

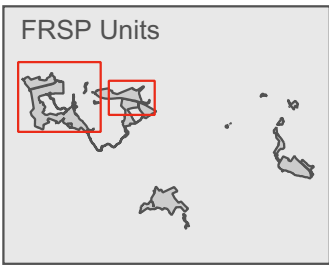


Map 1a. Tree Regeneration by Size Class

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 7.3 stem/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.

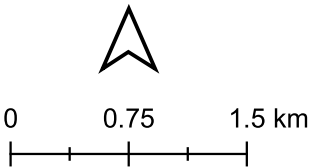
Vegetation type

- Mixed forest
- Deciduous forest
- Conifer forest
- Conifer plantation
- Forested wetland
- Open wetland
- Shrubland
- Open field
- Water
- Developed land
- No vegetation data
- Park boundary

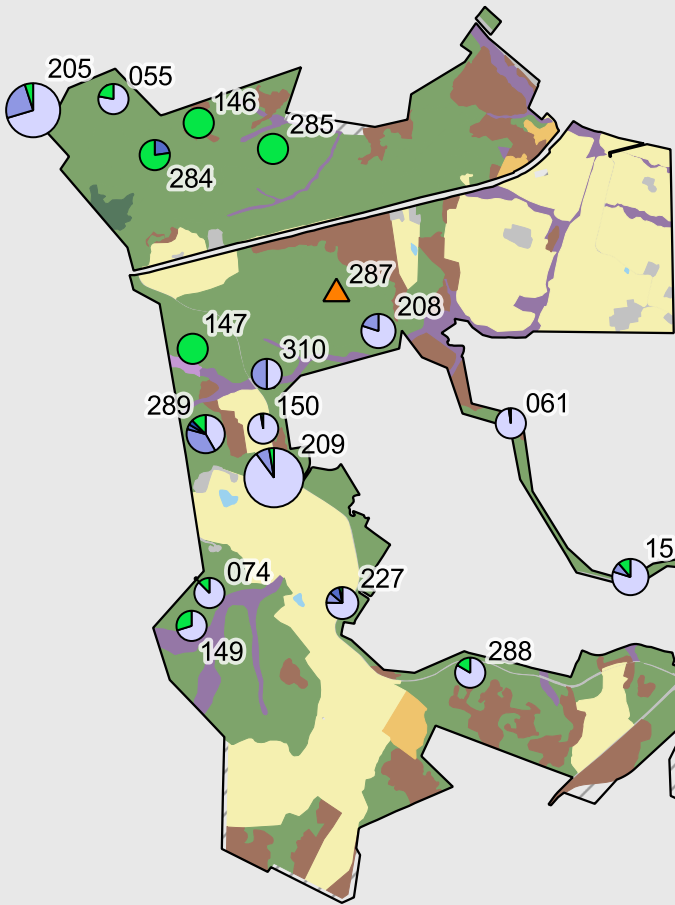


Regeneration density

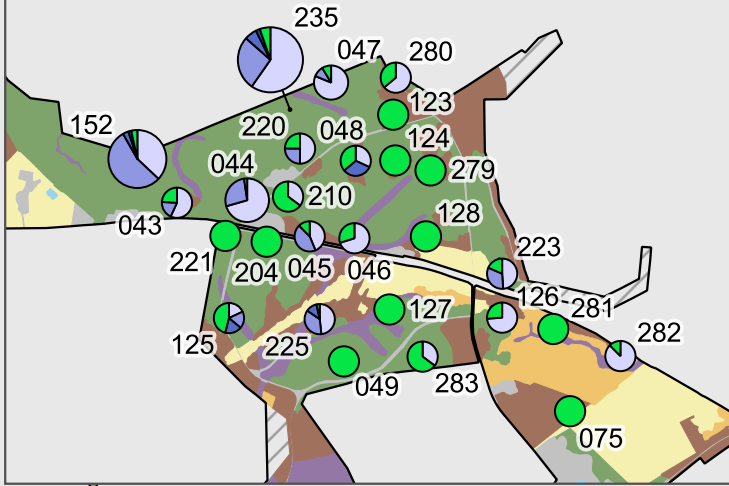
- Seedlings 15 – 30 cm
- Seedlings 30 – 100 cm
- Seedlings 100 – 150 cm
- Seedlings > 150 cm
- Saplings
- None present



Wilderness Battlefield



Chancellorsville Battlefield



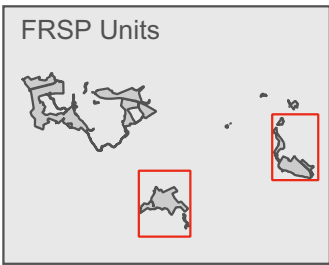


Map 1b. Tree Regeneration by Size Class

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 7.3 stem/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.

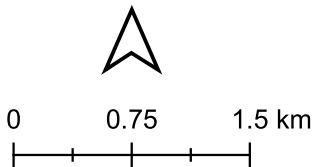
Vegetation type

- Mixed forest
- Deciduous forest
- Conifer forest
- Conifer plantation
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- Open wetland
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- Open field
- Water
- Developed land
- No vegetation data
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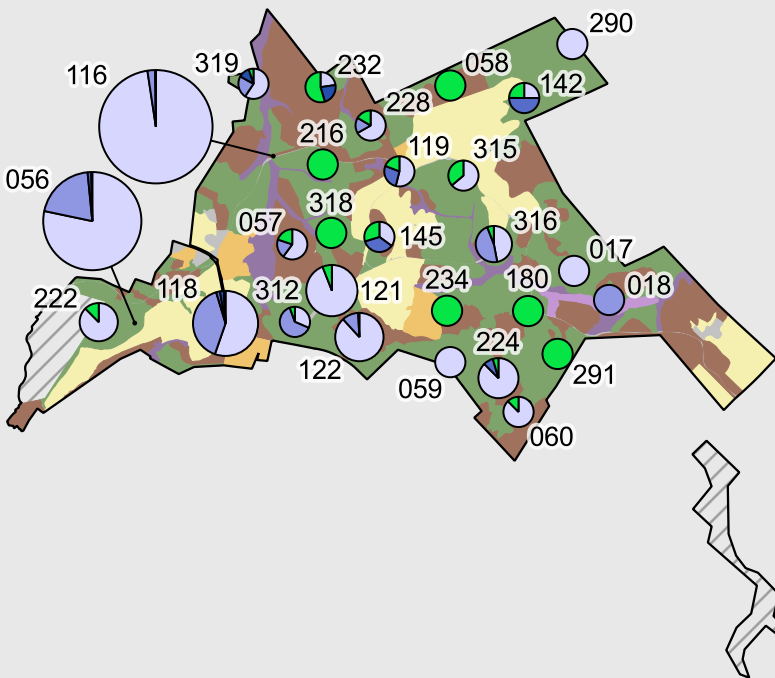


Regeneration density

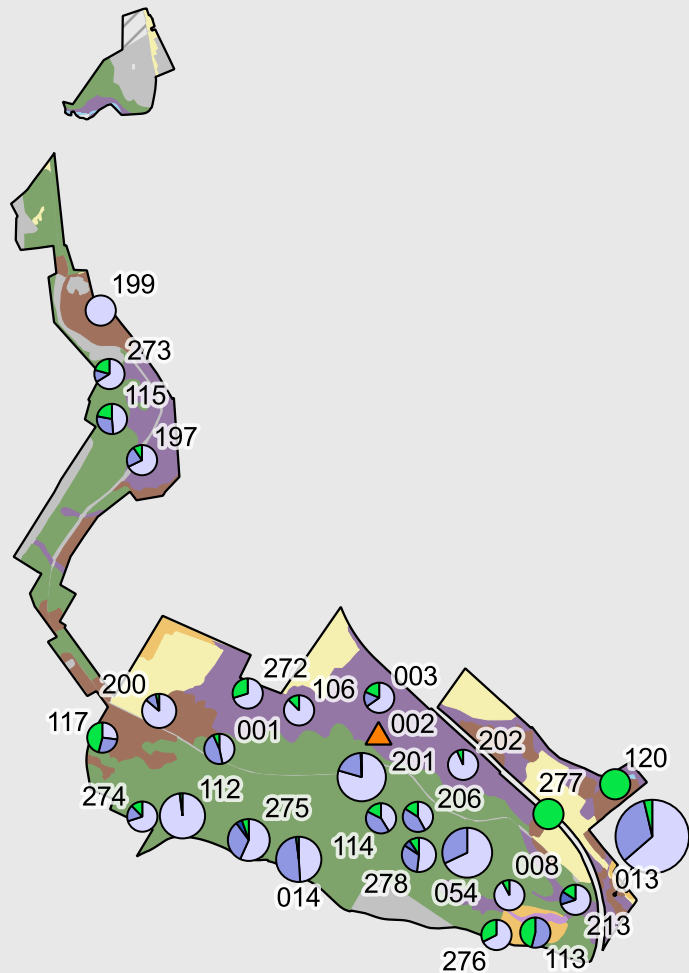
- Seedlings 15 – 30 cm
- Seedlings 30 – 100 cm
- Seedlings 100 – 150 cm
- Seedlings > 150 cm
- Saplings
- None present



Spotsylvania Courthouse Battlefield



Fredericksburg Battlefield



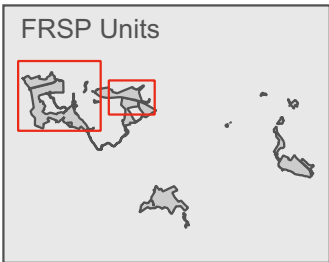


Map 2a. Tree Regeneration by Cycle

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 7.5 stems/sq.m, and only include native canopy-forming species. Charts may be shifted to prevent overlap. Reporting Date: 08/20/2020.

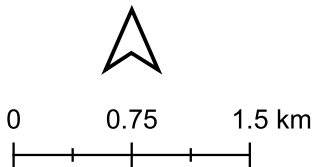
Vegetation type

- Mixed forest
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- Conifer forest
- Conifer plantation
- Forested wetland
- Open wetland
- Shrubland
- Open field
- Water
- Developed land
- No vegetation data
- Park boundary

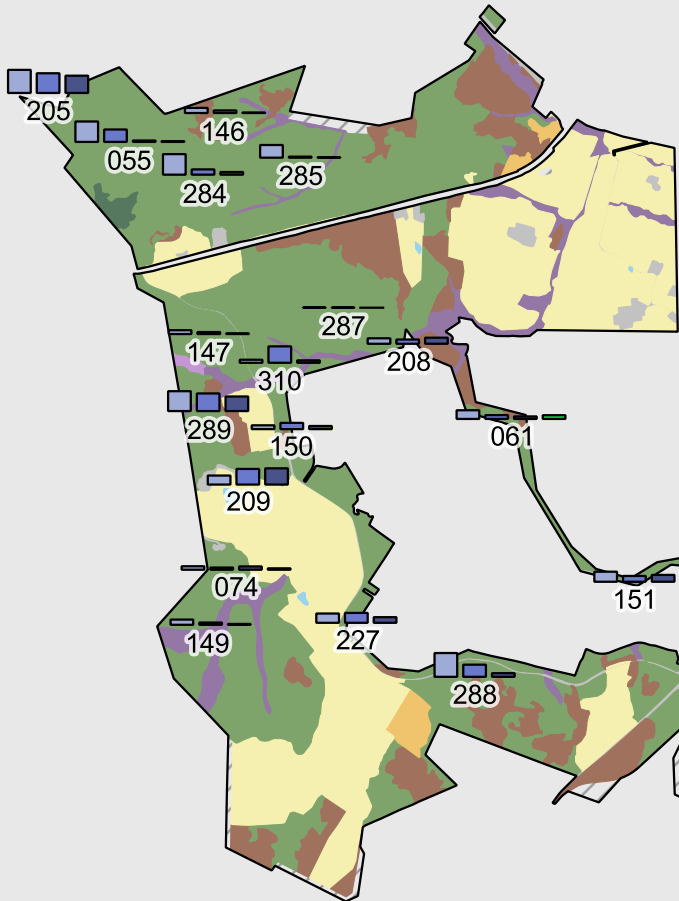


Regeneration density

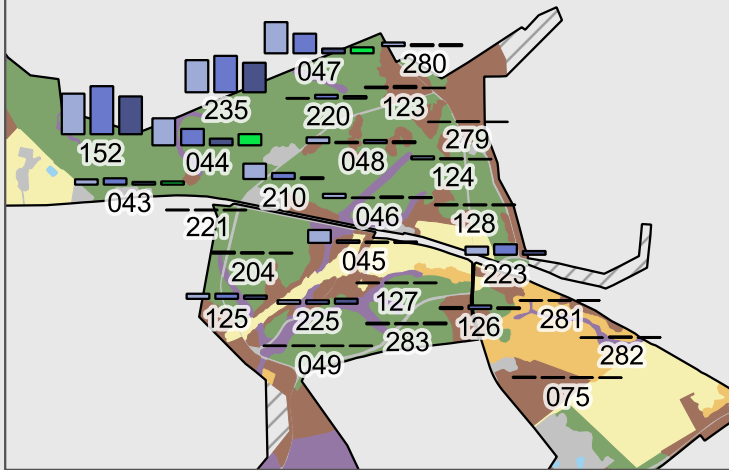
- Cycle 1: 2007 – 2010
- Cycle 2: 2011 – 2014
- Cycle 3: 2015 – 2018
- Cycle 4: 2019
- None present



Wilderness Battlefield



Chancellorsville Battlefield



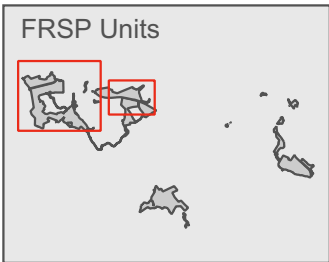


Map 2b. Tree Regeneration by Cycle

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 7.5 stems/sq.m, and only include native canopy-forming species. Charts may be shifted to prevent overlap. Reporting Date: 08/20/2020.

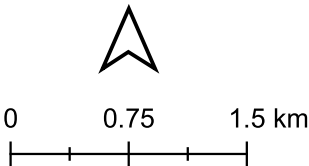
Vegetation type

- Mixed forest
- Deciduous forest
- Conifer forest
- Conifer plantation
- Forested wetland
- Open wetland
- Shrubland
- Open field
- Water
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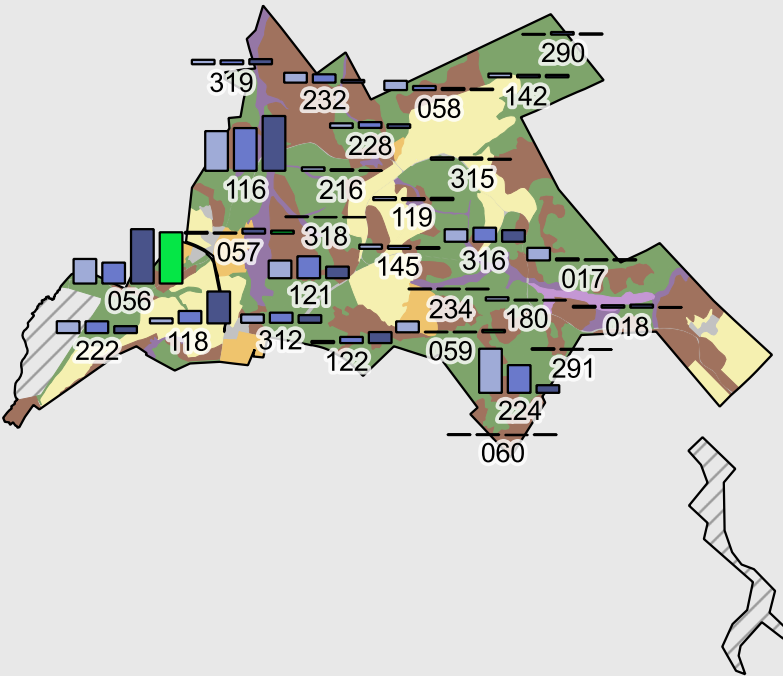


Regeneration density

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



Spotsylvania Courthouse Battlefield



Fredericksburg Battlefield

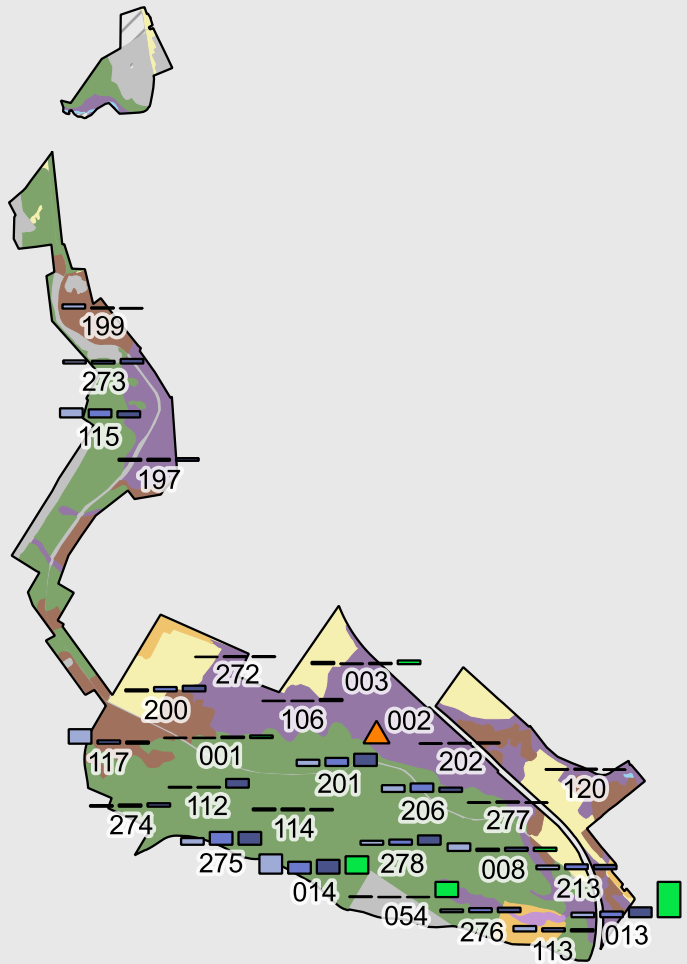


Table 1a. Average plot-level seedling and sapling stem densities (stems/sq.m), and stocking index by cycle for Fredericksburg & Spotsylvania National Military Park (Chancellorsville and Wilderness Battlefields). Only native canopy-forming species are included. Cycle 1 is 2007 – 2010, Cycle 2 is 2011 – 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
043	0.6	0.8	0.3	0.3	0.1	0.1	0.1	0.1	7.8	6.8	6.2	5.7
044	3.6	2.1	0.8	1.5	0.1	< 0.1	< 0.1	< 0.1	17.7	6.8	5.3	3.7
045	1.8	0.3	0.2	0.2	< 0.1	< 0.1	< 0.1	< 0.1	4.2	1.0	0.8	1.4
046	0.5	0	0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	8.3	2.4	2.5	1.9
047	4.2	2.6	0.6	0.8	0.1	0.1	< 0.1	< 0.1	10.2	8.1	4.1	4.4
048	0.7	< 0.1	0.3	0.2	0.1	< 0.1	< 0.1	< 0.1	8.9	4.8	6.7	6.5
049	0	0	0	0	< 0.1	< 0.1	< 0.1	< 0.1	2.4	2.4	1.8	1.8
055	2.8	1.7	0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	5.4	3.6	1.3	1.3
061	1.2	0.5	0.3	0.5	< 0.1	< 0.1	< 0.1	< 0.1	2.8	3.3	0.9	1.1
062	0.3	0.4	0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	3.3	5.0	3.7	3.1
074	0.4	0.3	0.4	0.2	< 0.1	< 0.1	< 0.1	< 0.1	3.4	2.6	2.2	1.3
075	0	0	0	0	0.2	0.1	< 0.1	< 0.1	7.7	5.3	3.5	2.4
123	0.2	0.3	0	-	< 0.1	< 0.1	< 0.1	-	1.4	2.6	1.8	-
124	0.3	< 0.1	0	-	< 0.1	< 0.1	< 0.1	-	4.2	3.0	2.4	-
125	0.5	0.5	0.3	-	0.2	0.2	0.2	-	10.8	14.4	12.5	-
126	0.2	0.4	0.2	-	< 0.1	< 0.1	< 0.1	-	4.9	4.0	3.1	-
127	0	0	0	-	< 0.1	< 0.1	< 0.1	-	4.7	4.7	4.7	-
128	0	0	0	-	0.2	0.1	0.1	-	7.7	6.5	6.5	-
146	0.6	0.3	0	-	0.1	0.1	< 0.1	-	6.5	5.6	2.9	-
147	0.4	0.2	0	-	0.1	0.1	< 0.1	-	5.7	5.5	4.7	-
149	0.6	0.3	< 0.1	-	0.1	< 0.1	< 0.1	-	7.2	3.2	1.9	-
150	0.5	0.8	0.4	-	< 0.1	< 0.1	< 0.1	-	1.8	2.1	1.0	-
151	1.3	0.7	0.8	-	0.1	0.1	0.1	-	9.9	9.0	6.2	-
152	5.4	6.4	5	-	0.1	0.1	0.2	-	18.5	25.3	23.9	-
204	< 0.1	0	0	-	0.2	0.2	0.1	-	8.9	9.4	6.5	-
205	3.1	2.6	2.3	-	< 0.1	0.1	0.1	-	19.6	8.9	8.7	-
208	0.8	0.6	0.8	-	0	0	0	-	0.8	0.7	1.0	-
209	1.2	2.1	2.2	-	< 0.1	< 0.1	< 0.1	-	5.1	5.2	5.3	-
210	1.9	0.7	< 0.1	-	0.2	0.2	0.2	-	11.4	10.5	7.7	-

Table 1a. (continued)

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
211	0.8	0.3	0.4	-	< 0.1	< 0.1	< 0.1	-	3.1	0.9	2.6	-
220	0	0.4	0.3	-	< 0.1	< 0.1	< 0.1	-	3.5	5.3	4.5	-
221	0	0	0	-	0.1	0.1	< 0.1	-	5.3	5.3	4.7	-
223	1	1.3	0.4	-	0.1	0.1	< 0.1	-	9.1	7.6	5.3	-
225	0.4	0.4	0.7	-	< 0.1	< 0.1	< 0.1	-	5.5	7.5	3.7	-
227	1.3	1.3	0.8	-	< 0.1	< 0.1	< 0.1	-	4.8	4.2	3.6	-
235	4.3	4.8	3.8	-	0.2	< 0.1	0.2	-	33.2	40.1	24.4	-
279	0	< 0.1	0	-	< 0.1	< 0.1	< 0.1	-	0.6	0.7	0.6	-
280	0.4	0.2	0.2	-	< 0.1	< 0.1	< 0.1	-	4.6	4.9	4.9	-
281	0	0	0	-	< 0.1	< 0.1	< 0.1	-	2.4	3.5	2.9	-
282	0	0.2	< 0.1	-	< 0.1	< 0.1	< 0.1	-	1.2	0.8	0.7	-
283	0	0	< 0.1	-	0.2	0.2	0.2	-	10.6	8.8	7.7	-
284	2.5	0.4	< 0.1	-	0.3	0.3	0.3	-	22.7	15.8	15.8	-
285	1.7	< 0.1	0	-	< 0.1	< 0.1	< 0.1	-	5.6	3.0	2.9	-
286	0.7	0.3	0.5	-	< 0.1	< 0.1	< 0.1	-	2.6	2.2	1.3	-
287	0	0	0	-	< 0.1	< 0.1	0	-	0.6	0.6	0.0	-
288	3.2	1.6	0.4	-	< 0.1	< 0.1	< 0.1	-	9.0	6.1	4.5	-
289	2.5	2.2	1.8	-	0.2	0.2	0.2	-	23.4	21.4	20.5	-
310	0.4	2.3	0.3	-	0	0	0	-	0.4	4.3	0.5	-

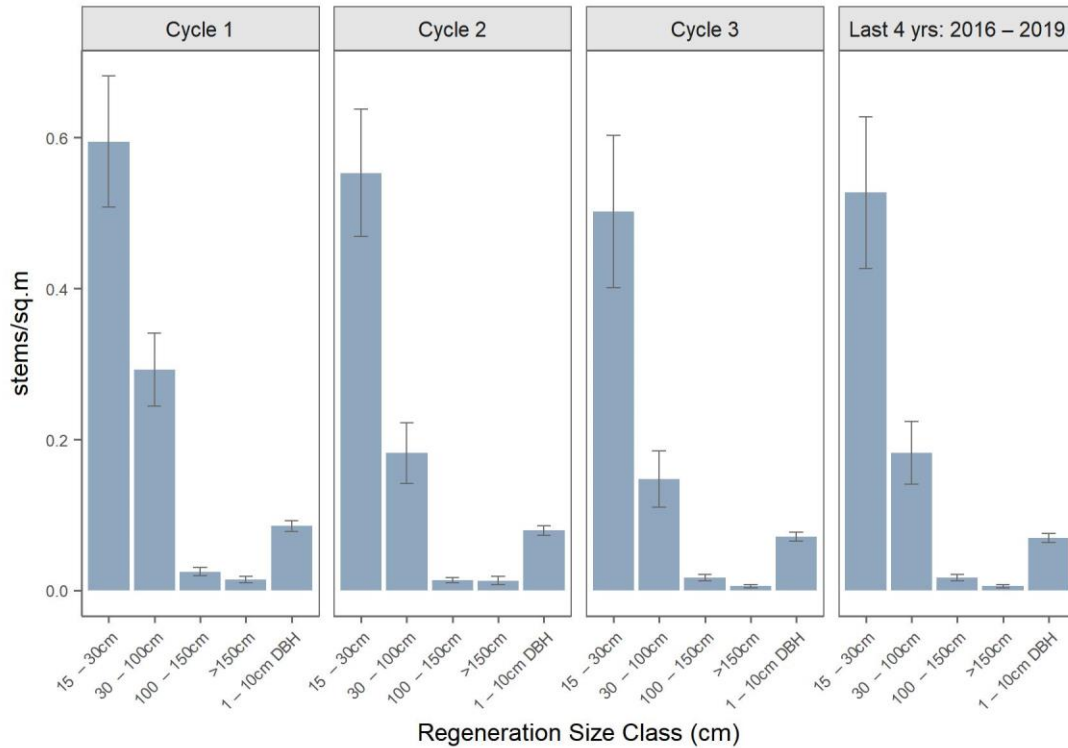
Table 1b. Average plot-level seedling and sapling stem densities (stems/sq.m), and stocking index by cycle for Fredericksburg & Spotsylvania National Military Park (Fredericksburg Battlefield). Only native canopy-forming species are included. Cycle 1 is 2007 – 2010, Cycle 2 is 2011 – 2014, Cycle 3 is 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.

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	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 1	Cycle 2	Cycle 3	Cycle 4
001	0	0	0.2	0.3	< 0.1	< 0.1	< 0.1	< 0.1	2.4	1.8	1.9	1.7
002	0	0	0	0	0	0	0	0	0	0	0	0
003	0.2	0	0.1	0.4	0.1	0.1	< 0.1	< 0.1	7.2	5.3	4.8	5.2
008	1.0	0.3	0.4	0.4	< 0.1	< 0.1	0	< 0.1	4.9	3.2	2.2	2.2
013	0.4	0.6	1.2	4.7	0.2	0.2	0.2	0.2	11.3	10.6	10.8	15.1
014	2.6	1.6	1.8	2.3	< 0.1	< 0.1	< 0.1	0	8.0	4.5	5.2	5.9
054	< 0.1	0	0	2.1	< 0.1	< 0.1	0	0	0.7	0.6	0.6	2.8
106	0	0	0.3	-	< 0.1	< 0.1	< 0.1	-	1.8	1.8	2.0	-
112	< 0.1	< 0.1	1.2	-	< 0.1	< 0.1	< 0.1	-	1.3	1.3	2.3	-
113	0.3	0.2	0.2	-	0.4	0.3	0.1	-	21.2	13.9	7.4	-
114	0.3	0.3	0.2	-	< 0.1	< 0.1	< 0.1	-	1.6	1.4	2.0	-
115	1.1	0.9	0.7	-	0.2	0.2	0.2	-	9.7	10.4	10.3	-
117	1.8	0.3	0.2	-	0.2	0.2	0.1	-	14.0	10.4	7.3	-
120	0	< 0.1	0	-	< 0.1	< 0.1	< 0.1	-	4.7	3.7	1.2	-
197	0.3	0.3	0.3	-	< 0.1	< 0.1	< 0.1	-	2.1	2.2	2.2	-
199	0.6	0.2	0.1	-	0	0	0	-	0.8	0.3	0.1	-
200	0.3	0.6	0.8	-	< 0.1	< 0.1	< 0.1	-	5.6	1.3	2.0	-
201	0.8	1.1	1.7	-	< 0.1	< 0.1	< 0.1	-	2.1	2.3	2.6	-
202	0	< 0.1	0.2	-	< 0.1	< 0.1	< 0.1	-	0.6	0.7	0.8	-
206	0.8	1.1	0.5	-	< 0.1	< 0.1	< 0.1	-	11.4	5.3	5.5	-
213	0.4	0.6	0.5	-	< 0.1	< 0.1	< 0.1	-	5.1	6.9	6.8	-
272	0	< 0.1	0.1	-	< 0.1	< 0.1	< 0.1	-	1.8	1.9	1.9	-
273	0.3	0.3	0.5	-	< 0.1	0.1	0.1	-	5.1	6.2	7.1	-
274	0.2	0.3	0.4	-	< 0.1	< 0.1	< 0.1	-	2.6	3.4	3.4	-
275	0.8	1.7	1.7	-	< 0.1	< 0.1	< 0.1	-	6.7	10.8	11.0	-
276	0.2	0.3	0.4	-	0.2	0.2	0.2	-	10.8	11.5	10.4	-
277	0	0.2	0	-	< 0.1	< 0.1	< 0.1	-	1.8	1.4	1.2	-
278	0.4	0.6	1.2	-	0.1	0.1	0.1	-	7.2	7.2	9.1	-

Table 1c. Average plot-level seedling and sapling stem densities (stems/sq.m), and stocking index by cycle for Fredericksburg & Spotsylvania National Military Park (Spotsylvania Battlefield). 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
017	1.7	0.3	0.2	0.2	< 0.1	<0.1	0	0	8.9	2.0	0.2	0.2
018	0.3	0.3	0.4	0.1	0	0	0	0	0.3	0.4	0.4	0.2
056	3.3	2.8	7.4	7.0	< 0.1	< 0.1	< 0.1	< 0.1	6.0	5.1	11.9	11.2
057	0.2	< 0.1	0.6	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	3.7	3.7	4.8	4.5
058	1.2	0.4	< 0.1	0	0.1	0.1	0.2	0.2	15.0	11.8	10.2	9.4
059	1.5	< 0.1	< 0.1	0.3	0	0	0	0	5.8	0.1	0.1	0.3
060	< 0.1	< 0.1	0	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	1.3	0.7	0.6	0.7
116	5.4	5.8	7.5	-	< 0.1	< 0.1	< 0.1	-	7.1	7.7	8.3	-
118	0.7	1.7	4.3	-	< 0.1	< 0.1	< 0.1	-	2.3	5.8	13.5	-
119	0.3	0.2	0.3	-	0.2	0.1	< 0.1	-	13.6	5.6	4.8	-
121	2.3	2.9	1.5	-	< 0.1	< 0.1	< 0.1	-	7.1	7.8	6.2	-
122	0.3	0.8	1.5	-	< 0.1	< 0.1	< 0.1	-	2.0	1.6	2.3	-
142	0.4	0.3	0.3	-	< 0.1	< 0.1	< 0.1	-	8.3	8.1	7.5	-
145	0.5	0.3	0.2	-	< 0.1	< 0.1	< 0.1	-	6.5	4.0	5.3	-
180	0.3	0	0	-	0.1	0.1	< 0.1	-	6.5	5.9	4.7	-
216	0.4	0.2	0	-	< 0.1	< 0.1	< 0.1	-	4.2	3.2	2.9	-
222	1.5	1.5	0.8	-	0.1	0.1	0.1	-	14.2	11.5	6.7	-
224	6.0	3.8	1	-	< 0.1	< 0.1	< 0.1	-	11.4	10.3	4.9	-
228	0.6	0.8	0.4	-	< 0.1	< 0.1	< 0.1	-	3.1	3.3	4.6	-
232	1.0	0.8	0.2	-	0.4	0.3	0.2	-	25.0	26.3	14.3	-
234	0	0	0	-	0.1	0.1	< 0.1	-	5.9	5.3	4.7	-
290	< 0.1	0.3	0.2	-	< 0.1	< 0.1	0	-	0.7	1.5	0.2	-
291	0.2	< 0.1	0	-	< 0.1	< 0.1	< 0.1	-	2.5	2.4	2.4	-
312	1.1	1.3	1	-	< 0.1	< 0.1	< 0.1	-	5.0	4.9	4.6	-
315	0.2	0.3	< 0.1	-	< 0.1	< 0.1	< 0.1	-	4.0	3.2	2.4	-
316	1.7	1.8	1.5	-	< 0.1	< 0.1	< 0.1	-	6.7	7.9	7.0	-
318	< 0.1	0	0	-	< 0.1	< 0.1	< 0.1	-	1.3	0.6	0.6	-
319	0.6	0.5	0.7	-	< 0.1	< 0.1	< 0.1	-	3.3	6.4	6.7	-

A)



B)

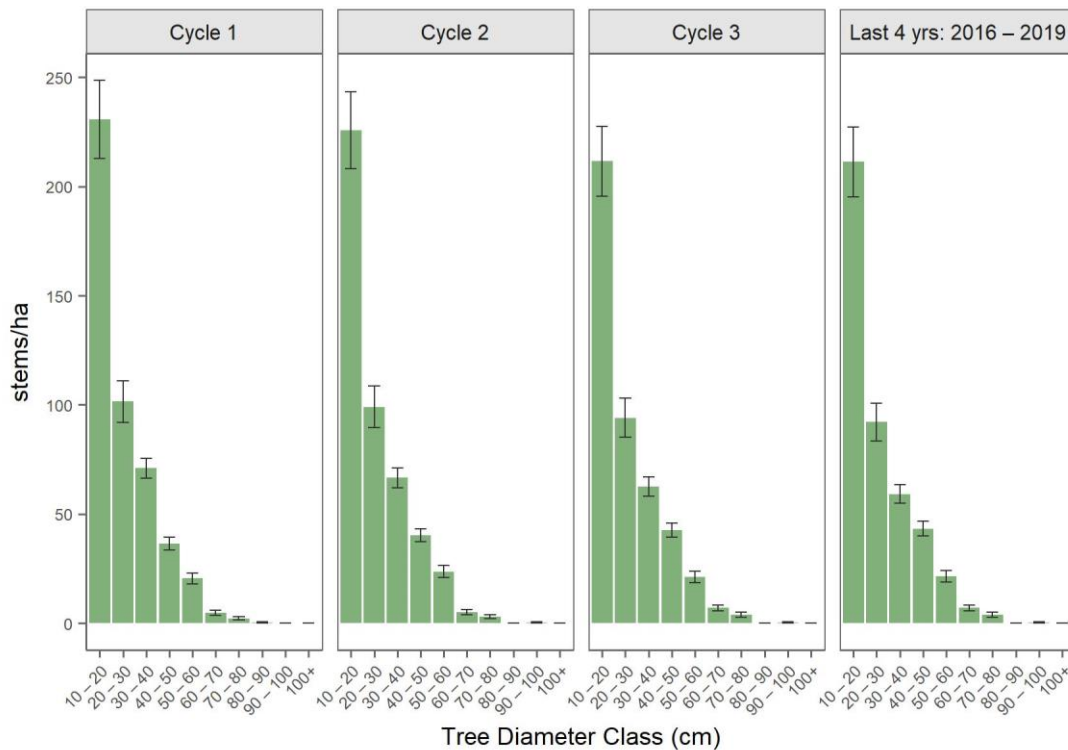


Figure 1. Stem density distributions for Fredericksburg & Spotsylvania National Military Park. Figure A shows seedling and sapling densities by size class. Figure B shows tree density by diameter at breast height at 10 cm increments. Cycle 1 is 2007 – 2010, Cycle 2 is 2011 – 2014, Cycle 3 is 2015 – 2018.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

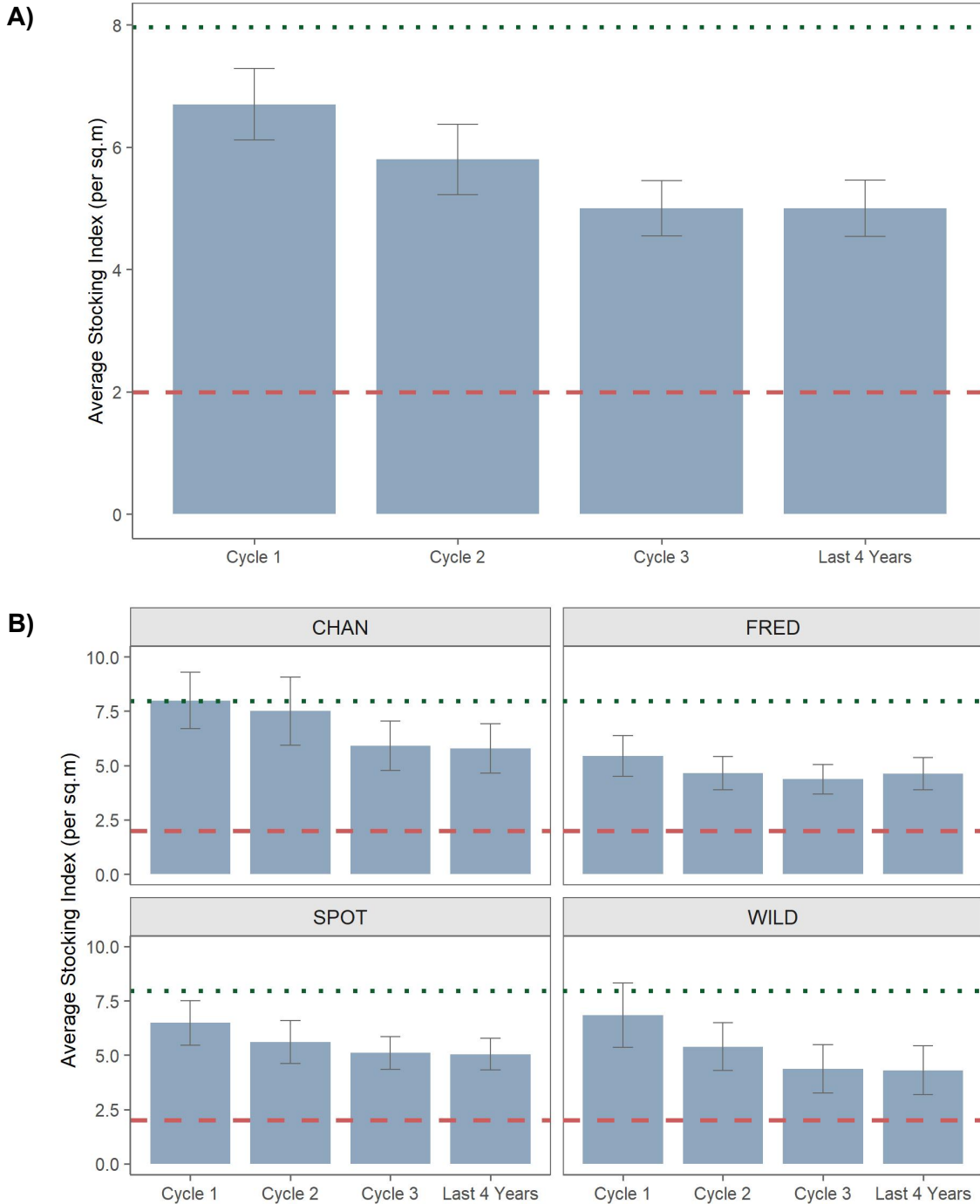


Figure 2. Regeneration stocking index averaged by cycle overall (A) and by unit (B) in Fredericksburg & Spotsylvania National Military Park. The index is a weighted sum of seedling and sapling densities where larger seedling size classes get higher weights. The stocking index only includes native canopy-forming species (range: 0 – 40.1). 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 ± 1 SE.

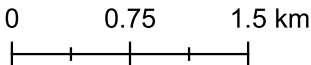
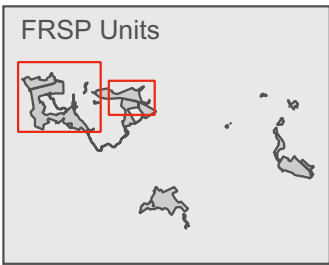


Map 3a. Tree Regeneration Stocking Index

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 – 24.4). 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.

Vegetation type

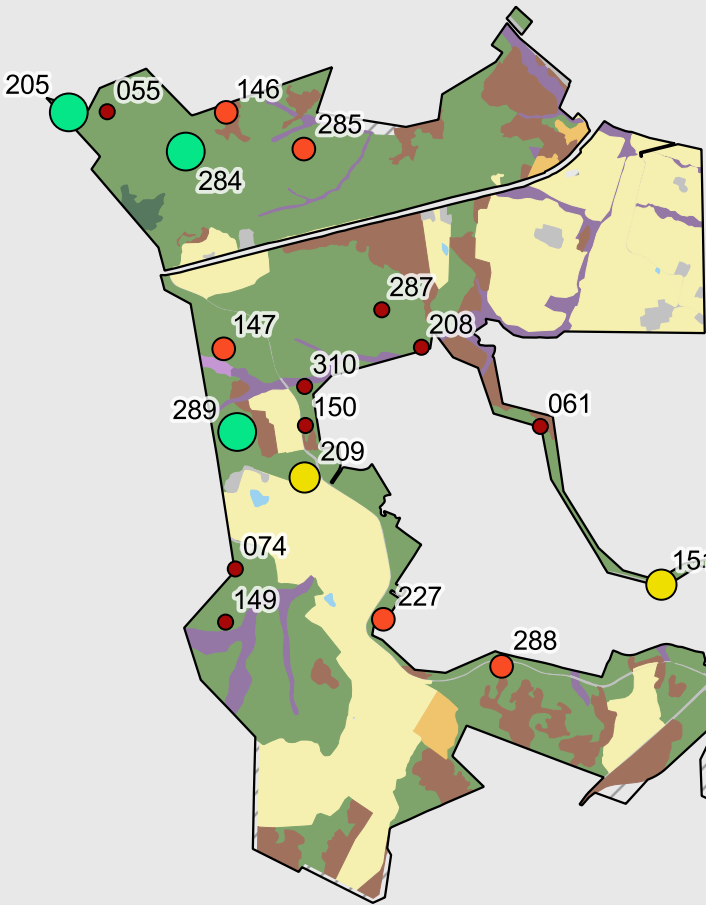
- Mixed forest
- Deciduous forest
- Conifer forest
- Conifer plantation
- Forested wetland
- Open wetland
- Shrubland
- Open field
- Water
- Developed land
- No vegetation data
- Park boundary



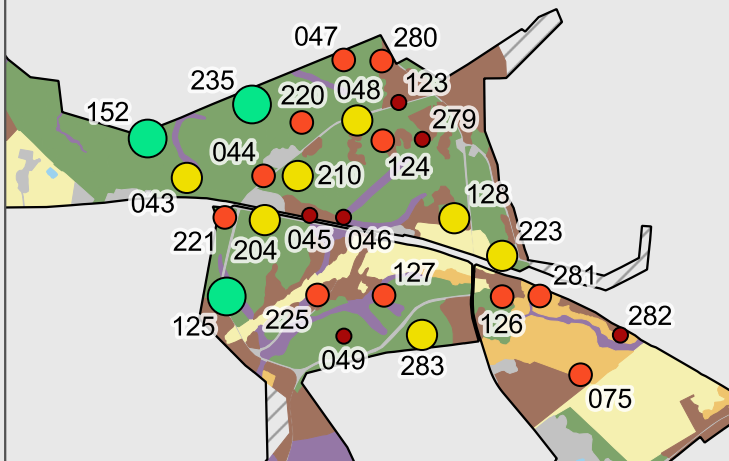
Stocking index ranges

- < 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.

Wilderness Battlefield



Chancellorsville Battlefield



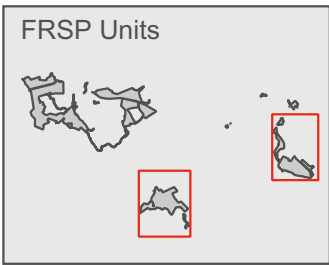


Map 3b. Tree Regeneration Stocking Index

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 – 24.4). 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.

Vegetation type

- Mixed forest
- Deciduous forest
- Conifer forest
- Conifer plantation
- Forested wetland
- Open wetland
- Shrubland
- Open field
- Water
- Developed land
- No vegetation data
- Park boundary

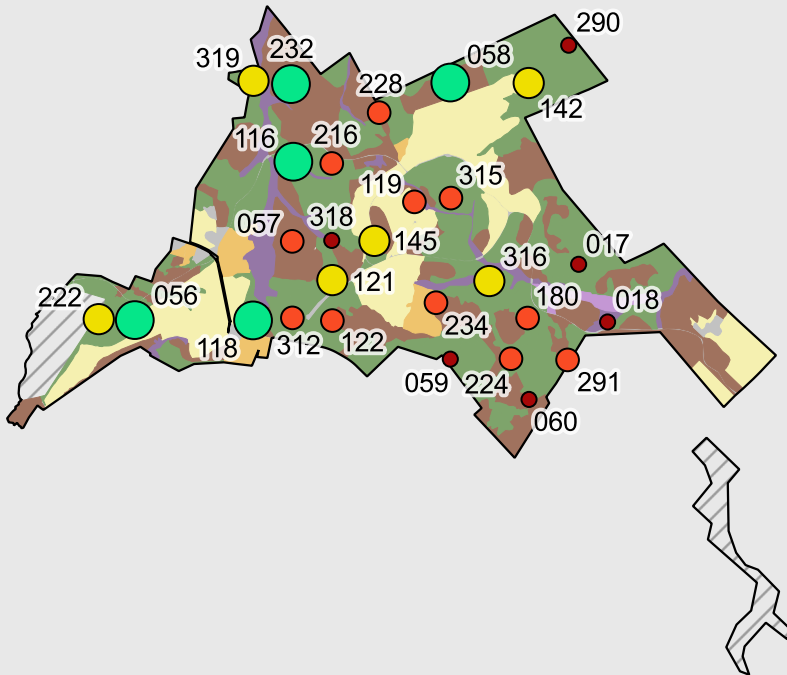


0 0.75 1.5 km

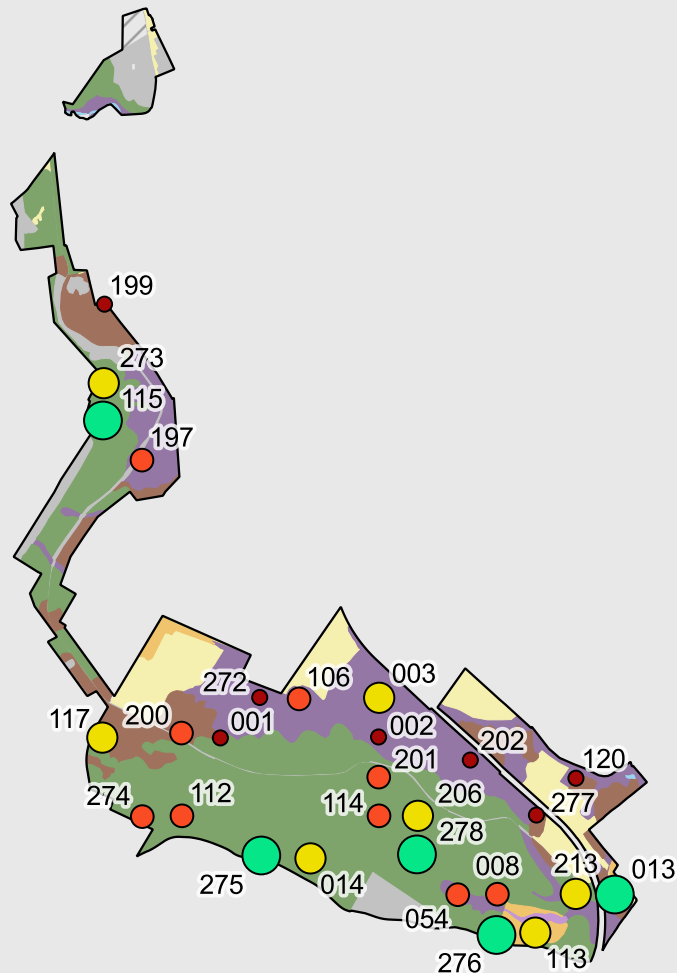
Stocking index ranges

- < 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.

Spotsylvania Courthouse Battlefield



Fredericksburg Battlefield



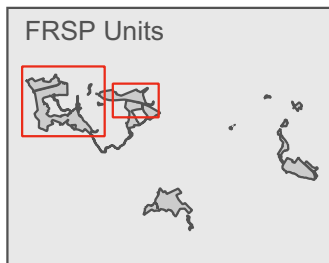


Map 4a. Index of Deer Browse Impacts

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.

Vegetation type

- Mixed forest
- Deciduous forest
- Conifer forest
- Conifer plantation
- Forested wetland
- Open wetland
- Shrubland
- Open field
- Water
- Developed land
- No vegetation data
- Park boundary

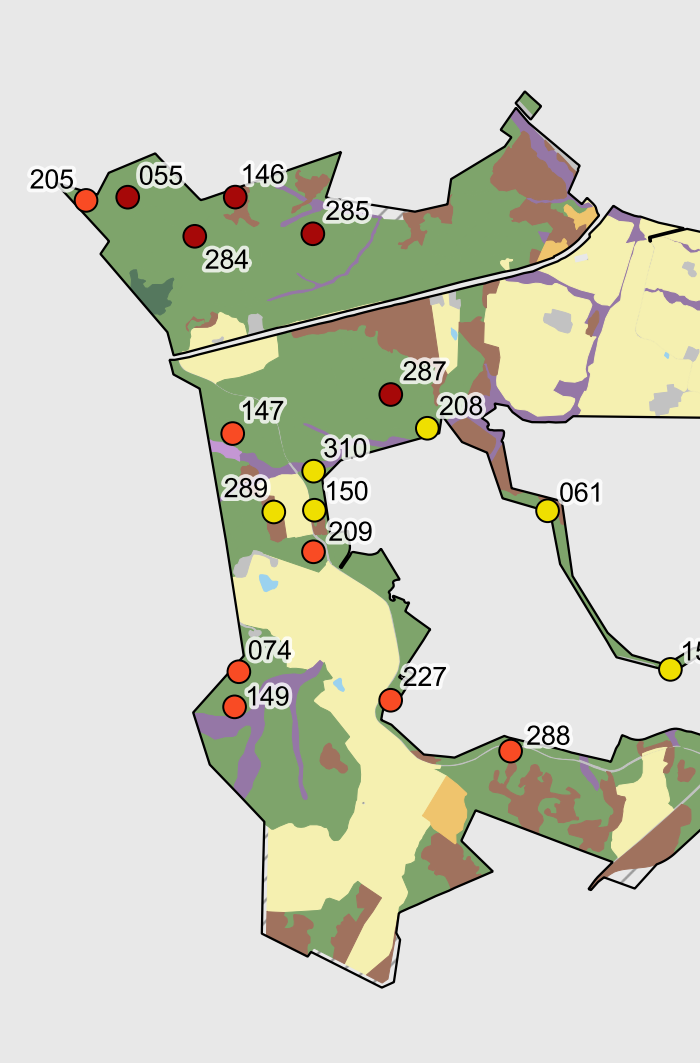


0 0.75 1.5 km

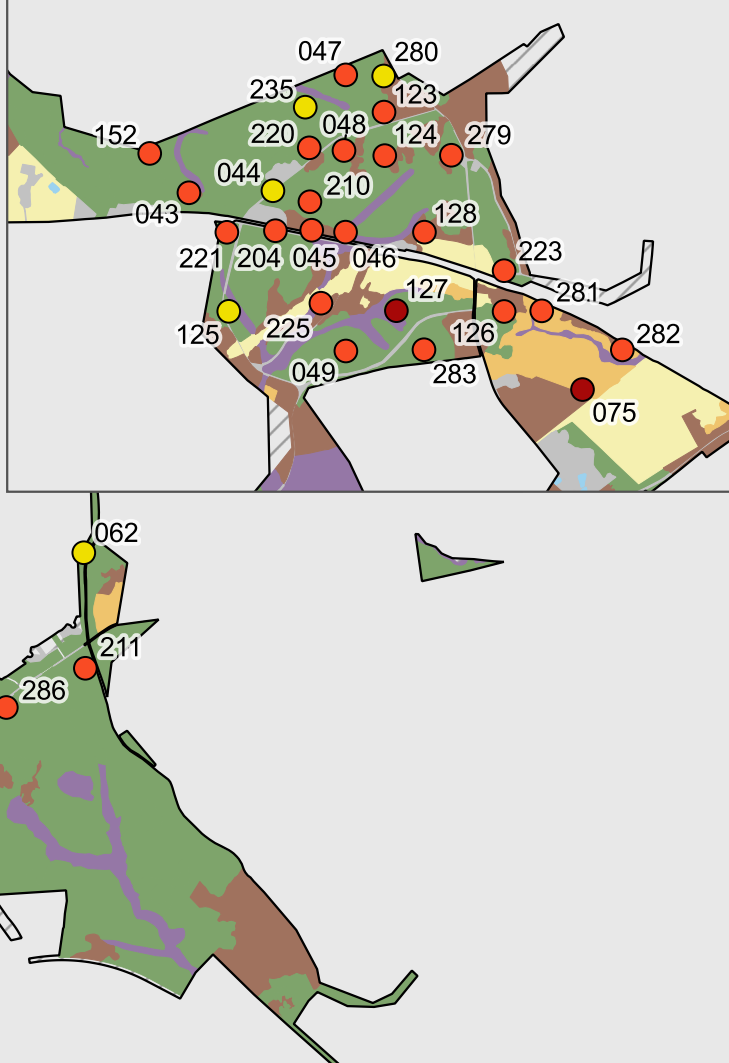
Deer browse index

- 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.

Wilderness Battlefield



Chancellorsville Battlefield



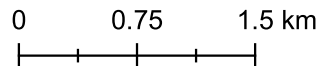
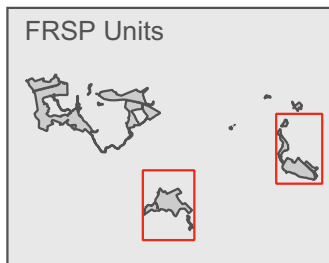


Map 4b. Index of Deer Browse Impacts

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.

Vegetation type

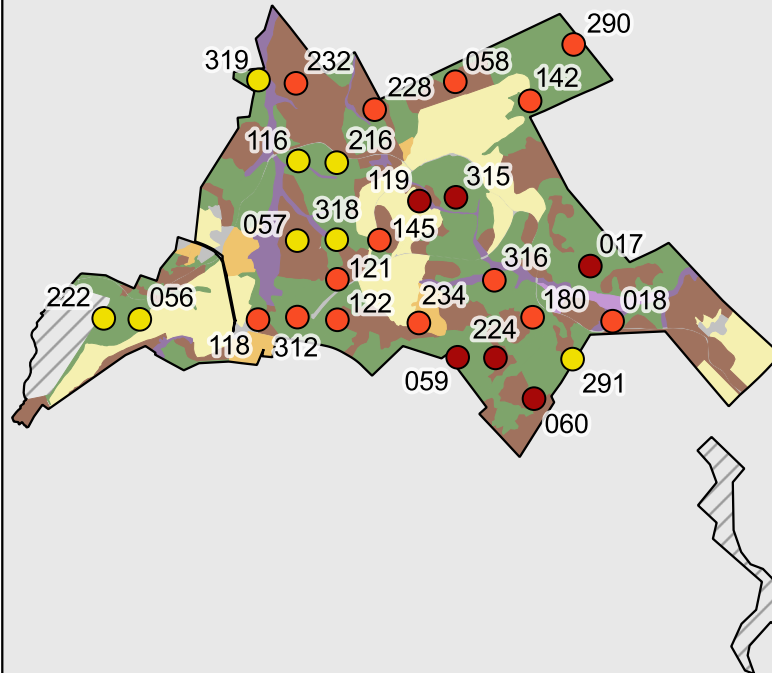
- Mixed forest
- Deciduous forest
- Conifer forest
- Conifer plantation
- Forested wetland
- Open wetland
- Shrubland
- Open field
- Water
- Developed land
- No vegetation data
- Park boundary



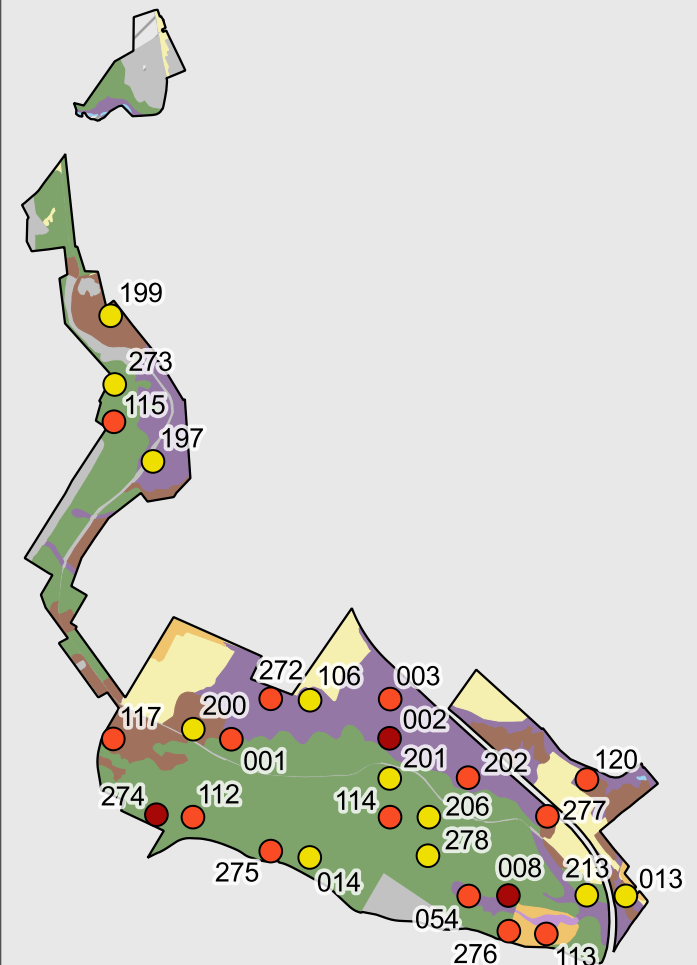
Deer browse index

- 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.

Spotsylvania Courthouse Battlefield



Fredericksburg Battlefield



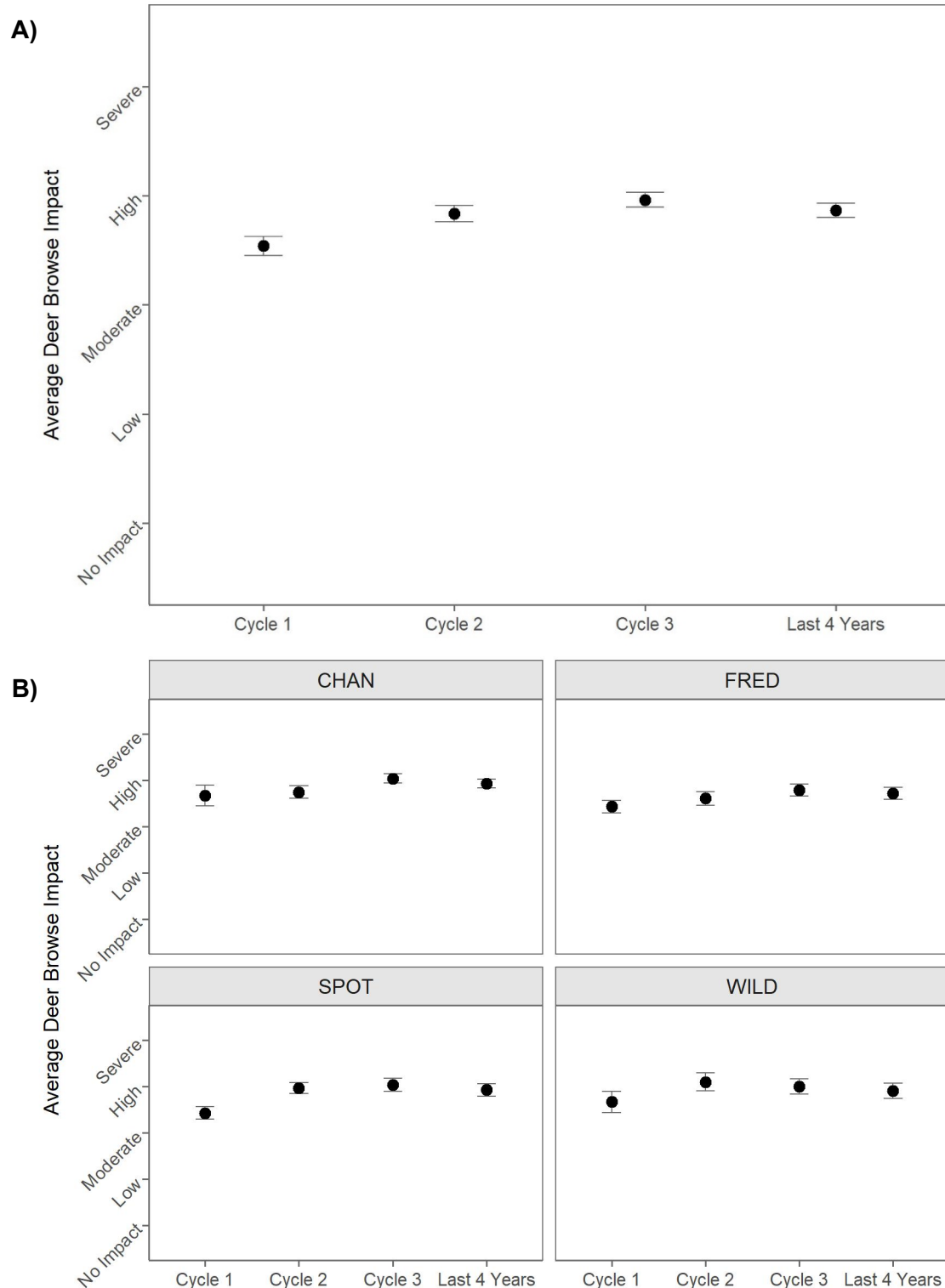


Figure 3. Average deer browse impact by cycle overall (A) and by unit (B), in Fredericksburg & Spotsylvania National Military Park. Deer browse impacts are assessed on a scale of 1 – 5, with 1 representing no impact and 5 representing severe impacts. Cycle 1 is 2009 – 2010, Cycle 2 is 2011 – 2014, Cycle 3 is 2015 – 2018, Last 4 Years is 2016 – 2019. DBI was not collected until 2009. Error bars are ± 1 SE.

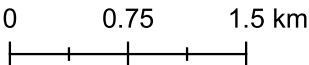
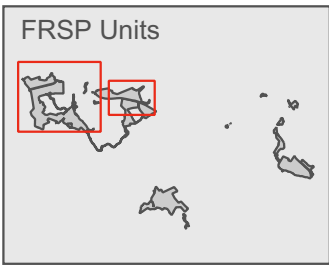


Map 5a. Tree Regeneration by Composition

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 7.3 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.

Vegetation type

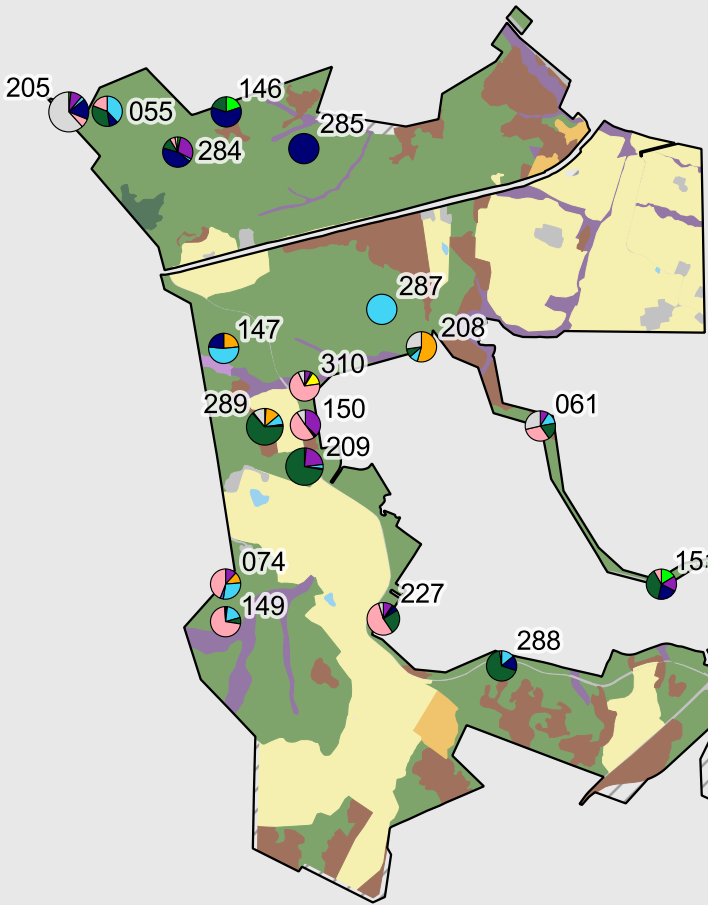
- Mixed forest
- Deciduous forest
- Conifer forest
- Conifer plantation
- Forested wetland
- Open wetland
- Shrubland
- Open field
- Water
- Developed land
- No vegetation data
- Park boundary



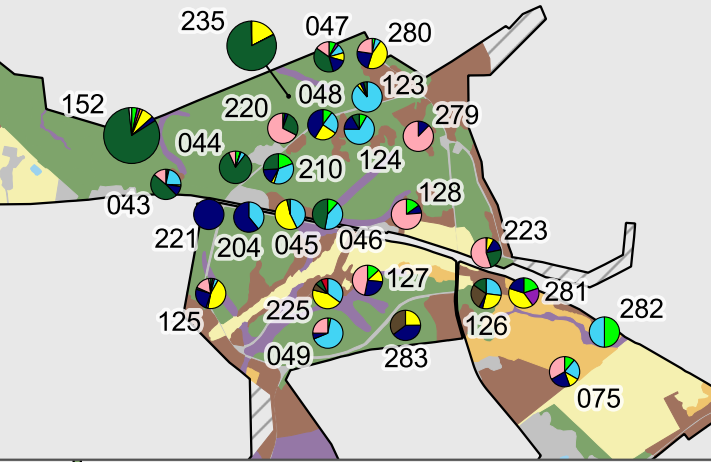
Species in pie charts

- Acer rubrum (Red maple)
- Carya spp. (Hickory)
- Fagus grandifolia (Beech)
- Ilex opaca (American holly)
- Liquidambar styraciflua (Sweetgum)
- Liriodendron tulipifera (Tuliptree)
- Nyssa sylvatica (Black tupelo)
- Pinus spp. (Pine)
- Quercus spp. (Oak)
- Exotic species
- Low canopy species
- Other native species

Wilderness Battlefield



Chancellorsville Battlefield



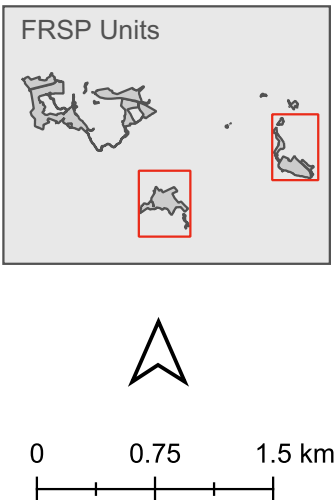


Map 5b. Tree Regeneration by Composition

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 7.3 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.

Vegetation type

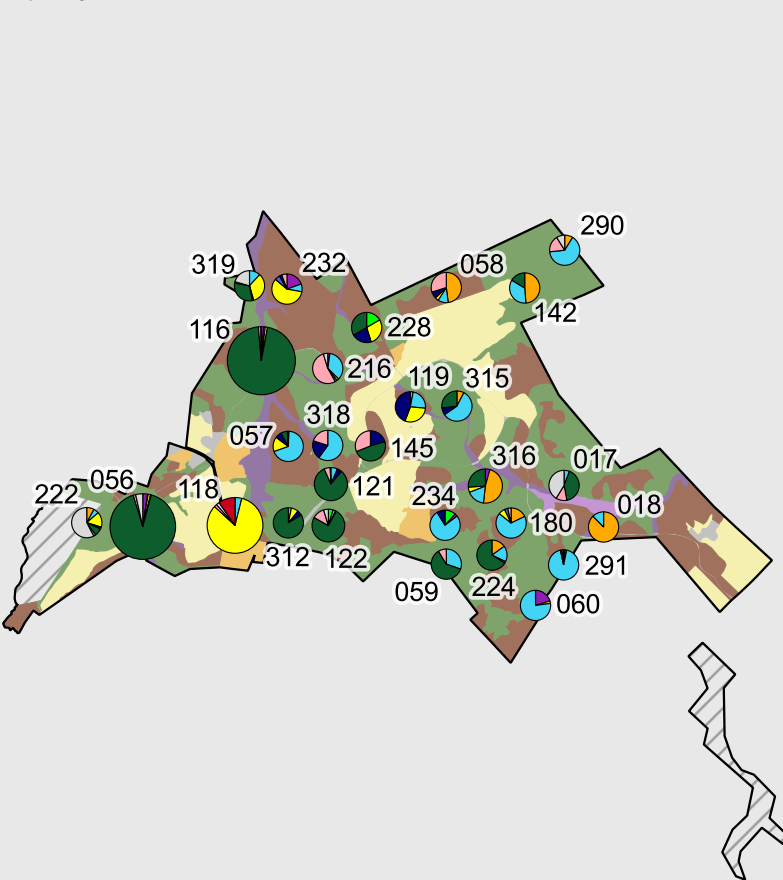
- Mixed forest
- Deciduous forest
- Conifer forest
- Conifer plantation
- Forested wetland
- Open wetland
- Shrubland
- Open field
- Water
- Developed land
- No vegetation data
- Park boundary



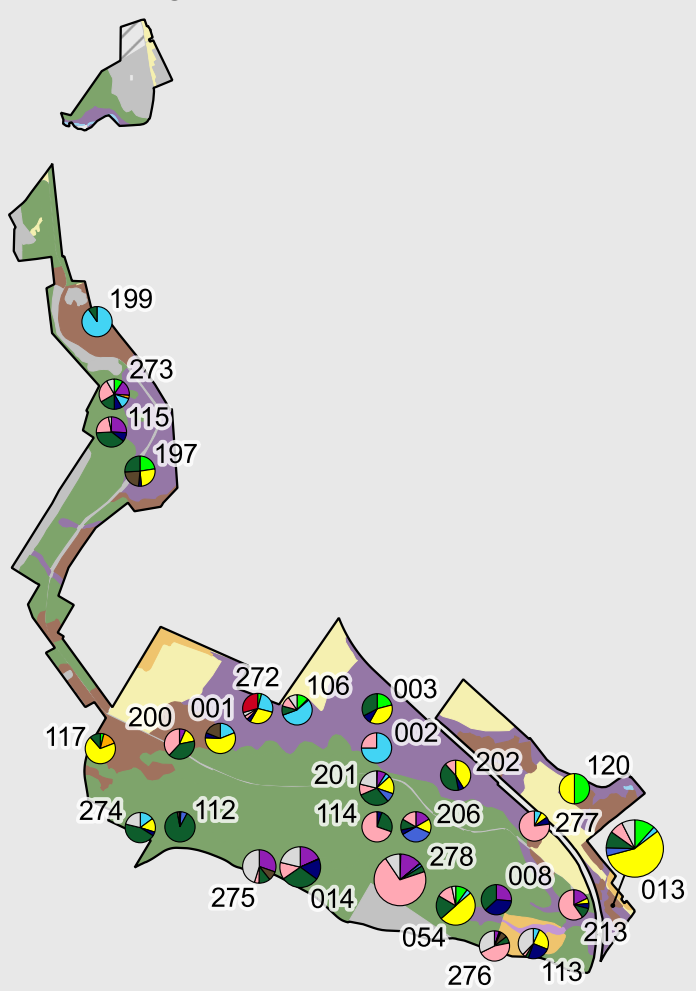
Species in pie charts

- Acer rubrum (Red maple)
- Carya spp. (Hickory)
- Fagus grandifolia (Beech)
- Ilex opaca (American holly)
- Liquidambar styraciflua (Sweetgum)
- Liriodendron tulipifera (Tuliptree)
- Nyssa sylvatica (Black tupelo)
- Pinus spp. (Pine)
- Quercus spp. (Oak)
- Exotic species
- Low canopy species
- Other native species

Spotsylvania Courthouse Battlefield



Fredericksburg Battlefield



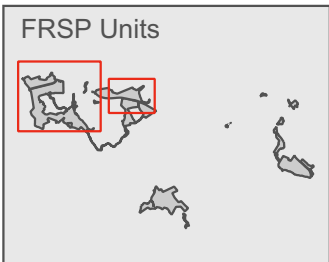


Map 6a. Tree Canopy Composition

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 42.6 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.

Vegetation type

- Mixed forest
- Deciduous forest
- Conifer forest
- Conifer plantation
- Forested wetland
- Open wetland
- Shrubland
- Open field
- Water
- Developed land
- No vegetation data
- Park boundary

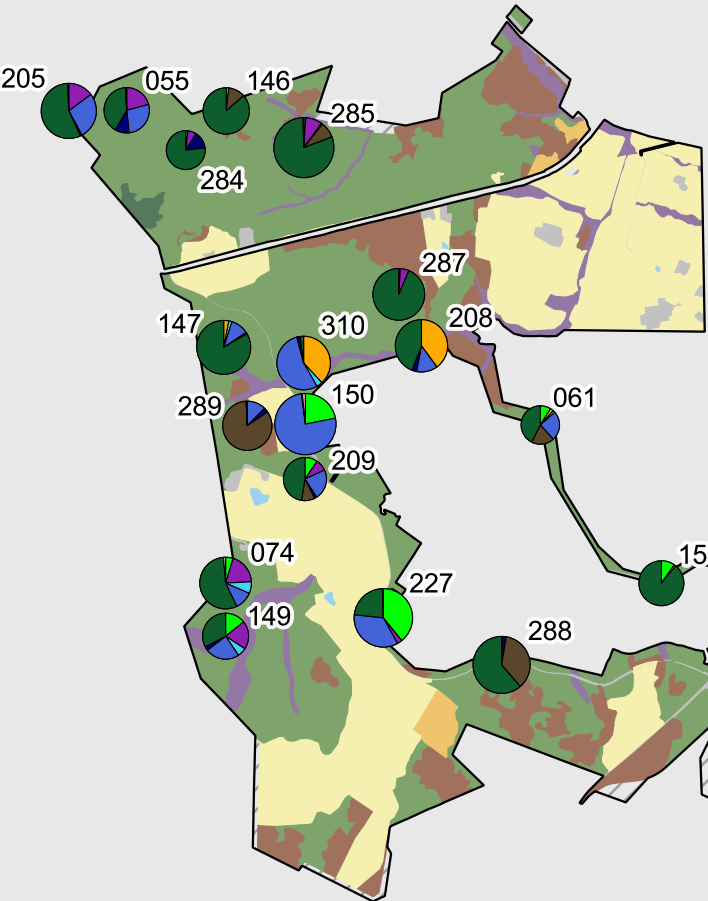


0 0.75 1.5 km

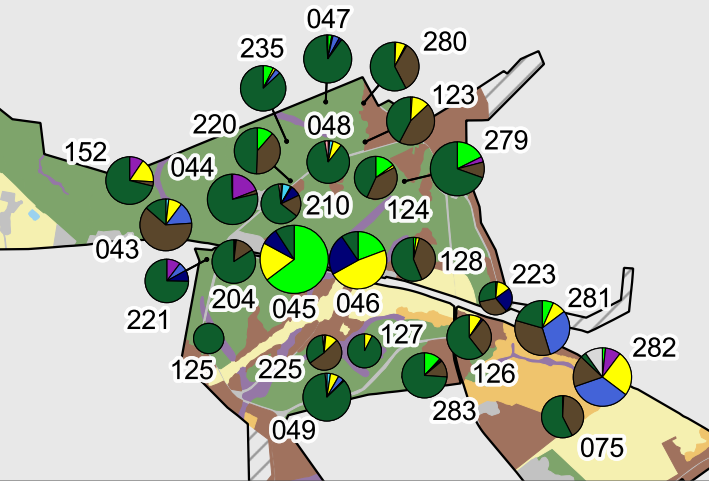
Species in pie charts

- Acer rubrum (Red maple)
- Ailanthus altissima (Tree-of-heaven)
- Carya spp. (Hickory)
- Fagus grandifolia (Beech)
- Ilex opaca (American holly)
- Liquidambar styraciflua (Sweetgum)
- Liriodendron tulipifera (Tuliptree)
- Nyssa sylvatica (Black tupelo)
- Pinus spp. (Pine)
- Quercus spp. (Oak)
- Low canopy species
- Other native species

Wilderness Battlefield



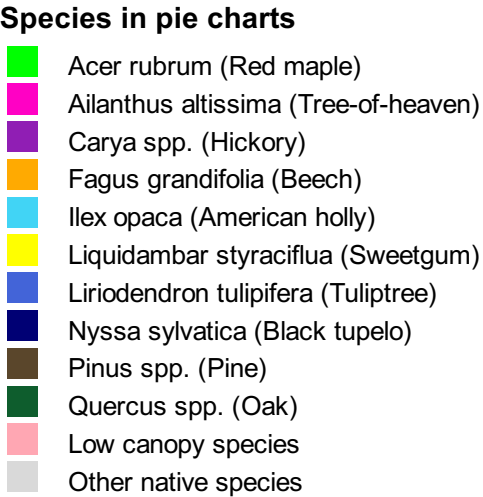
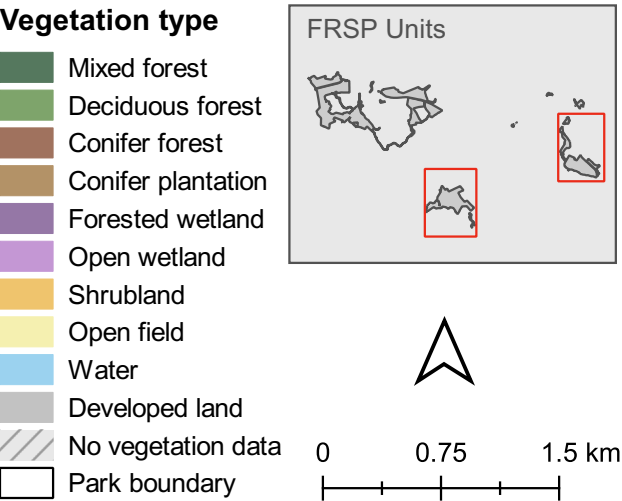
Chancellorsville Battlefield



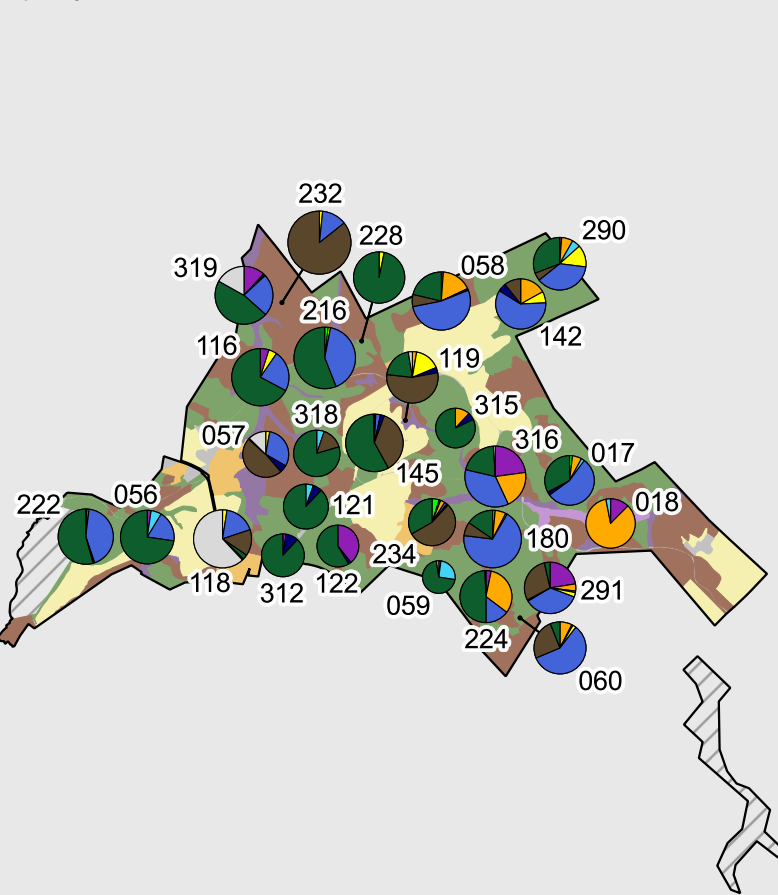


Map 6b. Tree Canopy Composition

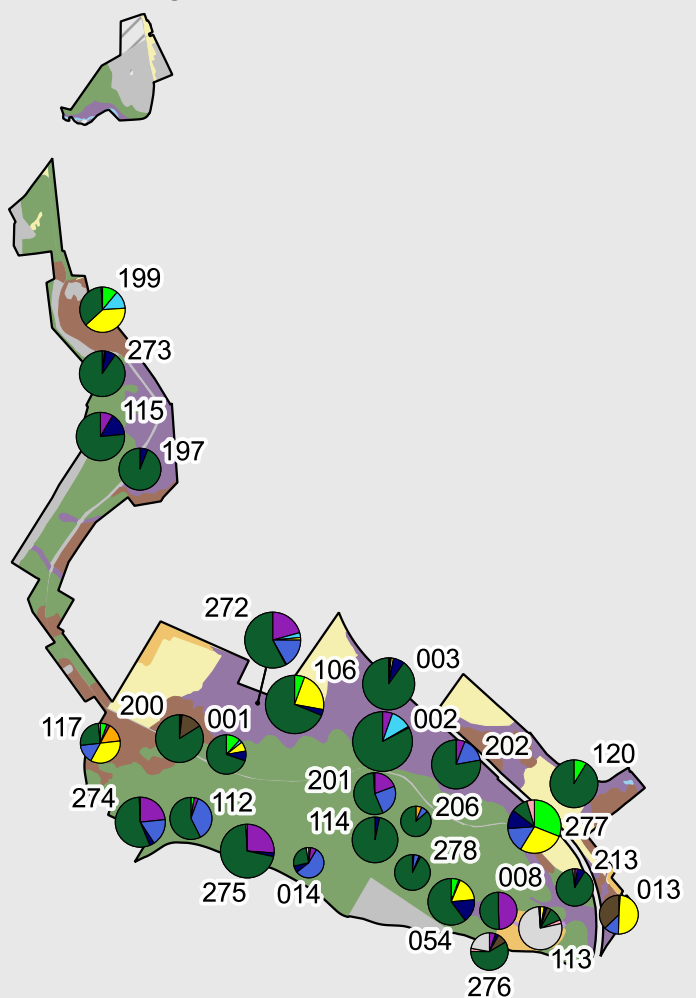
Live basal area by species group observed in forest plots sampled in the most recent survey cycle (2016 – 2019). Each plot is sampled on a 4-year cycle in a rotating panel, with one quarter of the plots sampled every year. Pie size is proportional to plot-level basal area. Pies may be shifted to prevent overlap. Basal areas range from 0 to 42.6 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.



Spotsylvania Courthouse Battlefield



Fredericksburg Battlefield



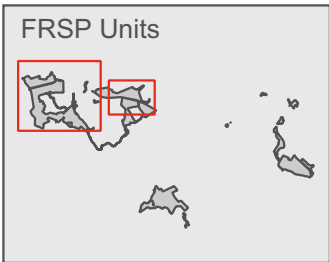


Map 7a. Invasive % Cover by Cycle

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 15.7%. 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.

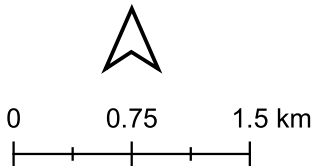
Vegetation type

- Mixed forest
- Deciduous forest
- Conifer forest
- Conifer plantation
- Forested wetland
- Open wetland
- Shrubland
- Open field
- Water
- Developed land
- No vegetation data
- Park boundary

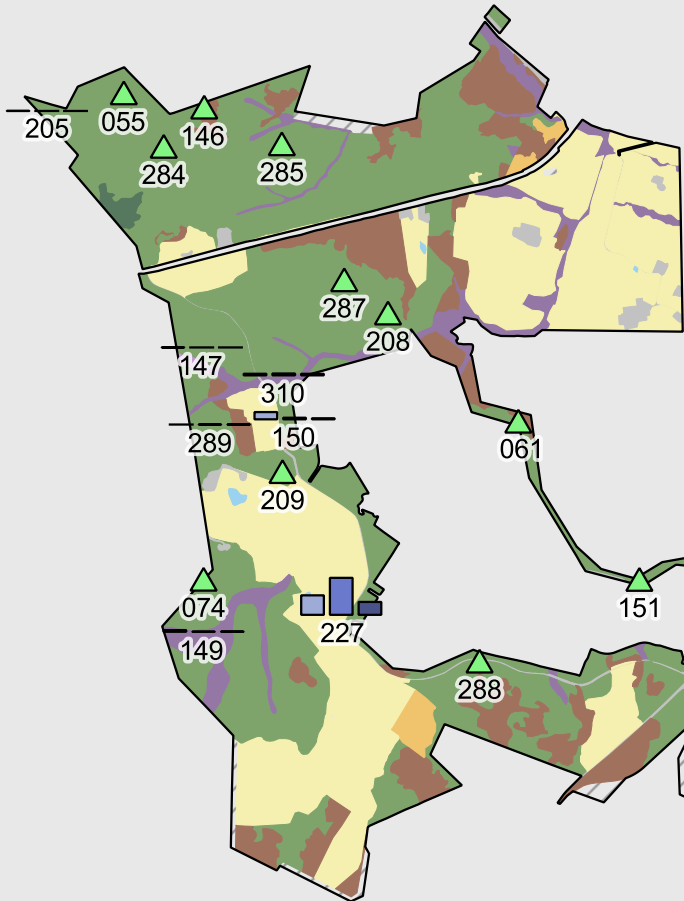


Invasive % cover

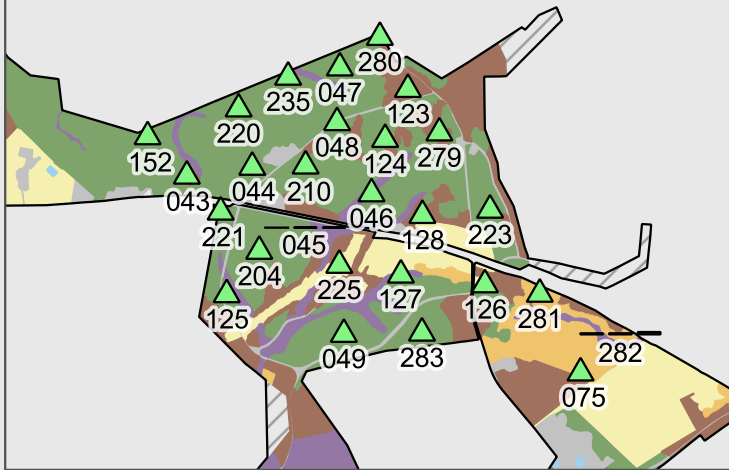
- Cycle 1: 2007 – 2010
- Cycle 2: 2011 – 2014
- Cycle 3: 2015 – 2018
- Cycle 4: 2019
- None present



Wilderness Battlefield



Chancellorsville Battlefield



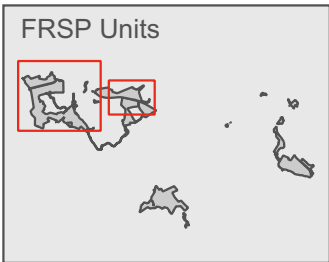


Map 7b. Invasive % Cover by Cycle

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 15.7%. 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.

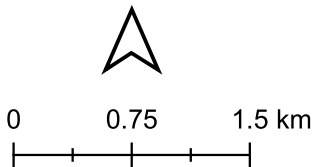
Vegetation type

- Mixed forest
- Deciduous forest
- Conifer forest
- Conifer plantation
- Forested wetland
- Open wetland
- Shrubland
- Open field
- Water
- Developed land
- No vegetation data
- Park boundary

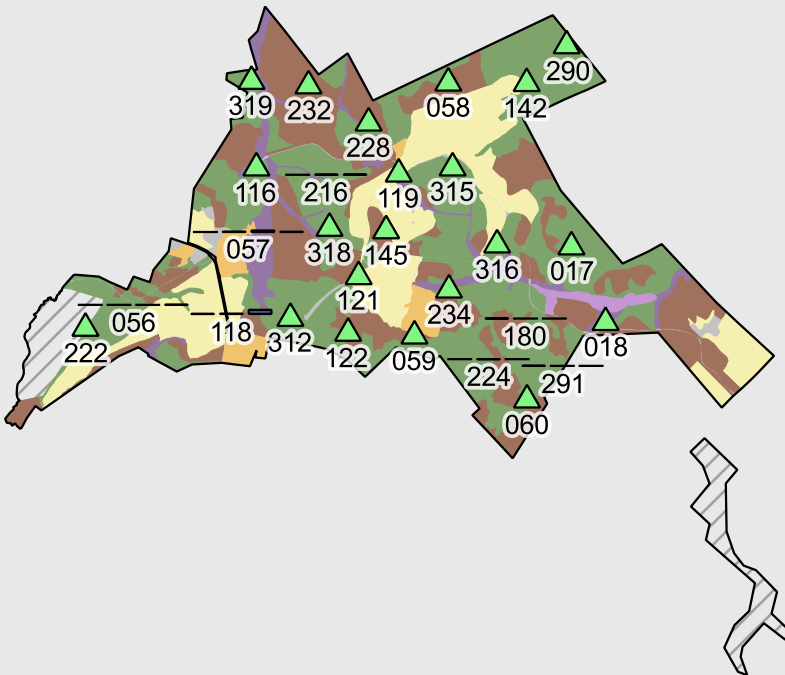


Invasive % cover

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



Spotsylvania Courthouse Battlefield



Fredericksburg Battlefield

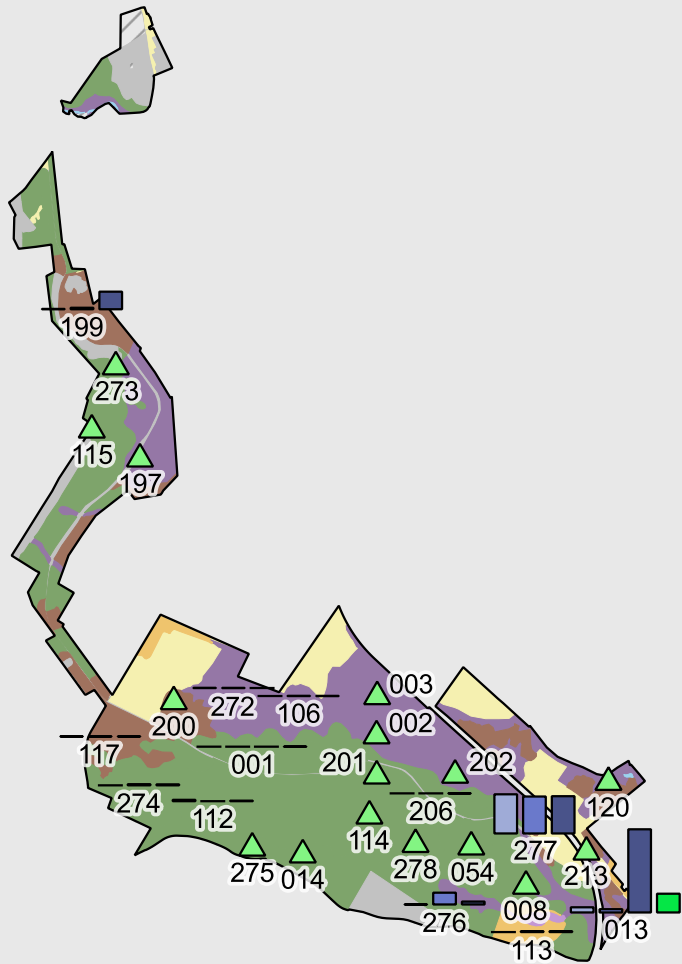


Table 2a. Average % cover of invasive species detected in each plot by cycle in Fredericksburg & Spotsylvania National Military Park (Chancellorsville and Wilderness Battlefield). Cycle 1 is 2007 – 2010, Cycle 2 is 2011 – 2014, Cycle 3 is 2015 – 2018. Note that only 1/4 of the plots have been sampled 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
043	0	0	0	0
044	0	0	0	0
045	0	< 0.1	< 0.1	0
046	0	0	0	0
047	0	0	0	0
048	0	0	0	0
049	0	0	0	0
055	0	0	0	0
061	0	0	0	0
062	0	0	0	0
074	0	0	0	0
075	0	0	0	0
123	0	0	0	-
124	0	0	0	-
125	0	0	0	-
126	0	0	0	-
127	0	0	0	-
128	0	0	0	-
146	0	0	0	-
147	< 0.1	0	0	-
149	0.3	< 0.1	< 0.1	-
150	1.4	0.3	0.2	-
151	0	0	0	-
152	0	0	0	-
204	0	0	0	-
205	< 0.1	0	0	-
208	0	0	0	-
209	0	0	0	-
210	0	0	0	-
211	0	0	0	-
220	0	0	0	-
221	0	0	0	-
223	0	0	0	-
225	0	0	0	-
227	3.7	7.0	2.4	-

Table 2a. (continued)

Plot	Average % cover			
	Cycle 1	Cycle 2	Cycle 3	Cycle 4
235	0	0	0	-
279	0	0	0	-
280	0	0	0	-
281	0	0	0	-
282	0.2	0.2	0.5	-
283	0	0	0	-
284	0	0	0	-
285	0	0	0	-
286	0	0	0	-
287	0	0	0	-
288	0	0	0	-
289	0	< 0.1	< 0.1	-
310	0.3	0.4	0.3	-

Table 2b. Average % cover of invasive species detected in each plot by cycle in Fredericksburg & Spotsylvania National Military Park (Fredericksburg Battlefield). 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
001	0	0	0	< 0.1
002	0	0	0	0
003	0	0	0	0
008	0	0	0	0
013	1.0	0.6	15.7	3.5
014	0	0	0	0
054	0	0	0	0
106	0	< 0.1	< 0.1	-
112	0.3	0	0.1	-
113	0	0.2	0.2	-
114	0	0	0	-
115	0	0	0	-
117	< 0.1	< 0.1	< 0.1	-
120	0	0	0	-
197	0	0	0	-
199	< 0.1	0.3	3.3	-
200	0	0	0	-
201	0	0	0	-
202	0	0	0	-
206	0	0	< 0.1	-
213	0	0	0	-
272	< 0.1	< 0.1	0	-
273	0	0	0	-
274	0	0.2	0.2	-
275	0	0	0	-
276	< 0.1	2.2	0.6	-
277	7.4	7.0	7.0	-
278	0	0	0	-

Table 2c. Average % cover of invasive species detected in each plot by cycle in Fredericksburg & Spotsylvania National Military Park (Spotsylvania Battlefield). 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
017	0	0	0	0
018	0	0	0	0
056	0	0	0	< 0.1
057	0	< 0.1	0.3	< 0.1
058	0	0	0	0
059	0	0	0	0
060	0	0	0	0
116	0	0	0	-
118	< 0.1	< 0.1	0.8	-
119	0	0	0	-
121	0	0	0	-
122	0	0	0	-
142	0	0	0	-
145	0	0	0	-
180	< 0.1	0	0	-
216	0	< 0.1	< 0.1	-
222	0	0	0	-
224	0	< 0.1	0	-
228	0	0	0	-
232	0	0	0	-
234	0	0	0	-
290	0	0	0	-
291	< 0.1	0	0	-
312	0	0	0	-
315	0	0	0	-
316	0	0	0	-
318	0	0	0	-
319	0	0	0	-

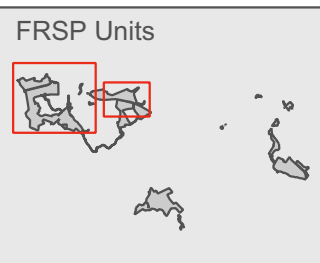


Map 8a. Invasive % Cover by Species

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 7.0% for an individual species. See Table 3 for more information. Reporting Date: 08/20/2020.

Vegetation type

- Mixed forest
- Deciduous forest
- Conifer forest
- Conifer plantation
- Forested wetland
- Open wetland
- Shrubland
- Open field
- Water
- Developed land
- No vegetation data
- Park boundary

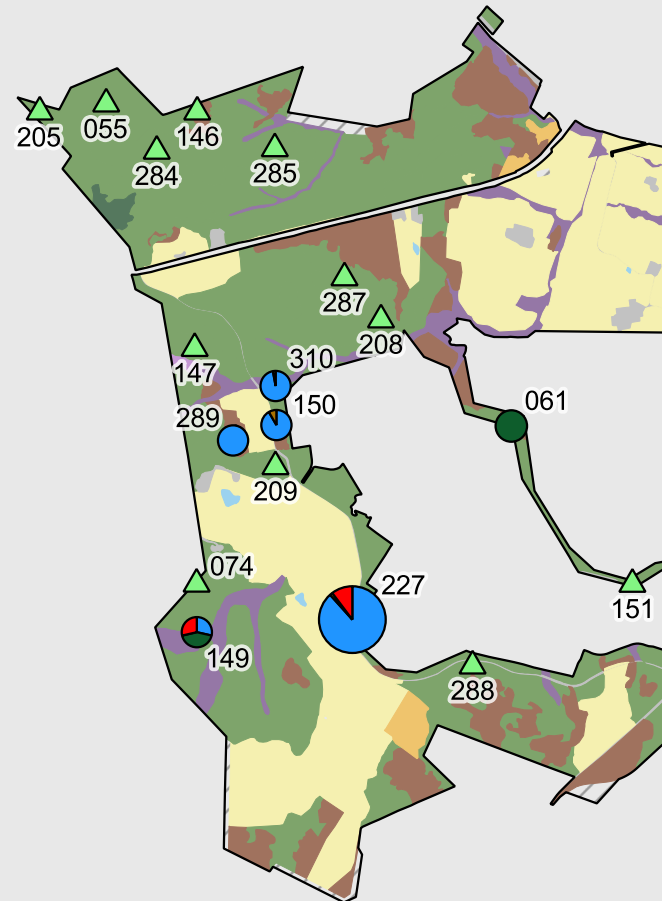


0 0.75 1.5 km

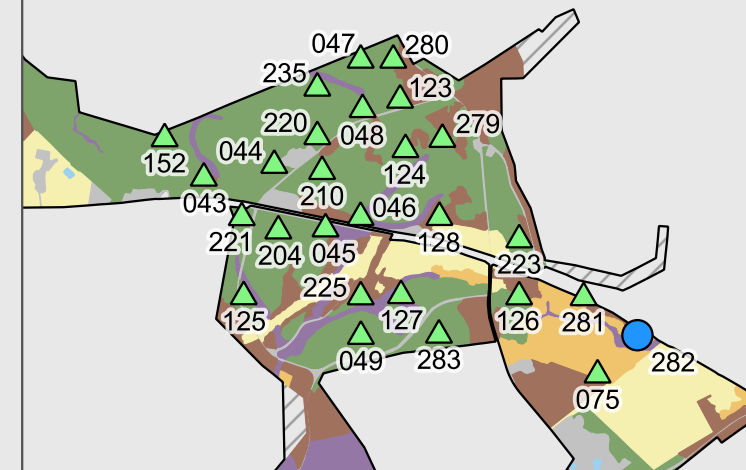
Species in pie charts

- Ailanthus altissima (Tree-of-heaven)
- Berberis thunbergii (Japanese barberry)
- Hedera helix (English ivy)
- Ligustrum spp. (Privet)
- Lonicera japonica (Japanese honeysuckle)
- Microstegium vimineum (Japanese stiltgrass)
- Morus alba (White mulberry)
- Rosa multiflora (Multiflora rose)
- Other exotic herbs
- Other invasive woody species
- None present

Wilderness Battlefield



Chancellorsville Battlefield



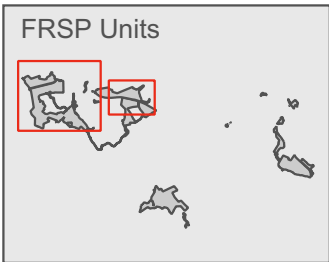


Map 8b. Invasive % Cover by Species

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 7.0% for an individual species. See Table 3 for more information. Reporting Date: 08/20/2020.

Vegetation type

- Mixed forest
- Deciduous forest
- Conifer forest
- Conifer plantation
- Forested wetland
- Open wetland
- Shrubland
- Open field
- Water
- Developed land
- No vegetation data
- Park boundary

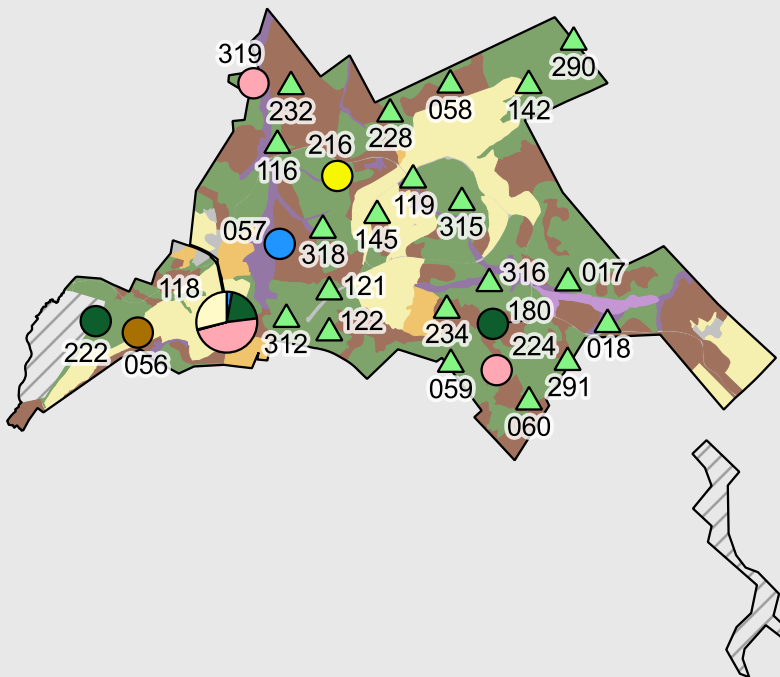


0 0.75 1.5 km

Species in pie charts

- Ailanthus altissima (Tree-of-heaven)
- Berberis thunbergii (Japanese barberry)
- Hedera helix (English ivy)
- Ligustrum spp. (Privet)
- Lonicera japonica (Japanese honeysuckle)
- Microstegium vimineum (Japanese stiltgrass)
- Morus alba (White mulberry)
- Rosa multiflora (Multiflora rose)
- Other exotic herbs
- Other invasive woody species
- None present

Spotsylvania Courthouse Battlefield



Fredericksburg Battlefield

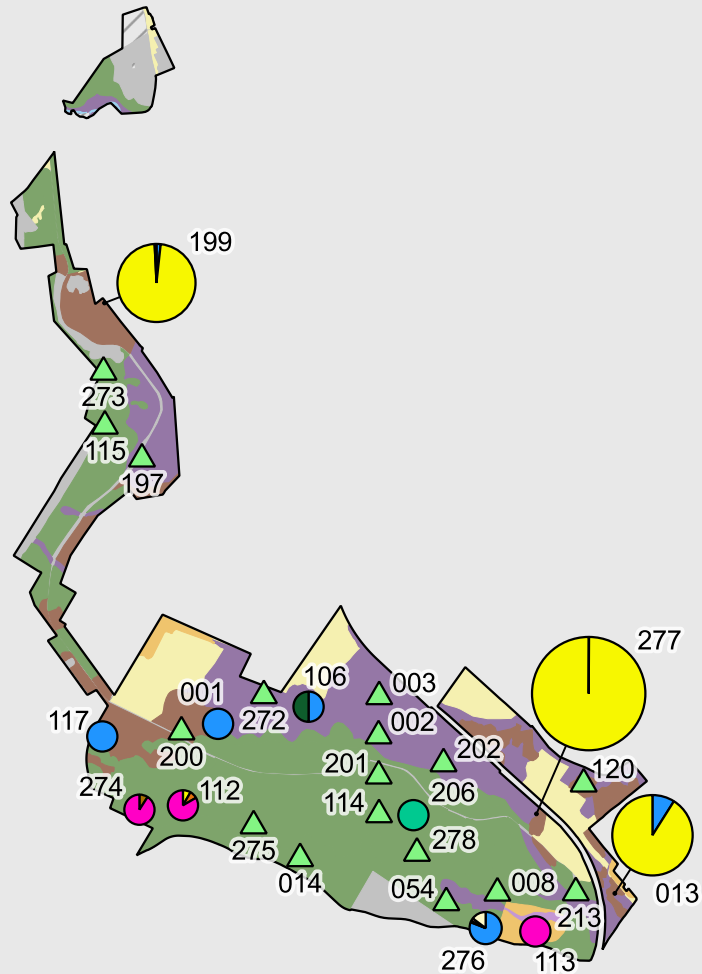


Table 3. Number of plots where invasive species were detected by cycle in Fredericksburg & Spotsylvania National Military Park. Cycle 1 is 2007 – 2010, Cycle 2 is 2011 – 2014, Cycle 3 is 2015 – 2018. Note that only 1/4 of the plots have been sampled for Cycle 4 in 2019. Note that not all species have 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	1	3	3	1
<i>Berberis thunbergii</i>	Japanese barberry	2007	2	1	5	0
<i>Celastrus orbiculatus</i>	Oriental bittersweet	2007	1	1	4	2
<i>Clematis terniflora</i>	Sweet autumn virginsbower	2007	1	0	0	0
<i>Dioscorea oppositifolia</i>	Chinese yam	2013	0	0	1	0
<i>Duchesnea indica</i> *	Mock strawberry	2007	6	0	6	0
<i>Elaeagnus</i> spp. ¹	Exotic olive	2019	0	1	1	0
<i>Euonymus alatus</i> ¹	Burningbush	2019	0	0	0	2
<i>Euonymus fortunei</i>	Climbing euonymus	2007	2	0	0	0
<i>Hedera helix</i>	English ivy	2007	1	0	4	0
<i>Lespedeza cuneata</i>	Chinese lespedeza	2007	1	3	1	2
<i>Ligustrum</i> spp.	Privet	2009	2	4	8	3
<i>Lonicera</i> spp. - Exotic	Exotic bush honeysuckle	2007	3	2	0	0
<i>Lonicera japonica</i>	Japanese honeysuckle	2007	12	22	26	3
<i>Microstegium vimineum</i>	Japanese stiltgrass	2007	2	7	12	4
<i>Morus alba</i>	White mulberry	2007	0	0	2	1
<i>Persicaria longiseta</i> *	Oriental lady's thumb	2009	1	2	3	3
<i>Persicaria perfoliata</i>	Mile-a-minute	2007	1	0	0	0
<i>Rosa multiflora</i>	Multiflora rose	2007	6	6	9	2
<i>Vinca minor</i> *	Lesser periwinkle	2007	0	1	1	0
Number of plots sampled	-	-	104	104	104	26

¹Species was added to the indicator list for quadrats in 2019, but has also been monitored in microplots since 2007.