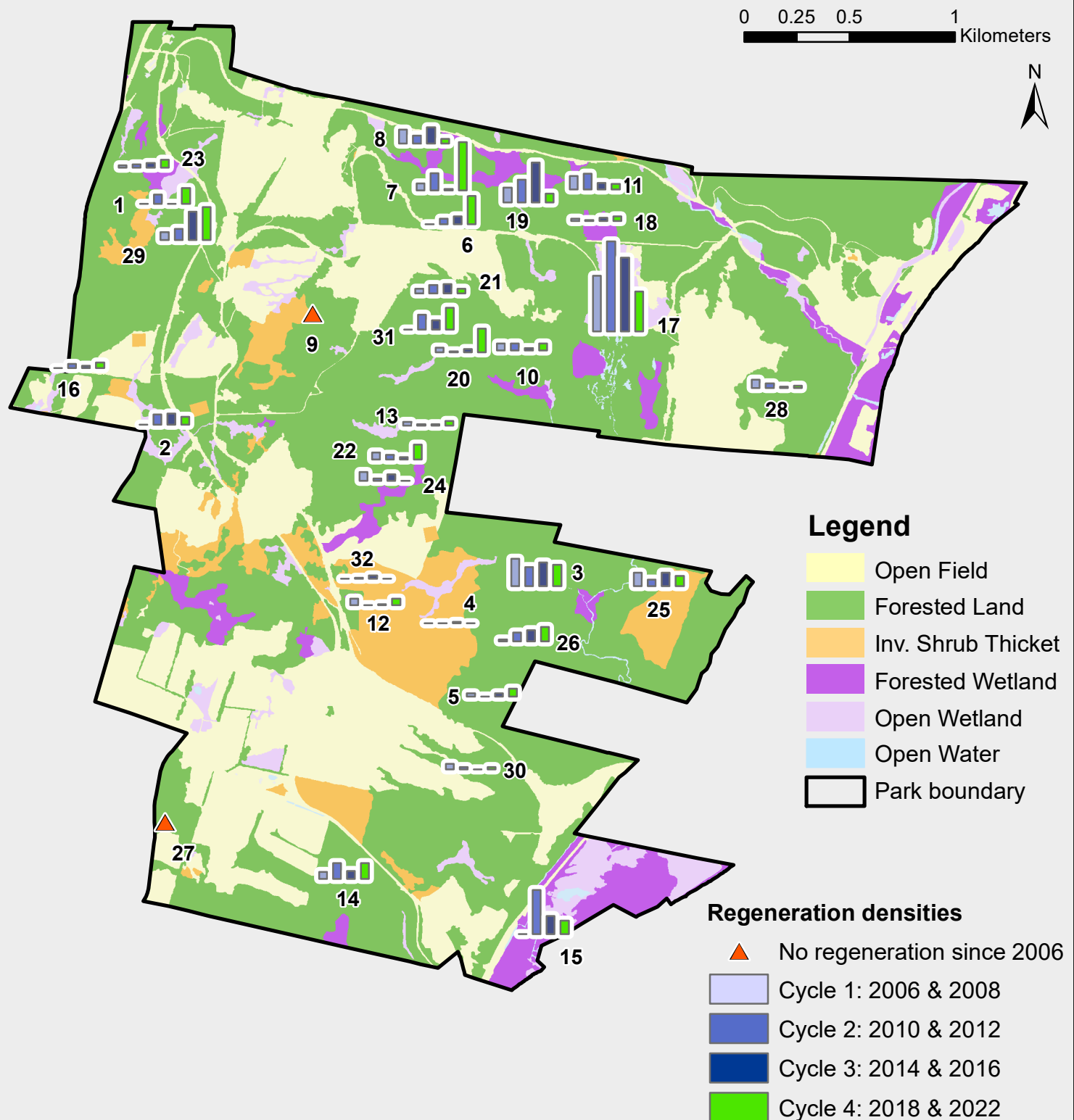




Map 1. Tree Regeneration by Cycle

Trends in tree regeneration, including seedlings and saplings, observed in forest plots sampled from 2006-2022. Plots are sampled an alternating panel, with plots 1-16 sampled in 2006, 2010, 2014, and 2018, and plots 17-32 sampled in 2008, 2012, 2016, and 2022. Densities range from 0 to 2.1 stems/m², and only include native canopy-forming species. Note the unit change from 2018 report to match manuscript in review. Plot 15 was not sampled in Cycle 1. See Table 1 for more details.
Date: 8/15/2022.





Map 2. Tree Regeneration By Size Class

Trends in tree regeneration by size class observed in forest plots in the most recent 4 survey cycle (2018 and 2022). Plots are sampled in an alternating panel, with plots 1-16 sampled in 2018, and plots 17-32 sampled in 2022. Pie size is proportional to the total plot-level regeneration and location may be shifted to prevent overlap. Total densities range from 0 to 1.1 stems/m² and only include native canopy-forming species. Note the unit change from the 2018 report to match manuscript in review.

Date: 8/15/2022.

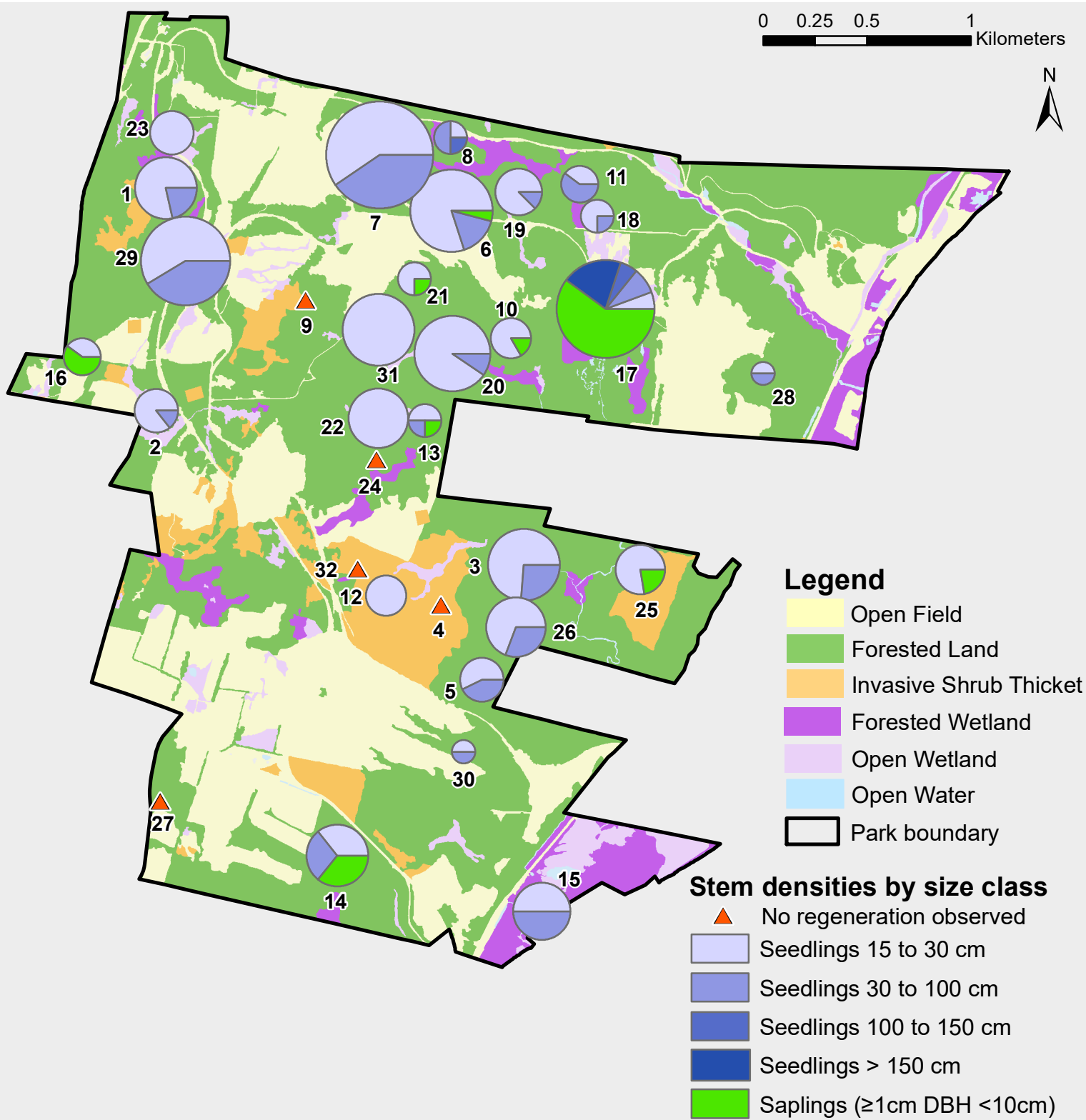


Table 1. Average plot-level seedling and sapling stem densities, converted to stems per m², and stocking index by cycle. Only native, canopy-forming species are included. Note that *Fraxinus* spp. (ash species) are no longer considered canopy-forming species, which differs from the 2018 summary. Cycle 1= 2006 & 2008; Cycle 2= 2010 & 2012; Cycle 3= 2014 & 2016, Cycle 4= 2018 & 2022. Plots are sampled in alternating years, with Panel 1 sampled the first year, and Panel 2 sampled the second 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. Cells highlighted in green are plots that meet the minimum management target of 0.25 seedlings/m² and 0.14 saplings/m² or have a stocking index >100. Note that plot 15 was not sampled in cycle 1.

[illegible]

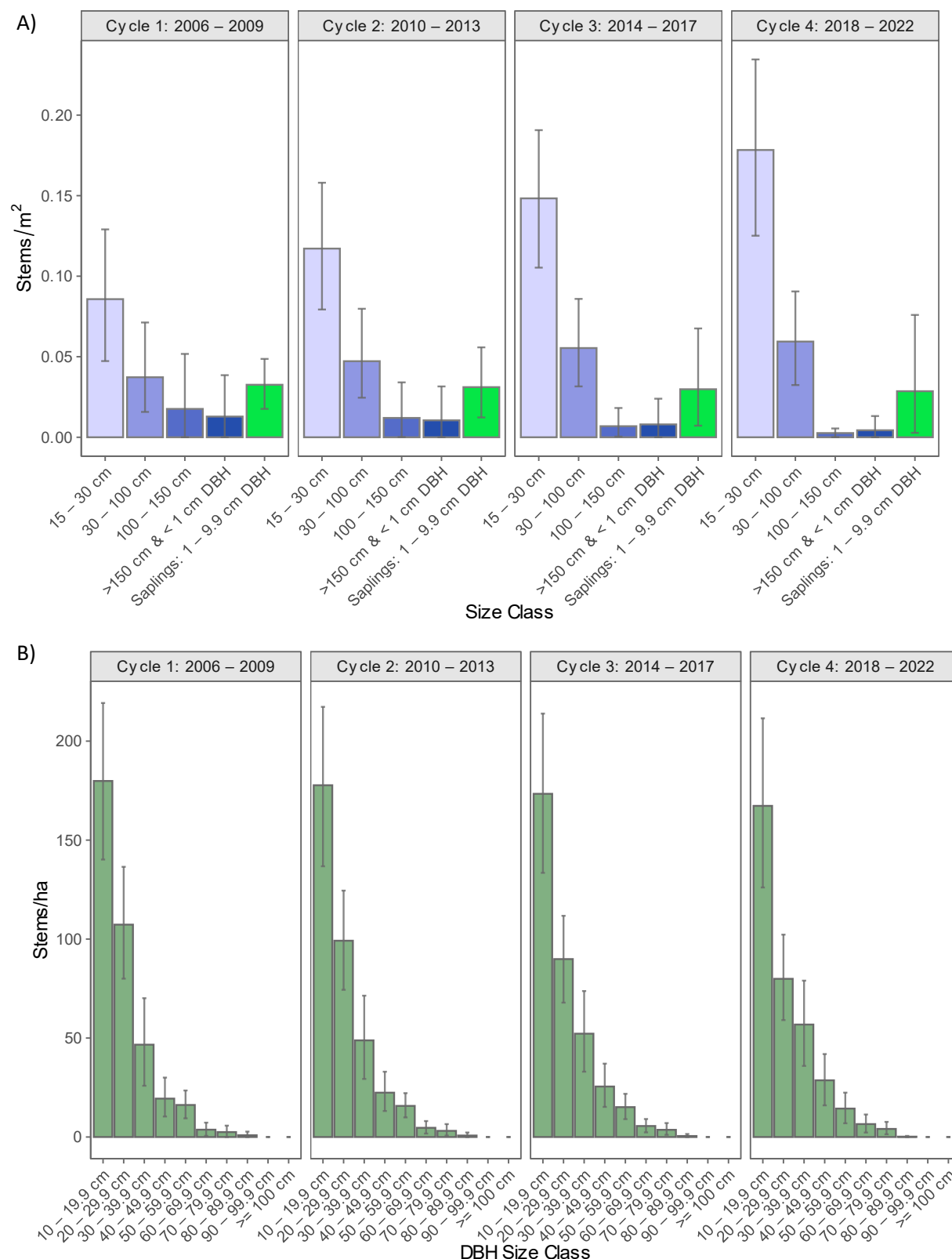
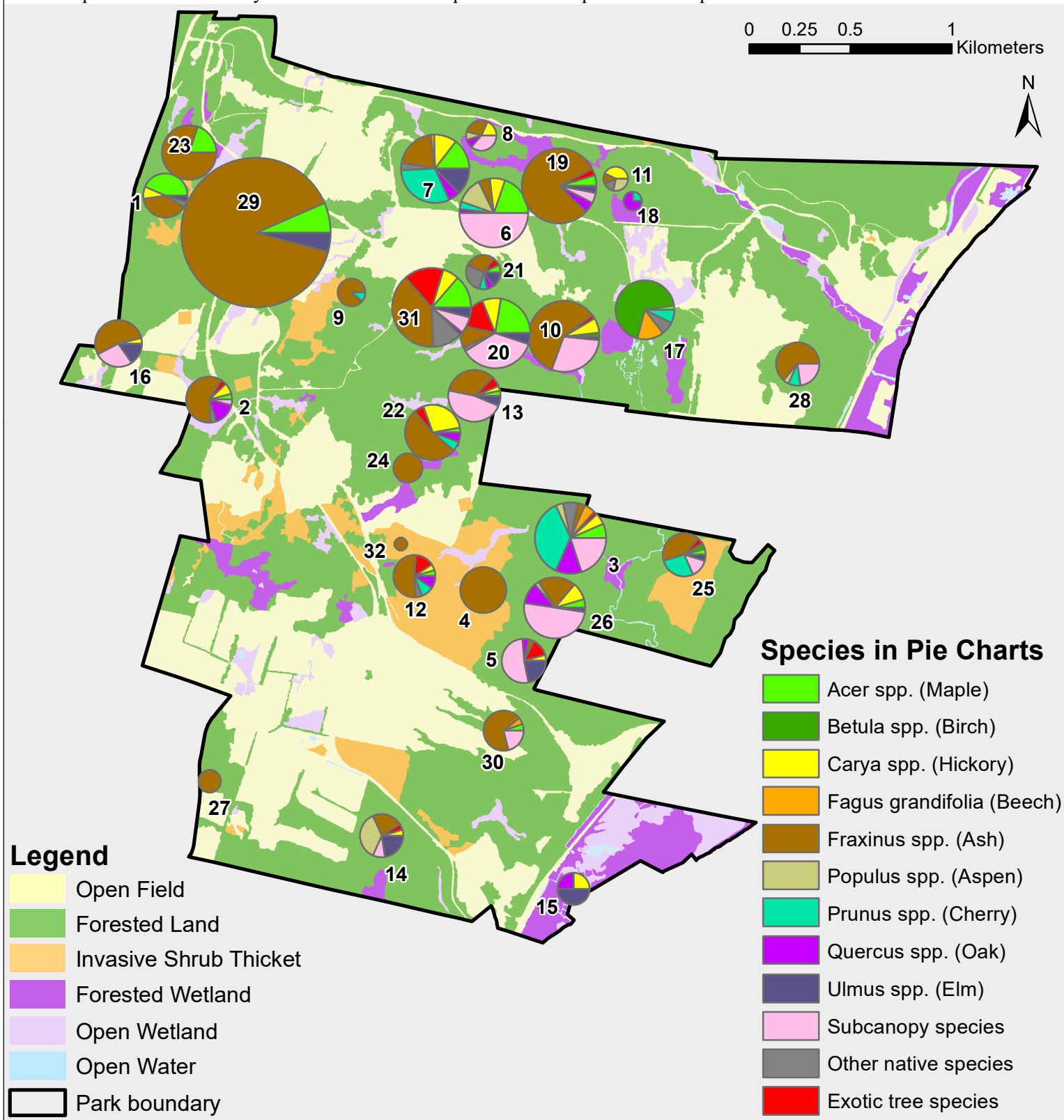


Figure 1. Stem density distributions by survey cycle in Saratoga National Historical Park. Cycle 1 is 2006-2009; Cycle 2 is 2010-2013; Cycle 3 is 2014-2017; Cycle 4 is 2018-2022. Figure A shows regeneration densities by size class. Figure B shows tree density by diameter at breast height (DBH) increments. Error bars are 95% bootstrapped confidence intervals. An asterisk denotes a linear DBH distribution that is indicative of long-term recruitment failure.



Map 3. Tree Regeneration Composition

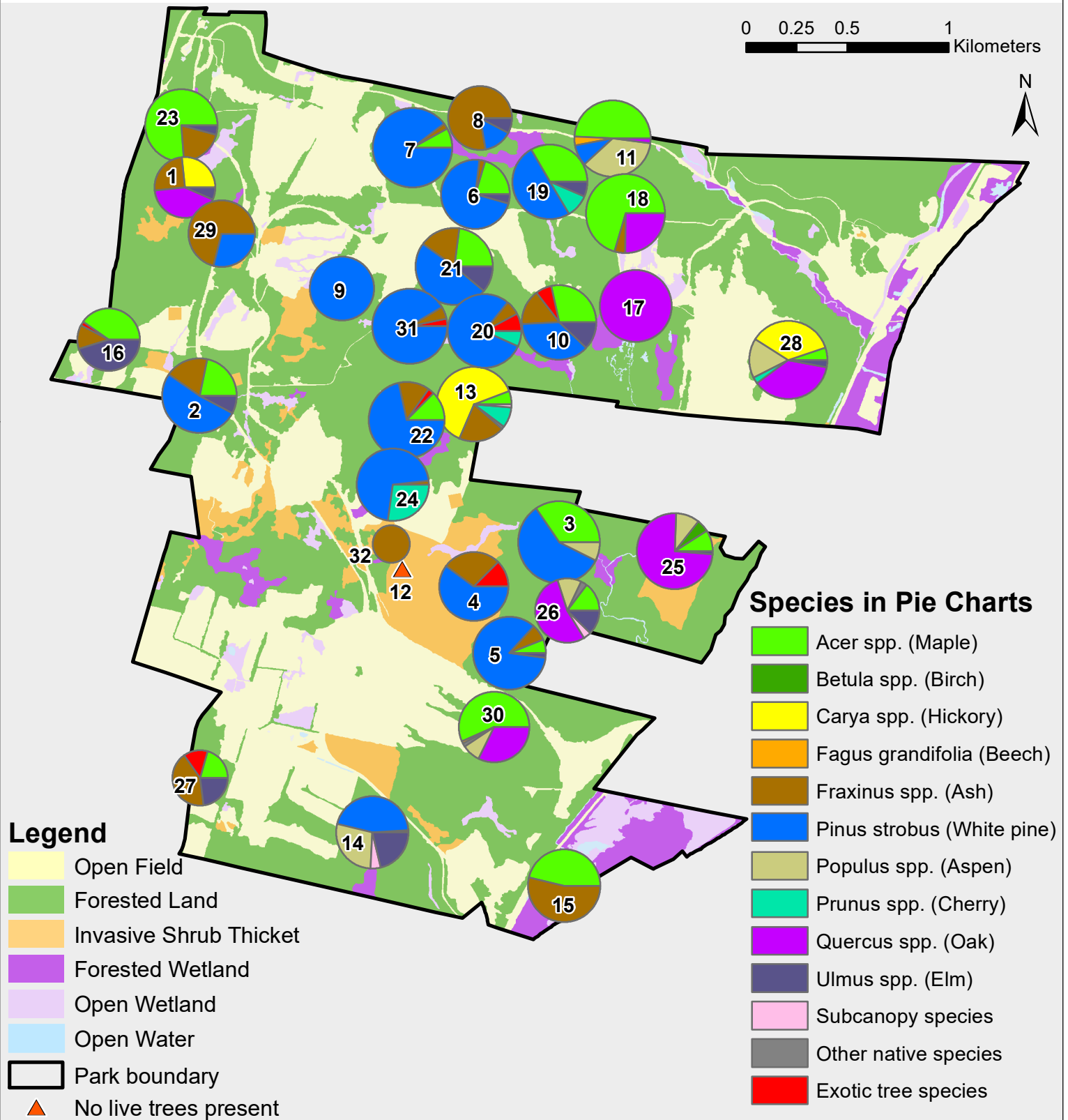
Trends in tree regeneration, including seedlings and saplings, by species group observed in forest plots in the most recent survey cycle (2018 and 2022). Plots 1-16 were sampled in 2018, and plots 17-32 were sampled in 2022. Pie size is proportional to the total plot-level regeneration (plot-level density range: 0.05 to 7.0 stems/m²). Note the unit change from the 2018 report to match manuscript in review. Pies may be shifted from actual plot location to prevent overlap. Date: 6/11/2018.





Map 4. Tree Canopy Composition

Trends in tree composition, by species group, observed in forest plots in the most recent survey cycle (2018 and 2022). Plots are sampled in an alternating panel, with plots 1-16 sampled in 2018, and plots 17-32 sampled in 2022. Pie size is proportional to the total plot-level basal area (range: 0 to 58.6 m²/ha). Pies may be shifted from actual plot location to prevent overlap.
Date: 8/15/2022.



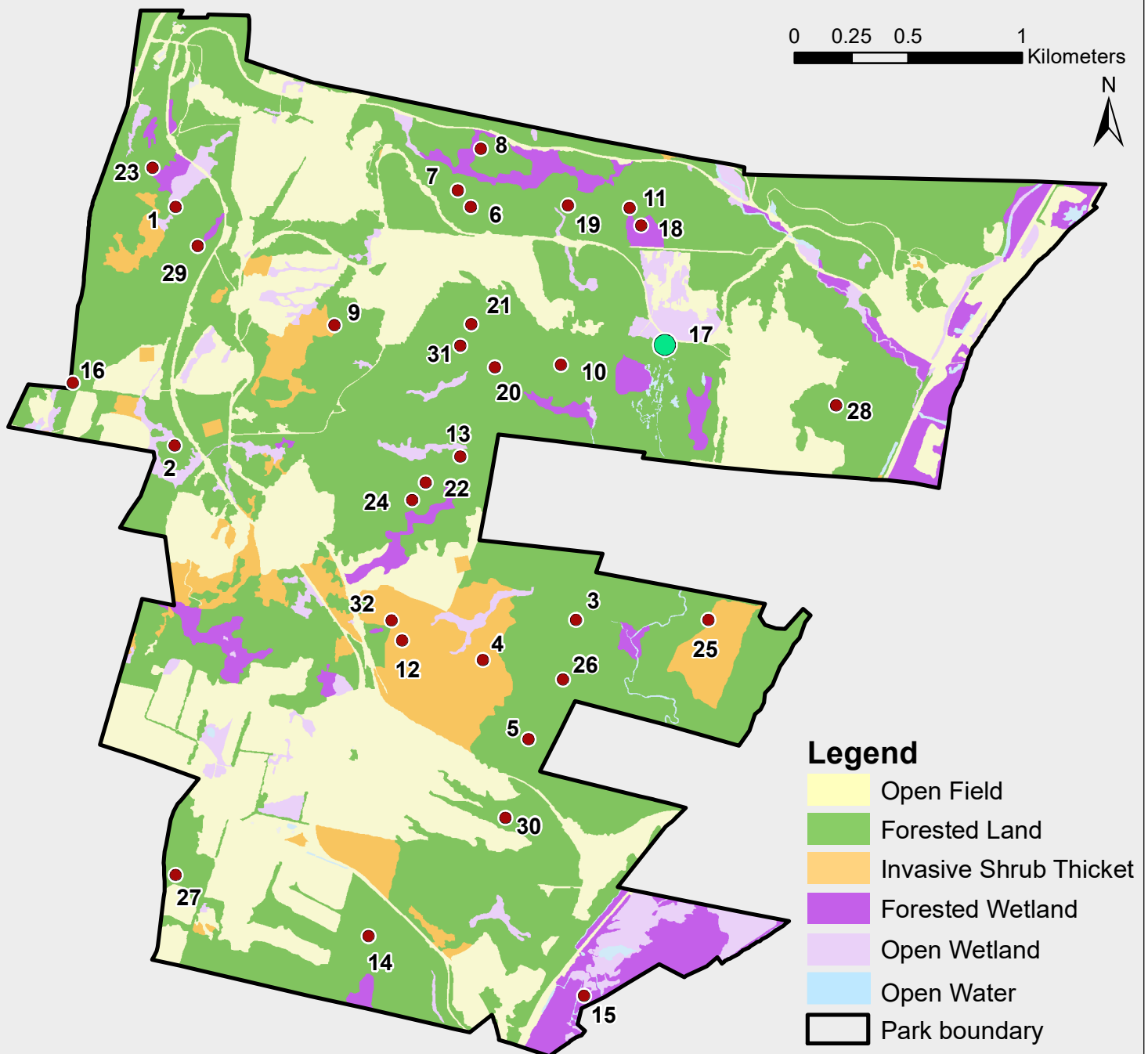


Map 5. Tree Regeneration Stocking Index

Trends in the regeneration stocking index for the most recent survey cycle (2018 & 2022). This index is a weighted sum of seedling and sapling densities where larger seedling size classes get higher weights and quantifies whether current regeneration densities are sufficient to restock a forest canopy. The stocking index is averaged over three 2-m radius microplots per forest plot and only includes native canopy-forming species (range 0 to 249.3). See Table 1 for stocking index values. Date: 8/15/2022.

Stocking Index Ranges

- < 25: Severely understocked. Regeneration is insufficient to replace the forest canopy.
- 25 to 50: Moderately stocked regeneration for areas with low deer impacts.
- 50 to 100: Sufficient regeneration to replace forest canopy in areas with low deer impacts.
- > 100: Sufficiently stocked with regeneration for areas with high deer impacts.



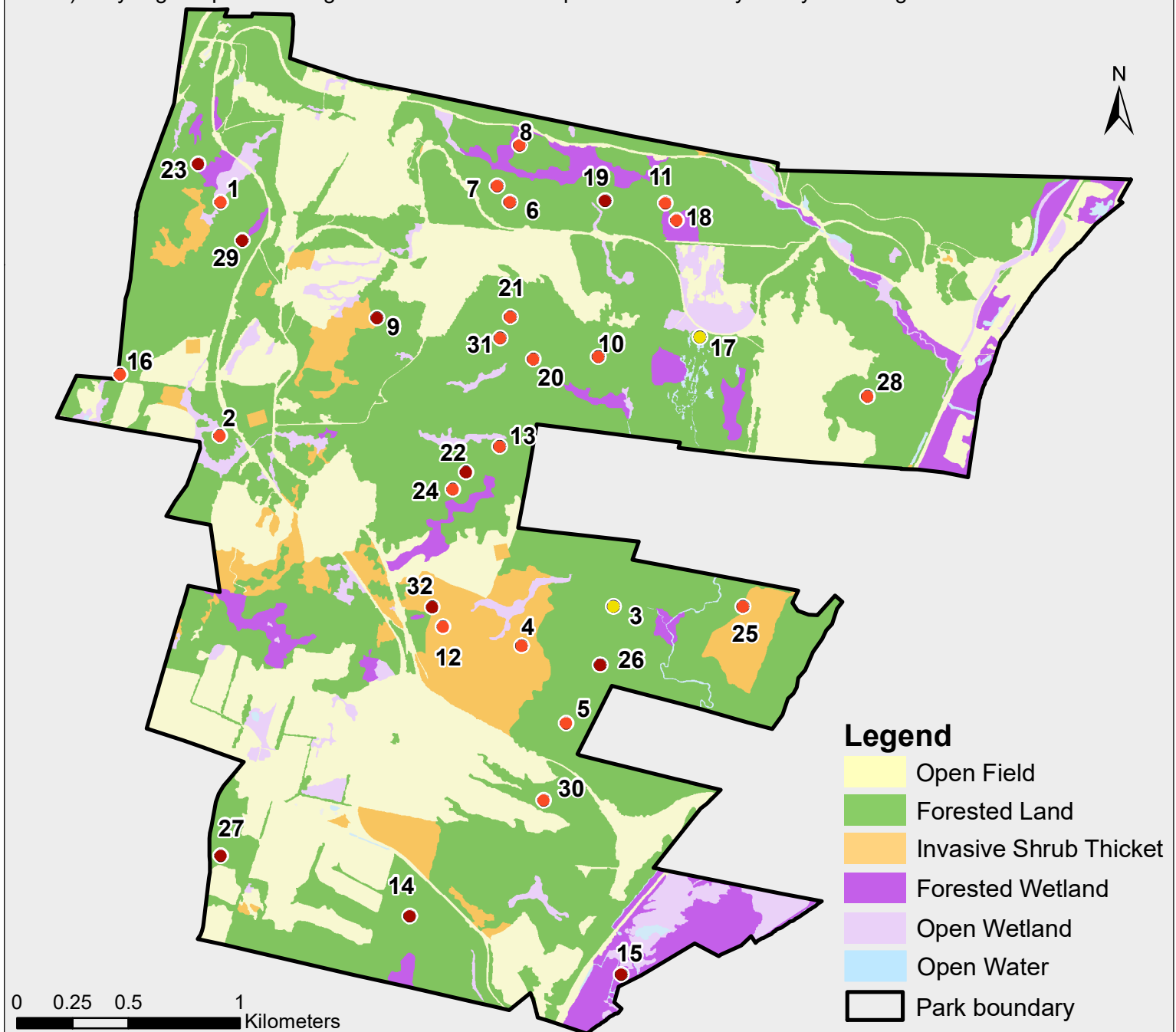


Map 6. Index of Deer Browse Impacts

Index of deer browse impacts observed in forest plots in the most recent survey cycle (2019 & 2022). Plots are sampled in an alternating panel, with plots 1-16 sampled in 2018 and plots 17-32 sampled in 2022. Deer browse impacts are assessed on a scale of 1-5, with 1 representing no impact and 5 representing severe impacts. Date: 8/15/2022.

Deer Browse Index

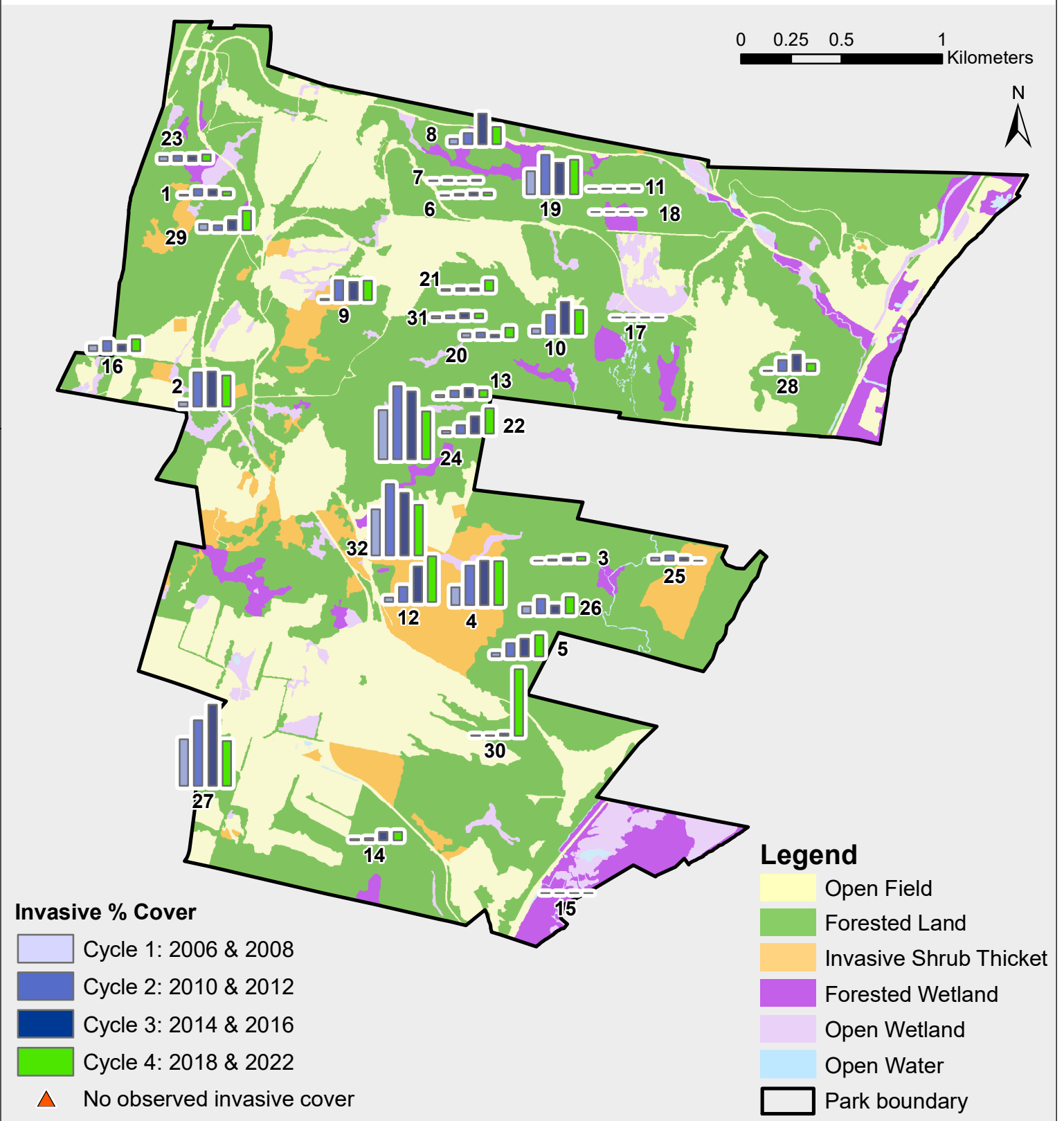
- 1) No Impact: found only in well-maintained deer exclosures.
- 2) Low Impact: deer preferred (DP) species abundant and of varying heights.
- 3) Medium Impact: DP species present, but most under 30 cm tall. DP herbs present, but stunted, and flowering is uncommon.
- 4) High Impact: DP species are rare to absent. Non-preferred (NP) 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. NP species reduced by heavy browsing. Distinct browse line.





Map 7. Invasive % Cover by Cycle

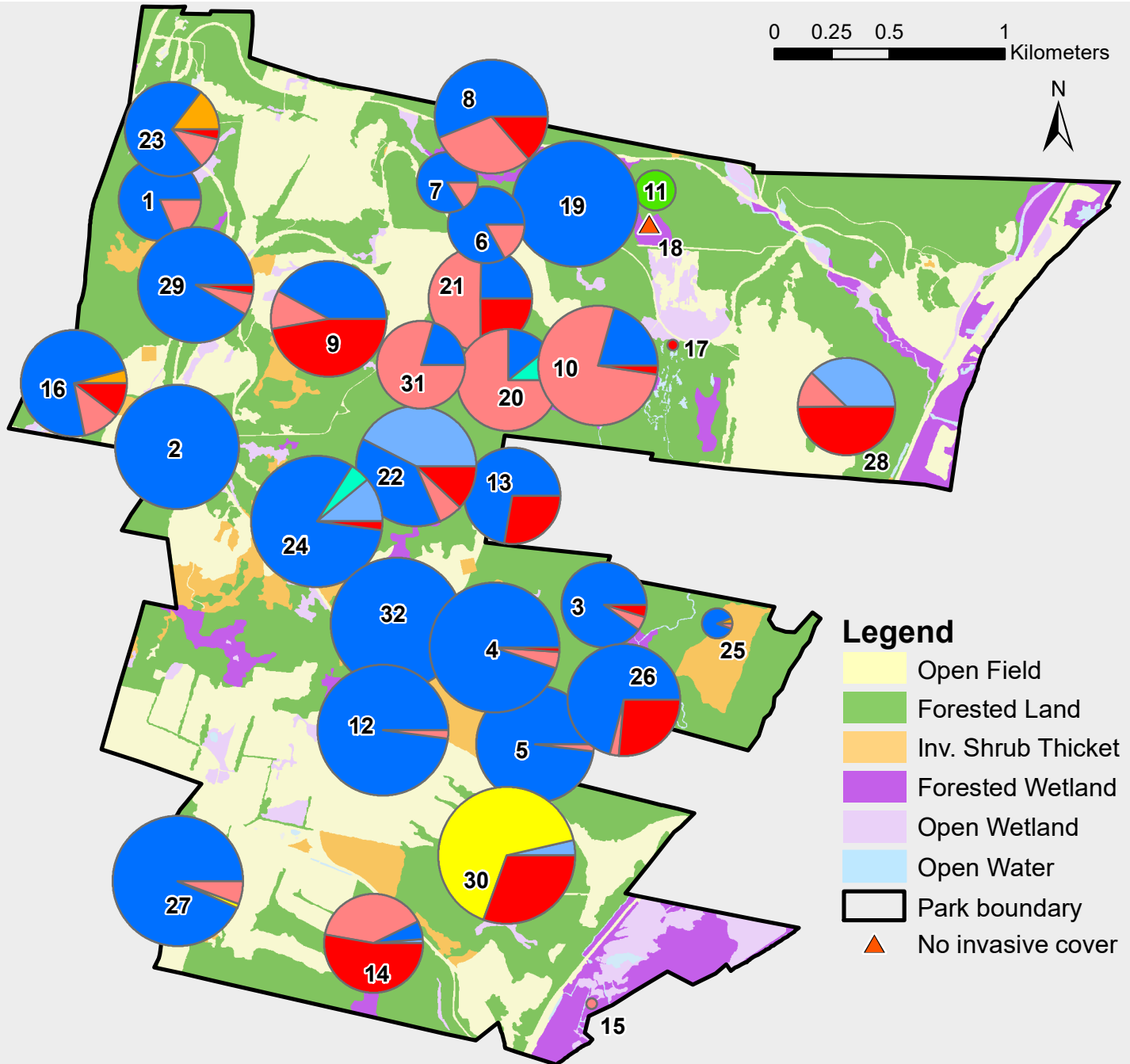
Trends in percent cover of invasive species observed in plots sampled from 2006-2022. Plots are sampled in an alternating panel, with plots 1-16 sampled in 2006, 2010, 2014, and 2018, and plots 17-32 sampled in 2008, 2012, 2016, and 2022. Average invasive cover ranges from 0 to 75.8%. See Table 2 for % cover values. Date: 8/15/2022.





Map 8. Invasive % Cover by Species

Trends in % invasive cover by species observed in quadrats for plots in the most recent survey cycle (2018 & 2022). Plots are sampled in an alternating panel, with plots 1-16 sampled in 2018, and plots 17-32 sampled in 2022. Pie size is proportional to total invasive cover (range: 0 to 61.9%), and location may be shifted to prevent overlap. See Table 2 for more information.
Date: 8/15/2022.



Species in Pie Charts

Alliaria petiolata (garlic mustard)	Lonicera spp. (exotic bush honeysuckle)
Berberis thunbergii (Japanese barberry)	Microstegium vimineum (Japanese stiltgrass)
Cardamine impatiens (narrowleaf bittercress)	Rhamnus cathartica (common buckthorn)
Celastrus orbiculatus (Asian bittersweet)	Rosa multiflora (multiflora rose)

Table 2. Average % cover and number of invasive species detected in each plot by cycle. Cycle 1= 2006 & 2008; Cycle 2= 2010 & 2012; Cycle 3= 2014 & 2016, Cycle 4= 2018 & 2022. Plots are sampled in alternating years, with Panel 1 sampled the first year, and Panel 2 sampled the second year. Note that plot 15 was not sampled in the first cycle.

Plot	Panel	Average % Cover				Number of Species per Plot			
		Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 1	Cycle 2	Cycle 3	Cycle 4
1	1	0.8	6.1	5.6	3.5	3	4	3	5
2	1	4.0	31.9	32.7	29.1	2	3	4	5
3	1	0.2	1.3	2.9	4.0	3	3	4	5
4	1	16.4	36.9	41.4	40.8	3	4	4	3
5	1	3.5	12.7	16.8	19.9	3	5	5	6
6	1	0.5	1.6	2.6	2.7	2	3	4	3
7	1	0.4	1.1	0.5	1.3	3	3	3	3
8	1	4.9	10.4	28.5	16.2	3	4	3	3
9	1	1.3	18.8	16.9	18.5	3	3	4	4
10	1	5.0	17.8	29.8	22.6	2	3	4	4
11	1	0.0	0.0	0.2	0.4	3	4	2	4
12	1	4.3	14.3	33.2	42.5	3	3	3	3
13	1	2.4	6.5	8.8	6.8	4	4	4	6
14	1	1.1	1.7	7.7	7.7	4	5	4	5
15	1	---	0.0	0.0	0.0	---	1	0	2
16	1	5.3	9.3	6.0	11.2	4	5	5	5
17	2	0.0	0.0	0.0	0.0	0	0	0	3
18	2	0.0	0.0	0.0	0.0	0	0	1	0
19	2	21.5	36.8	29.4	32.2	3	2	4	5
20	2	3.5	4.5	2.6	8.9	4	3	4	5
21	2	1.5	2.2	2.3	9.7	2	2	3	6
22	2	2.5	7.8	16.1	23.5	4	4	6	7
23	2	4.2	4.8	4.9	6.2	2	6	5	5
24	2	91.3	68.0	63.3	44.5	9	4	5	6
25	2	2.8	5.1	2.9	0.2	3	5	5	5
26	2	6.6	13.7	7.3	15.4	3	4	5	4
27	2	43.7	61.2	75.8	41.9	4	4	4	4
28	2	0.7	10.4	15.2	7.2	5	5	5	5
29	2	5.8	4.5	9.3	18.0	3	4	4	5
30	2	0.2	0.4	2.0	61.9	3	2	4	7
31	2	2.3	3.1	5.0	4.6	2	3	3	4
32	2	42.8	66.2	58.2	46.9	3	3	4	5

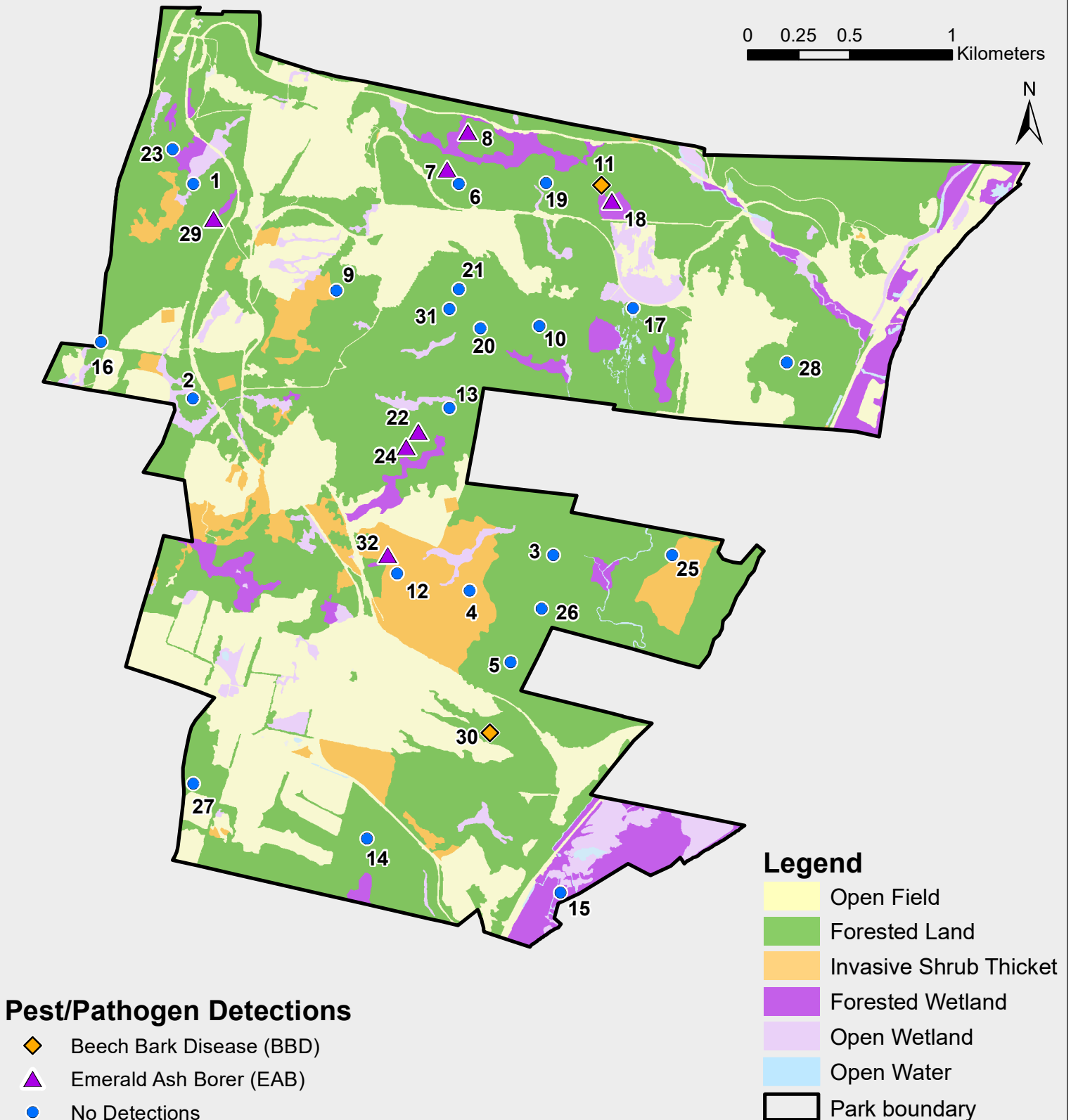
Table 3. Number of plots out of 32 where priority invasive species were detected by cycle. Cycle 1 = 2006 & 2008; Cycle 2 = 2010 & 2012; Cycle 3 = 2014 & 2016; Cycle 4 = 2018 & 2022. Species on the list include all exotic vascular plant species that are capable of dominating Northeastern US forest habitats, and does not include all exotic species detected in SARA forest plots. Note that the total number of plots in cycle 1 is 31 because plot 15 was not sampled.

Latin Name	Common Name	Cycle1	Cycle2	Cycle3	Cycle4
<i>Acer palmatum</i>	Japanese maple	0	0	0	1
<i>Alliaria petiolata</i>	garlic mustard	9	11	13	13
<i>Berberis thunbergii</i>	Japanese barberry	3	3	6	8
<i>Bromus inermis</i>	smooth brome	0	0	1	0
<i>Cardamine impatiens</i>	narrowleaf bittercress	0	0	4	6
<i>Celastrus orbiculatus</i>	Asian bittersweet	0	5	6	13
<i>Centaurea</i> spp.	knapweed	4	5	6	3
<i>Cirsium vulgare</i>	bull thistle	0	0	1	1
<i>Clinopodium vulgare</i>	wild basil	18	10	15	16
<i>Euonymus</i> spp.	burningbush	0	0	1	0
<i>Glechoma hederacea</i>	ground ivy	4	8	6	5
<i>Iris pseudacorus</i>	paleyellow iris	0	1	1	1
<i>Ligustrum</i>	privet	0	4	0	0
<i>Lonicera</i> spp.	exotic bush honeysuckle	29	29	29	30
<i>Lysimachia nummularia</i>	creeping jenny	3	4	4	4
<i>Lythrum salicaria</i>	purple loosestrife	0	1	0	0
<i>Microstegium vimineum</i>	Japanese stiltgrass	0	0	0	2
<i>Phalaris arundinacea</i>	reed canary grass	2	6	9	8
<i>Rhamnus cathartica</i>	common buckthorn	30	27	28	31
<i>Rosa multiflora</i>	multiflora rose	21	21	27	29
<i>Valeriana officinalis</i>	garden heliotrope	0	0	0	1
<i>Viburnum lantana</i>	wayfaringtree	0	0	1	0



Map 9. Forest Pest/Pathogen Detections

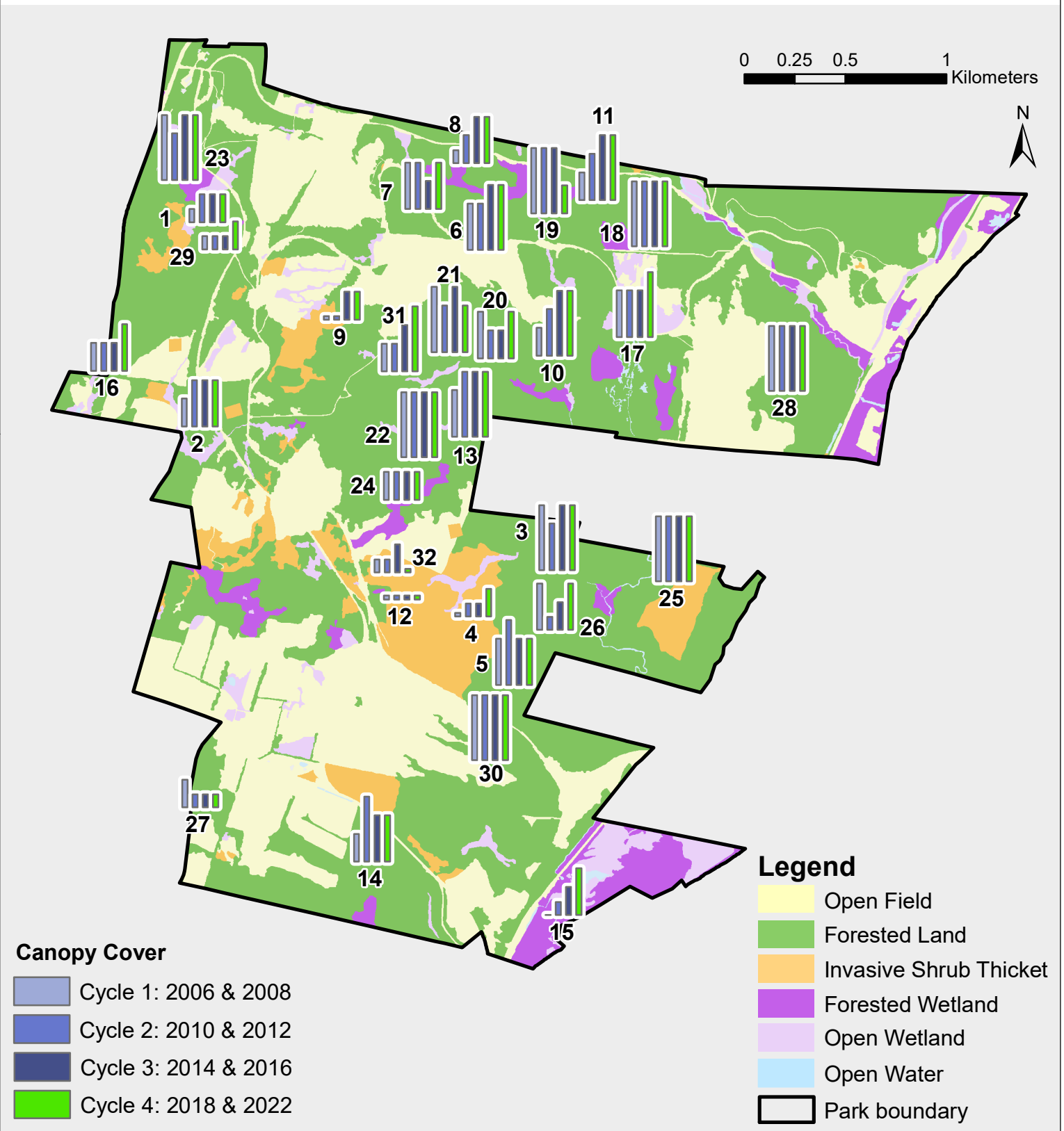
Priority pest and pathogen detections in forest plots sampled from 2018-2022. Plots are sampled in an alternating panel with plots 1-16 sampled in 2018 and plots 17-32 sampled in 2022. Date 8/15/2022.





Map 10. Canopy Cover by Cycle

Trends in tree canopy cover in forest plots sampled from 2006-2022. Plots are sampled in an alternating panel, with plots 1-16 sampled in 2006, 2010, 2014, and 2018, and plots 17-32 sampled in 2008, 2012, 2016, and 2022. Canopy cover ranges from 0 - 10% to >75%. Date: 8/15/2022.



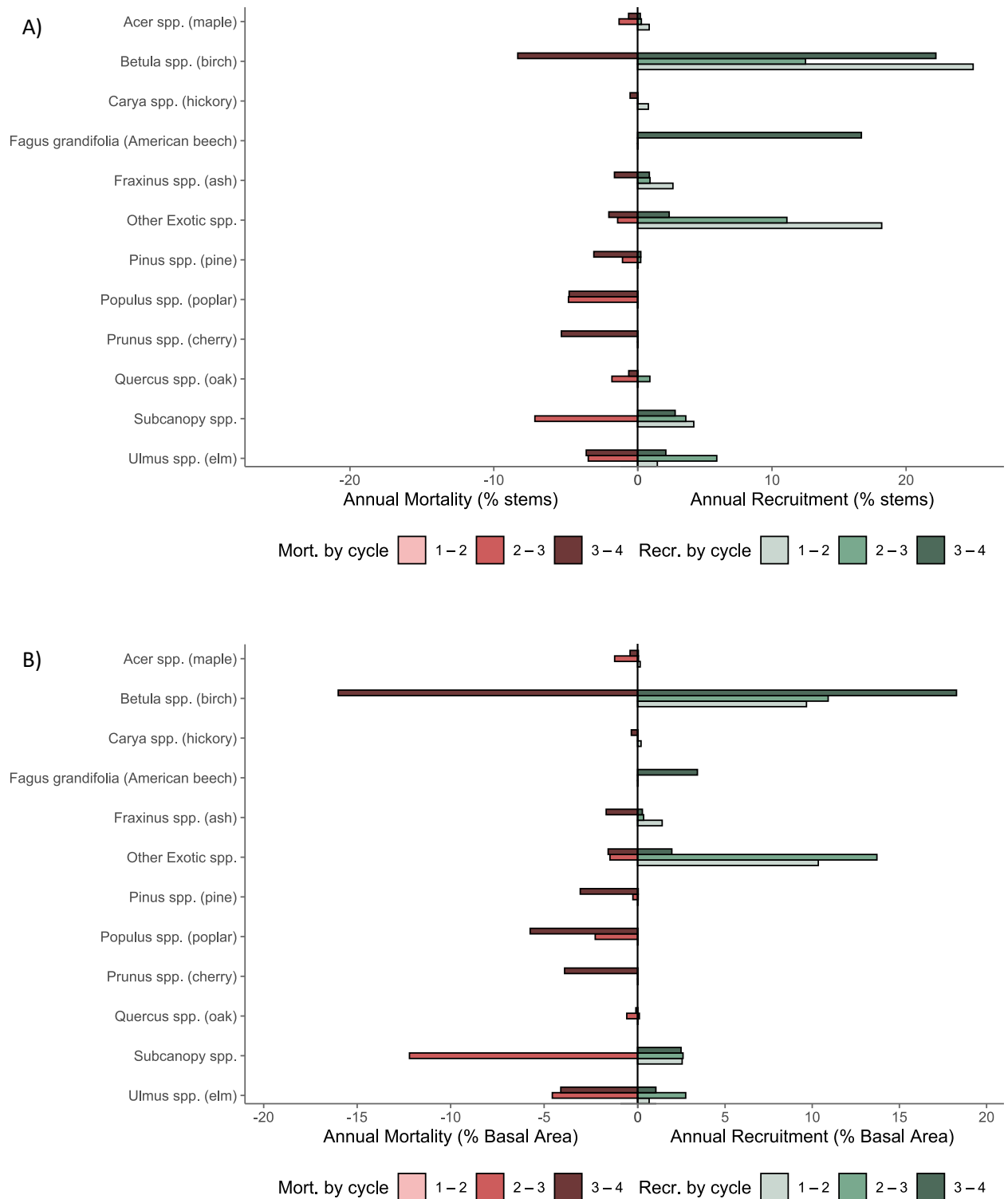


Figure 2. Annual tree mortality and recruitment rates by cycle in Saratoga National Historical Park. Figure A represents % of stems that died (mortality) and the % of stems gained (recruitment) per year from the previous cycle. Figure B is the % of basal area per year that died or was gained from the previous cycle.

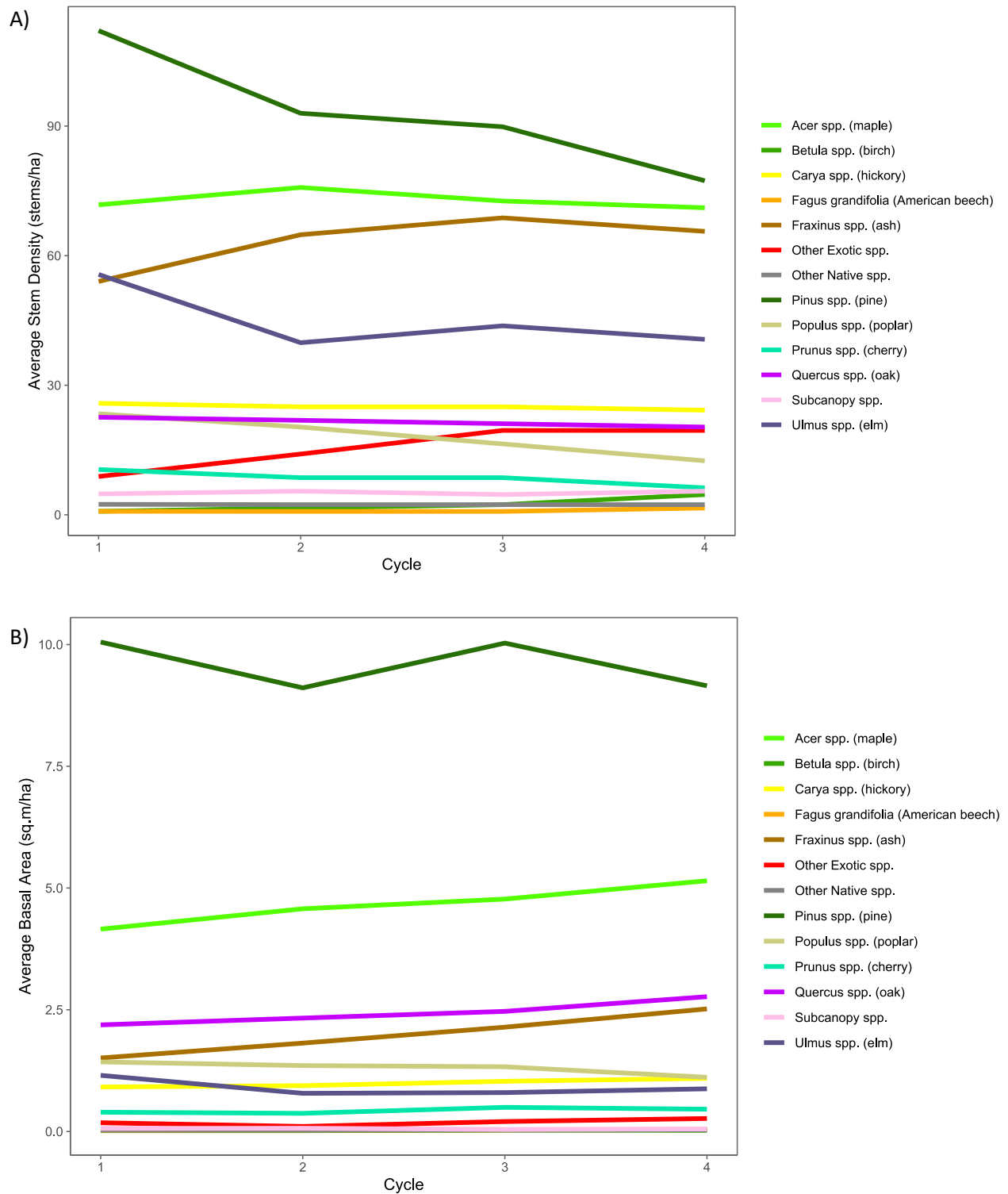


Figure 3. Change in stem density (A) and basal area (B) by species and cycle in Saratoga National Historical Park. Cycle 1 = 2006 – 2009; Cycle 2 = 2010 – 2013; Cycle 3 = 2014 – 2017; Cycle 4 = 2018 – 2022.

