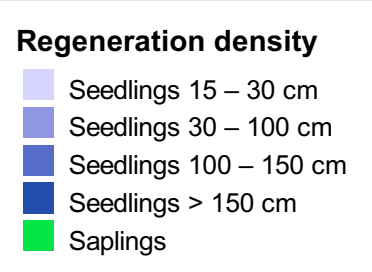
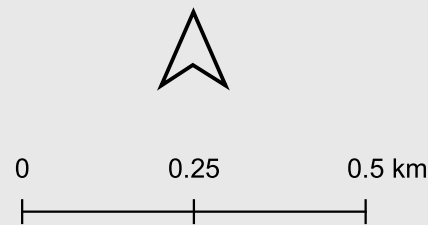
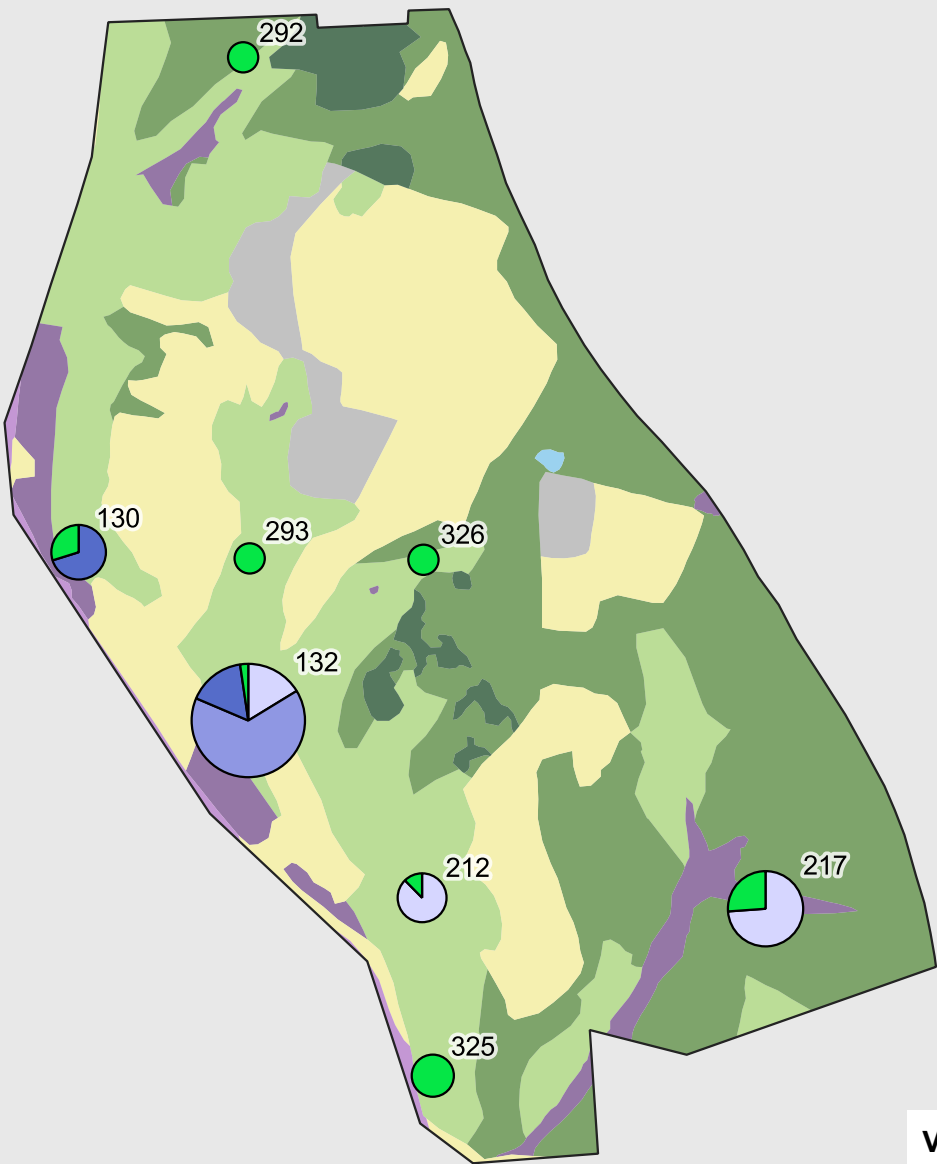




Map 1. Tree Regeneration by Size Class

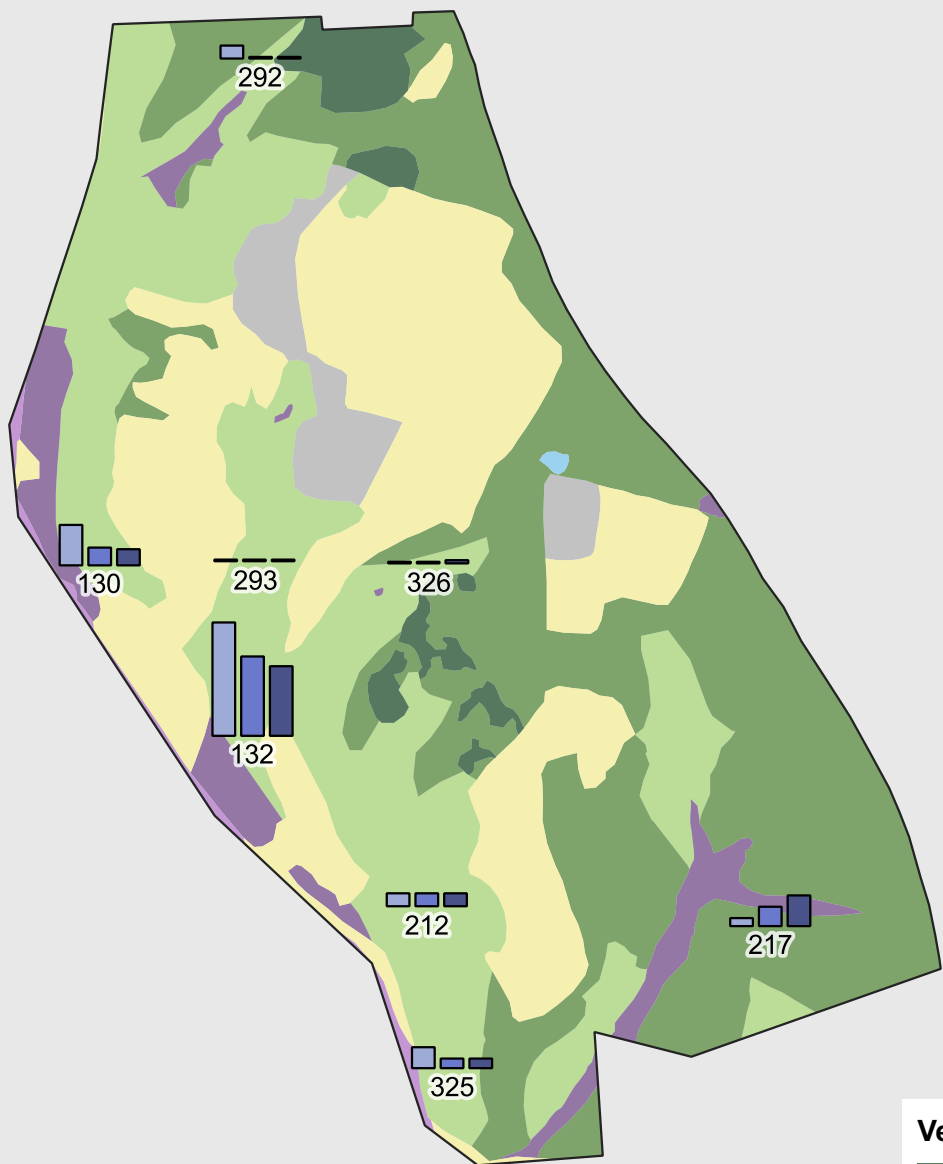
Tree regeneration stem densities by size class in forest plots from the most recent survey cycle (2016 – 2019). Each plot is sampled on a 4-year cycle in a rotating panel, with one quarter of the plots sampled every year. Pie size is proportional to plot-level regeneration density. Densities range from 0 to 0.2 stems/sq.m for an individual size class and only include native canopy-forming species. Seedlings are individuals ≥ 15 cm tall and < 1 cm diameter at breast height (DBH). Saplings are individuals ≥ 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 2008 – 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 0.8 stems/sq.m, and only include native canopy-forming species. Reporting Date: 08/20/2020.



Vegetation types

- Mixed forest
- Deciduous forest
- Successional forest
- Forested wetland
- Open wetland
- Open water
- Open field
- Developed land
- Park boundary

Regeneration density

- Cycle 1: 2008 – 2011
- Cycle 2: 2012 – 2015
- Cycle 3: 2016 – 2019

Table 1. Average plot-level seedling and sapling stem densities (stems/sq.m), and stocking index by cycle in Thomas Stone National Historic Site. Only native canopy-forming species are included. Cycle 1 is 2008 – 2011, Cycle 2 is 2012 – 2015, Cycle 3 is 2016 – 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. No plots in Thomas Stone National Historic Site meet this threshold.

Plot	Seedlings per sq. meter			Saplings per sq. meter			Stocking Index		
	Cycle 1	Cycle 2	Cycle 3	Cycle 1	Cycle 2	Cycle 3	Cycle 1	Cycle 2	Cycle 3
130	0.3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	4.4	4.0	3.4
132	0.8	0.6	0.5	0	0	< 0.1	2.7	1.1	3.0
212	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.8	0.7	0.7
217	0	< 0.1	0.2	< 0.1	< 0.1	< 0.1	2.9	3.0	3.1
292	< 0.1	0	0	< 0.1	< 0.1	< 0.1	0.8	0.6	0.6
293	0	0	0	< 0.1	< 0.1	< 0.1	0.6	0.6	0.6
325	< 0.1	0	0	< 0.1	< 0.1	< 0.1	3.6	3.5	3.5
326	0	0	0	< 0.1	< 0.1	< 0.1	0.6	0.6	1.2

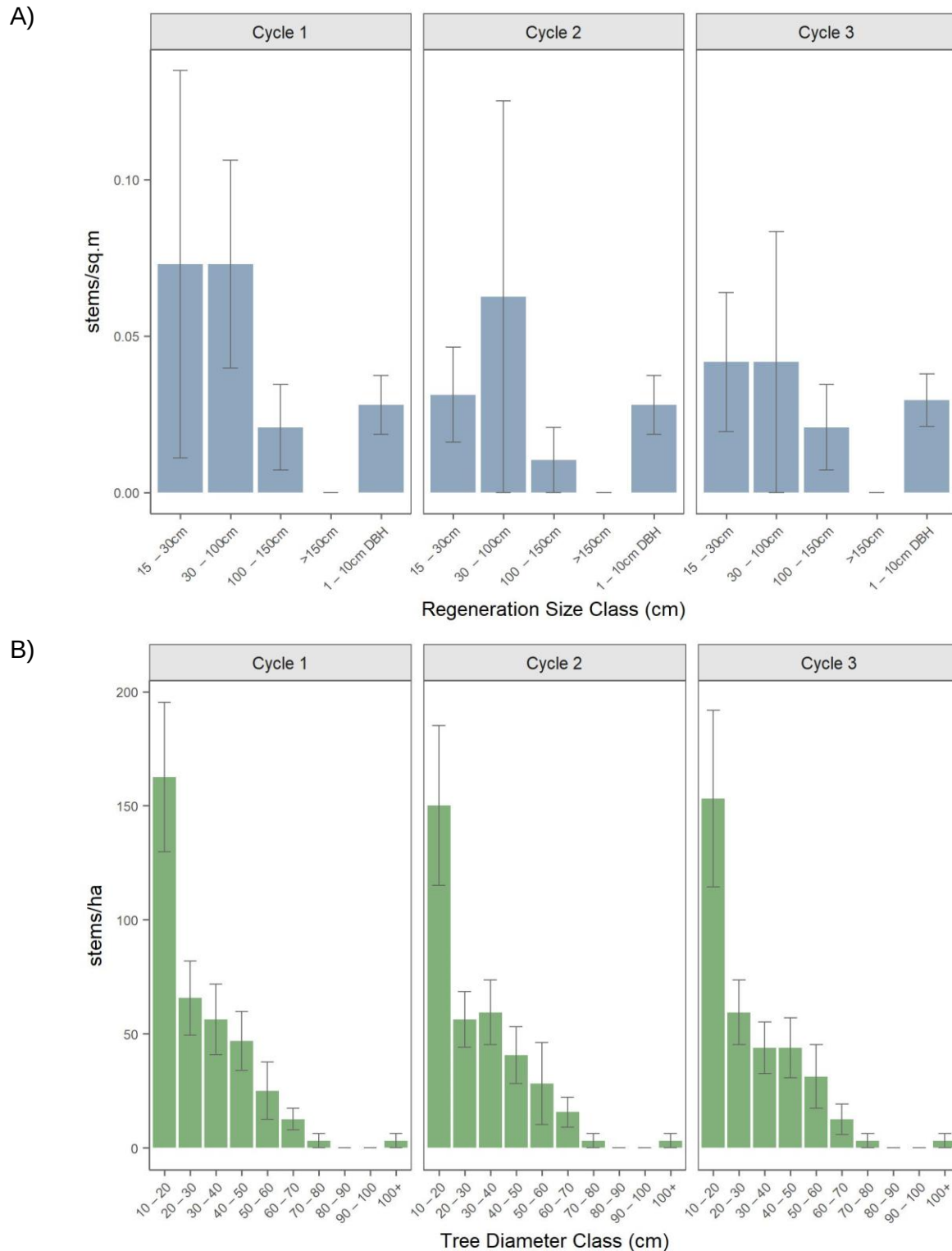
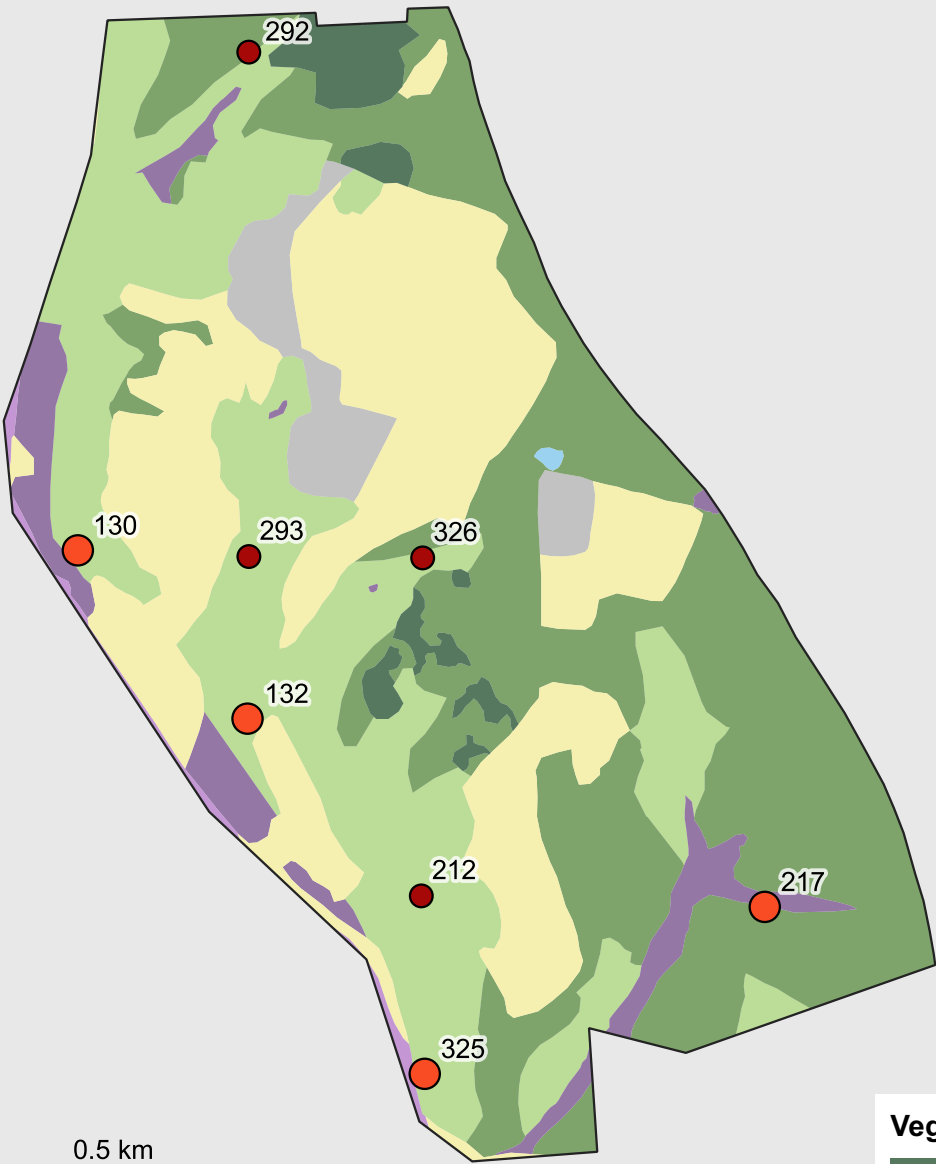


Figure 1. Stem density distributions for Thomas Stone National Historic Site. Figure A shows seedling and sapling densities by size class. Figure B shows tree density by diameter at breast height at 10 cm increments. Cycle 1 is 2008 – 2011, Cycle 2 is 2012 – 2015, Cycle 3 is 2016 – 2019. Error bars are ± 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: 0.6 – 4.4). 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: 08/20/2020.



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

- Mixed forest
- Deciduous forest
- Successional forest
- Forested wetland
- Open wetland
- Open water
- Open field
- Developed land
- Park boundary

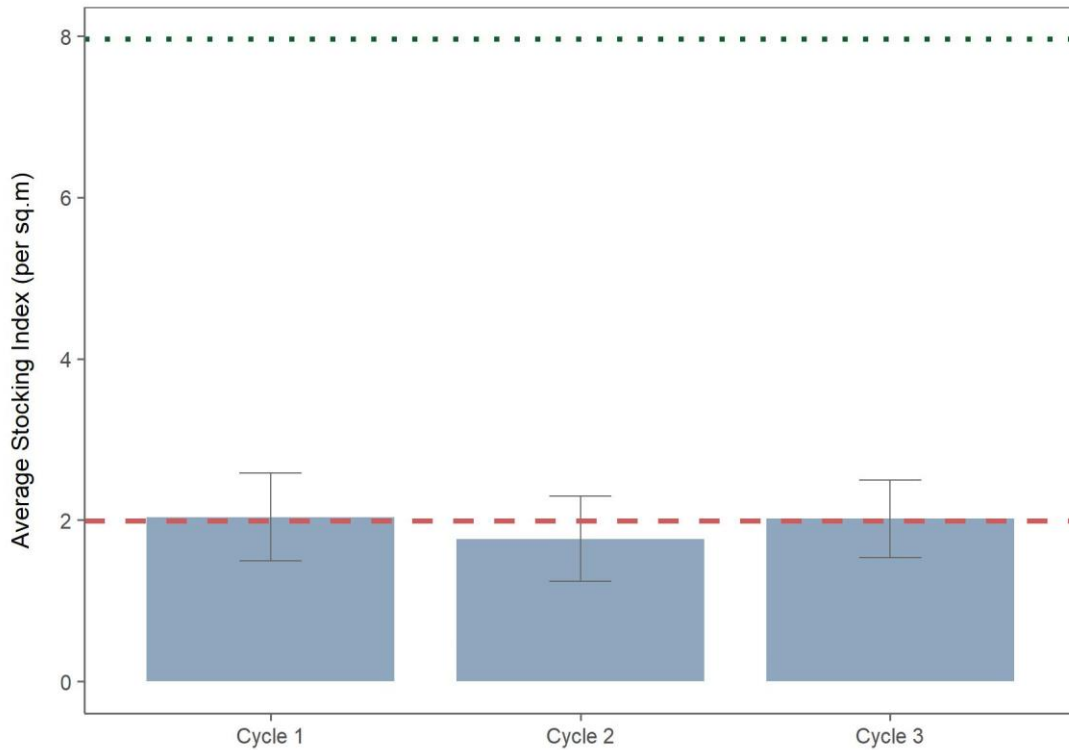
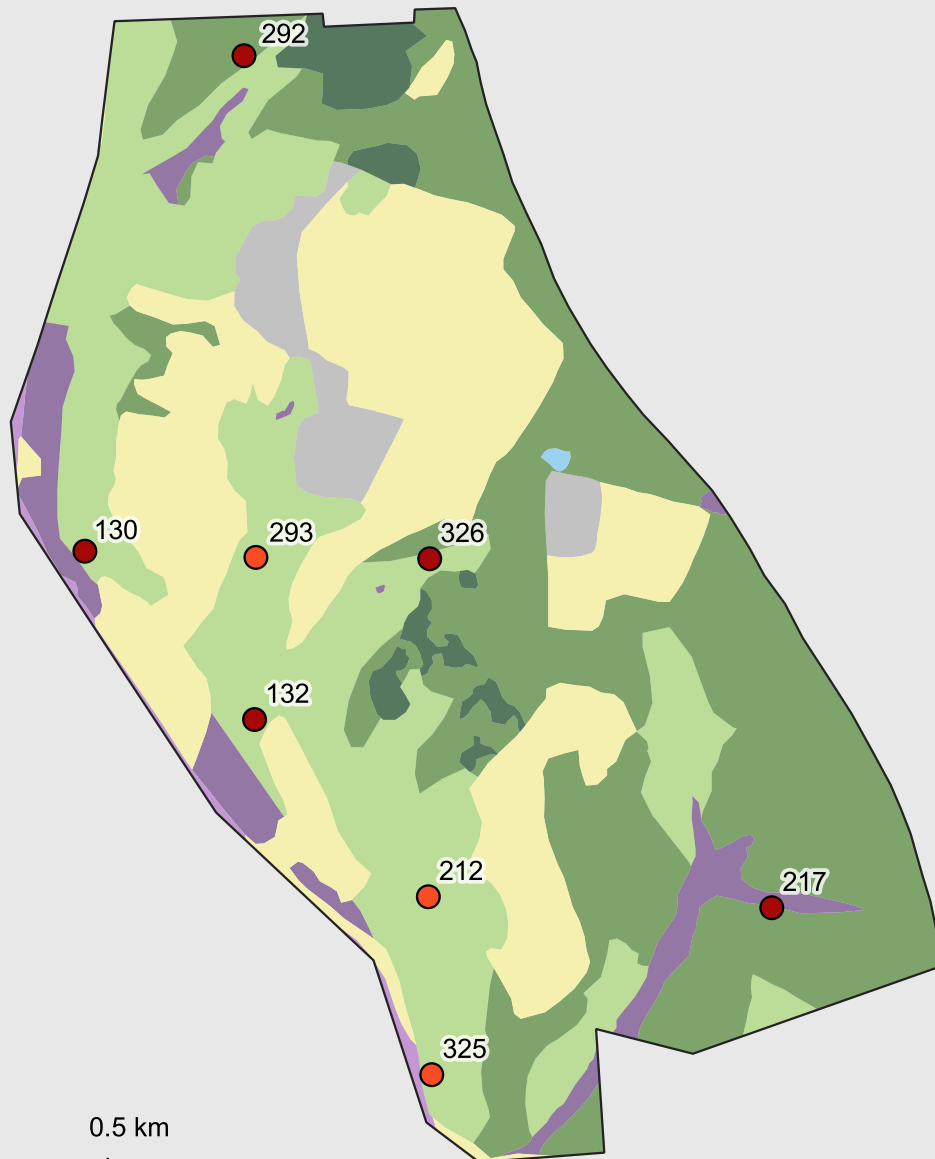


Figure 2. Regeneration stocking index averaged by cycle in Thomas Stone National Historic Site. The index is a weighted sum of seedling and sapling densities where larger seedling size classes get higher weights. The stocking index only includes native canopy-forming species (range: 0 – 4.4). Values 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 2008 – 2011, Cycle 2 is 2012 – 2015, Cycle 3 is 2016 – 2019. Error bars are ± 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: 08/20/2020.



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

- Mixed forest
- Deciduous forest
- Successional forest
- Forested wetland
- Open wetland
- Open water
- Open field
- Developed land
- Park boundary

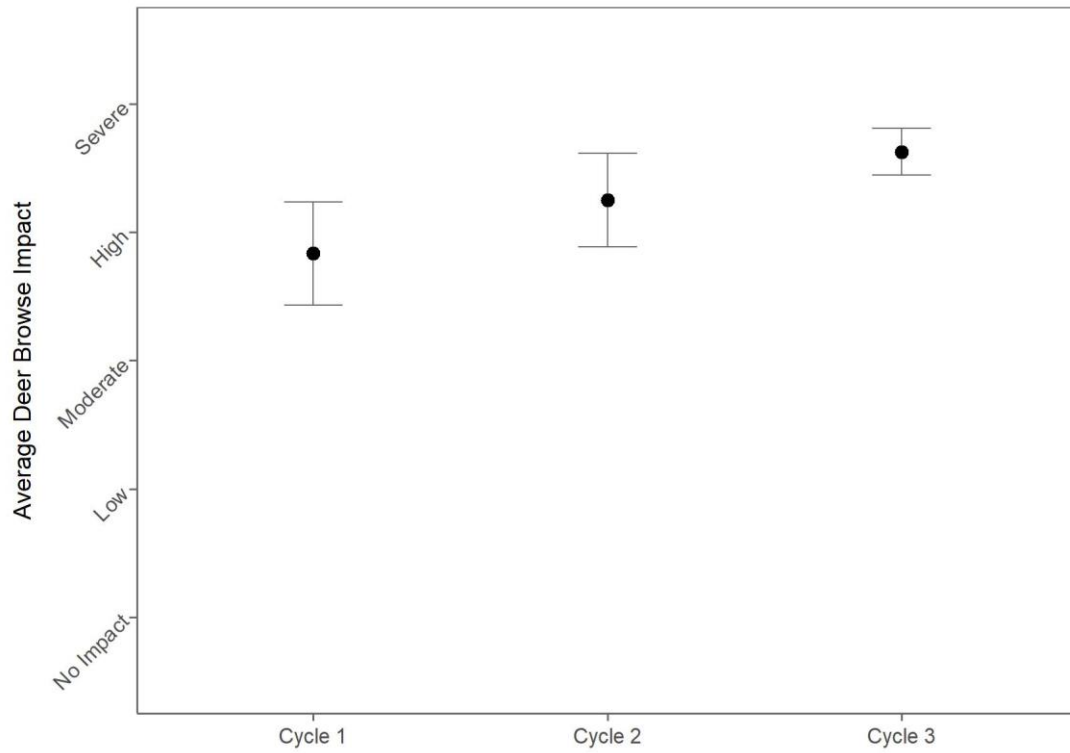
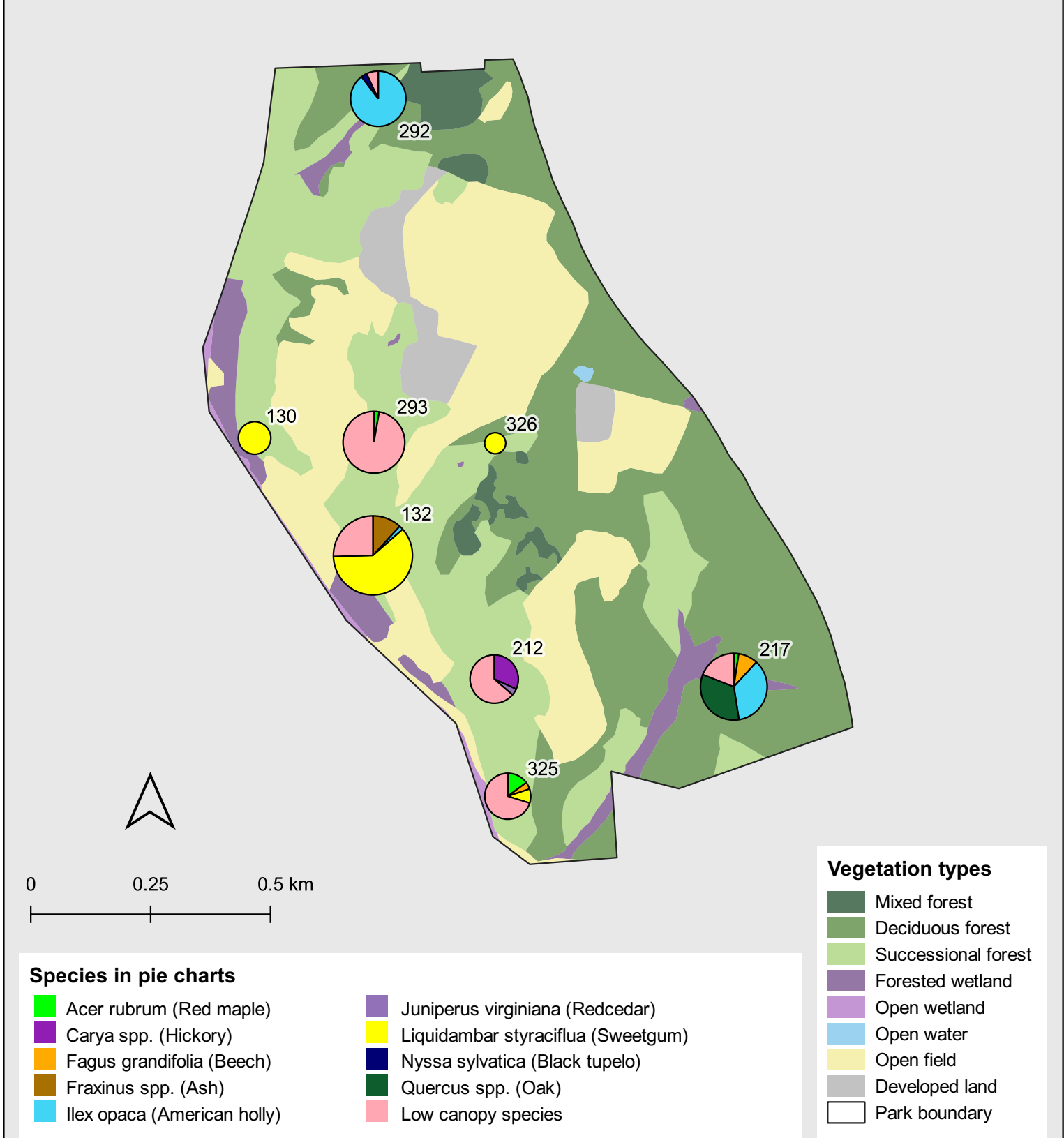


Figure 3. Average deer browse impact by cycle in Thomas Stone National Historic Site. Deer browse impacts are assessed on a scale of 1 – 5, with 1 representing no impact and 5 representing severe impacts. Cycle 1 is 2009 – 2011, Cycle 2 is 2012 – 2015, Cycle 3 is 2016 – 2019. DBI was not collected until 2009. Error bars are ± 1 SE.



Map 5. Tree Regeneration by Composition

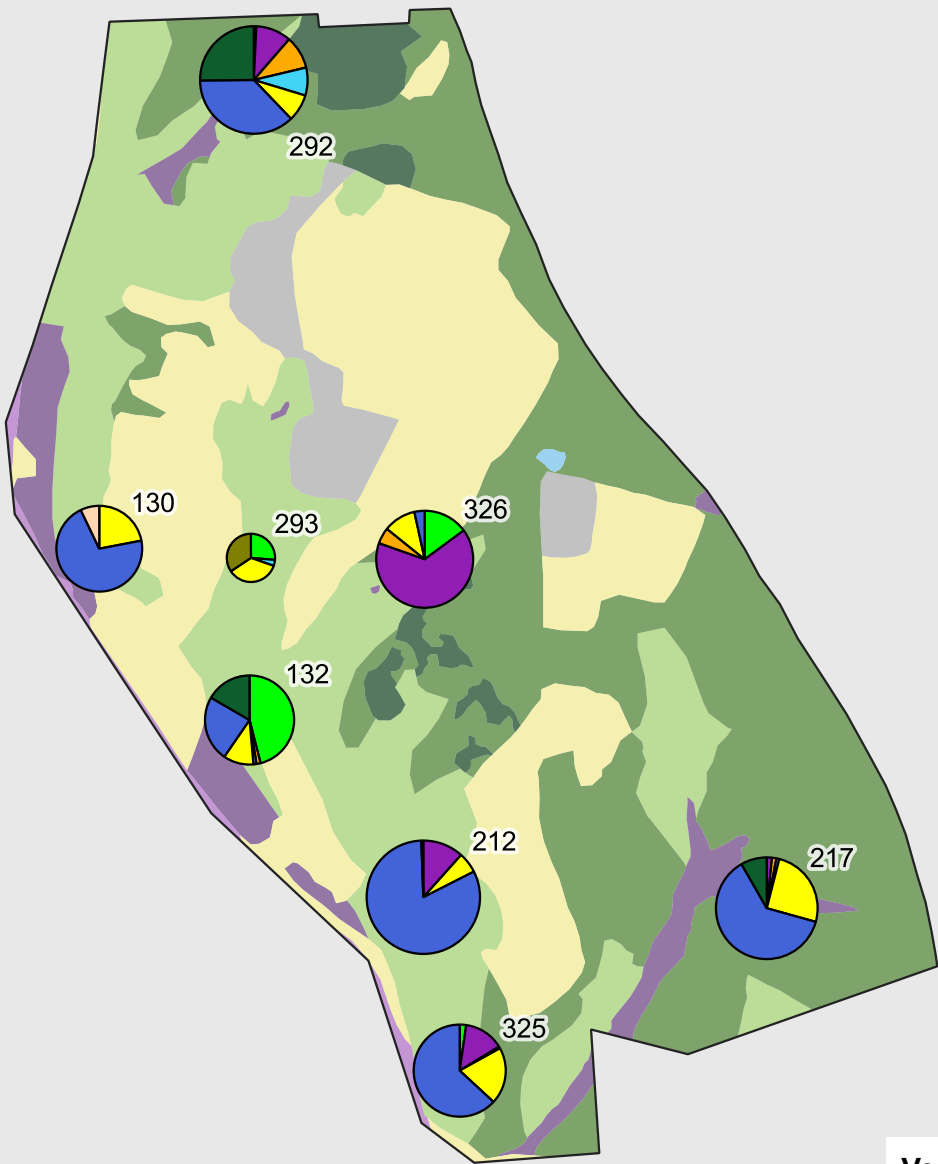
Tree regeneration stem densities, including seedlings and saplings, by species group observed in forest plots sampled in the most recent survey cycle (2016 – 2019). Each plot is sampled on a 4-year cycle in a rotating panel, with one quarter of the plots sampled every year. Pie size is proportional to plot-level regeneration density. Pies may be shifted to prevent overlap. Densities range from 0 to 0.4 stems/sq.m for an individual species group. See <https://npsforveg.shinyapps.io/midn/> for more specific plot level information. Reporting Date: 08/20/2020.





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 38.7 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.



Species in pie charts

- | | |
|------------------------------------|---|
| Acer rubrum (Red maple) | Liriodendron tulipifera (Tuliptree) |
| Carya spp. (Hickory) | Platanus occidentalis (American sycamore) |
| Fagus grandifolia (Beech) | Quercus spp. (Oak) |
| Ilex opaca (American holly) | Ulmus spp. (Elm) |
| Liquidambar styraciflua (Sweetgum) | |

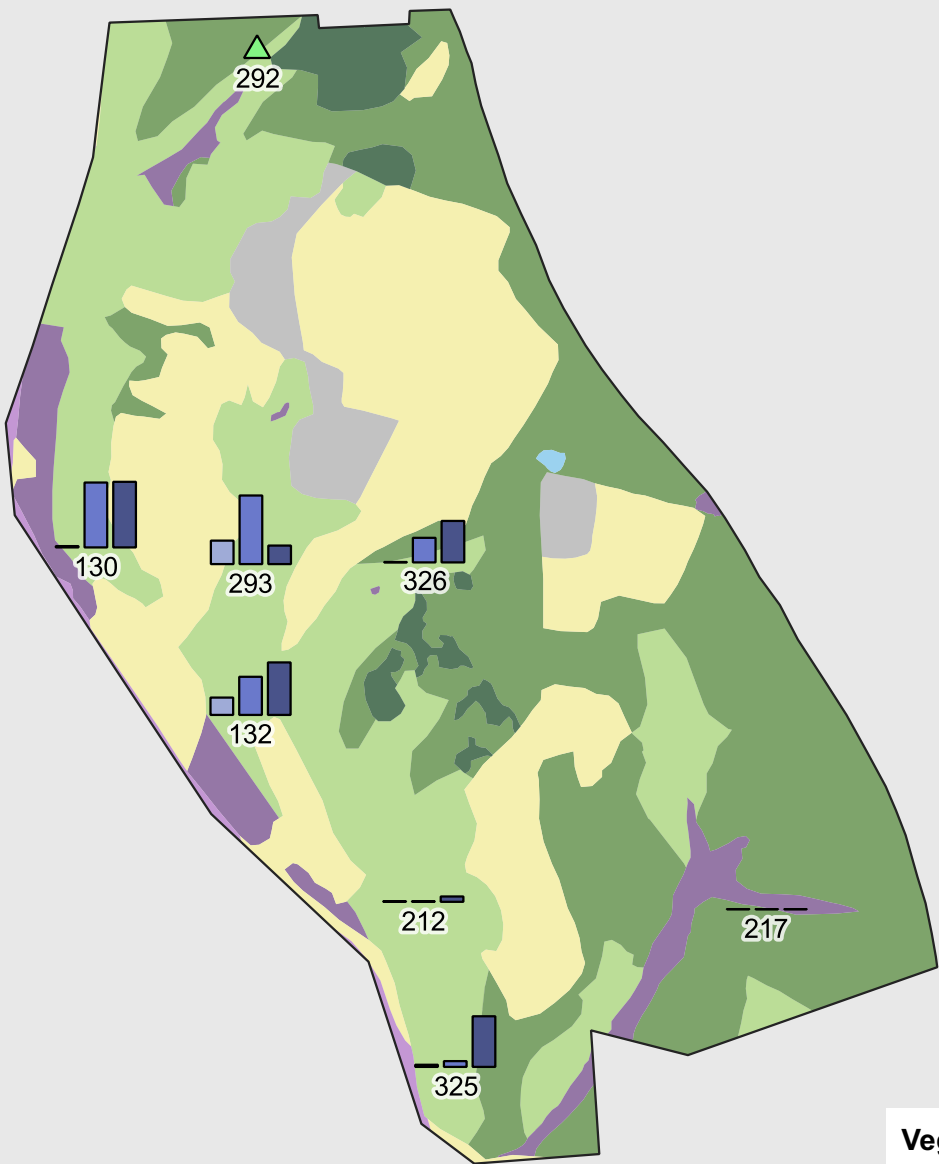
Vegetation types

- | | |
|--|---------------------|
| | Mixed forest |
| | Deciduous forest |
| | Successional forest |
| | Forested wetland |
| | Open wetland |
| | Open water |
| | Open field |
| | Developed land |
| | Park boundary |



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. Average invasive cover per plot ranges from < 0.1% to 32.0%. See Table 2 for % cover values. See Table 3 for a species list; only species monitored since 2007 were included in this metric. Bars are scaled to the maximum average invasive percent cover per plot at George Washington Birthplace National Monument (52.9%). Reporting Date: 08/20/2020.



Vegetation types

- Mixed forest
- Deciduous forest
- Successional forest
- Forested wetland
- Open wetland
- Open water
- Open field
- Developed land
- Park boundary

Regeneration density

- Cycle 1: 2008 – 2011
- Cycle 2: 2012 – 2015
- Cycle 3: 2016 – 2019
- None present

Table 2. Average % cover of invasive species detected in each plot by cycle in Thomas Stone National Historic Site. Cycle 1 is 2008 – 2011, Cycle 2 is 2012 – 2015, Cycle 3 is 2016 – 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
130	0.6	30.3	30.6
132	8.1	17.8	24.5
212	0.3	0.3	2.5
217	< 0.1	<0.1	< 0.1
292	0	0	0
293	11.0	32.0	8.6
325	1.0	2.7	23.6
326	0.2	11.5	19.4

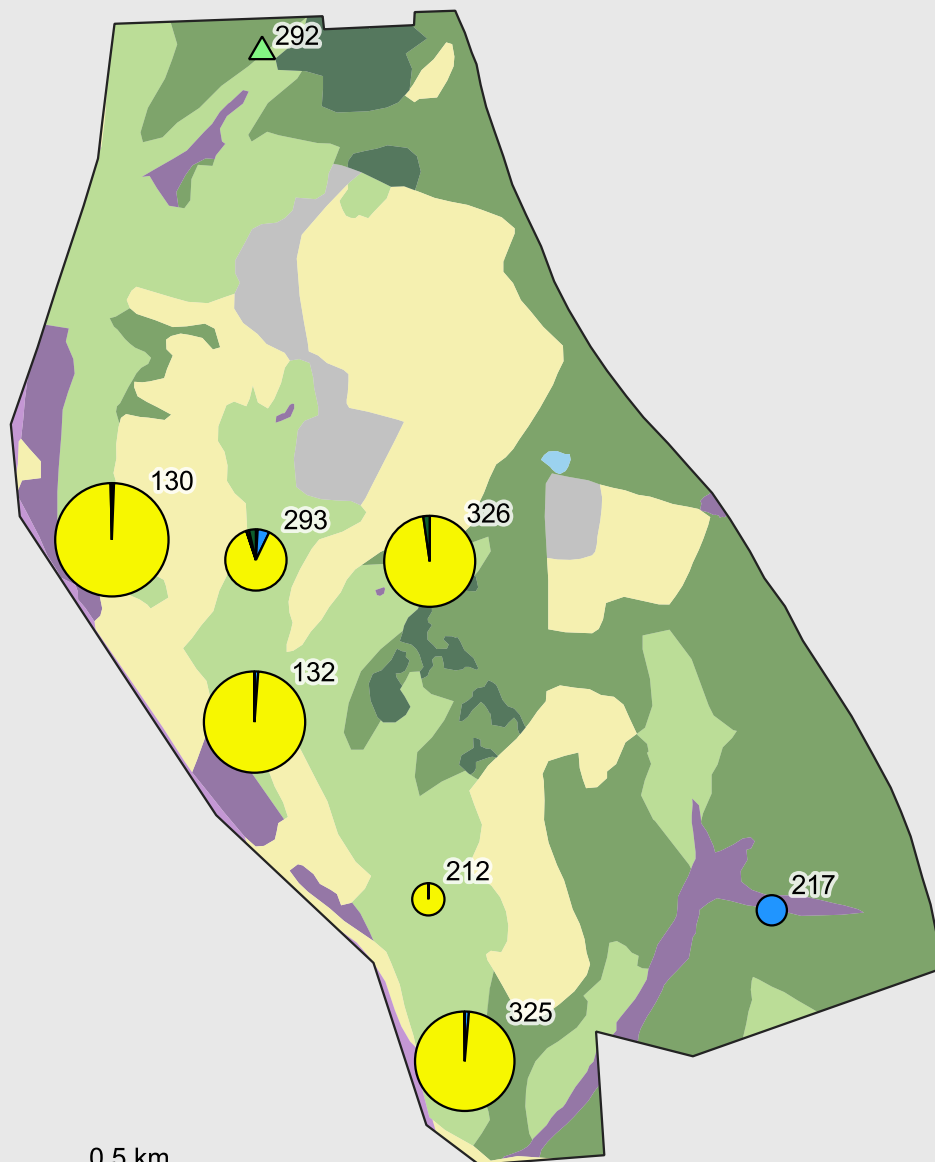
Table 3. Number of plots where invasive species were detected by cycle in Thomas Stone National Historic Site. Cycle 1 is 2008 – 2011, Cycle 2 is 2012 – 2015; Cycle 3 is 2016 – 2019. Note that not all species have been monitored for the same amount of time, as indicated by the Year added column. Species 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
<i>Ailanthus altissima</i>	Tree-of-heaven	2007	0	0	1
<i>Duchesnea indica</i> *	Mock strawberry	2007	2	2	4
<i>Hedera helix</i>	English ivy	2007	0	0	1
<i>Lespedeza cuneata</i>	Chinese lespedeza	2007	0	0	1
<i>Ligustrum</i> spp.	Privet	2009	0	1	1
<i>Lonicera</i> spp. - Exotic	Exotic bush honeysuckle	2007	1	0	0
<i>Lonicera japonica</i>	Japanese honeysuckle	2007	6	8	7
<i>Microstegium vimineum</i>	Japanese stiltgrass	2007	5	8	6
<i>Oplismenus hirtellus</i> ssp. <i>undulatifolius</i>	Wavyleaf basketgrass	2009	0	1	3
<i>Persicaria longisetata</i> *	Oriental lady's thumb	2009	4	6	6
<i>Rosa multiflora</i>	Multiflora rose	2007	0	2	0
<i>Rubus phoenicolasius</i>	Wine raspberry	2007	1	4	4
Number of plots sampled	-	-	8	8	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 30.4% for an individual species. See Table 3 for more information. Reporting Date: 08/20/2020.



Species in pie charts

- *Ailanthus altissima* (Tree-of-heaven)
- *Lonicera japonica* (Japanese honeysuckle)
- *Microstegium vimineum* (Japanese stiltgrass)
- *Oplismenus hirtellus* ssp. *undulatifolius* (Wavyleaf basketgrass)
- *Rubus phoenicolasius* (Wine raspberry)
- Other exotic herbs
- ▲ None present

Vegetation types

- Mixed forest
- Deciduous forest
- Successional forest
- Forested wetland
- Open wetland
- Open water
- Open field
- Developed land
- Park boundary