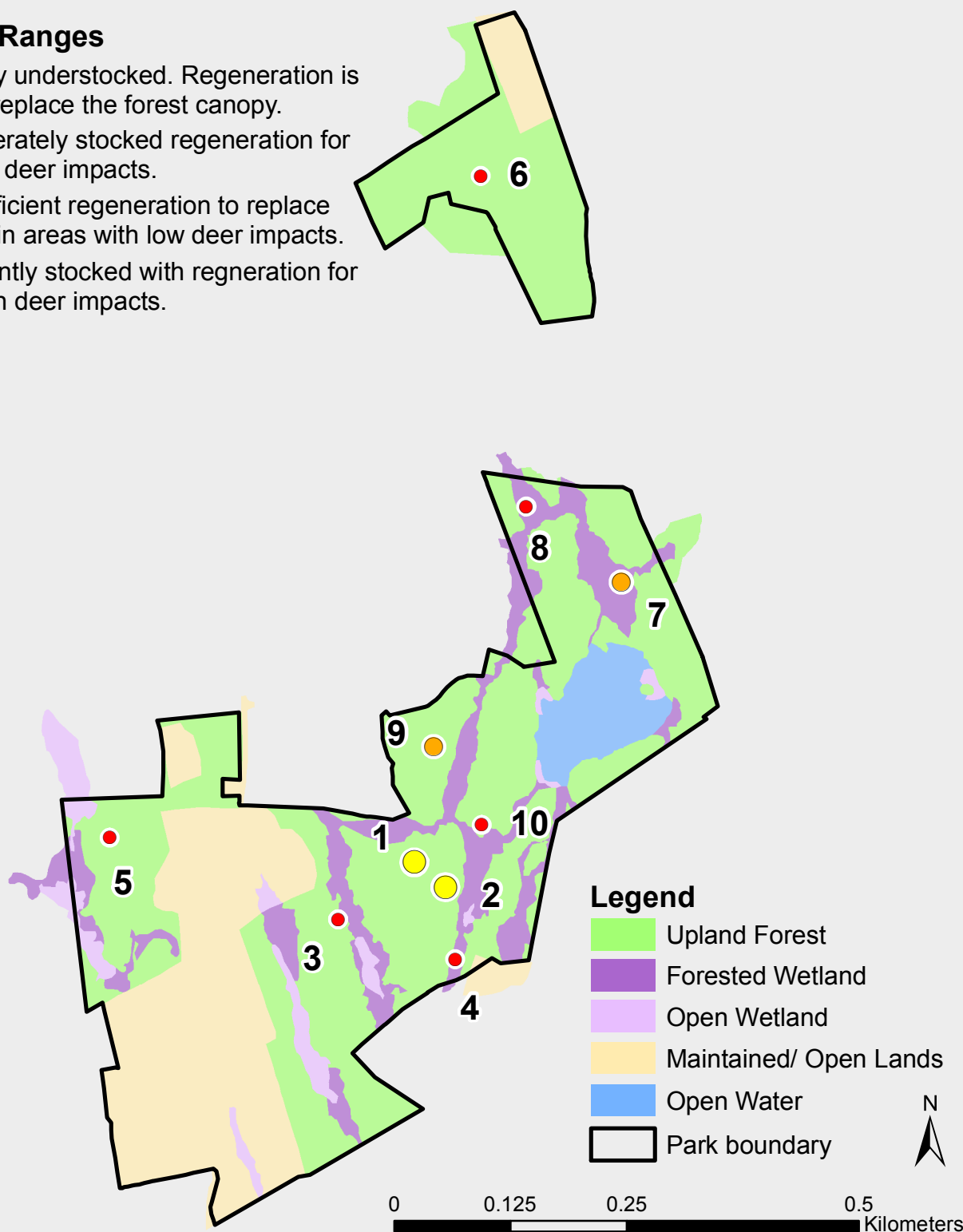


Regeneration Stocking Index

Trends in the regeneration stocking index for the most recent survey cycle (2015 & 2017). The stocking index quantifies whether current regeneration densities are sufficient to restock a forest canopy. The index is a weighted sum of seedling and sapling densities where larger seedling size classes get higher weights. The stocking index is averaged over three 2-m microplots per forest plot (range 0.3 to 180.3).
Date: 7/7/2017.

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.



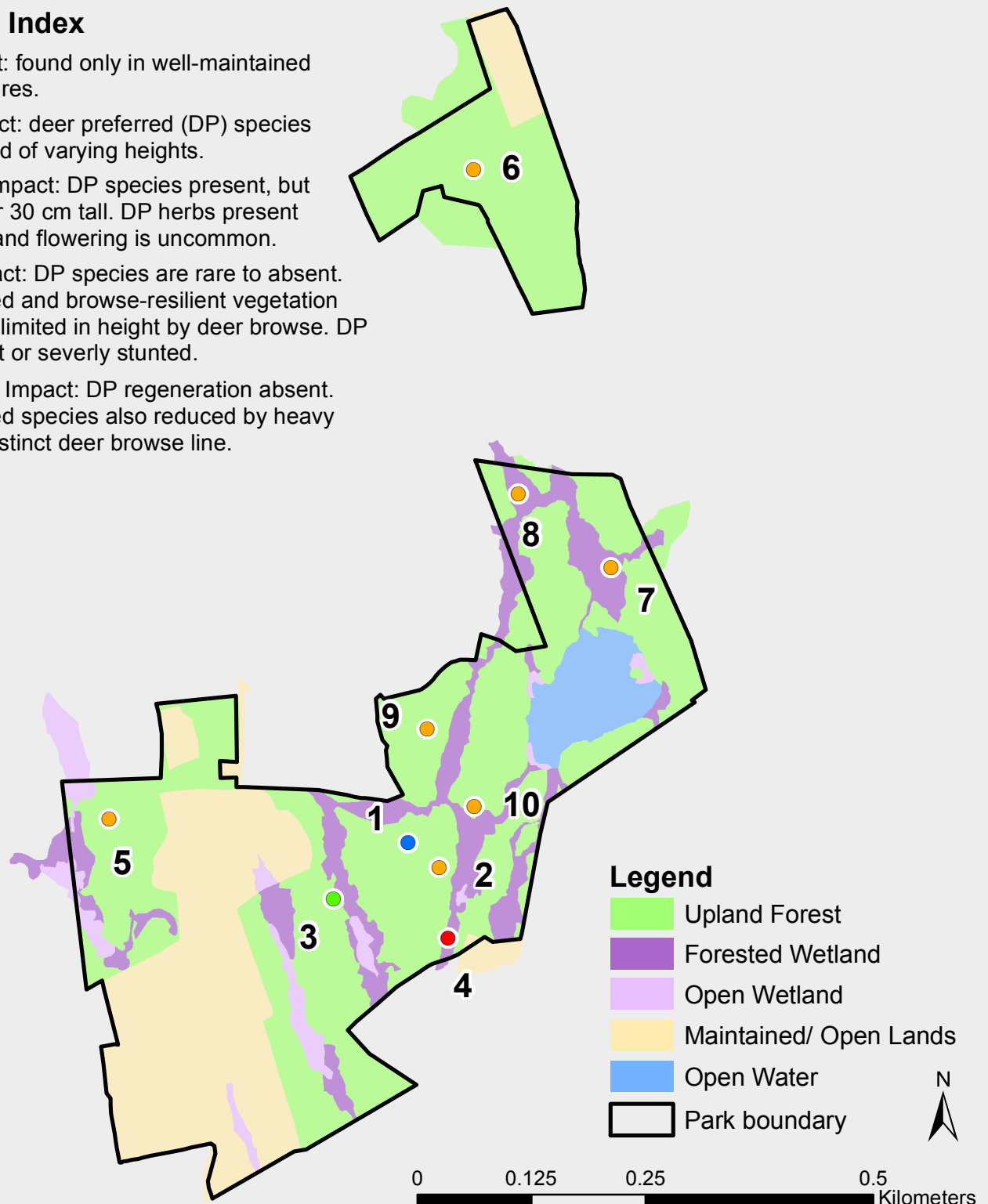


Index of Deer Browse Impacts: Cycle 3

Index of deer browse impacts observed in forest plots in the most recent survey cycle (Cycle 3= 2015 & 2017). Each plot is sampled on a 4-year cycle, with plots 1-5 sampled in 2015 and plots 6-10 sampled in 2017. Deer browse impacts are assessed on a scale of 1-5, with 1 representing no impact and 5 representing severe impacts. Date: 7/7/2017.

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.



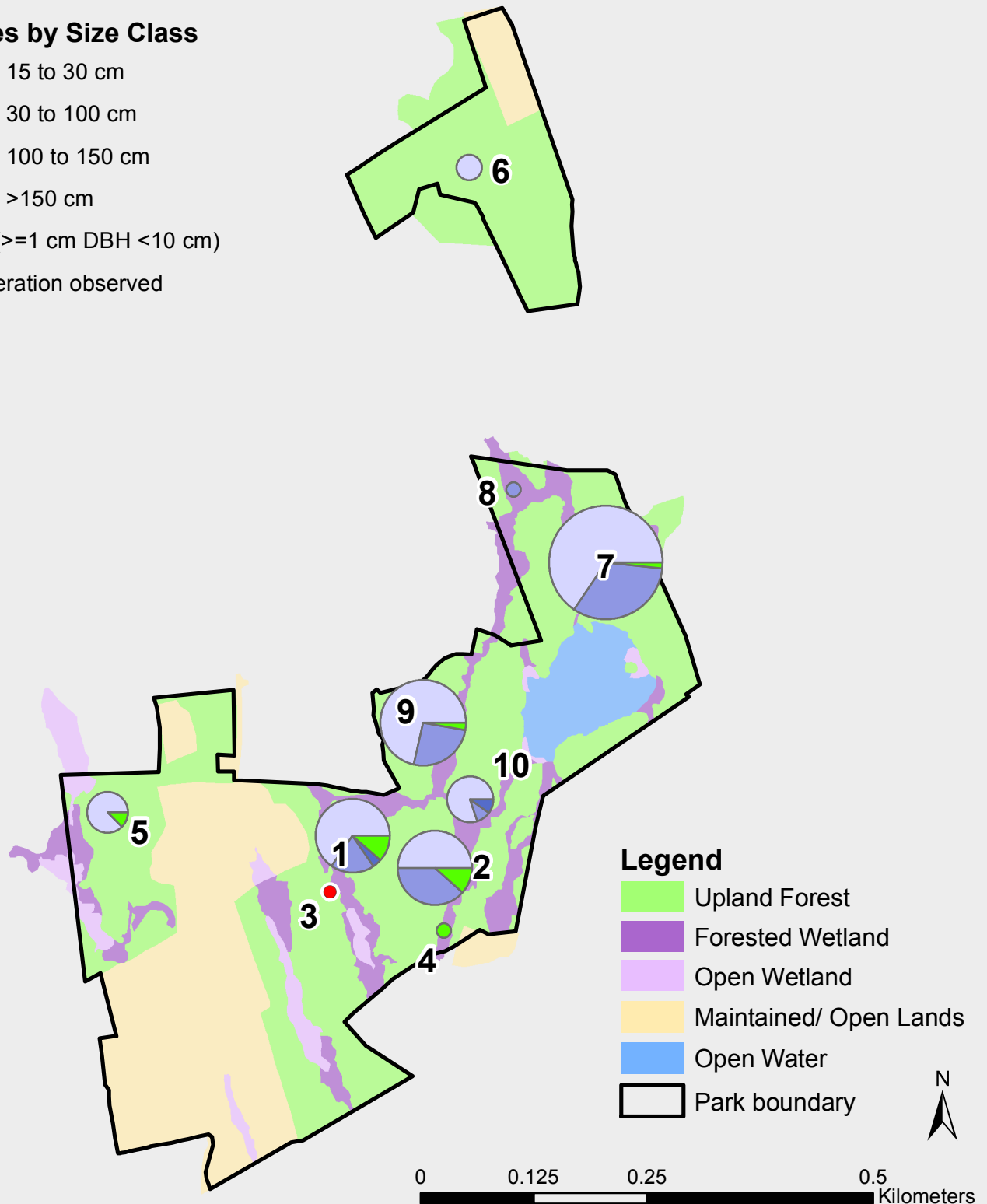


Regeneration by Size Class

Trends in tree regeneration stem densities by size class observed in forest plots in the most recent survey cycle (2015 & 2017). Each plot is sampled on a 4-year cycle in an alternating panel, with plots 1 to 5 sampled in 2015, and plots 6 to 10 sampled in 2017. Densities range from 0 to 10,610 stems/acre for an individual size class. Date: 6/12/2017

Stem Densities by Size Class

-  Seedlings 15 to 30 cm
-  Seedlings 30 to 100 cm
-  Seedlings 100 to 150 cm
-  Seedlings >150 cm
-  Saplings (≥ 1 cm DBH <10 cm)
-  No regeneration observed



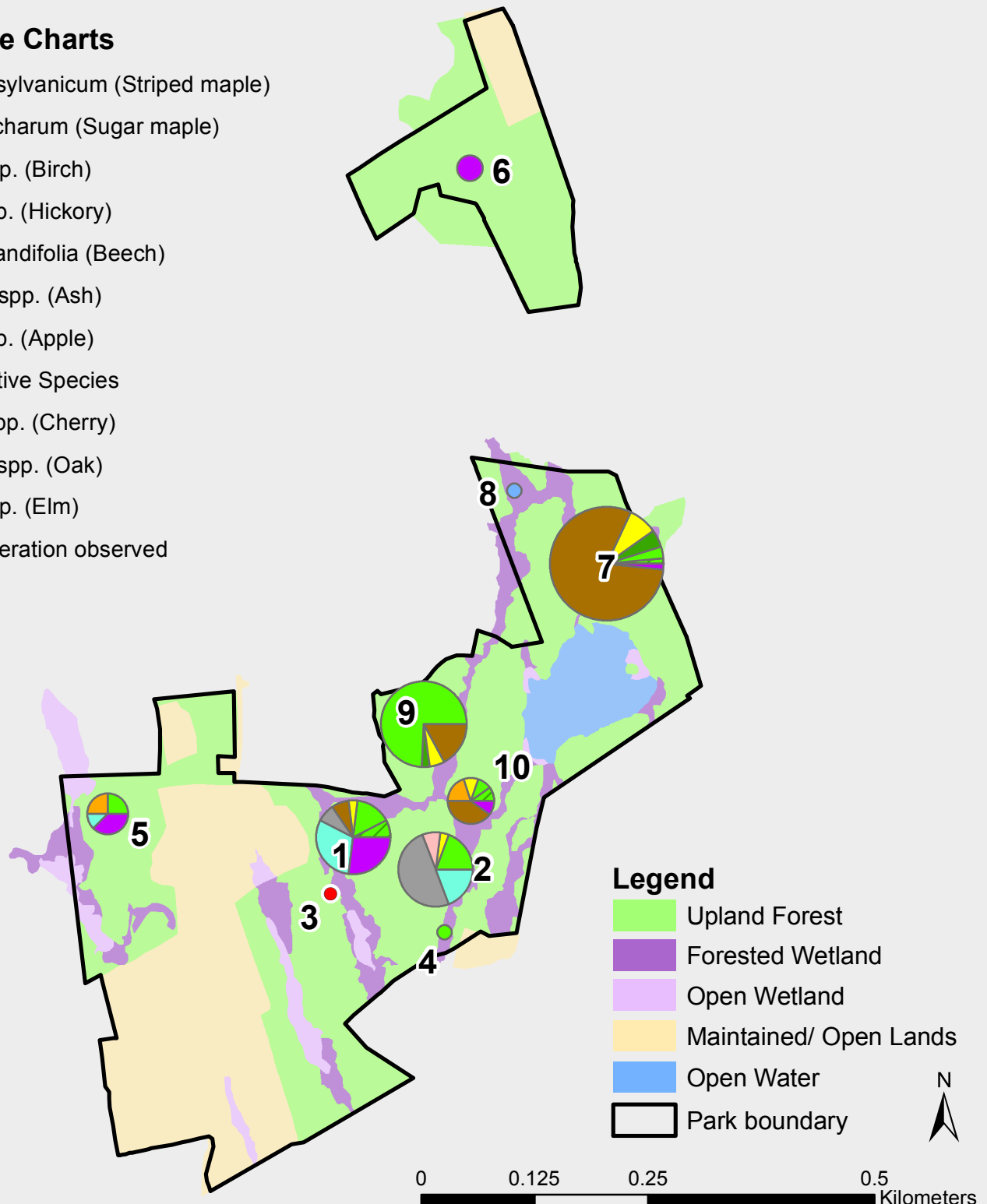


Regeneration Composition

Trends in tree regeneration, including seedlings and saplings, by species group observed in forest plots in the most recent survey cycle (2015 & 2017). Each plot is sampled on a 4-year cycle, with plots 1 to 5 sampled in 2015 and plots 6 to 10 sampled in 2017. Pie size is proportional to the total plot-level regeneration (range 0 to over 12,990 stems/ha for a species). Pies may be shifted from actual location to prevent overlap. Date: 7/7/2017.

Species in Pie Charts

-  *Acer pensylvanicum* (Striped maple)
-  *Acer saccharum* (Sugar maple)
-  *Betula* spp. (Birch)
-  *Carya* spp. (Hickory)
-  *Fagus grandifolia* (Beech)
-  *Fraxinus* spp. (Ash)
-  *Malus* spp. (Apple)
-  Other Native Species
-  *Prunus* spp. (Cherry)
-  *Quercus* spp. (Oak)
-  *Ulmus* spp. (Elm)
-  No regeneration observed



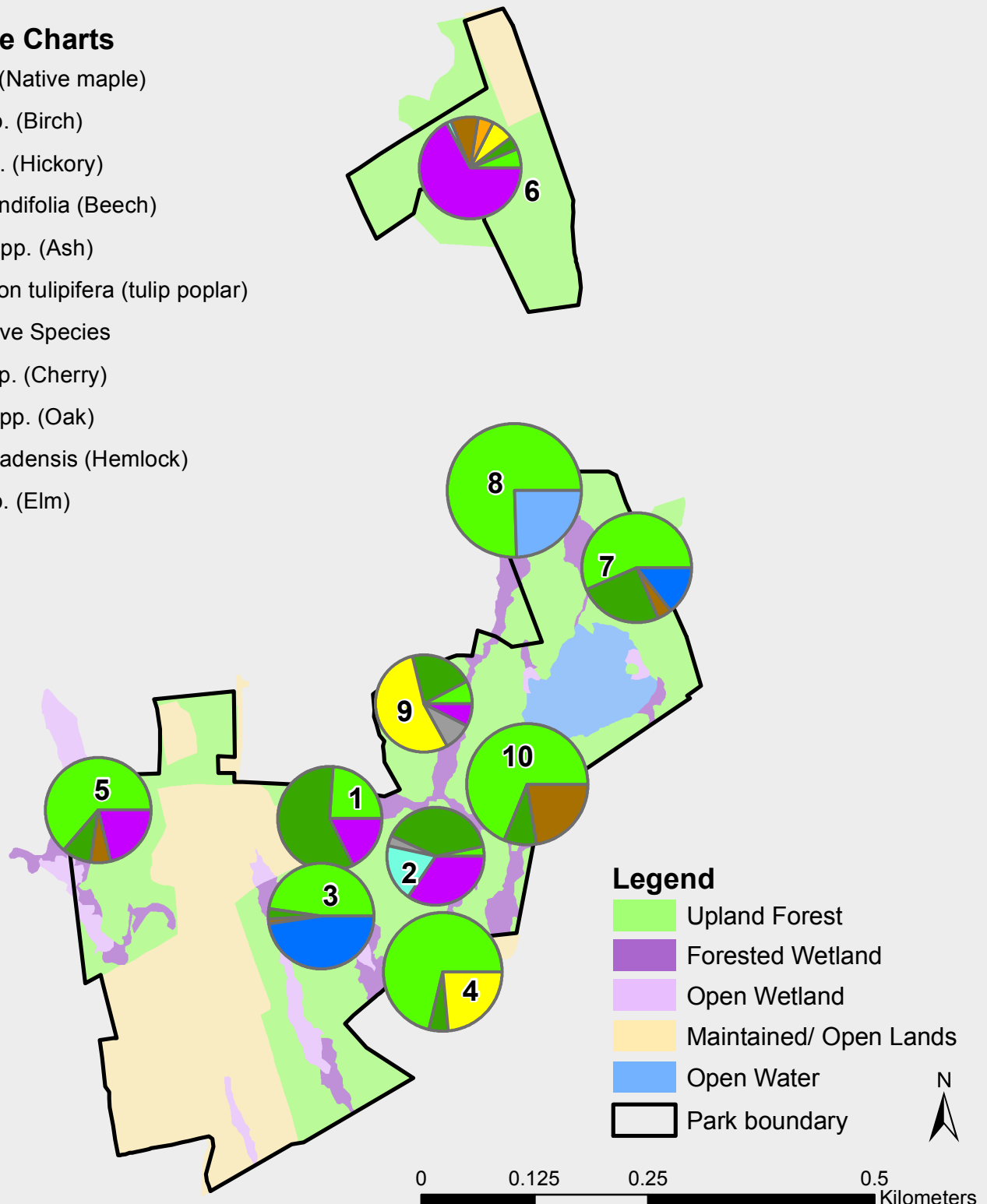


Tree Composition by Basal Area

Trends in live tree basal area by species group observed in forest plots in the most recent survey cycle (2015 & 2017). Each plot is sampled on a 4-year cycle, with plots 1 to 5 sampled in 2015 and plots 6 to 10 sampled in 2017. Basal area is a measure of the cross-sectional area occupied by each tree species per plot, converted to m²/ha. Pie size is proportional to the total plot-level basal area (range 26 to 50 m²/ha for a plot). Pies may be shifted from actual location to prevent overlap. Date: 7/7/2017.

Species in Pie Charts

- Acer spp. (Native maple)
- Betula spp. (Birch)
- Carya spp. (Hickory)
- Fagus grandifolia (Beech)
- Fraxinus spp. (Ash)
- Liriodendron tulipifera (tulip poplar)
- Other Native Species
- Prunus spp. (Cherry)
- Quercus spp. (Oak)
- Tsuga canadensis (Hemlock)
- Ulmus spp. (Elm)





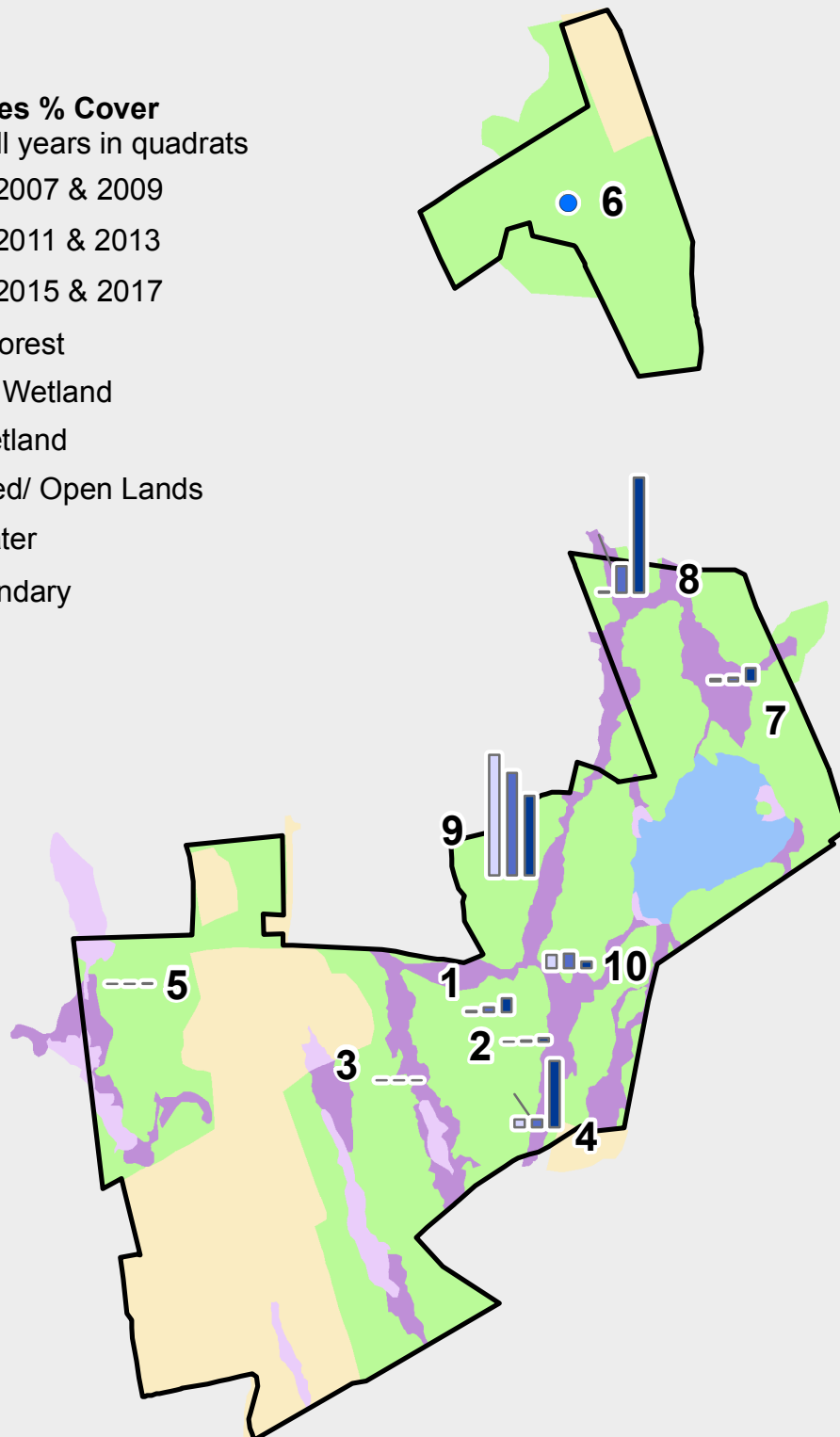
Invasive Species % Cover by Cycle

Trends in percent cover of invasive species observed in quadrats for plots sampled from 2007-2017. Each plot is sampled on a 4-year cycle in an alternating panel, with plots 1-5 sampled in 2007, 2011, and 2015, and plots 6-20 sampled in 2009, 2013, and 2017. Average invasive cover ranges from 0 to 21%. Date: 7/7/2017.

Legend

Invasive Species % Cover

- Absent all years in quadrats
- Cycle 1: 2007 & 2009
- Cycle 2: 2011 & 2013
- Cycle 3: 2015 & 2017
- Upland Forest
- Forested Wetland
- Open Wetland
- Maintained/ Open Lands
- Open Water
- Park boundary



0 0.125 0.25 0.5 Kilometers