

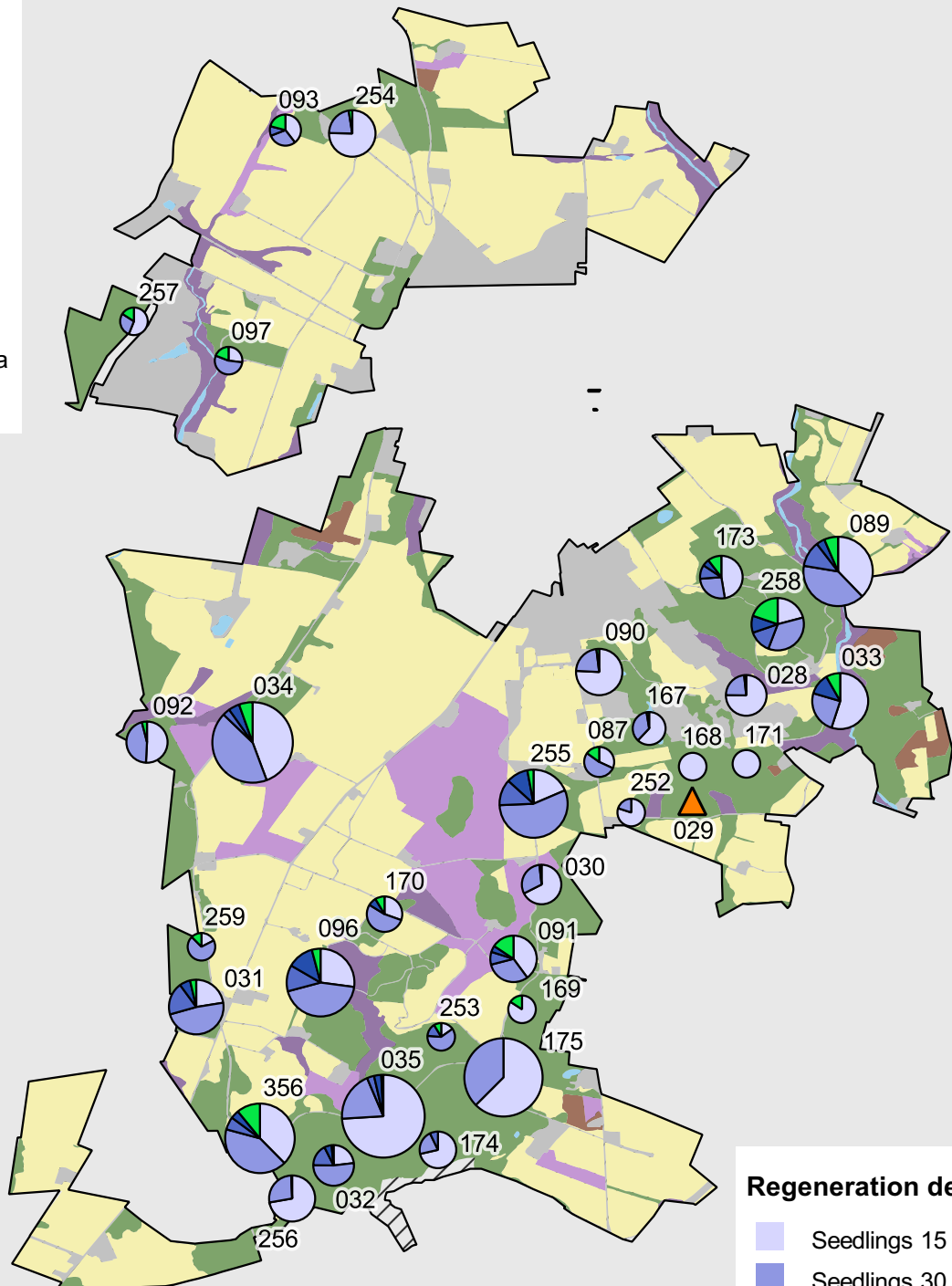


Map 1. Tree Regeneration by Size Class

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 4.4 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 types

- Deciduous forest
- Conifer forest
- Floodplain forest
- Open wetland
- Open field
- Open 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

0 0.5 1 km



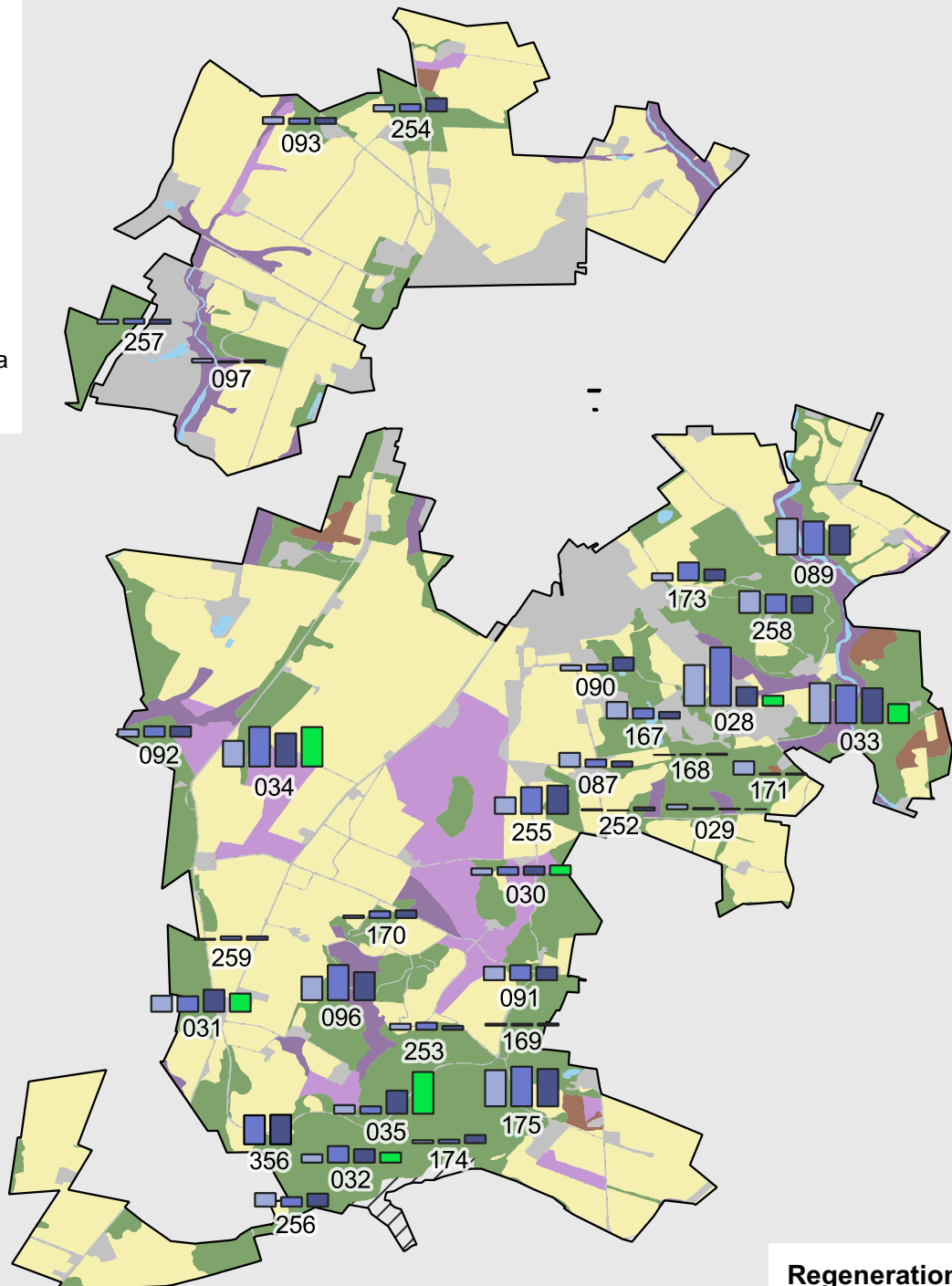


Map 2. Tree Regeneration by Cycle

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 8.4 stems/sq.m, and only include native canopy-forming species. Charts may be shifted to prevent overlap. Plot 356 was not established until 2012 and was not sampled in Cycle 1. Reporting Date: 08/20/2020.

Vegetation types

- Deciduous forest
- Conifer forest
- Floodplain forest
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Regeneration density

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

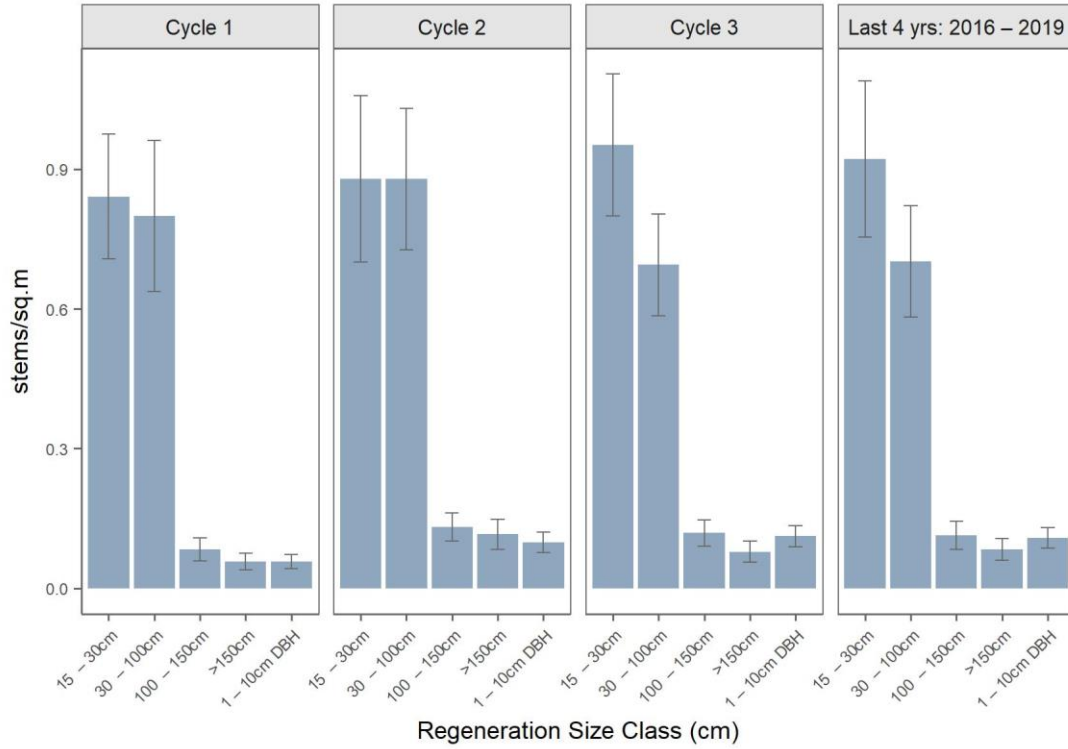
0 0.5 1 km



Table 1. Average plot-level seedling and sapling stem densities (stems/sq.m), and stocking index by cycle for Gettysburg National Military 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 356 was not established until 2012 and was not sampled in Cycle 1.

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
028	5.8	8.3	2.4	1.4	< 0.1	0.1	0.3	< 0.1	23.0	40.2	28.9	2.9
029	0.7	0.2	< 0.1	0	0	0	0	0	0.8	0.2	< 0.1	0
030	0.9	1.1	1.2	1.3	< 0.1	< 0.1	< 0.1	< 0.1	1.8	3.5	3.7	2.9
031	2.3	2.2	3.1	2.5	< 0.1	< 0.1	< 0.1	< 0.1	4.3	4.5	13.1	26.1
032	1.2	2.3	1.9	1.4	< 0.1	< 0.1	0	< 0.1	2.7	10.8	10.0	12.2
033	5.7	5.3	4.8	2.5	< 0.1	0.2	0.2	0.2	15.1	51.3	40.3	30.7
034	3.7	5.7	4.5	5.3	< 0.1	< 0.1	0.2	0.3	12.2	28.5	30.6	38.5
035	1.2	1.0	3.3	5.9	< 0.1	< 0.1	< 0.1	< 0.1	4.2	3.9	9.4	20.8
087	1.9	0.9	0.7	-	< 0.1	0.2	0.1	-	12.0	18.8	7.0	-
089	5.0	4.4	3.9	-	0.1	0.3	0.3	-	35.3	50.4	36.8	-
090	0.8	0.8	1.8	-	< 0.1	< 0.1	< 0.1	-	1.3	3.8	4.0	-
091	1.8	1.8	1.6	-	0.2	0.3	0.3	-	19.2	25.3	24.2	-
092	1.0	1.4	1.4	-	< 0.1	< 0.1	< 0.1	-	4.3	9.0	5.0	-
093	0.8	0.6	0.7	-	0.2	0.2	0.2	-	13.3	11.3	11.3	-
096	3.3	4.9	3.8	-	< 0.1	0.1	0.2	-	21.0	50.1	47.8	-
097	0.5	0.2	0.3	-	< 0.1	< 0.1	< 0.1	-	3.4	4.9	3.4	-
167	2.3	1.4	0.9	-	< 0.1	< 0.1	< 0.1	-	5.4	3.3	2.4	-
168	0	< 0.1	0.2	-	0	0	0	-	0	< 0.1	0.2	-
169	0.3	0.3	0.3	-	< 0.1	< 0.1	< 0.1	-	6.5	0.9	2.6	-
170	0.3	0.9	1.0	-	< 0.1	< 0.1	< 0.1	-	2.6	9.4	10.4	-
171	1.9	0.2	0.2	-	0	0	0	-	2.8	0.2	0.2	-
173	1.0	2.4	1.4	-	< 0.1	0.2	0.2	-	12.3	37.1	17.3	-
174	0.4	0.5	1.2	-	0	0	0	-	0.5	0.8	3.0	-
175	5.2	5.7	5.3	-	0	0	0	-	7.8	7.7	7.3	-
252	0.2	0	0.4	-	0	0	0	-	0.3	0	0.5	-
253	0.7	0.8	0.5	-	0.2	0.2	< 0.1	-	20.2	19.8	4.8	-
254	0.9	1.0	1.8	-	0	< 0.1	< 0.1	-	6.8	3.9	4.6	-
255	2.3	3.8	3.9	-	< 0.1	< 0.1	0.1	-	13.5	17.5	42.0	-
256	1.9	1.3	1.8	-	< 0.1	< 0.1	< 0.1	-	3.7	2.3	2.9	-
257	0.5	0.6	0.5	-	< 0.1	0.1	< 0.1	-	5.4	6.7	5.4	-
258	2.8	2.1	1.9	-	0.4	0.6	0.5	-	51.0	60.0	44.9	-
259	< 0.1	0.4	0.4	-	< 0.1	< 0.1	< 0.1	-	2.4	3.4	3.7	-
356	-	3.8	3.8	-	-	0.4	0.5	-	-	38.2	41.4	-

A)



B)

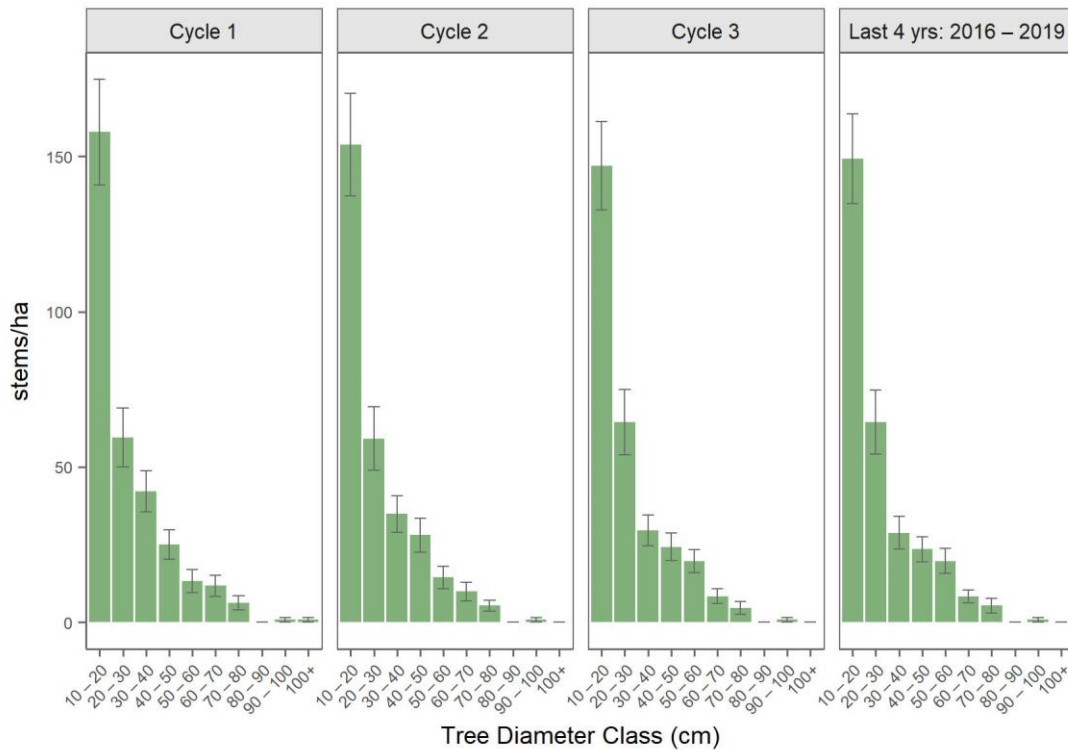
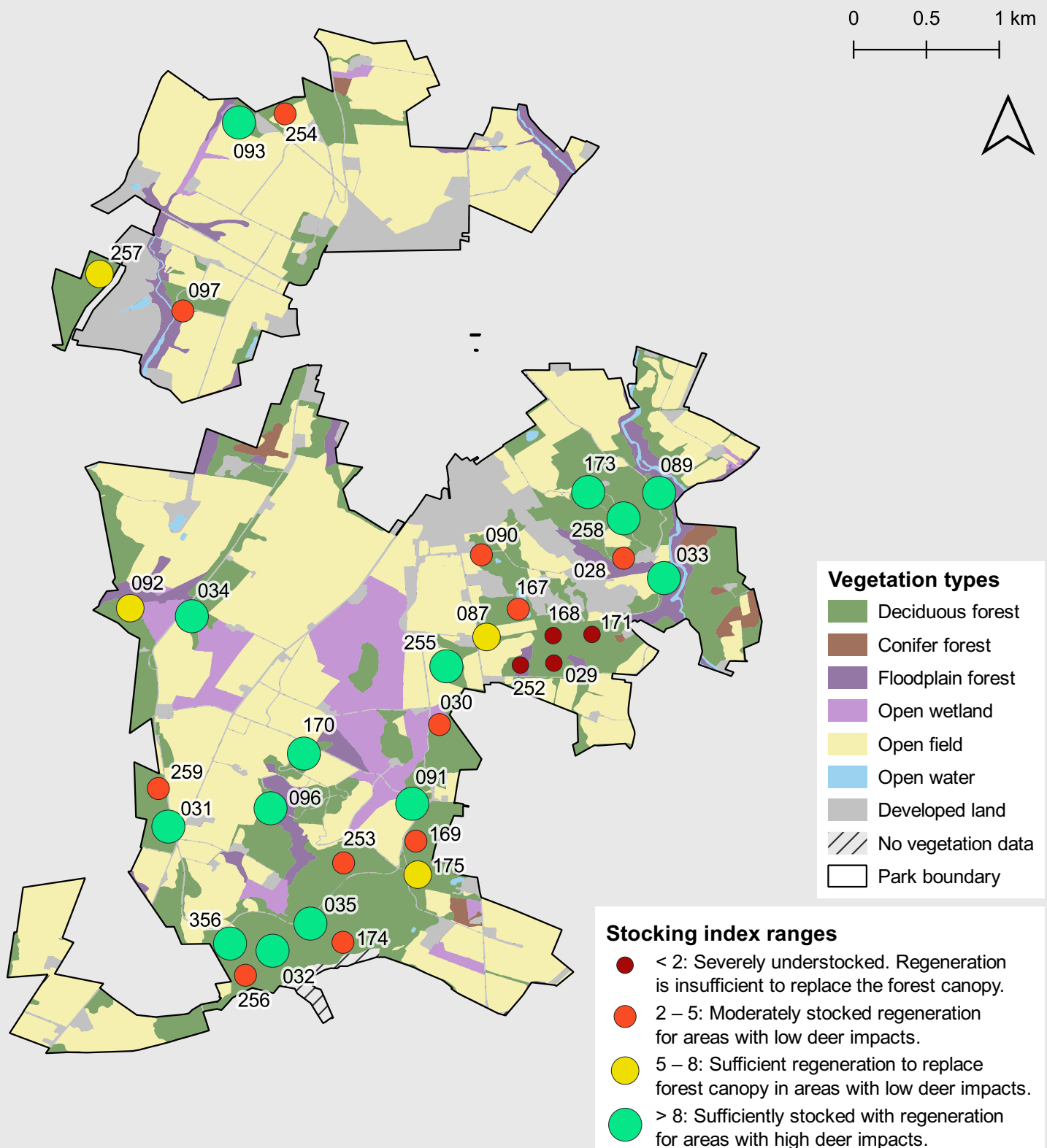


Figure 1. Stem density distributions for Gettysburg National Military Park. Figure A shows seedling and sapling densities by size class. Figure B shows tree density by diameter at breast height at 10 cm increments. Cycle 1 is 2007 – 2010, Cycle 2 is 2011 – 2014, Cycle 3 is 2015 – 2018. The last 4 years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



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 – 47.8). 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.



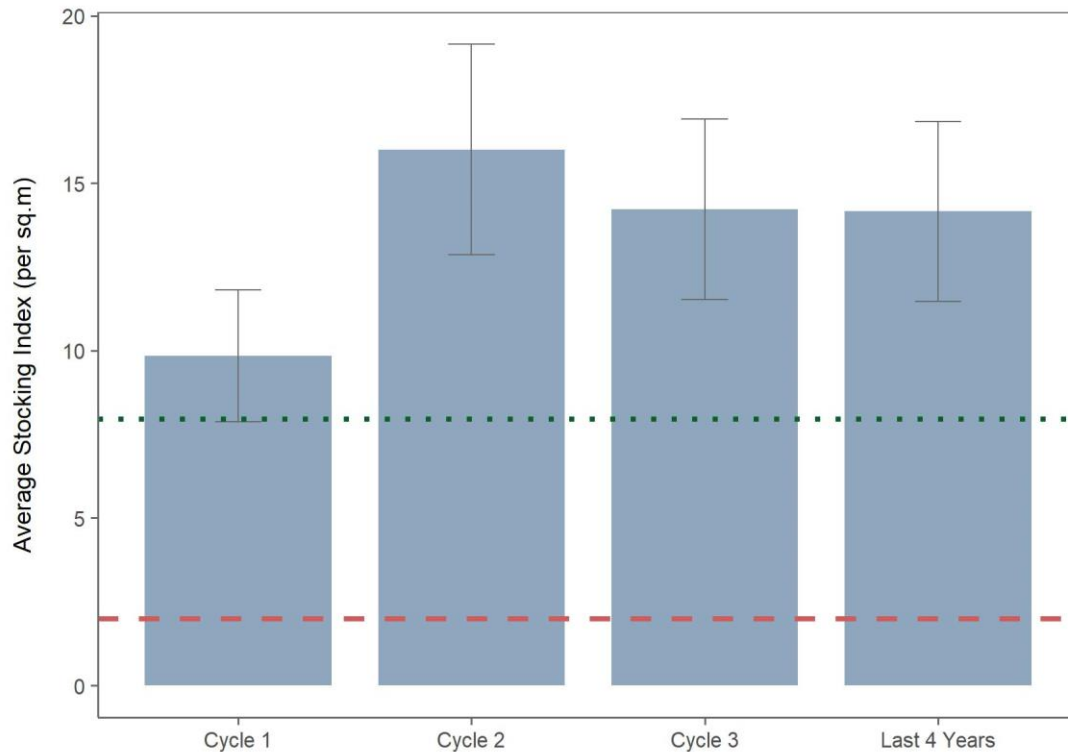


Figure 2. Regeneration stocking index averaged by cycle in Gettysburg National Military Park. The index is a weighted sum of seedling and sapling densities where larger seedling size classes get higher weights. The stocking index only includes native canopy-forming species (range: 0 – 60.0). Values below 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.

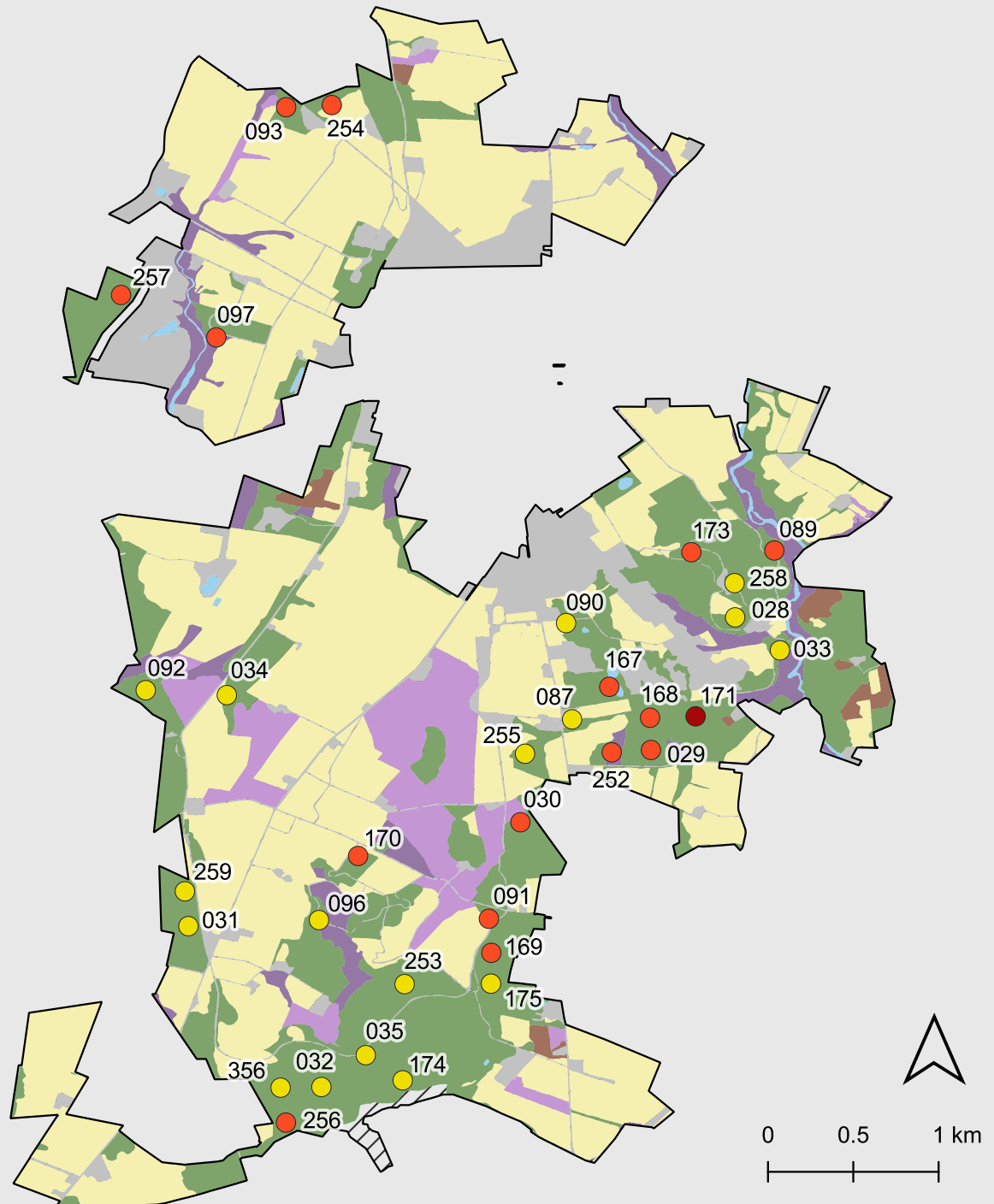


Map 4. Index of Deer Browse Impacts

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.

Vegetation types

- Deciduous forest
- Conifer forest
- Floodplain forest
- Open wetland
- Open field
- Open 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) Moderate impact: DP species present, but most < 30 cm tall. DP herbs present, but stunted, & 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) Severe impact: DP regeneration absent. Non-preferred species reduced by heavy browsing. Distinct deer browse line.

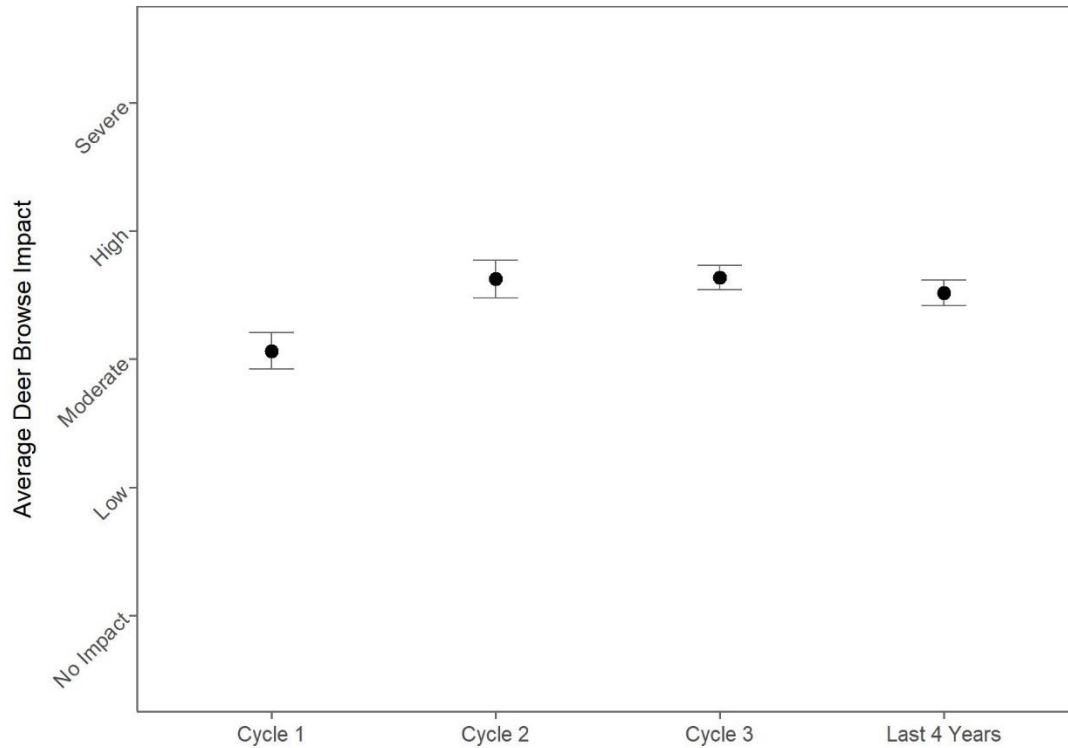


Figure 3. Average deer browse impact by cycle in Gettysburg National Military Park. Deer browse impacts are assessed on a scale of 1 – 5, with 1 representing no impact and 5 representing severe impacts. Cycle 1 is 2009 – 2010, Cycle 2 is 2011 – 2014, Cycle 3 is 2015 – 2018, Last 4 Years is 2016 – 2019. DBI was not collected until 2009. Error bars are ± 1 SE. Note that the average DBI calculation for Cycle 2 is missing data for one plot.

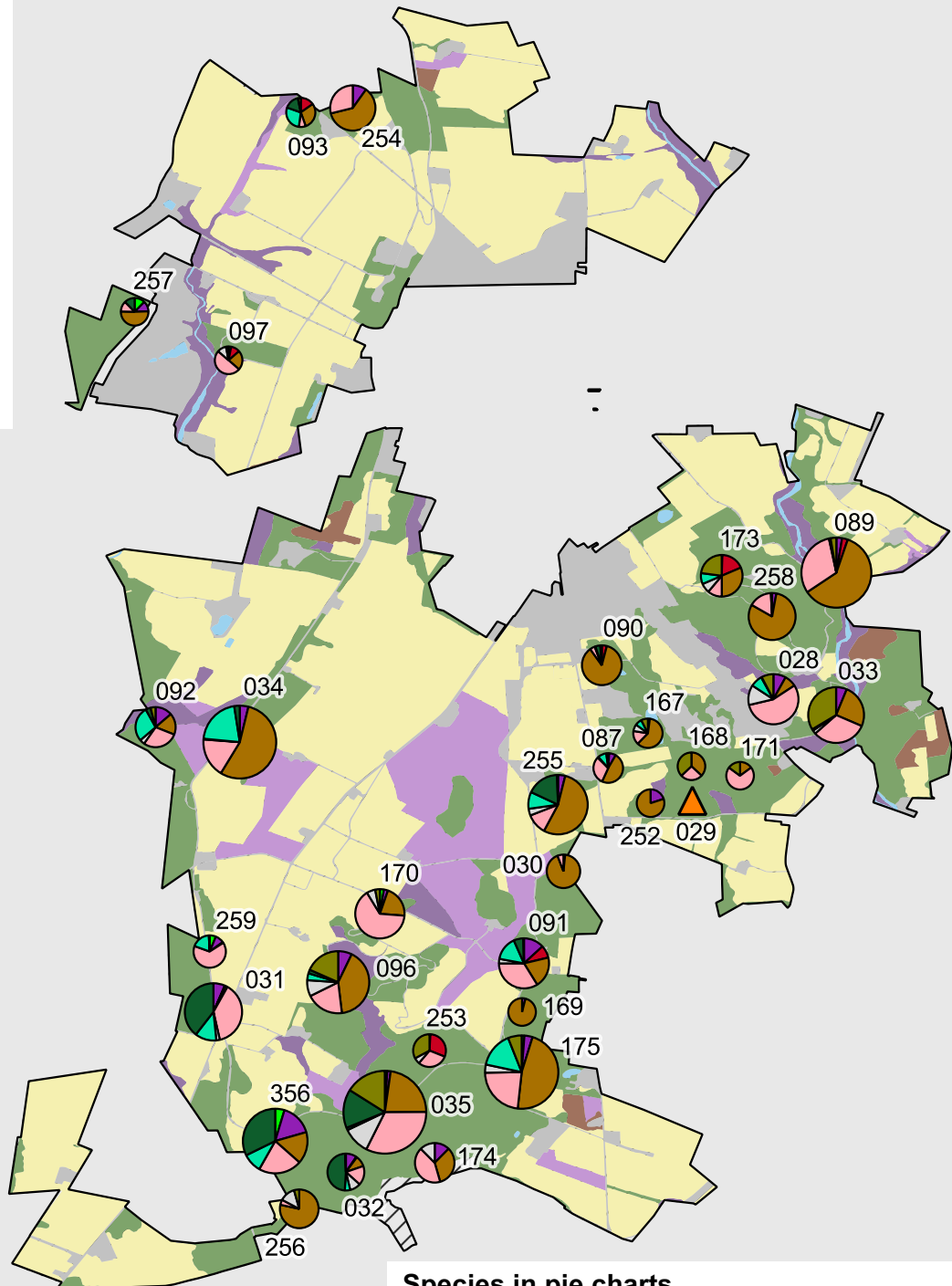


Map 5. Tree Regeneration by Composition

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 3.8 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 types

- Deciduous forest
- Conifer forest
- Floodplain forest
- Open wetland
- Open field
- Open water
- Developed land
- ▨ No vegetation data
- Park boundary



Species in pie charts

- | | |
|--|--|
| ■ Acer spp. (Maple) | ■ Ulmus spp. (Elm) |
| ■ Carya spp. (Hickory) | ■ Exotic species |
| ■ Fraxinus spp. (Ash) | ■ Low canopy species |
| ■ Prunus serotina (Black cherry) | ■ Other native species |
| ■ Quercus spp. (Oak) | ▲ None present |

0 0.5 1 km



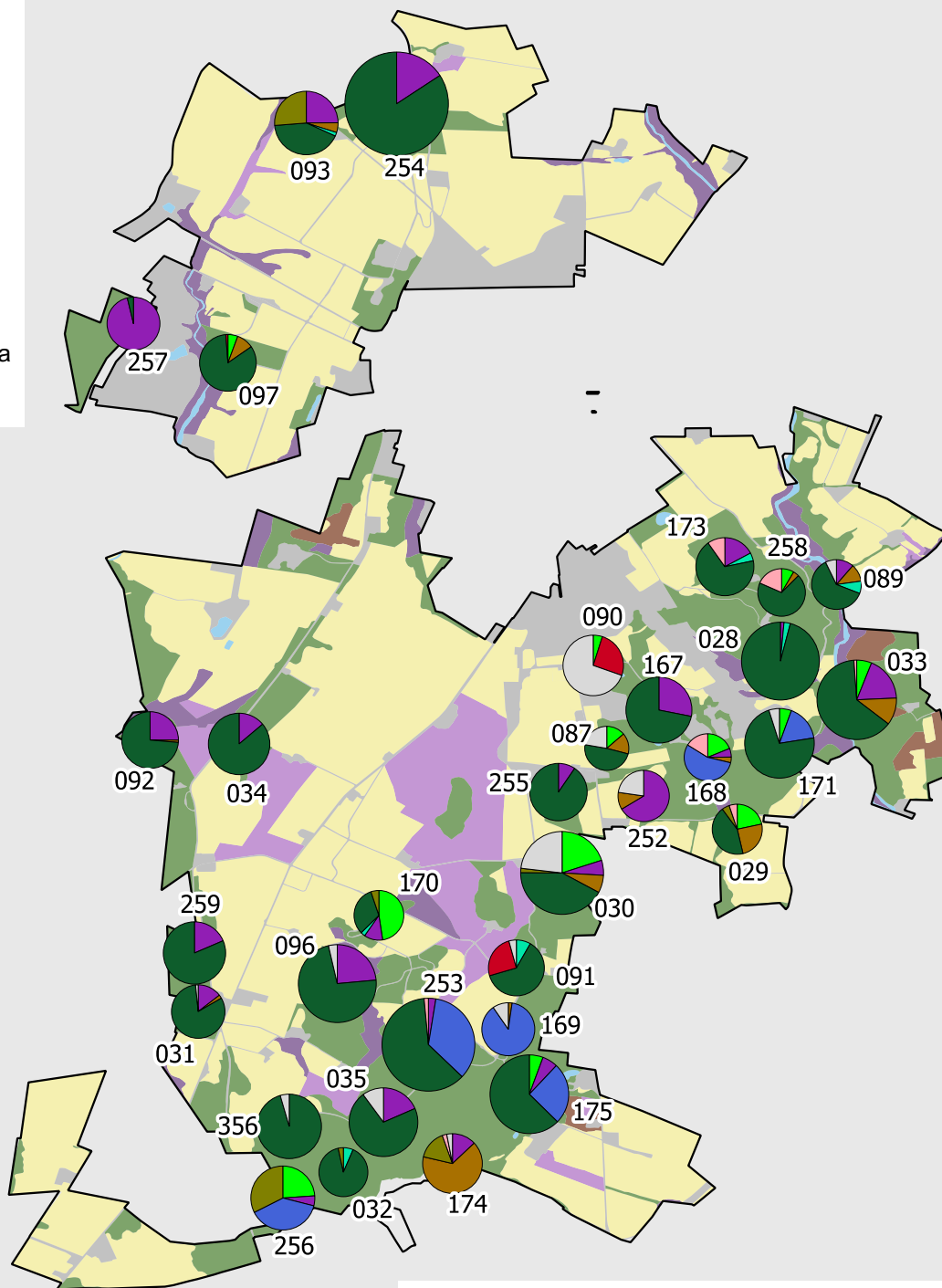


Map 6. Tree Canopy Composition

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 48.8 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 types

- Deciduous forest
- Conifer forest
- Floodplain forest
- Open wetland
- Open field
- Open water
- Developed land
- No vegetation data
- Park boundary



Species in pie charts

- | | |
|--|---|
| Acer spp. (Maple) | Quercus spp. (Oak) |
| Carya spp. (Hickory) | Ulmus spp. (Elm) |
| Fraxinus spp. (Ash) | Exotic species |
| Liriodendron tulipifera (Tuliptree) | Low canopy species |
| Prunus serotina (Black cherry) | Other native species |

0 0.5 1 km





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 75.9%. See Table 2 for % cover values. See Table 3 for a species list; only species monitored since 2007 were included in this metric. Plot 356 was not established until 2012 and was not sampled in Cycle 1. Reporting Date: 08/20/2020.

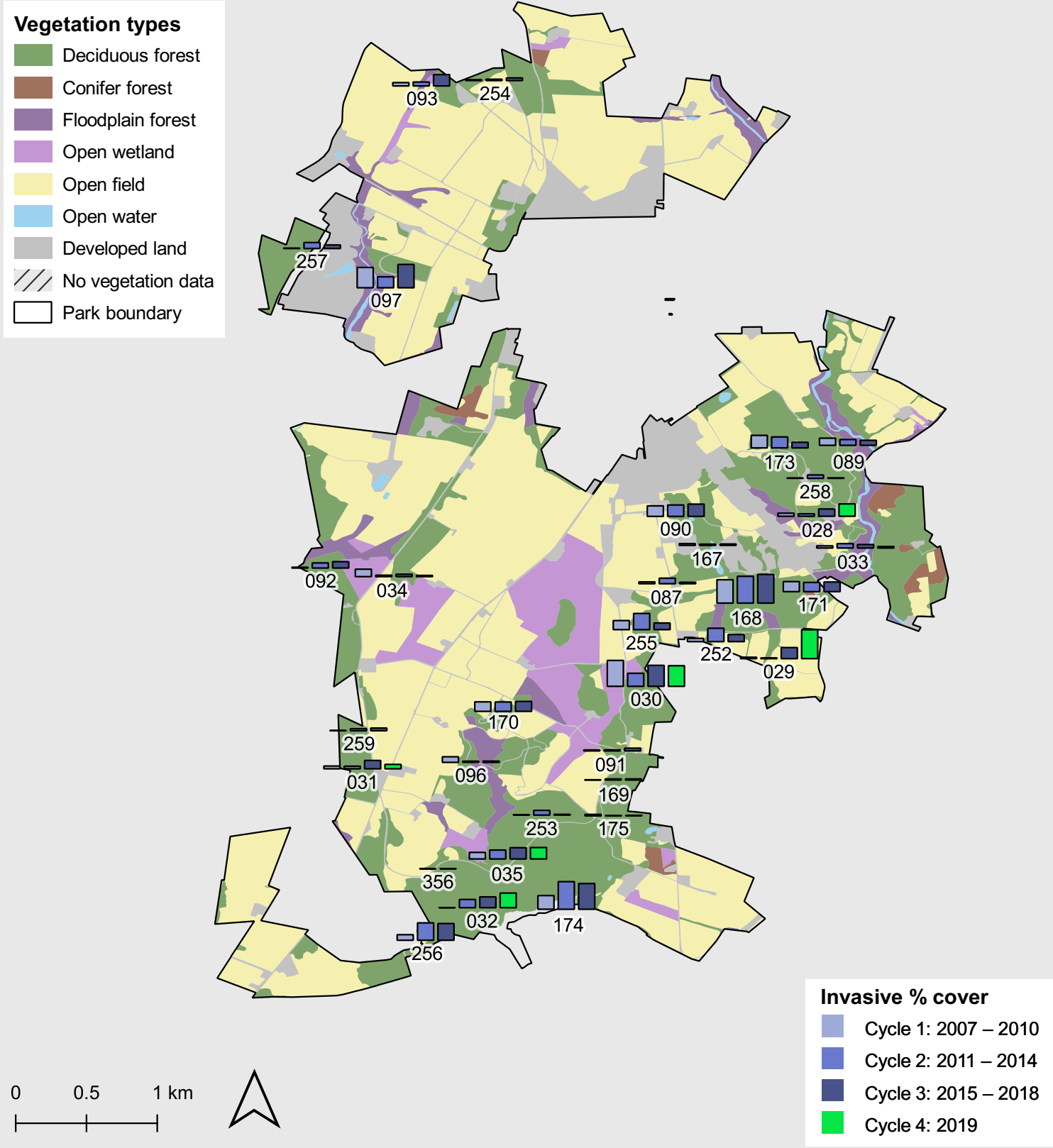


Table 2. Average % cover of invasive species detected in each plot by cycle in Gettysburg National Military Park. Cycle 1 is 2007 – 2010, Cycle 2 is 2011 – 2014, Cycle 3 is 2015 – 2018. Note that only 1/4 of the plots have been sampled for Cycle 4 in 2019. See Table 3 for a species list; only species monitored since 2007 were included in this metric. Plot 356 was not established until 2012 and was not sampled in Cycle 1.

Plot	Average % Cover			
	Cycle 1	Cycle 2	Cycle 3	Cycle 4
028	8.0	6.4	19.1	32.4
029	3.7	2.0	29.1	75.9
030	67.9	34.2	54.9	54.0
031	7.2	6.8	21.8	11.5
032	0.3	21.6	28.3	38.4
033	5.7	11.5	9.1	3.9
034	19.5	3.7	6.3	3.2
035	17.2	23.4	29.5	30.0
087	4.8	14.5	3.8	-
089	18.7	15.1	13.1	-
090	27.6	29.9	32.2	-
091	2.5	2.7	7.2	-
092	2.1	13.4	16.7	-
093	8.8	10.3	29.7	-
096	14.6	3.0	3.3	-
097	53.2	28.7	61.1	-
167	4.5	3.1	3.6	-
168	61.3	70.3	75.3	-
169	0.7	2.9	2.9	-
170	24.9	24.6	26.0	-
171	26.3	24.1	25.2	-
173	32.9	28.7	14.7	-
174	35.9	72.4	67.5	-
175	3.9	0.5	1.1	-
252	8.5	35.1	18.5	-
253	1.0	12.3	1.9	-
254	2.2	3.5	6.9	-
255	23.8	42.5	17.4	-
256	14.6	45.5	43.8	-
257	1.0	15.7	9.3	-
258	1.0	8.8	1.2	-
259	0.8	5.4	7.1	-
356	-	< 0.1	0.2	-



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 74.9% for an individual species. See Table 3 for more information. Reporting Date: 08/20/2020.

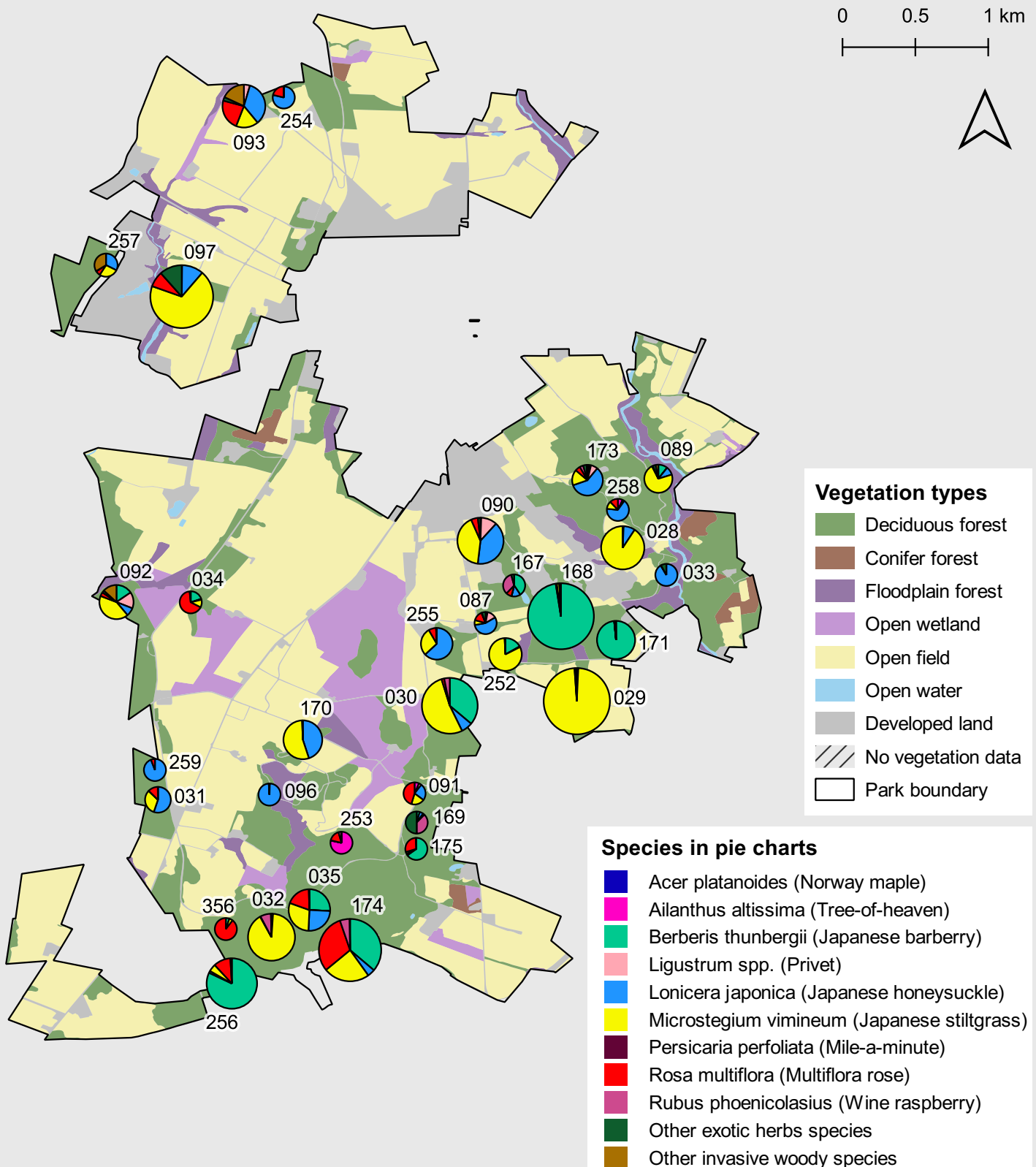


Table 3. Number of plots where invasive species were detected by cycle in Gettysburg National Military Park. Cycle 1 is 2007 – 2010, Cycle 2 is 2011 – 2014, Cycle 3 is 2015 – 2018. Note that only 1/4 of the plots have been sampled for Cycle 4 in 2019. Note that not all species have been monitored for 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>Acer platanoides</i>	Norway maple	2007	4	3	3	1
<i>Ailanthus altissima</i>	Tree-of-heaven	2007	3	6	6	2
<i>Albizia julibrissin</i>	Silktree	2007	0	0	0	2
<i>Alliaria petiolata</i>	Garlic mustard	2007	15	15	20	5
<i>Berberis thunbergii</i>	Japanese barberry	2007	17	24	26	8
<i>Berberis vulgaris</i> ¹	Common barberry	2019	0	1	0	0
<i>Celastrus orbiculatus</i>	Oriental bittersweet	2007	1	2	5	3
<i>Cirsium arvense</i> *	Californian thistle	2007	1	0	1	0
<i>Dioscorea oppositifolia</i>	Chinese yam	2013	0	0	1	0
<i>Duchesnea indica</i> *	Mock strawberry	2007	7	8	6	0
<i>Elaeagnus</i> spp. ¹	Exotic olive	2019	3	5	9	4
<i>Euonymus fortunei</i>	Climbing euonymus	2007	0	1	0	0
<i>Glechoma hederacea</i> *	Ground ivy	2007	0	0	1	0
<i>Ligustrum</i> spp.	Privet	2009	3	17	15	4
<i>Lonicera</i> spp.- Exotic	Exotic bush honeysuckle	2007	6	9	17	3
<i>Lonicera japonica</i>	Japanese honeysuckle	2007	29	31	31	8
<i>Lonicera maackii</i>	Amur honeysuckle	2007	0	1	1	1
<i>Microstegium vimineum</i>	Japanese stiltgrass	2007	25	26	32	8
<i>Morus alba</i>	White mulberry	2007	1	1	1	3
<i>Persicaria longiseta</i> *	Oriental lady's thumb	2009	7	12	21	4
<i>Persicaria perfoliata</i>	Mile-a-minute	2007	0	1	2	4
<i>Prunus avium</i> *	Sweet cherry	2007	2	0	0	0
<i>Ranunculus ficaria</i>	Fig buttercup	2007	1	0	0	0
<i>Rosa multiflora</i>	Multiflora rose	2007	26	32	31	8
<i>Rubus phoenicolasius</i>	Wine raspberry	2007	9	16	14	6
Number of plots sampled	-	-	32	33	33	8

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