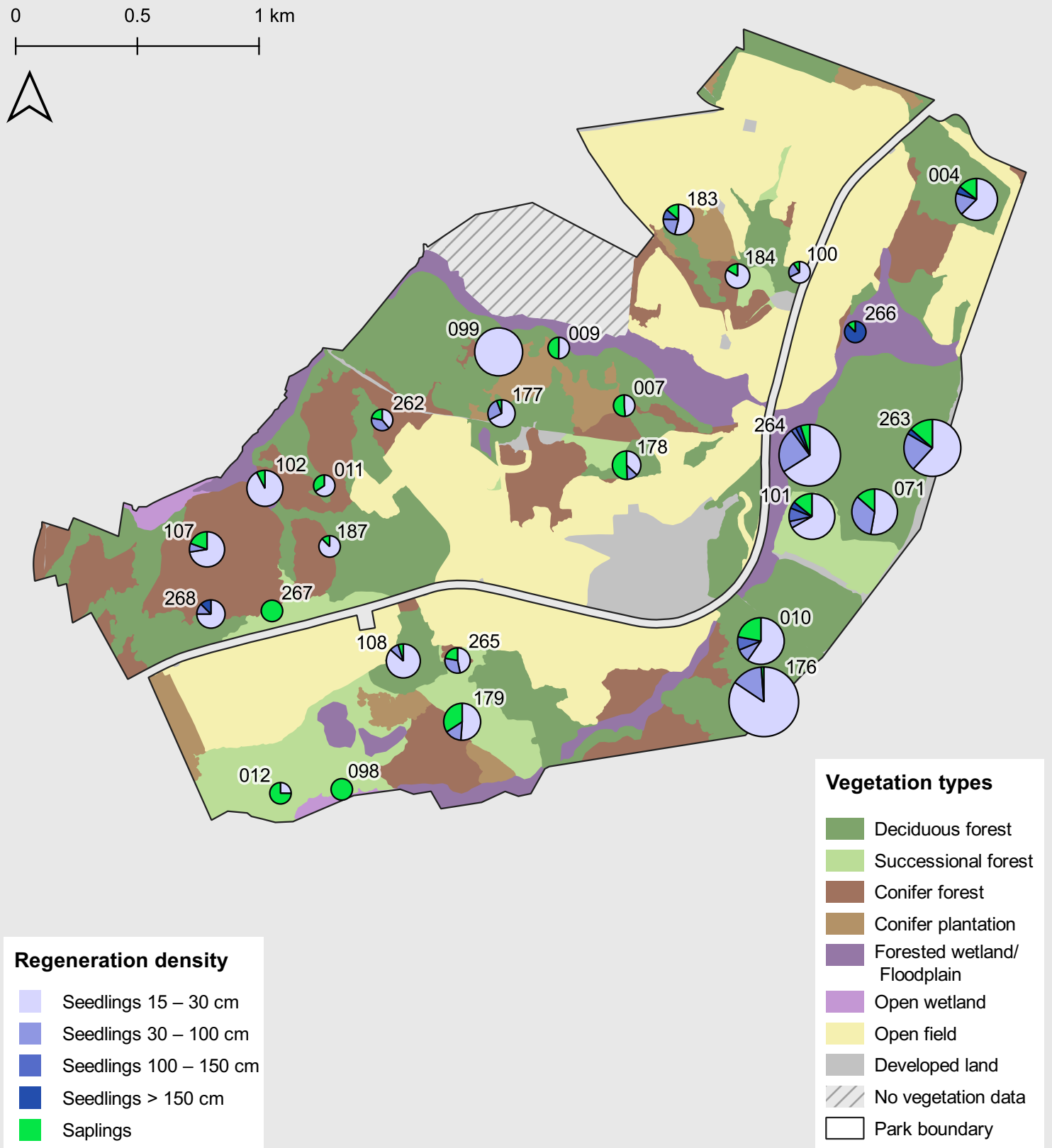




# Map 1. Tree Regeneration by Size Class

Tree regeneration stem densities by size class in forest plots from the most recent survey cycle (2016 – 2019). Each plot is sampled on a 4-year cycle in a rotating panel, with one quarter of the plots sampled every year. Pie size is proportional to plot-level regeneration density. Pies may be shifted to prevent overlap. Densities range from 0 to 3.4 stem/sq.m for an individual size class and only include native canopy-forming species. Seedlings are individuals  $\geq 15$  cm tall and  $< 1$  cm diameter at breast height (DBH). Saplings are individuals  $\geq 1$  cm and  $< 10$  cm DBH. Reporting Date: 08/20/2020.

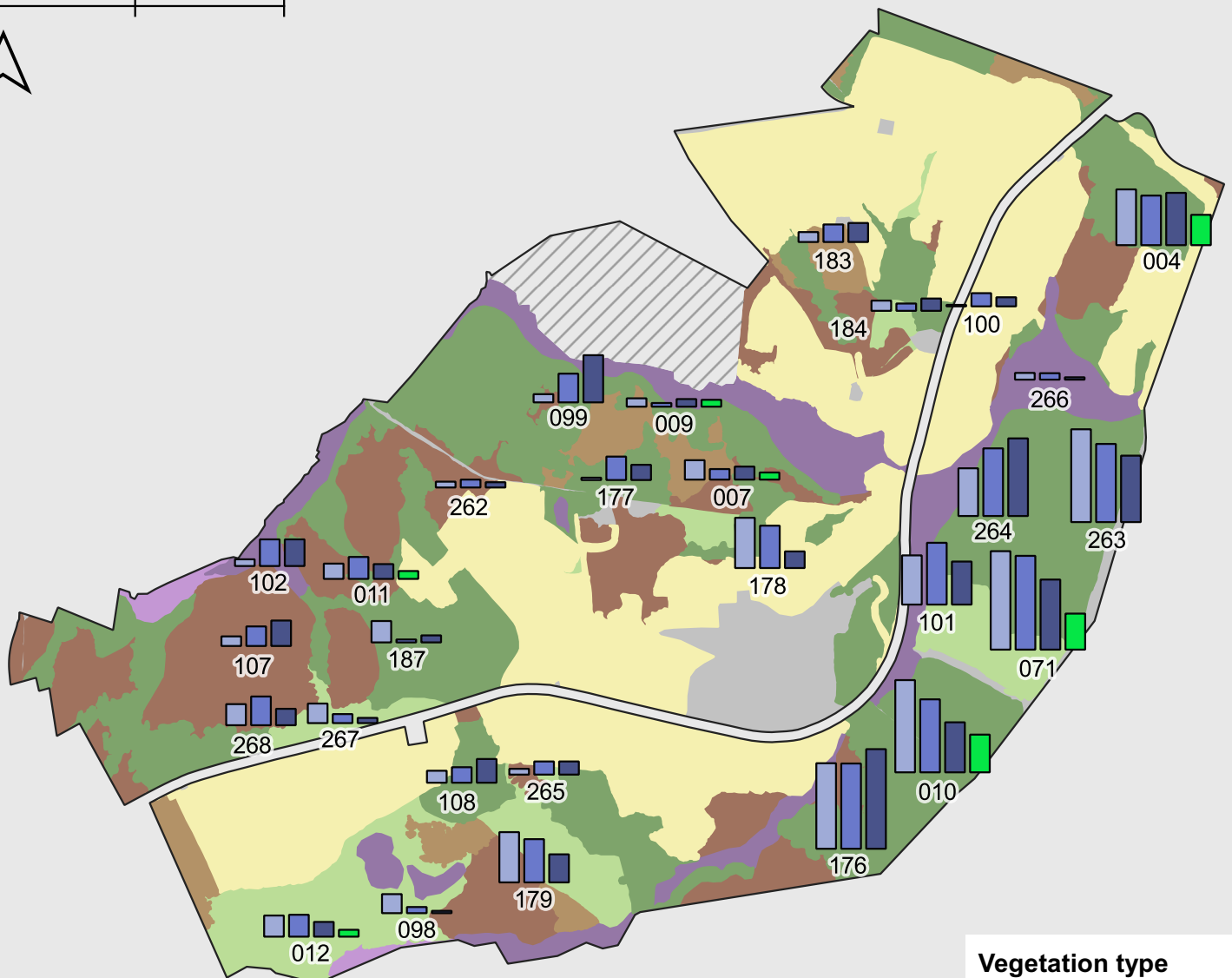




## Map 2. Tree Regeneration by Cycle

Tree regeneration stem densities, including seedlings and saplings, in forest plots sampled from 2007 – 2019. Each plot is sampled on a 4-year cycle in a rotating panel, with one quarter of the plots sampled every year. The number of bars per plot corresponds to the number of times the plot has been sampled. Densities range from 0 to 4.7 stems/sq.m, and only include native canopy-forming species. Charts may be shifted to prevent overlap. Reporting Date: 07/31/2020.

0 0.5 1 km



### Regeneration density

- Cycle 1: 2007 – 2010
- Cycle 2: 2011 – 2014
- Cycle 3: 2015 – 2018
- Cycle 4: 2019

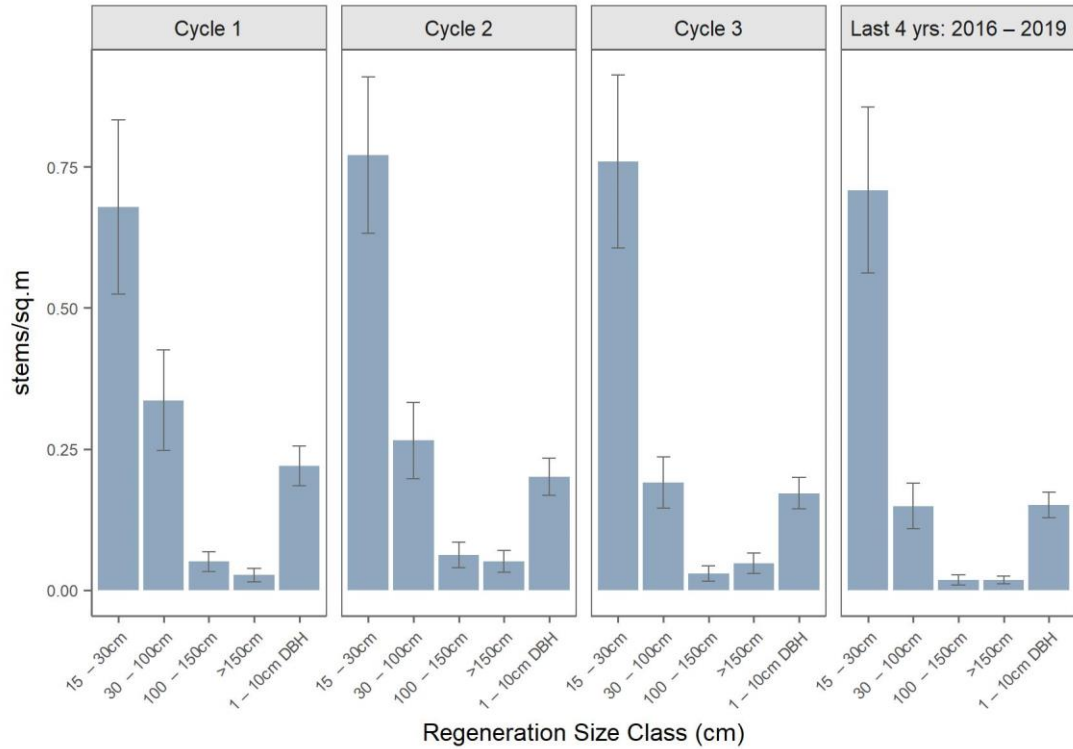
### Vegetation type

- Deciduous forest
- Successional forest
- Conifer forest
- Conifer plantation
- Forested wetland/  
Floodplain
- Open wetland
- Open field
- Developed land
- No vegetation data
- Park boundary

**Table 1.** Average plot-level seedling and sapling stem densities (stems/sq.m), and stocking index by cycle for Appomattox Court House National Historical Park. Only native canopy-forming species are included. Cycle 1 is 2007 – 2010, Cycle 2 is 2011 – 2014, Cycle 3 is 2015 – 2018. Note that only 1/4 of the plots have been sampled for Cycle 4 in 2019. 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. Stocking index values below 2 indicate severely understocked regeneration. Forests in areas with high deer densities need a stocking index value of at least 8 to be sufficiently stocked. Plots that meet this threshold are green.

| Plot | Seedlings per sq. meter |         |         |         | Saplings per sq. meter |         |         |         | Stocking Index |         |         |         |
|------|-------------------------|---------|---------|---------|------------------------|---------|---------|---------|----------------|---------|---------|---------|
|      | Cycle 1                 | Cycle 2 | Cycle 3 | Cycle 4 | Cycle 1                | Cycle 2 | Cycle 3 | Cycle 4 | Cycle 1        | Cycle 2 | Cycle 3 | Cycle 4 |
| 004  | 2.4                     | 2.1     | 2.3     | 1.3     | 0.3                    | 0.3     | 0.3     | 0.2     | 30.0           | 43.1    | 39.1    | 16.2    |
| 007  | 0.5                     | 0.2     | 0.3     | 0.2     | 0.4                    | 0.3     | 0.3     | 0.2     | 22.3           | 18.8    | 15.2    | 9.0     |
| 009  | 0.3                     | 0       | 0.2     | 0.2     | 0.2                    | 0.2     | 0.2     | 0.2     | 7.9            | 8.8     | 10.2    | 8.4     |
| 010  | 3.8                     | 3.0     | 1.8     | 1.4     | 0.6                    | 0.5     | 0.6     | 0.4     | 37.8           | 44.7    | 49.1    | 24.8    |
| 011  | 0.6                     | 0.9     | 0.6     | 0.3     | 0.2                    | 0.1     | 0.1     | 0.1     | 8.3            | 8.0     | 7.1     | 6.7     |
| 012  | 0.5                     | 0.6     | 0.3     | < 0.1   | 0.5                    | 0.5     | 0.4     | 0.2     | 26.8           | 32.6    | 19.4    | 12.5    |
| 071  | 4.4                     | 4.3     | 3.1     | 1.5     | 0.3                    | 0.3     | 0.3     | 0.2     | 28.3           | 39.0    | 32.3    | 13.9    |
| 098  | 0.7                     | 0.2     | 0       | –       | 0.1                    | < 0.1   | < 0.1   | –       | 13.3           | 4.4     | 4.7     | –       |
| 099  | 0.3                     | 1.2     | 1.9     | –       | 0                      | 0       | 0       | –       | 0.4            | 1.2     | 1.9     | –       |
| 100  | 0                       | 0.5     | 0.3     | –       | < 0.1                  | < 0.1   | < 0.1   | –       | 2.9            | 4.0     | 2.2     | –       |
| 101  | 1.8                     | 2.3     | 1.5     | –       | 0.2                    | 0.3     | 0.2     | –       | 12.4           | 25.6    | 21.2    | –       |
| 102  | 0.2                     | 1.0     | 1.0     | –       | 0.1                    | < 0.1   | < 0.1   | –       | 5.5            | 5.2     | 5.1     | –       |
| 107  | < 0.1                   | 0.5     | 0.8     | –       | 0.3                    | 0.3     | 0.2     | –       | 15.5           | 15.4    | 10.9    | –       |
| 108  | 0.4                     | 0.6     | 0.9     | –       | < 0.1                  | < 0.1   | < 0.1   | –       | 4.0            | 3.0     | 3.4     | –       |
| 176  | 3.4                     | 3.4     | 4.0     | –       | < 0.1                  | < 0.1   | < 0.1   | –       | 6.9            | 6.4     | 6.9     | –       |
| 177  | 0.4                     | 0.9     | 0.6     | –       | < 0.1                  | < 0.1   | < 0.1   | –       | 1.4            | 2.8     | 2.5     | –       |
| 178  | 1.5                     | 1.2     | 0.3     | –       | 0.5                    | 0.6     | 0.3     | –       | 42.8           | 30.5    | 17.5    | –       |
| 179  | 1.4                     | 1.2     | 0.8     | –       | 0.6                    | 0.6     | 0.4     | –       | 42.9           | 32.6    | 20.4    | –       |
| 183  | 0.3                     | 0.6     | 0.7     | –       | 0.2                    | 0.1     | 0.1     | –       | 8.1            | 7.2     | 7.7     | –       |
| 184  | 0.3                     | 0.2     | 0.4     | –       | 0.2                    | 0.1     | < 0.1   | –       | 8.5            | 6.7     | 4.5     | –       |
| 187  | 0.8                     | < 0.1   | 0.3     | –       | < 0.1                  | < 0.1   | < 0.1   | –       | 2.8            | 1.9     | 2.0     | –       |
| 262  | < 0.1                   | 0.3     | 0.2     | –       | 0.2                    | < 0.1   | < 0.1   | –       | 7.8            | 3.8     | 2.6     | –       |
| 263  | 3.4                     | 2.8     | 2.3     | –       | 0.4                    | 0.3     | 0.4     | –       | 26.5           | 29.1    | 25.3    | –       |
| 264  | 1.8                     | 2.6     | 3.0     | –       | 0.2                    | 0.2     | 0.2     | –       | 16.7           | 21.9    | 17.1    | –       |
| 265  | 0                       | 0.3     | 0.4     | –       | 0.2                    | 0.2     | 0.1     | –       | 11.8           | 10.4    | 6.5     | –       |
| 266  | 0.3                     | 0.3     | < 0.1   | –       | < 0.1                  | < 0.1   | < 0.1   | –       | 1.4            | 0.8     | 4.8     | –       |
| 267  | 0.5                     | < 0.1   | 0       | –       | 0.3                    | 0.3     | 0.2     | –       | 16.9           | 14.2    | 10.6    | –       |
| 268  | 0.8                     | 1.2     | 0.7     | –       | < 0.1                  | 0       | 0       | –       | 2.0            | 1.3     | 4.8     | –       |

A)



B)

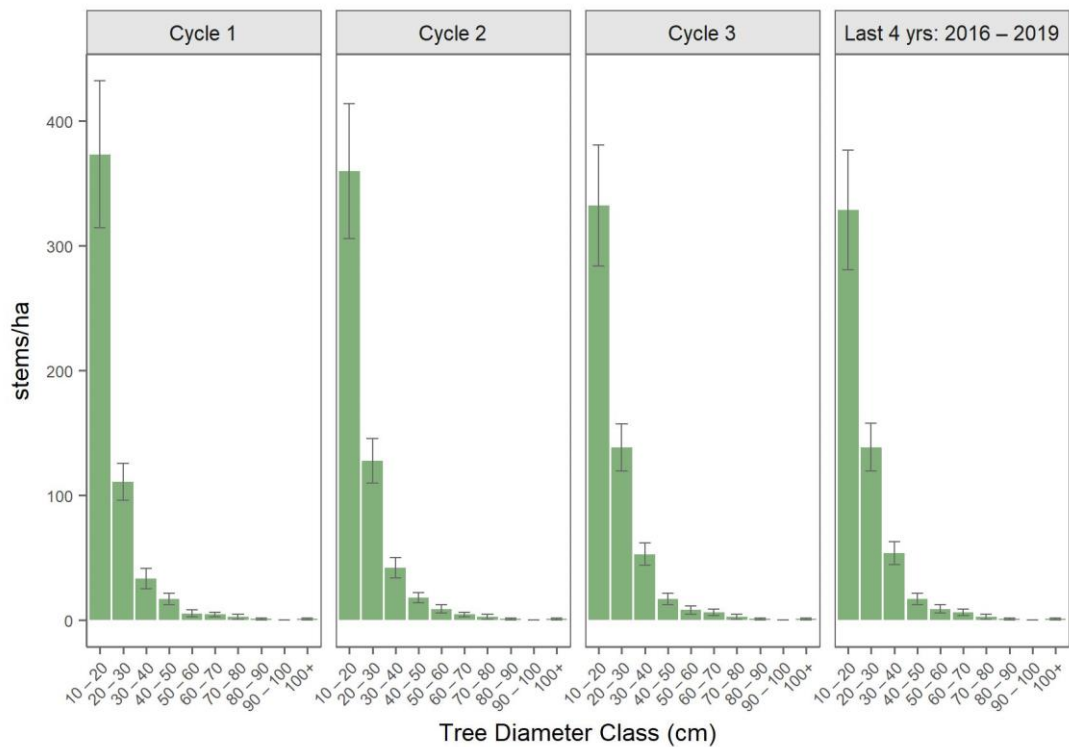


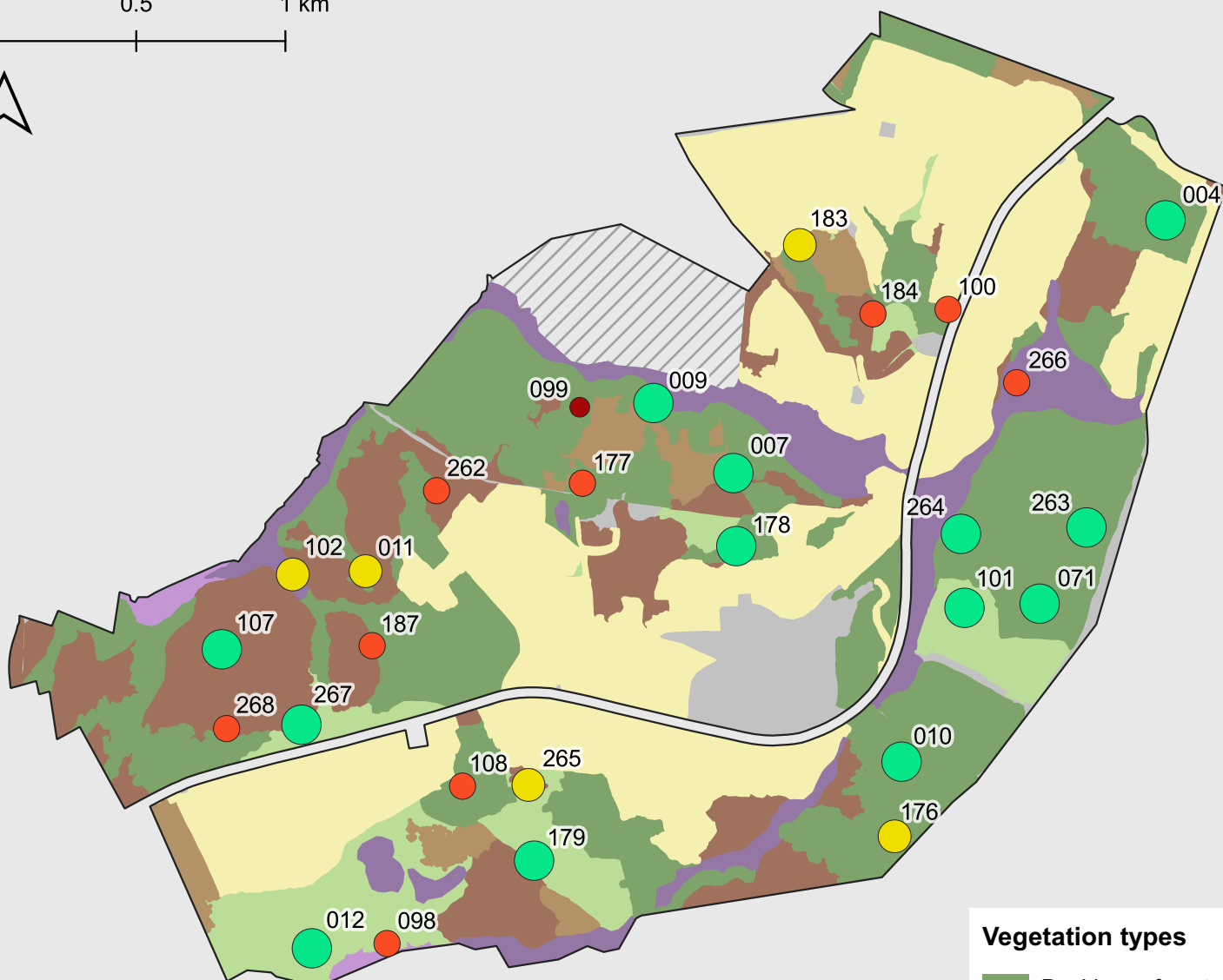
**Figure 1.** Stem density distributions for Appomattox Court House National Historical Park. Figure A shows seedling and sapling densities by size class. Figure B shows tree density by diameter at breast height at 10 cm increments. Cycle 1 is 2007 – 2010, Cycle 2 is 2011 – 2014, Cycle 3 is 2015 – 2018. The last 4 years is the most recent survey of every plot. Error bars are  $\pm 1$  SE.



## Map 3. Tree Regeneration Stocking Index

Regeneration stocking index for the most recent survey cycle (2016 – 2019). Each plot is sampled on a 4-year cycle in a rotating panel, with one quarter of the plots sampled every year. 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 only includes native canopy-forming species (range: 1.9 – 25.3). Values below 2 are severely understocked. Values above 8 are sufficiently stocked for areas with high deer abundance. See Table 1 for plot-level stocking values. Reporting Date: 07/31/2020.

0 0.5 1 km



### Stocking index ranges

- < 2: Severely understocked. Regeneration is insufficient to replace the forest canopy.
- 2 – 5: Moderately stocked regeneration for areas with low deer impacts.
- 5 – 8: Sufficient regeneration to replace forest canopy in areas with low deer impacts.
- > 8: Sufficiently stocked with regeneration for areas with high deer impacts.

### Vegetation types

- Deciduous forest
- Successional forest
- Conifer forest
- Conifer plantation
- Forested wetland/  
Floodplain
- Open wetland
- Open field
- Developed land
- ▨ No vegetation data
- Park boundary

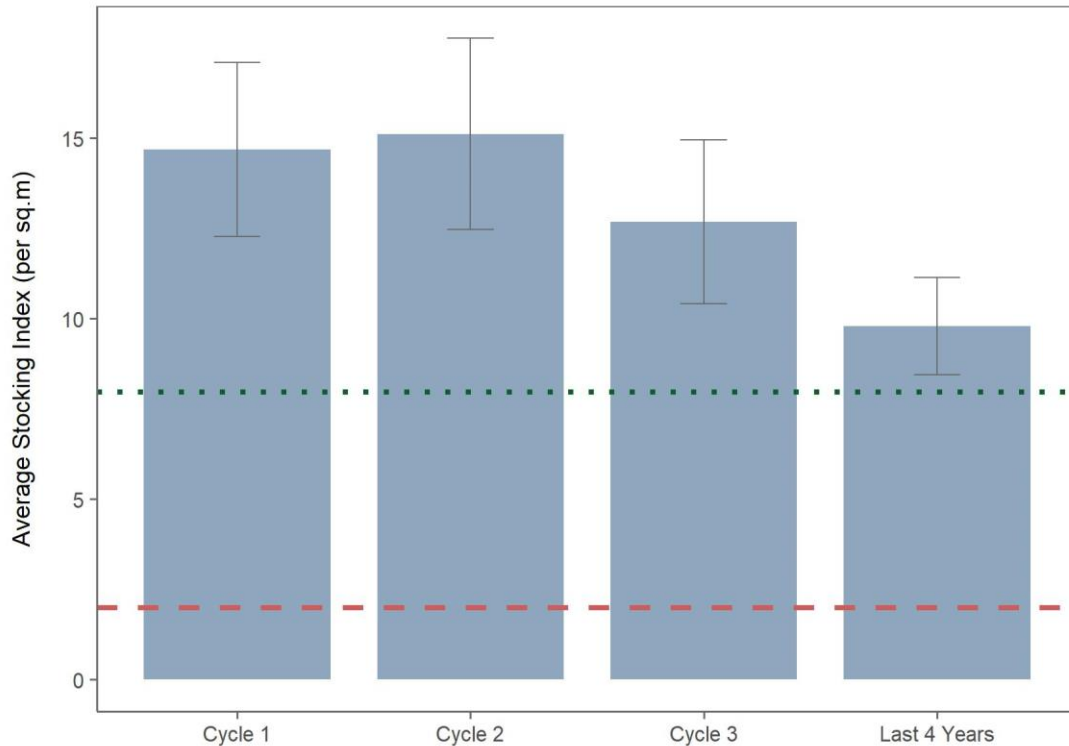


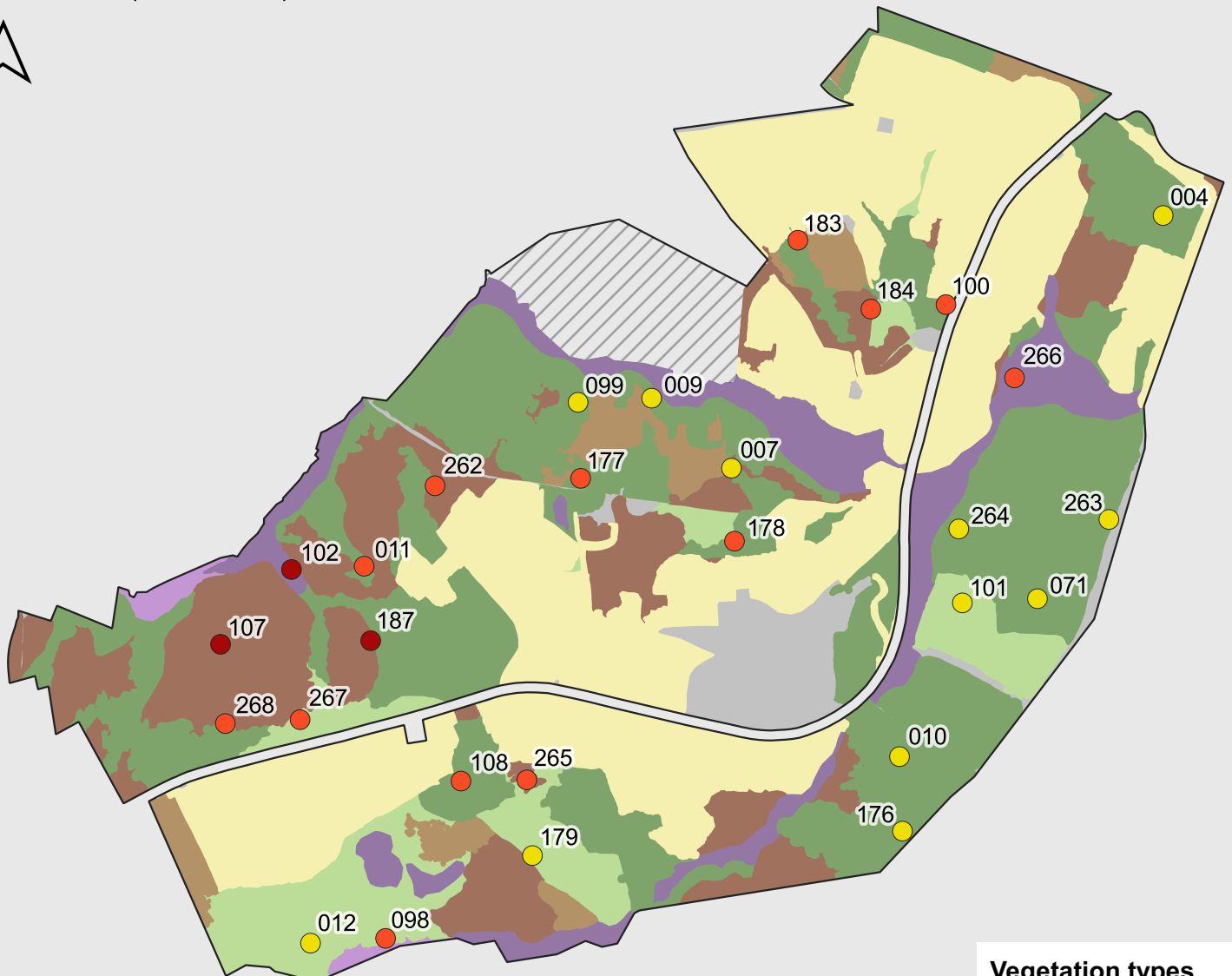
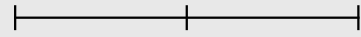
**Figure 2.** Regeneration stocking index averaged by cycle in Appomattox Court House National Historical Park. The index is a weighted sum of seedling and sapling densities where larger seedling size classes get higher weights. The stocking index only includes native canopy-forming species (range: 0.4 – 49.1). Values below 2 (red dashed line) are severely understocked. Values above 8 (green dotted line) are sufficiently stocked for areas with high deer abundance. Cycle 1 is 2007 – 2010, Cycle 2 is 2011 – 2014, Cycle 3 is 2015 – 2018, Last 4 Years is 2016 – 2019. Error bars are  $\pm 1$  SE.



## Map 4. Index of Deer Browse Impacts

Index of deer browse impacts observed in forest plots in the most recent survey cycle (2016 – 2019). Each plot is sampled on a 4-year cycle, with one quarter of the plots sampled every year. Deer browse impacts are assessed on a scale of 1 – 5, with 1 representing no impact and 5 representing severe impacts. Reporting Date: 07/31/2020.

0 0.5 1 km



### 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.

### Vegetation types

- Deciduous forest
- Successional forest
- Conifer forest
- Conifer plantation
- Forested wetland/  
Floodplain
- Open wetland
- Open field
- Developed land
- No vegetation data
- Park boundary

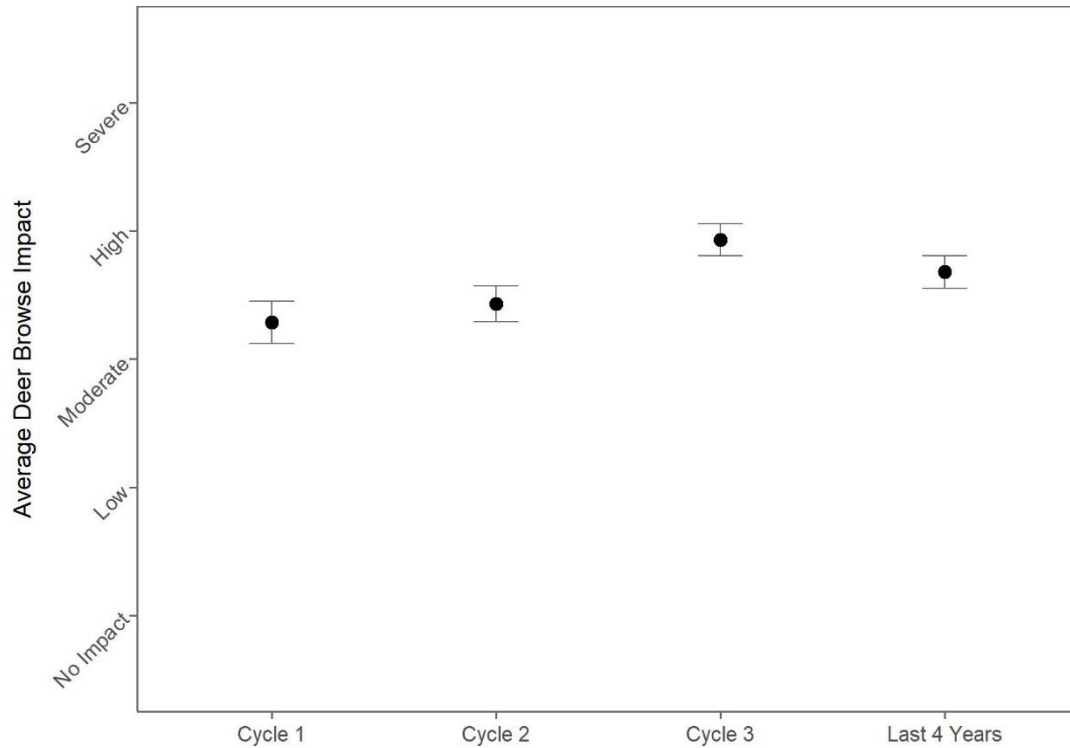


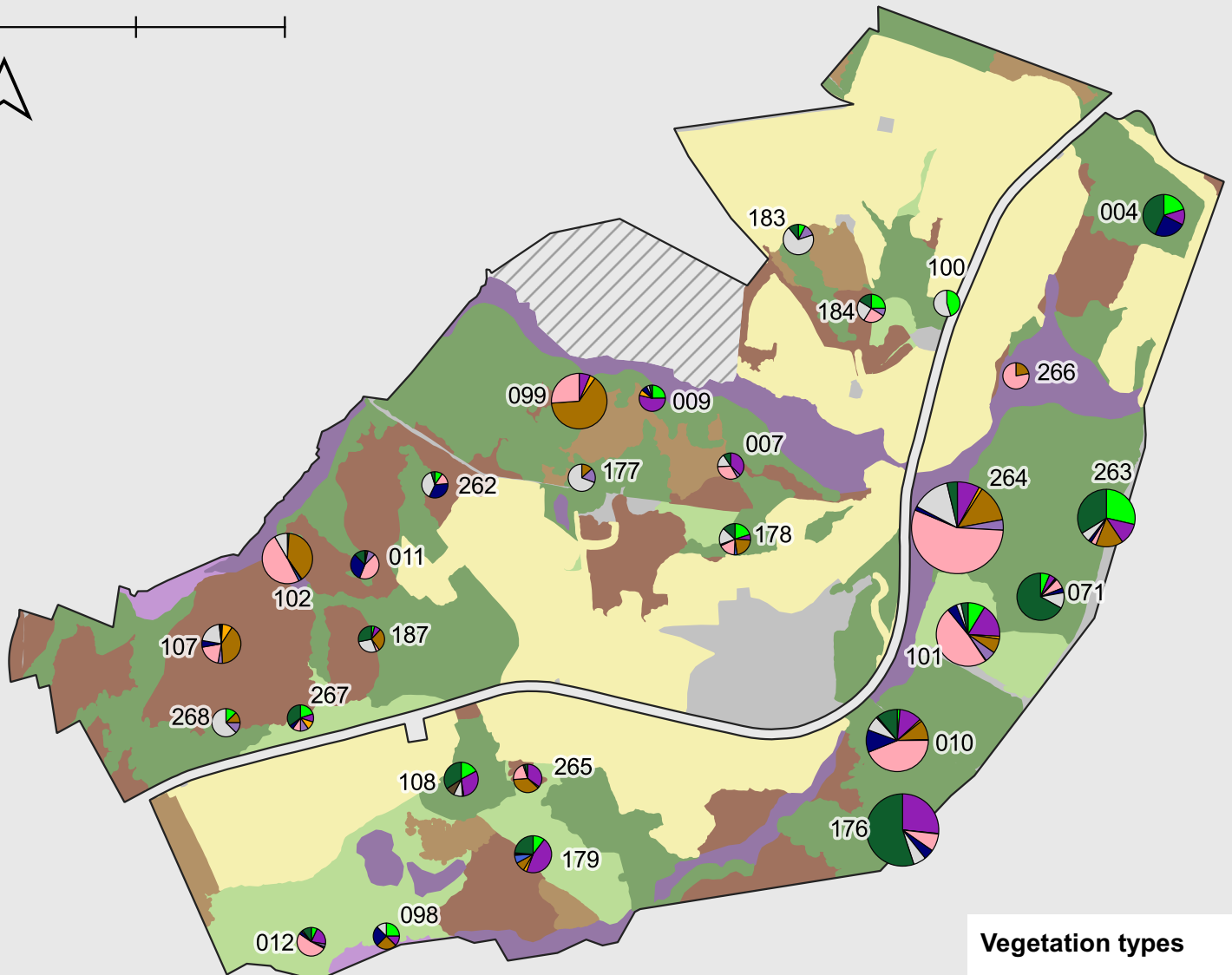
**Figure 3.** Average deer browse impact by cycle in Appomattox Court House National Historical Park. Deer browse impacts are assessed on a scale of 1 – 5, with 1 representing no impact and 5 representing severe impacts. Cycle 1 is 2009 – 2010, Cycle 2 is 2011 – 2014, Cycle 3 is 2015 – 2018, Last 4 Years is 2016 – 2019. DBI was not collected until 2009. Error bars are  $\pm 1$  SE.



## Map 5. Tree Regeneration by Composition

Tree regeneration stem densities, including seedlings and saplings, by species group observed in forest plots sampled in the most recent survey cycle (2016 – 2019). Each plot is sampled on a 4-year cycle in a rotating panel, with one quarter of the plots sampled every year. Pie size is proportional to plot-level regeneration density. Pies may be shifted to prevent overlap. Densities range from 0 to 3.9 stem/sq.m for an individual species group. See <https://npsforveg.shinyapps.io/midn/> for more specific plot level information. Reporting Date: 08/20/2020.

0 0.5 1 km



### Species in pie charts

- |                                                                         |                                                                    |
|-------------------------------------------------------------------------|--------------------------------------------------------------------|
| <span style="color: green;">■</span> Acer spp. (Maple)                  | <span style="color: blue;">■</span> Nyssa sylvatica (Black tupelo) |
| <span style="color: purple;">■</span> Carya spp. (Hickory)              | <span style="color: brown;">■</span> Pinus spp. (Pine)             |
| <span style="color: orange;">■</span> Fagus grandifolia (Beech)         | <span style="color: darkgreen;">■</span> Quercus spp. (Oak)        |
| <span style="color: gold;">■</span> Fraxinus spp. (Ash)                 | <span style="color: pink;">■</span> Low canopy species             |
| <span style="color: purple;">■</span> Juniperus virginiana (Redcedar)   | <span style="color: gray;">■</span> Other native species           |
| <span style="color: blue;">■</span> Liriodendron tulipifera (Tuliptree) |                                                                    |

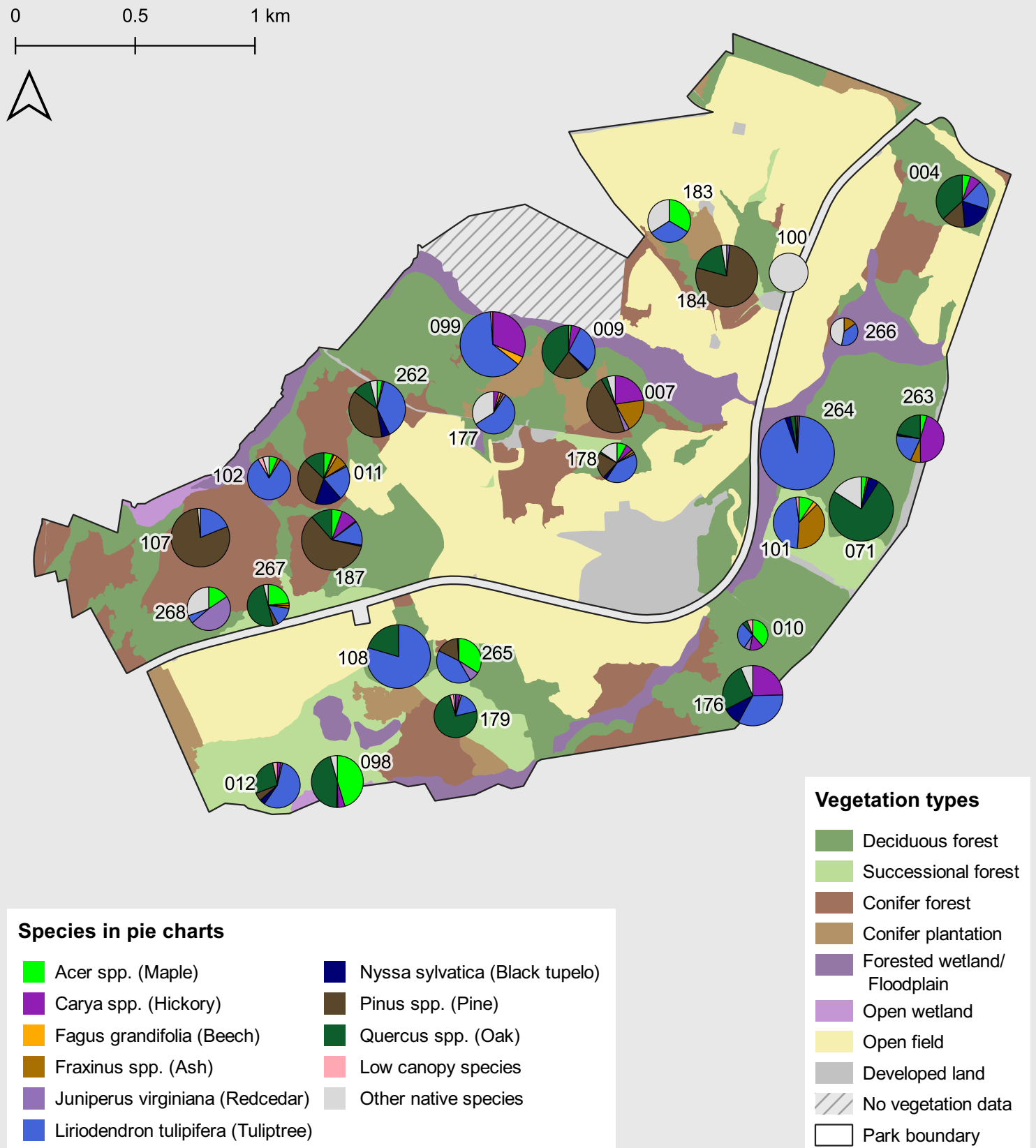
### Vegetation types

- |                                                                                                  |                                 |
|--------------------------------------------------------------------------------------------------|---------------------------------|
| <span style="color: green;">■</span>                                                             | Deciduous forest                |
| <span style="color: lightgreen;">■</span>                                                        | Successional forest             |
| <span style="color: brown;">■</span>                                                             | Conifer forest                  |
| <span style="color: gold;">■</span>                                                              | Conifer plantation              |
| <span style="color: purple;">■</span>                                                            | Forested wetland/<br>Floodplain |
| <span style="color: lightpurple;">■</span>                                                       | Open wetland                    |
| <span style="color: yellow;">■</span>                                                            | Open field                      |
| <span style="color: gray;">■</span>                                                              | Developed land                  |
| <span style="color: gray;">▨</span>                                                              | No vegetation data              |
| <span style="border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span> | Park boundary                   |



# Map 6. Tree Canopy Composition

Live basal area by species group observed in forest plots sampled in the most recent survey cycle (2016 – 2019). Each plot is sampled on a 4-year cycle in a rotating panel, with one quarter of the plots sampled every year. Pie size is proportional to plot-level basal area. Pies may be shifted to prevent overlap. Basal areas range from 0 to 49.5 sq.m/ha for an individual species group. See <https://npsforveg.shinyapps.io/midn/> for more specific plot level information. Reporting Date: 08/20/2020.

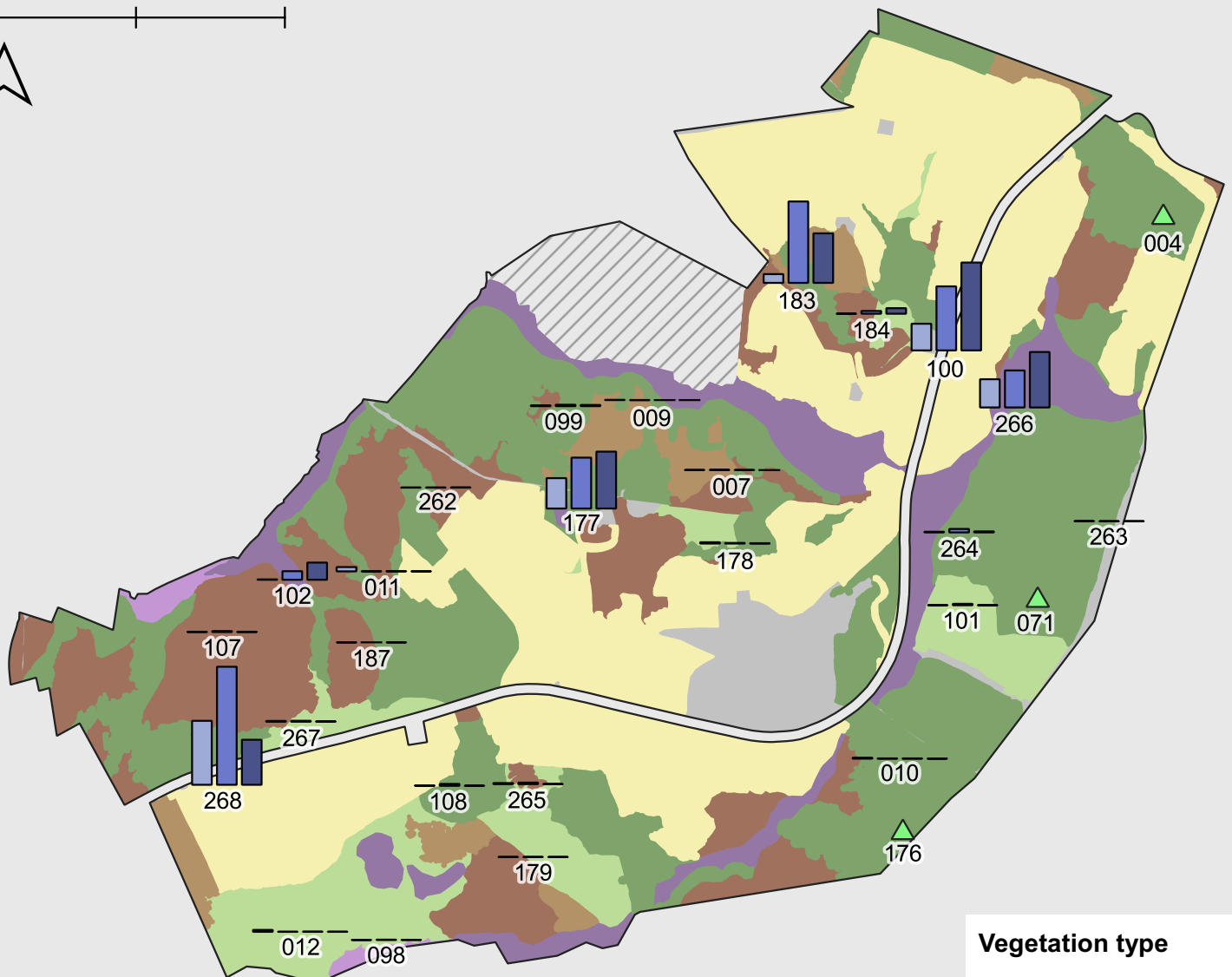




## Map 7. Invasive % Cover by Cycle

Average percent cover of invasive species observed in quadrats in forest plots sampled from 2007 – 2019. Each plot is sampled on a 4-year cycle in a rotating panel, with one quarter of the plots sampled every year. The number of bars per plot corresponds to the number of times the plot has been sampled. Average invasive cover per plot ranges from 0 to 75.4%. See Table 2 for % cover values. See Table 3 for a species list; only species monitored since 2007 were included in this metric. Reporting Date: 08/20/2020.

0 0.5 1 km



### Invasive % cover

- Cycle 1: 2007 – 2010
- Cycle 2: 2011 – 2014
- Cycle 3: 2015 – 2018
- Cycle 4: 2019
- ▲ None present

### Vegetation type

- Deciduous forest
- Successional forest
- Conifer forest
- Conifer plantation
- Forested wetland/  
Floodplain
- Open wetland
- Open field
- Developed land
- No vegetation data
- Park boundary

**Table 2.** Average % cover of invasive species detected in each plot by cycle in Appomattox Court House National Historical Park. Cycle 1 is 2007 – 2010, Cycle 2 is 2011 – 2014, Cycle 3 is 2015 – 2018. Note that only 1/4 of the plots have been sampled for Cycle 4 in 2019. See Table 3 for a species list; only species monitored since 2007 were included in this metric.

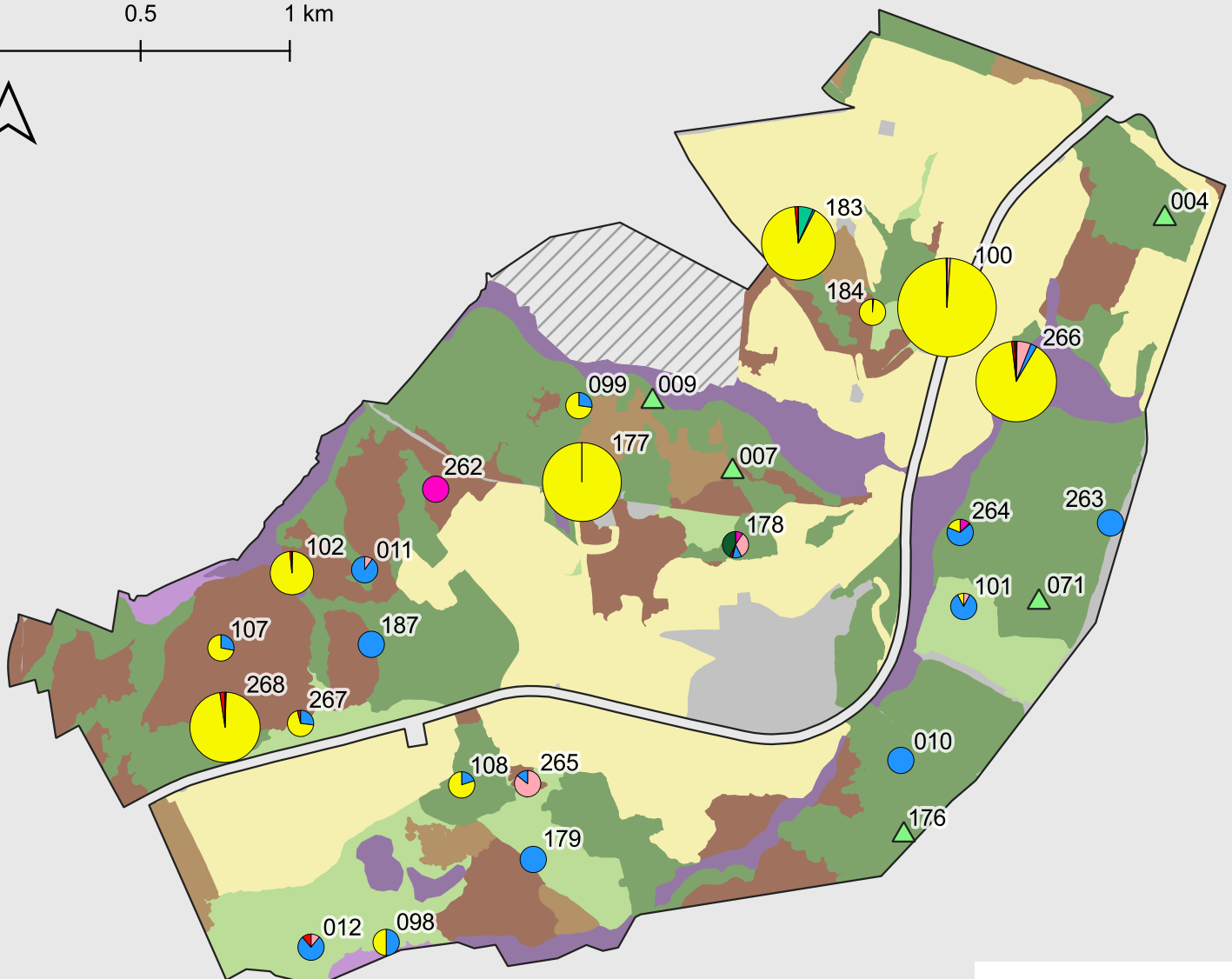
| Plot | Average % cover |         |         |         |
|------|-----------------|---------|---------|---------|
|      | Cycle 1         | Cycle 2 | Cycle 3 | Cycle 4 |
| 004  | 0               | 0       | 0       | 0       |
| 007  | < 0.1           | 0.1     | < 0.1   | 0       |
| 009  | 0.1             | < 0.1   | 0       | 0       |
| 010  | 0.6             | 0.2     | 0.2     | < 0.1   |
| 011  | 2.7             | < 0.1   | 0.2     | < 0.1   |
| 012  | 1.2             | < 0.1   | 0.1     | < 0.1   |
| 071  | 0               | 0       | 0       | 0       |
| 098  | < 0.1           | 0.2     | < 0.1   | –       |
| 099  | 0.5             | 0.9     | 0.8     | –       |
| 100  | 17.0            | 40.9    | 56.1    | –       |
| 101  | < 0.1           | 0.9     | 0.1     | –       |
| 102  | 0.2             | 5.5     | 11.0    | –       |
| 107  | 0.2             | 0.6     | 0.2     | –       |
| 108  | 0.3             | 1.2     | < 0.1   | –       |
| 176  | 0               | 0       | 0       | –       |
| 177  | 19.4            | 32.5    | 36.3    | –       |
| 178  | 0.8             | 0.4     | 0.2     | –       |
| 179  | < 0.1           | < 0.1   | < 0.1   | –       |
| 183  | 5.6             | 52.0    | 31.6    | –       |
| 184  | < 0.1           | 1.8     | 3.6     | –       |
| 187  | < 0.1           | 0       | < 0.1   | –       |
| 262  | < 0.1           | < 0.1   | < 0.1   | –       |
| 263  | 0.1             | < 0.1   | < 0.1   | –       |
| 264  | 0.4             | 2.2     | 0.7     | –       |
| 265  | 0.7             | 1.0     | < 0.1   | –       |
| 266  | 18.0            | 23.6    | 35.4    | –       |
| 267  | 0.5             | 0.6     | 0.2     | –       |
| 268  | 40.9            | 75.4    | 28.8    | –       |



## Map 8. Invasive % Cover by Species

Average percent invasive cover by species observed in quadrats in forest plots sampled in the most recent survey cycle (2016 – 2019). Each plot is sampled on a 4-year cycle in a rotating panel, with one quarter of the plots sampled every year. Pie size is proportional to plot-level invasive cover. Pies may be shifted to prevent overlap. Average invasive cover ranges from 0 to 56.0% for an individual species. See Table 3 for more information. Reporting Date: 07/30/2020.

0 0.5 1 km



### Species in pie charts

- *Ailanthus altissima* (Tree-of-heaven)
- *Berberis thunbergii* (Japanese barberry)
- *Dioscorea oppositifolia* (Chinese yam)
- *Ligustrum* spp. (Privet)
- *Lonicera japonica* (Japanese honeysuckle)
- *Microstegium vimineum* (Japanese stiltgrass)
- *Rosa multiflora* (Multiflora rose)
- Other exotic herbs
- ▲ None present

### Vegetation types

- Deciduous forest
- Successional forest
- Conifer forest
- Conifer plantation
- Forested wetland/  
Floodplain
- Open wetland
- Open field
- Developed land
- ▨ No vegetation data
- Park boundary

**Table 3.** Number of plots where invasive species were detected by cycle in Appomattox Court House National Historical Park. Cycle 1 is 2007 – 2010, Cycle 2 is 2011 – 2014, Cycle 3 is 2015 – 2018. Note that only 1/4 of the plots have been sampled for Cycle 4 in 2019. Note that not all species have been monitored for the same amount of time, as indicated by the Year added column. Species that are exotic to the mid-Atlantic region, but not considered invasive are indicated by \*.

| Latin name                          | Common name             | Year added | Number of plots with species present |         |         |         |
|-------------------------------------|-------------------------|------------|--------------------------------------|---------|---------|---------|
|                                     |                         |            | Cycle 1                              | Cycle 2 | Cycle 3 | Cycle 4 |
| <i>Ailanthus altissima</i>          | Tree-of-heaven          | 2007       | 0                                    | 0       | 4       | 0       |
| <i>Albizia julibrissin</i>          | Silktree                | 2007       | 0                                    | 0       | 0       | 1       |
| <i>Berberis thunbergii</i>          | Japanese barberry       | 2007       | 2                                    | 3       | 5       | 2       |
| <i>Celastrus orbiculatus</i>        | Oriental bittersweet    | 2007       | 0                                    | 1       | 1       | 0       |
| <i>Dioscorea oppositifolia</i>      | Chinese yam             | 2013       | 0                                    | 1       | 1       | 0       |
| <i>Duchesnea indica</i> *           | Mock strawberry         | 2007       | 6                                    | 4       | 10      | 0       |
| <i>Euonymus alatus</i> <sup>1</sup> | Burningbush             | 2019       | 0                                    | 0       | 1       | 1       |
| <i>Euonymus fortunei</i>            | Climbing euonymus       | 2007       | 1                                    | 0       | 0       | 1       |
| <i>Hedera helix</i>                 | English ivy             | 2007       | 1                                    | 0       | 1       | 0       |
| <i>Ligustrum</i> spp.               | Privet                  | 2009       | 4                                    | 11      | 12      | 2       |
| <i>Lonicera</i> spp. - Exotic       | Exotic bush honeysuckle | 2007       | 5                                    | 2       | 5       | 0       |
| <i>Lonicera japonica</i>            | Japanese honeysuckle    | 2007       | 22                                   | 25      | 22      | 4       |
| <i>Microstegium vimineum</i>        | Japanese stiltgrass     | 2007       | 13                                   | 16      | 16      | 1       |
| <i>Morus alba</i>                   | White mulberry          | 2007       | 0                                    | 0       | 0       | 1       |
| <i>Persicaria longiseta</i> *       | Oriental lady's thumb   | 2009       | 3                                    | 4       | 4       | 0       |
| <i>Rosa multiflora</i>              | Multiflora rose         | 2007       | 6                                    | 13      | 14      | 2       |
| <i>Rubus phoenicolasius</i>         | Wine raspberry          | 2007       | 0                                    | 1       | 0       | 0       |
| <i>Vinca minor</i> *                | Lesser periwinkle       | 2007       | 0                                    | 1       | 1       | 0       |
| Number of plots sampled             | –                       | –          | 28                                   | 28      | 28      | 7       |

<sup>1</sup>*Euonymus alatus* was added to the indicator list for quadrats in 2019, but has also been monitored in microplots since 2007.