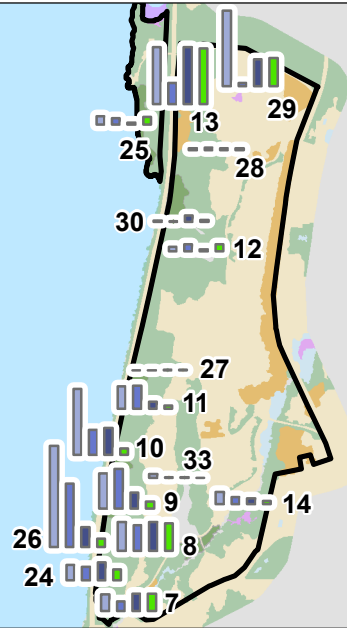


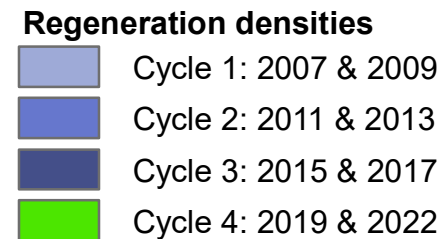


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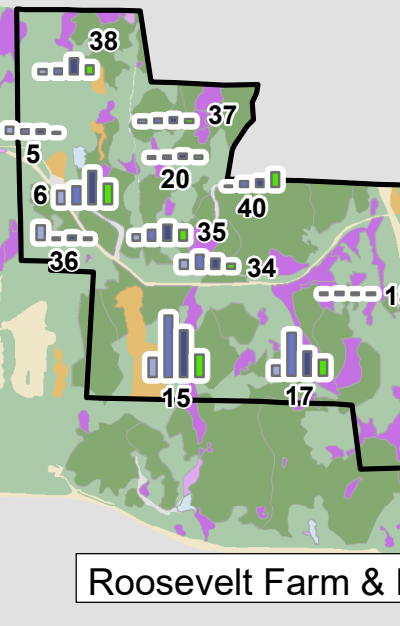
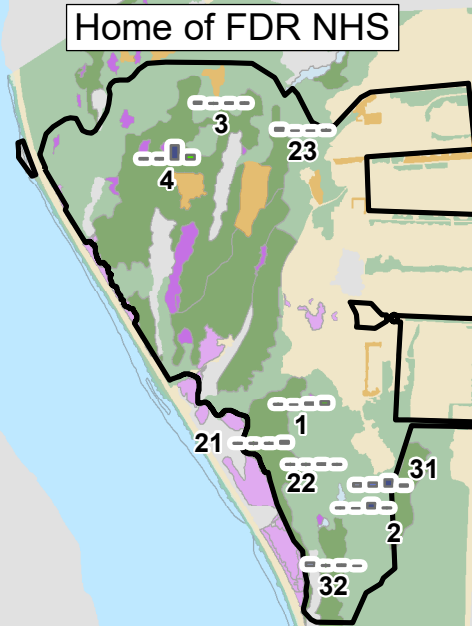


Map 1. Tree Regeneration by Cycle

Trends in tree regeneration, including seedlings and saplings, in forest plots sampled from 2007-2022. Plots are sampled in an alternating panel, with plots 1-20 sampled in 2007, 2011, 2015, and 2019, and plots 21-40 sampled in 2009, 2013, 2017, and 2022. Densities range from 0 to 2.4 stems/m² and only include native canopy-forming species. Note the unit change from the 2019 report to match manuscript in review. See Table 1 for more details. Date: 8/16/2022.

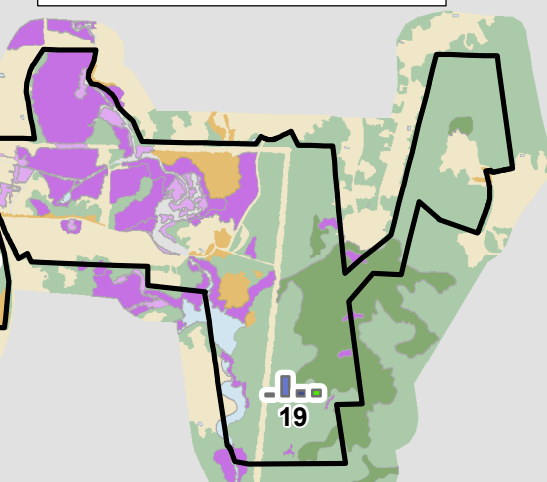


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0 0.25 0.5 1
Kilometers

Eleanor Roosevelt NHS

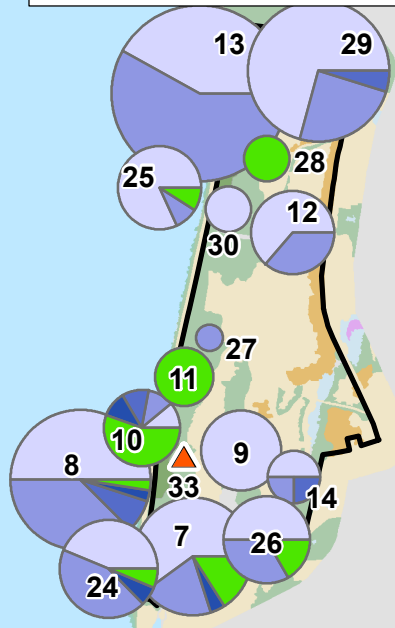


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Vanderbilt Mansion NHS

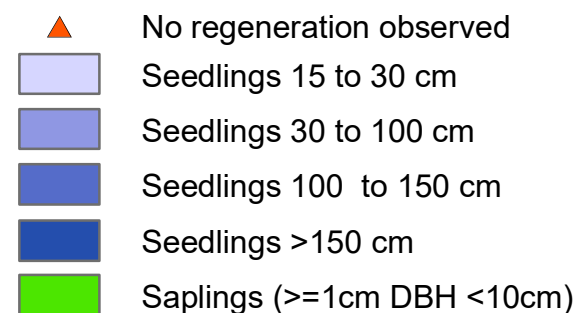


Map 2. Tree Regeneration by Size Class

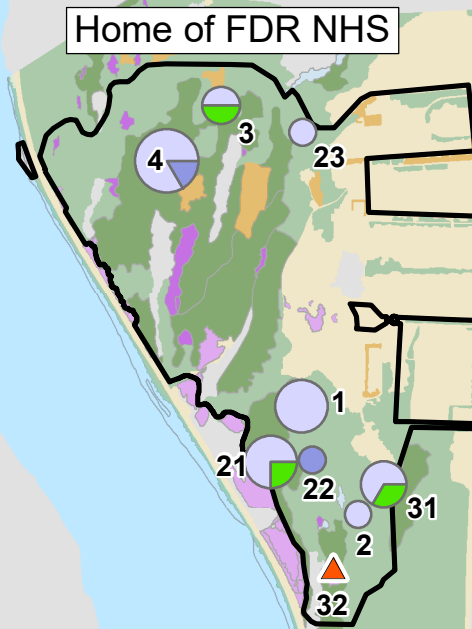
Trends in tree regeneration stem densities by size class in forest plots from the most recent survey cycle (2019 and 2022). Plots are sampled in an alternating panel, with plots 1-20 sampled in 2019, and plots 21-40 sampled in 2022. Pie size is proportional to plot-level regeneration, and location may be shifted to prevent overlap. Total densities range from 0 to 2.1 stems/m² and only include native canopy-forming species. Note the unit change from the 2019 report to match manuscript in review. Date: 8/16/2022.



Stem densities by size class

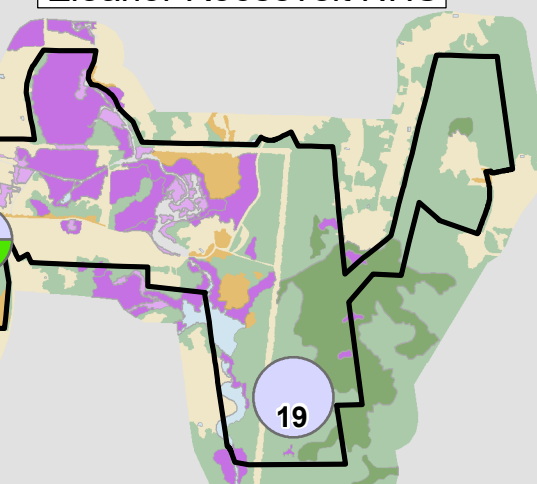


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Kilometers

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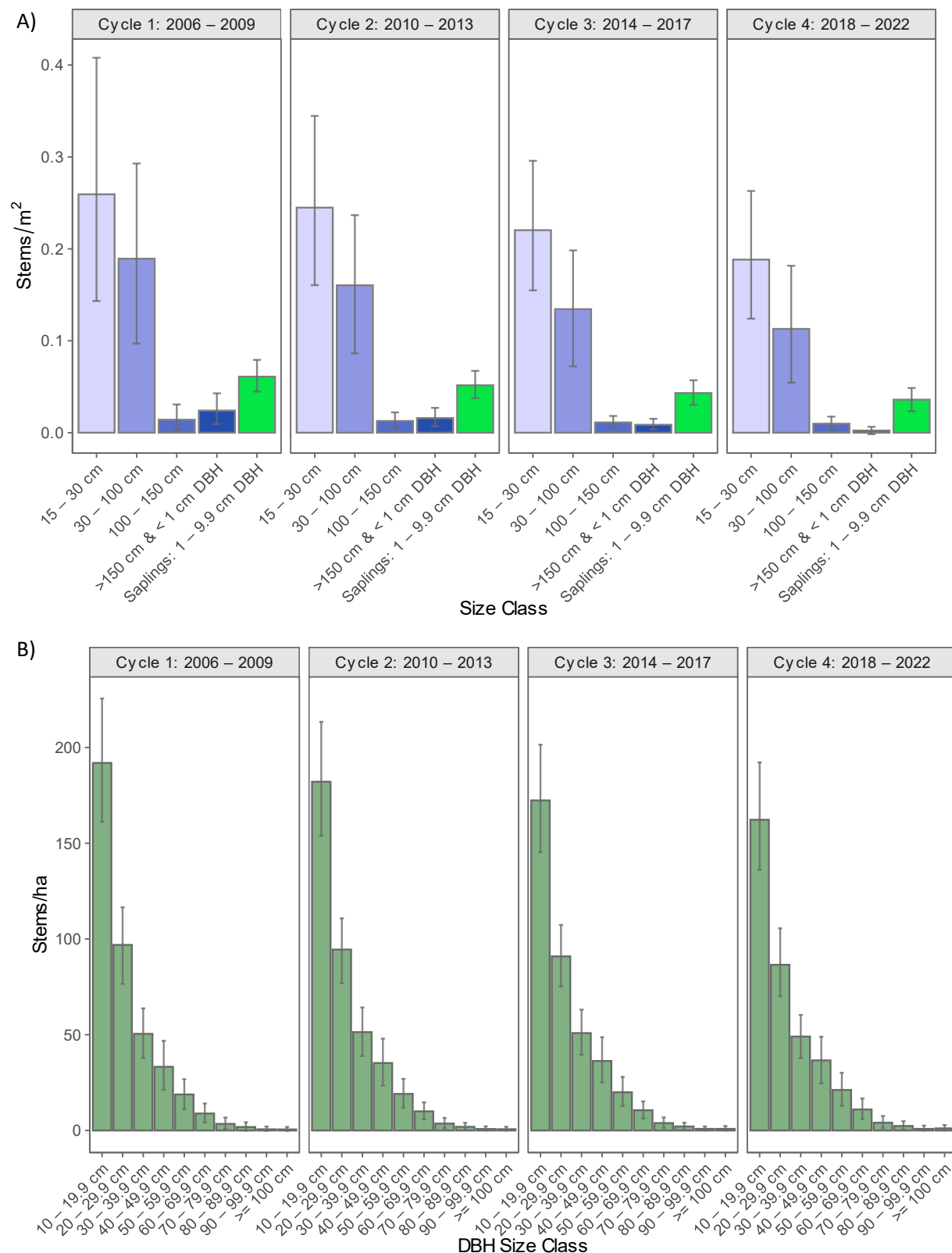


Roosevelt Farm & Forest



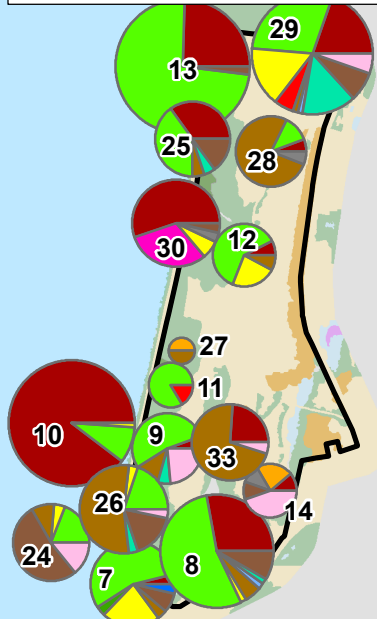
Table 1. Average plot-level seedling and sapling stem densities, converted to stems per m², and stocking index by cycle. Only native, canopy-forming species are included. Note that *Fraxinus* spp. (ash species) are no longer considered canopy-forming species, which differs from the 2019 summary. Cycle 1= 2007 & 2009; Cycle 2= 2011 & 2013; Cycle 3= 2015 & 2017, Cycle 4= 2019 & 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.

Plot	Panel	Seedlings per m ²				Saplings per m ²				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
1	1	0	0	0.08	0.11	0.03	0	0	0	0	0	1	1.33
2	1	0.03	0	0.19	0.03	0	0	0	0	0.33	0	2.33	0.33
3	1	0.05	0	0.03	0.03	0.03	0.03	0.03	0.03	17.33	16.67	0.33	0.33
4	1	0.03	0.05	0.53	0.16	0.03	0	0	0	0.67	0.67	6.67	2.33
5	1	0.21	0.13	0.13	0.03	0.05	0.03	0.03	0.03	3	1.67	2.33	0.67
6	1	0.48	0.64	1.22	0.74	0.05	0.05	0.08	0.05	47.33	44	65.67	30.33
7	1	0.48	0.32	0.56	0.56	0.16	0.05	0.11	0.11	98.33	72.33	91	58.33
8	1	1.06	0.95	1.06	1.03	0.05	0.03	0.05	0.03	45.33	41.33	28	53.33
9	1	1.3	1.49	0.61	0.27	0.05	0.03	0	0	25	25.67	8.33	3.33
10	1	2.39	0.8	0.93	0.11	0.16	0.16	0.11	0.13	319.67	211	163.67	91
11	1	0.64	0.66	0.08	0	0.24	0.24	0.19	0.13	111.67	110.33	67.67	33.33
12	1	0.13	0.27	0.08	0.29	0.05	0.03	0	0	18	3.33	1	5
13	1	2.18	0.82	2.2	2.15	0.03	0	0	0	378	16	37.33	42.67
14	1	0.27	0.13	0.13	0.11	0.19	0.13	0.08	0	37.33	35.67	2.33	8
15	1	0.69	2.33	1.75	0.82	0.05	0.05	0.05	0.05	44.67	68	87.67	38.33
16	1	0.16	0.5	0.37	0.56	0.16	0.11	0.13	0.08	85.67	65	57	27.67
17	1	0.24	1.57	0.82	0.5	0.16	0.08	0.11	0.11	103.67	116	91.33	69.33
18	1	0	0.03	0.03	0.05	0.11	0.11	0.08	0.05	16.67	17	23.33	0.67
19	1	0.11	0.77	0.24	0.27	0	0	0	0	1.67	10	3	3.33
20	1	0.05	0.11	0.13	0.08	0.05	0.03	0.05	0.05	17.67	18.33	19.33	18.33
21	2	0	0	0	0.08	0.03	0.03	0.03	0.03	0	0	0	1
22	2	0	0	0.05	0.03	0.03	0.03	0	0	0	0	0.67	0.67
23	2	0.11	0	0	0.03	0	0	0	0	1.33	0	0	0.33
24	2	0.56	0.53	0.64	0.4	0.05	0	0.05	0.03	25.33	29.67	30	23.67
25	2	0.27	0.19	0.08	0.27	0.05	0.05	0	0.03	4	3.33	1	3.67
26	2	3.79	2.33	0.72	0.27	0.11	0.11	0.05	0.05	97.33	74	10.33	4.67
27	2	0	0	0.03	0.03	0	0	0	0	0	0	0.33	0.67
28	2	0.03	0.03	0	0	0.05	0.08	0.08	0.08	0.33	0.33	0	0
29	2	2.84	0.13	1.03	1.09	0.08	0	0	0	49.67	1.67	18	29.67
30	2	0	0	0.21	0.08	0.05	0.03	0.03	0	0	0	2.67	1
31	2	0.05	0.16	0.19	0.05	0.08	0	0.08	0.03	0.67	2	2.33	0.67
32	2	0.11	0.03	0.05	0	0	0	0	0	1.33	0.33	0.67	0
33	2	0.13	0.03	0.03	0	0	0	0	0	2	0.33	0.33	0
34	2	0.21	0.37	0.32	0.13	0.13	0.19	0.08	0.08	27	64.67	37	15.33
35	2	0.24	0.4	0.58	0.32	0.03	0.03	0.05	0.11	4	56.67	71.33	78.67
36	2	0.58	0.11	0.19	0.11	0	0	0	0	7.33	1.67	2.67	1.33
37	2	0.08	0.13	0.19	0.13	0.05	0.05	0.05	0.03	18	19.33	19.67	2.67
38	2	0.08	0.11	0.5	0.24	0.11	0.11	0.11	0.11	51	2.33	8	5.67
39	2	0.13	0.19	0.16	0.16	0.03	0.03	0.03	0.03	1.67	3	2.67	3.33
40	2	0.03	0.21	0.27	0.56	0.03	0.03	0.03	0.03	0.33	3	3.33	9.33





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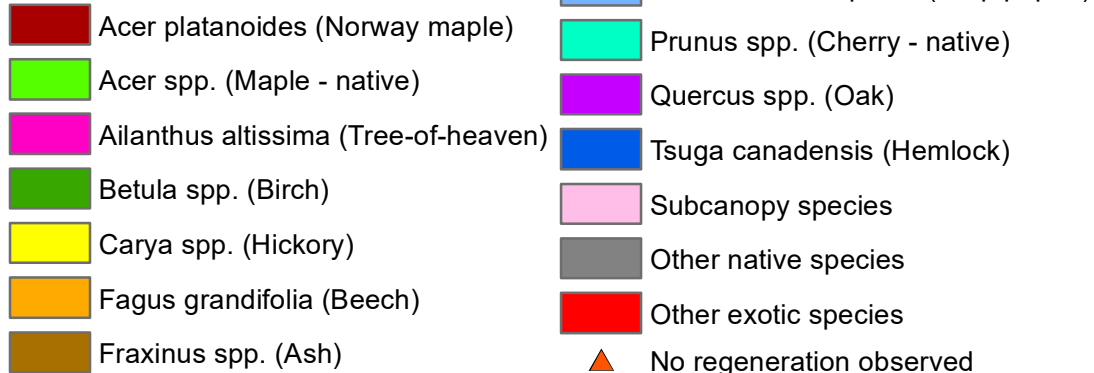


Map 3. Tree Regeneration Composition

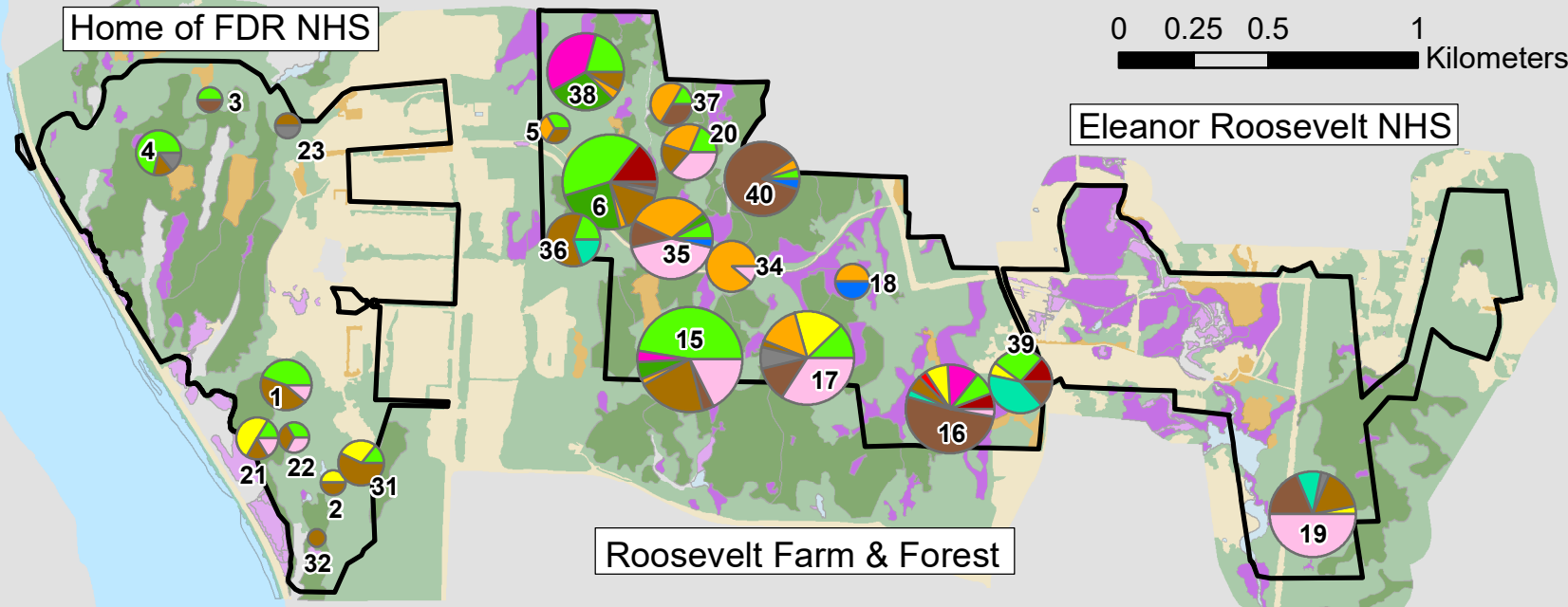
Trends in tree regeneration, including seedlings and saplings, by species group observed in forest plots in the most recent survey cycle (2019 and 2022). Plots are sampled in an alternating panel, with plots 1-20 sampled in 2019 and plots 21-40 sampled in 2022. Pie size is proportional to the total plot-level regeneration (plot-level density range: 0.02 to 2.9 stems/m²). Pies may be shifted from actual location to prevent overlap. Date: 8/16/2022.



Species in Pie Charts



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0 0.25 0.5 1
Kilometers

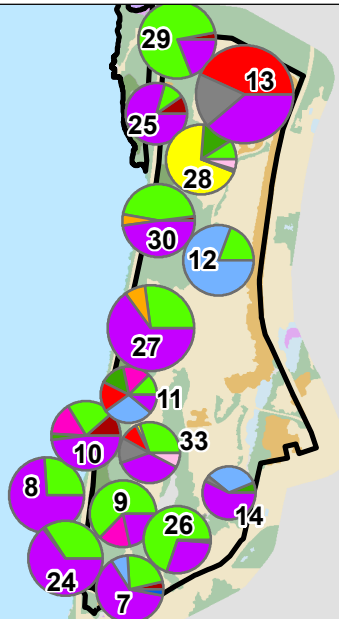
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Map 4. Tree Canopy Composition

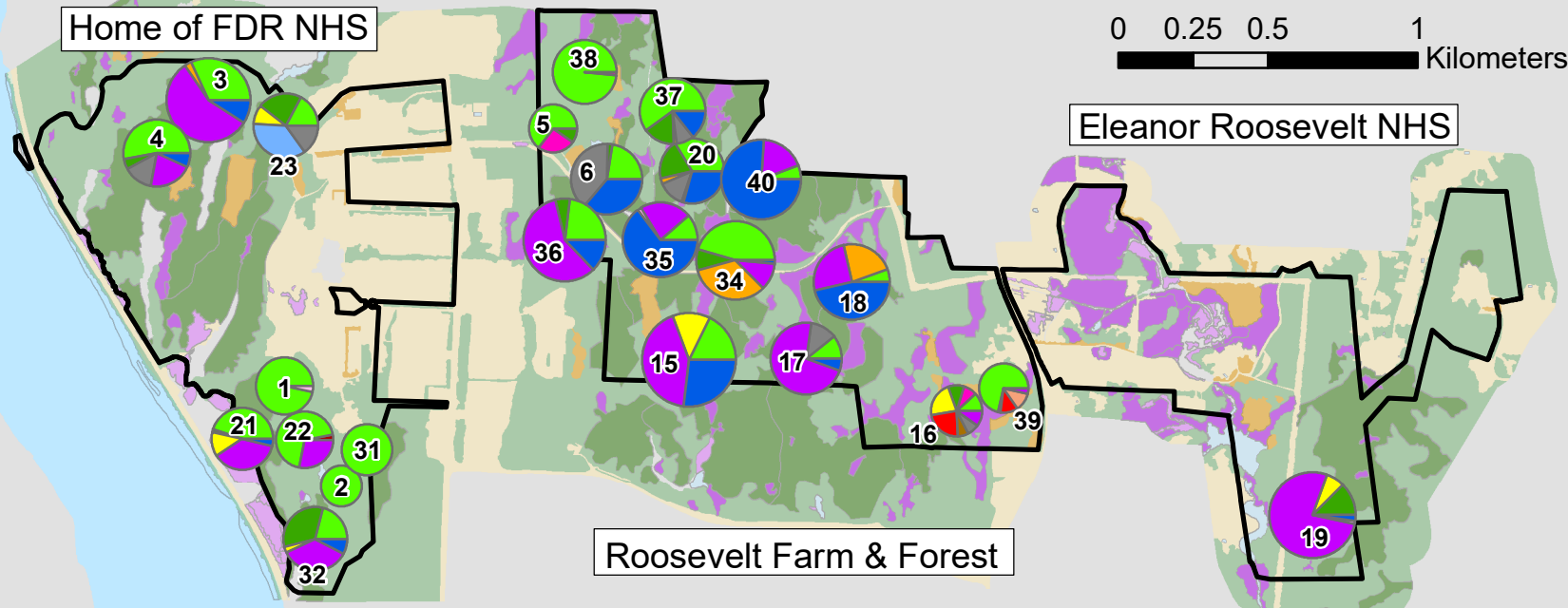
Trends in live tree basal area by species group for plots in the most recent survey cycle (2019 and 2022). Plots are sampled in an alternating panel, with plots 1-20 sampled in 2019 and plots 21-40 sampled in 2022. Pie size is proportional to the total plot-level basal area (range 10.4 to 55.8 m²/ha for a species). Pies may be shifted from actual location to prevent overlap. Date: 8/16/2022.



Species in Pie Charts



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0 0.25 0.5 1
Kilometers

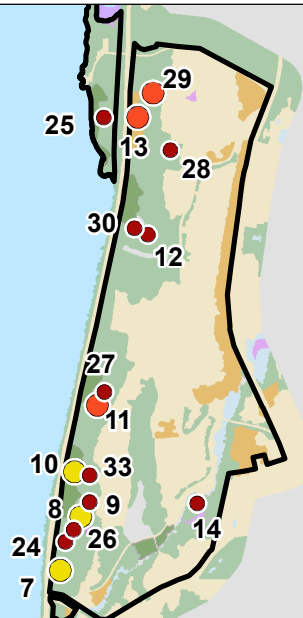
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Map 5. Tree Regeneration Stocking Index

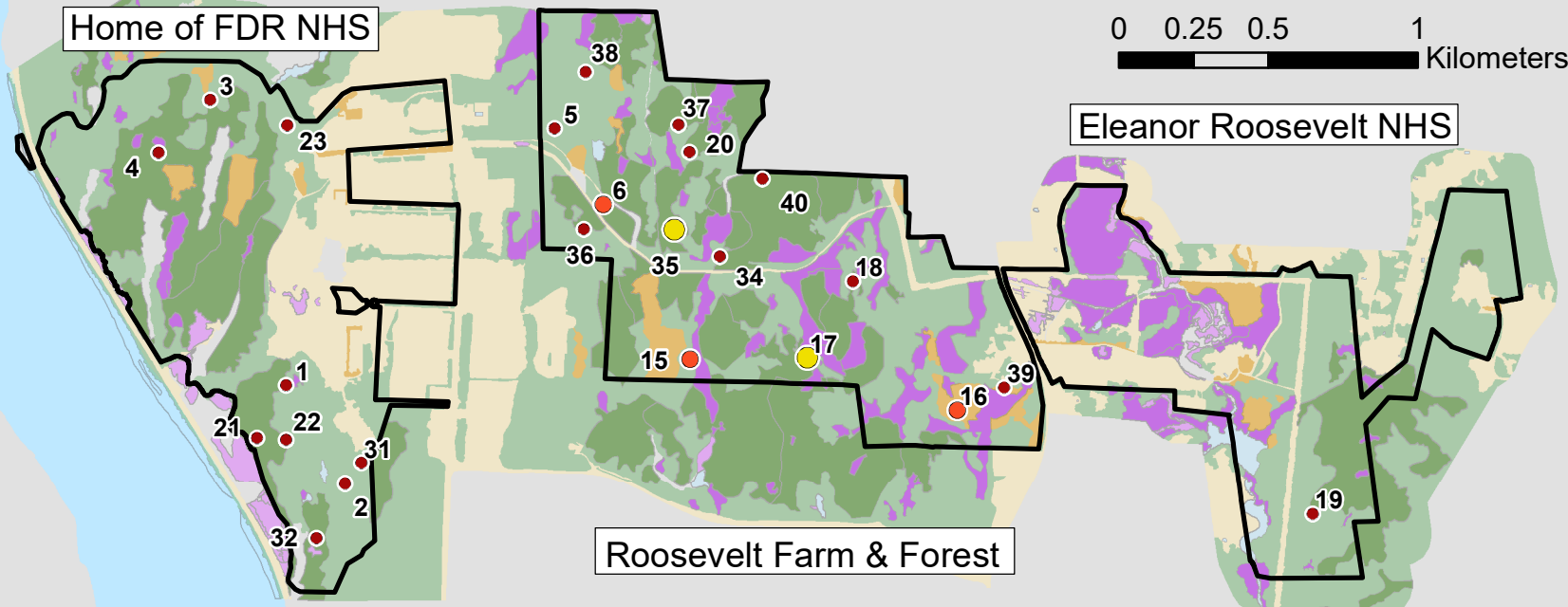
Trends in the regeneration stocking index for the most recent survey cycle (2019 & 2022). This index is a weighted sum of seedling and sapling densities where larger seedling size classes get higher weights and quantifies whether current regeneration densities are sufficient to restock a forest canopy. The stocking index only includes native canopy-forming species (range: 0-91). See Table 1 for plot-level stocking values. Date: 8/16/2022.



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.

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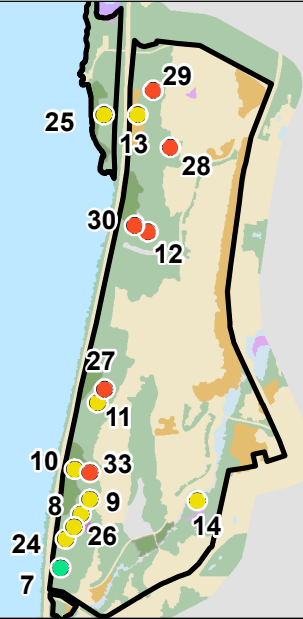


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Map 6. Index of Deer Browse Impacts

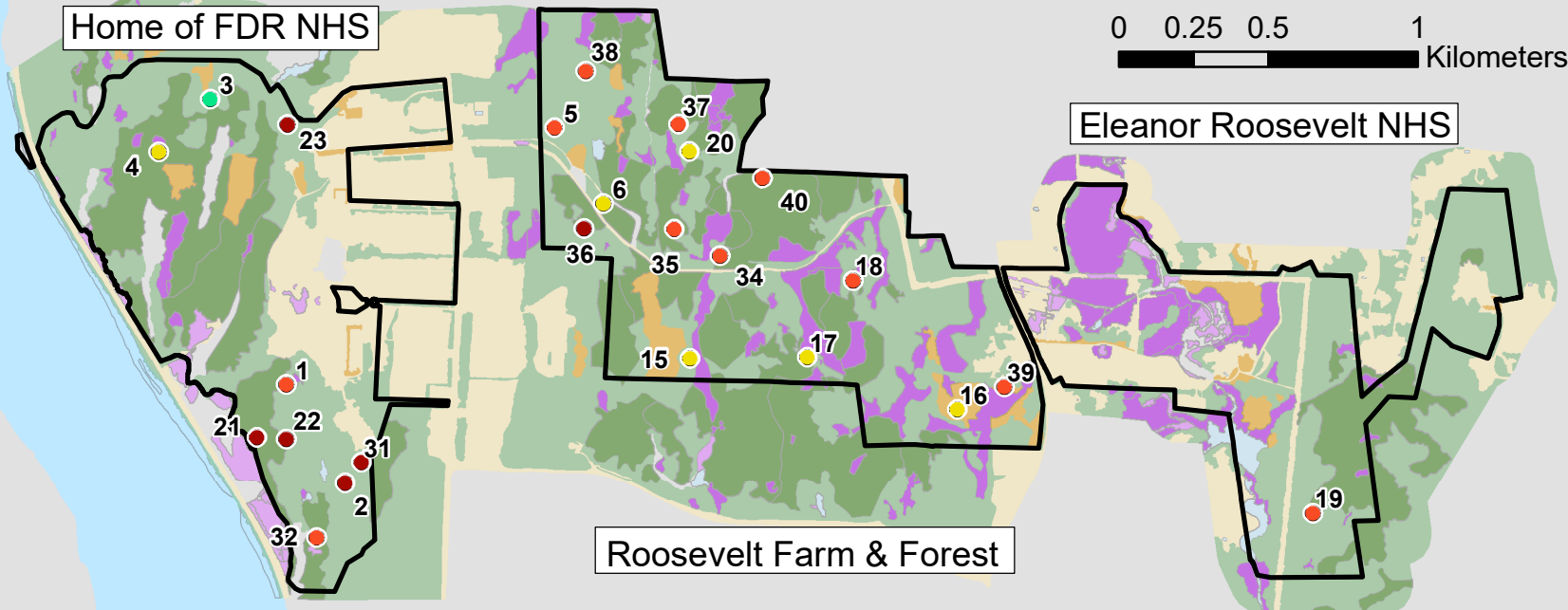
Index of deer browse impacts observed in forest plots in the most recent survey cycle (2019 & 2022). Plots are sampled in an alternating panel with plots 1-20 sampled in 2019 and plots 21-40 sampled in 2022. Deer browse impacts are assessed on a scale of 1-5 and follow the methods described on page 3 of the Assessing Vegetation Impacts from Deer (AVID) protocol. Date: 8/16/2022.



Deer Browse Index

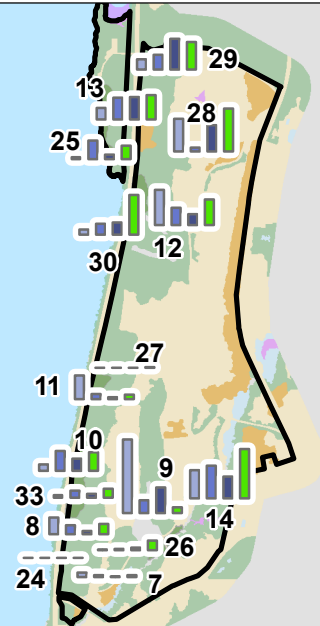
- 1) No Impact: found only in well-maintained deer exclosures.
- 2) Low Impact: deer preferred (DP) species abundant and of varying heights.
- 3) Medium impact: DP species present, but mostly under 30 cm tall. DP herbs present but stunted and flowering is uncommon.
- 4) High Impact: DP species are rare 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.

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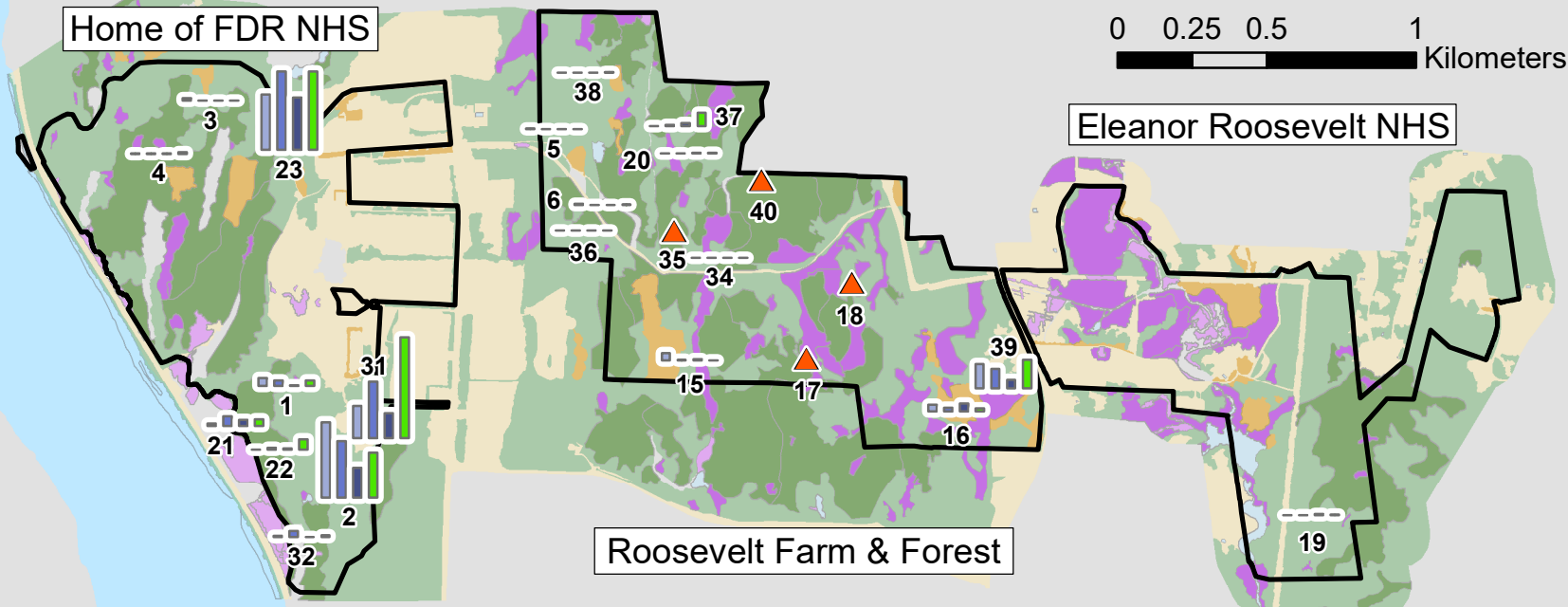


Map 7. Invasive % Cover by Cycle

Trends in percent cover of invasive species observed in plots sampled from 2007-2022. Plots are sampled in an alternating panel, with plots 1-20 sampled in 2007, 2011, 2015, and 2019 and plots 21-40 sampled in 2009, 2013, 2017, and 2022. Average invasive cover ranges from 0 to 35.4%. See Table 2 for plot-level % cover values.
Date: 8/17/2022.



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Kilometers

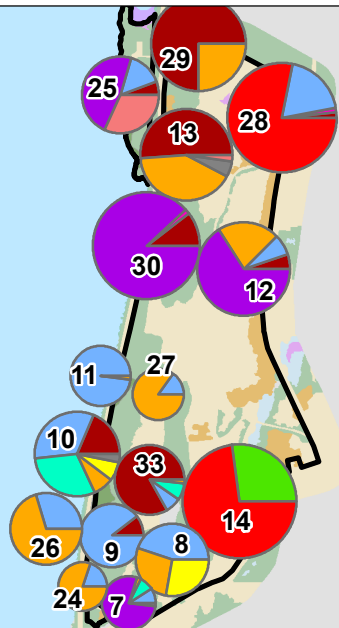
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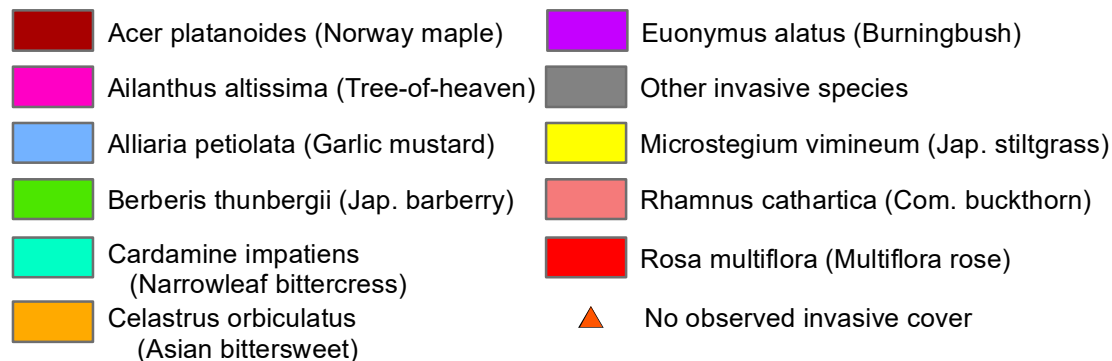


Map 8. Invasive % Cover by Species

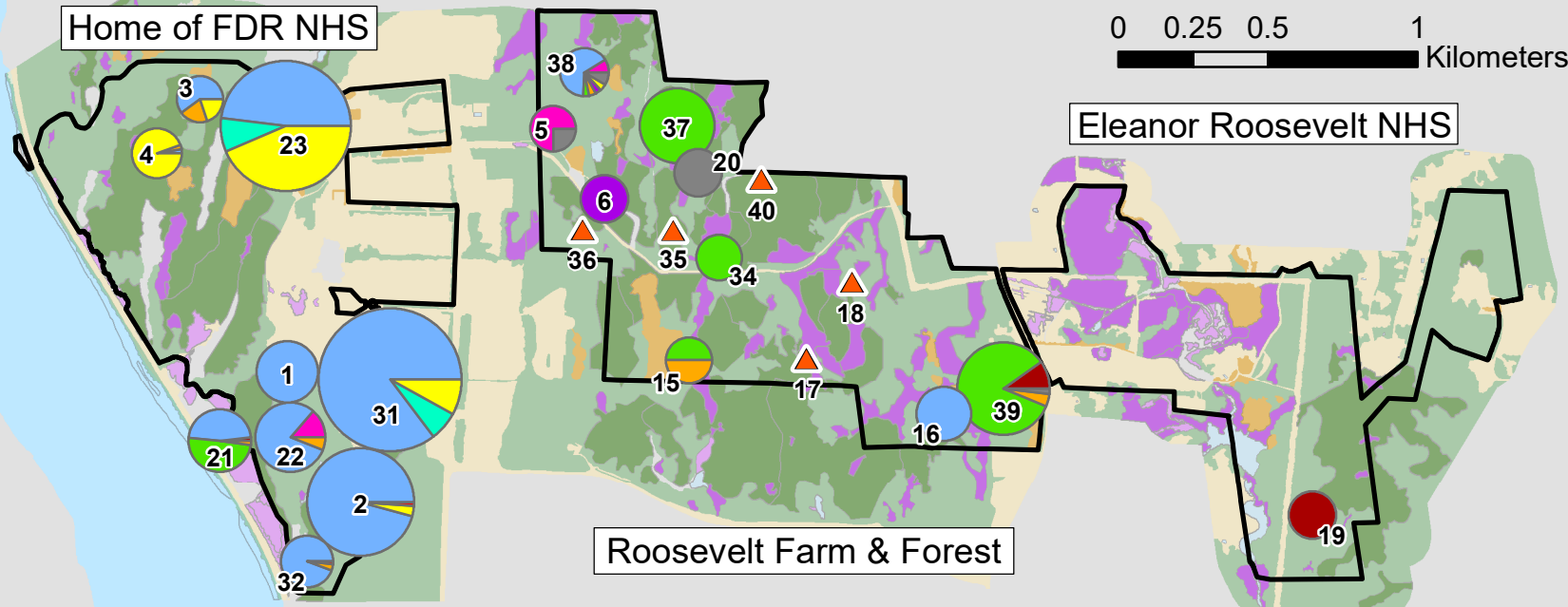
Trends in percent invasive cover by species observed in quadrats for plots in the most recent survey cycle (2019 & 2022). Plots are sampled in an alternating panel, with plots 1-20 sampled in 2019, and plots 21-40 sampled in 2022. Pie size is proportional to total invasive cover (range: 0 to 35.4%), and location may be shifted to prevent overlap. Date: 8/23/2022.



Species in Pie Charts



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Kilometers

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Table 2. Average % cover and number of invasive species detected in each plot by cycle. Cycle 1= 2007 & 2009; Cycle 2= 2011 & 2013; Cycle 3= 2015 & 2017, Cycle 4= 2019 & 2022. Plots are sampled in alternating years, with Panel 1 sampled the first year, and Panel 2 sampled the second year.

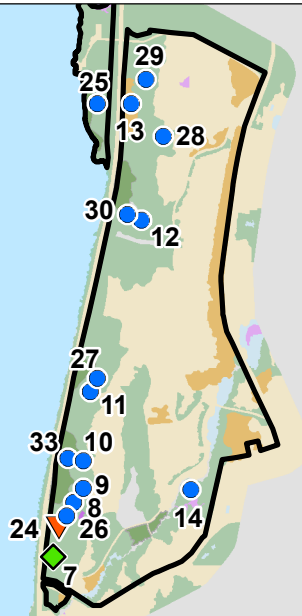
Plot	Panel	Average % Cover				Number of Species per Plot			
		Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 1	Cycle 2	Cycle 3	Cycle 4
1	1	2.7	1.9	0.3	2.0	6	6	7	4
2	1	26.3	19.7	10.4	15.7	5	4	7	6
3	1	0.9	0.2	0.0	0.1	3	4	3	6
4	1	0.0	0.0	0.0	0.5	1	4	4	5
5	1	0.3	0.0	0.0	0.1	6	4	6	6
6	1	0.5	0.0	0.0	0.2	3	2	4	5
7	1	1.6	0.7	0.3	0.6	3	4	6	6
8	1	5.7	3.0	1.2	3.5	2	5	7	13
9	1	24.3	4.1	8.4	1.8	3	7	5	8
10	1	2.3	6.6	4.1	6.2	7	7	9	10
11	1	7.8	1.6	0.5	1.4	4	7	8	8
12	1	11.6	10.9	3.5	8.5	3	7	6	7
13	1	4.0	7.3	7.6	8.1	2	6	8	7
14	1	9.4	21.4	7.2	16.3	5	11	11	11
15	1	2.6	0.2	0.5	0.0	2	6	6	6
16	1	2.2	1.1	2.6	1.0	5	4	6	5
17	1	0.0	0.0	0.0	0.0	2	2	2	3
18	1	0.0	0.0	0.0	0.0	0	0	0	1
19	1	0.0	0.0	0.4	0.2	1	2	2	2
20	1	0.0	0.0	0.0	0.2	1	2	2	2
21	2	0.8	3.3	2.0	2.3	5	5	7	9
22	2	0.0	0.6	0.5	3.5	3	4	6	9
23	2	19.3	27.3	18.2	27.4	6	6	7	9
24	2	0.0	0.0	0.0	0.1	5	9	5	4
25	2	0.6	6.0	1.5	4.3	4	6	5	7
26	2	0.0	0.4	0.9	3.2	2	5	6	4
27	2	0.1	0.1	0.1	0.3	2	3	5	4
28	2	10.6	1.2	8.6	14.0	6	8	8	9
29	2	3.4	4.9	10.1	9.1	5	6	6	7
30	2	1.6	3.6	4.0	13.2	5	4	6	5
31	2	11.3	19.7	8.8	35.4	2	5	6	6
32	2	0.4	2.1	0.1	0.7	5	8	6	5
33	2	0.8	2.4	1.3	2.9	6	6	6	6
34	2	0.0	0.0	0.0	0.0	3	2	1	3
35	2	0.0	0.0	0.0	0.0	0	0	0	1
36	2	0.0	0.0	0.0	0.0	3	3	3	7
37	2	0.0	0.4	0.9	4.7	3	1	1	3
38	2	0.0	0.0	0.0	0.3	2	5	4	8
39	2	8.4	6.9	3.0	9.8	7	5	6	8
40	2	0.0	0.0	0.0	0.0	0	0	1	1

Table 3. Number of plots out of 40 where priority invasive species were detected by cycle. Cycle 1= 2007 & 2009; Cycle 2= 2011 & 2013; Cycle 3= 2015 & 2017; Cycle 4= 2019 & 2022. This list includes all exotic vascular plant species that are capable of dominating Northeastern US forest habitats, but does not include all exotic species detected in ROVA forest plots.

Latin Name	Common Name	Cycle 1	Cycle 2	Cycle 3	Cycle 4
<i>Acer palmatum</i>	Japanese maple	0	1	0	0
<i>Acer platanoides</i>	Norway maple	13	18	22	26
<i>Ailanthus altissima</i>	tree-of-heaven	18	14	13	15
<i>Alliaria petiolata</i>	garlic mustard	28	31	29	30
<i>Anthriscus sylvestris</i>	wild chervil	2	9	6	10
<i>Berberis thunbergii</i>	Japanese barberry	14	20	31	27
<i>Cardamine impatiens</i>	narrowleaf bittercress	2	4	9	11
<i>Celastrus orbiculatus</i>	Asian bittersweet	19	26	24	28
<i>Euonymus alatus</i>	burningbush	8	13	19	27
<i>Glechoma hederacea</i>	ground ivy	5	10	9	7
<i>Gleditsia triacanthos</i>	honey locust	0	0	0	2
<i>Hesperis matronalis</i>	dames rocket	3	3	3	2
<i>Ligustrum</i> spp.	privet	0	2	4	5
<i>Lonicera</i> spp.	exotic bush honeysuckle	9	13	11	9
<i>Lonicera japonica</i>	Japanese honeysuckle	1	0	1	0
<i>Lysimachia nummularia</i>	creeping jenny	3	3	2	2
<i>Lythrum salicaria</i>	purple loosestrife	0	0	0	1
<i>Microstegium vimineum</i>	Japanese stiltgrass	7	8	8	12
<i>Phragmites australis</i>	common reed	1	2	1	1
<i>Rhamnus cathartica</i>	common buckthorn	2	4	4	6
<i>Robinia pseudoacacia</i>	black locust	3	7	4	6
<i>Rosa multiflora</i>	multiflora rose	10	15	17	24
<i>Rubus phoenicolasius</i>	wine raspberry	1	2	1	2
<i>Vincetoxicum</i> spp.	swallow-wort	0	1	0	2
<i>Wisteria</i> spp.	exotic wisteria	0	2	1	2



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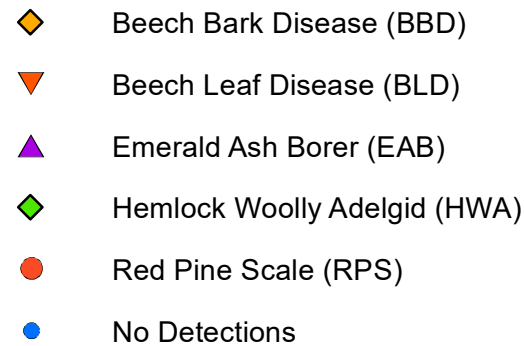


Map 9. Forest Pest/Pathogen Detections

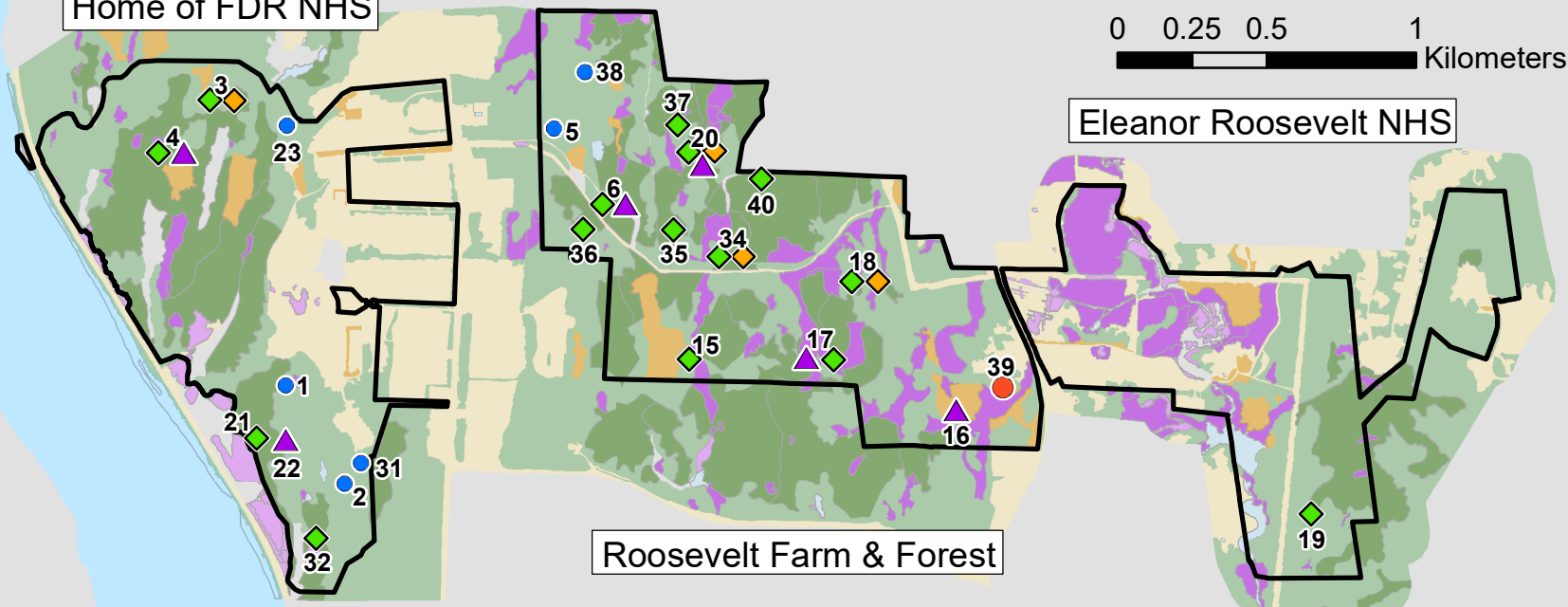
Priority pest and pathogen detections in forest plots sampled from 2019-2022. Plots are sampled in an alternating panel with plots 1-20 sampled in 2019 and plots 21-40 sampled in 2022. Plots with multiple pests present (e.g. 3, 4, 6, etc.) have multiple symbols. Note that BLD may be more widespread than map indicates, as plots 1-20 were sampled prior to the first detection in 2022. Date: 8/17/2022.



Pest/Pathogen Detections

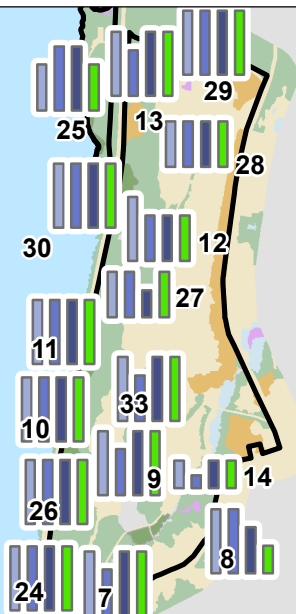


Home of FDR NHS



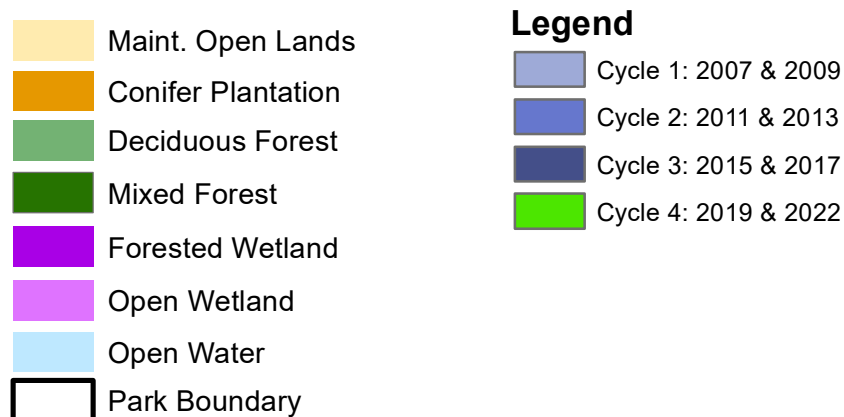


Vanderbilt Mansion NHS

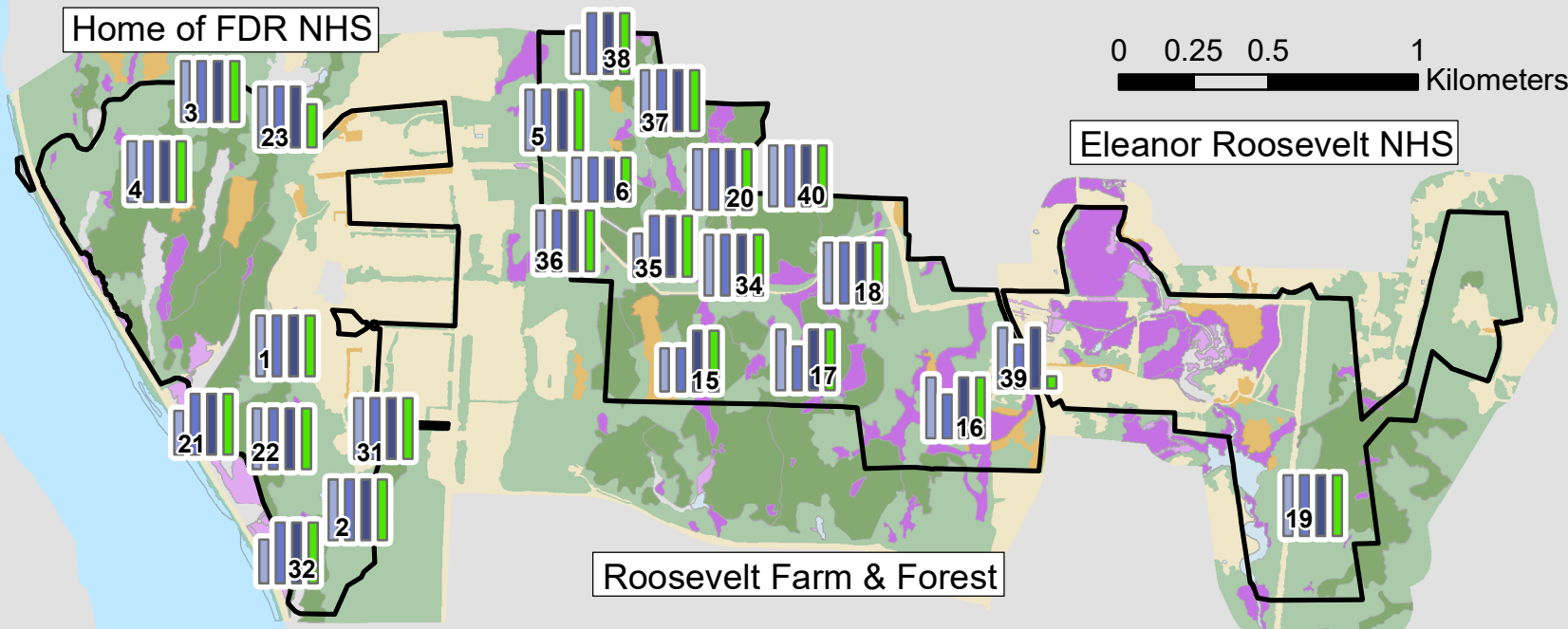


Map 10. Canopy Cover by Cycle

Trends in tree canopy cover in forest plots sampled from 2007-2022. Plots are sampled in an alternating panel, with plots 1-20 sampled in 2007, 2011, 2015, and 2019, and plots 21-40 sampled in 2009, 2013, 2017, and 2022. Canopy cover ranges from 10 - 25% to > 75%. Date: 8/17/2022.



Home of FDR NHS



0 0.25 0.5 1
Kilometers

Eleanor Roosevelt NHS

Roosevelt Farm & Forest



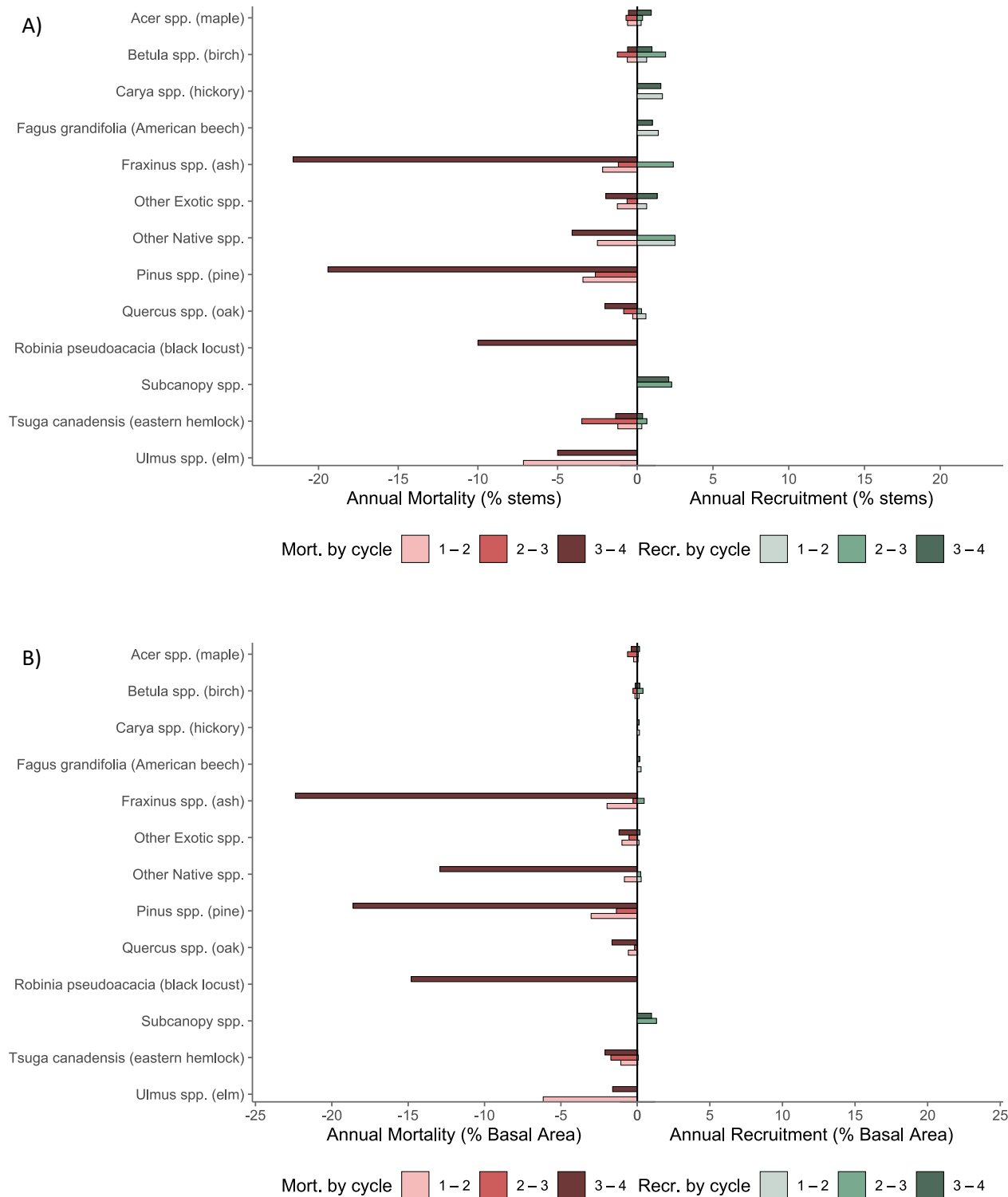


Figure 2. Annual tree mortality and recruitment rates by cycle in Roosevelt-Vanderbilt National Historic Sites. Figure A represents % of stems that died (mortality) and the % of stems gained (recruitment) per year from the previous cycle. Figure B is the % of basal area per year that died or was gained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

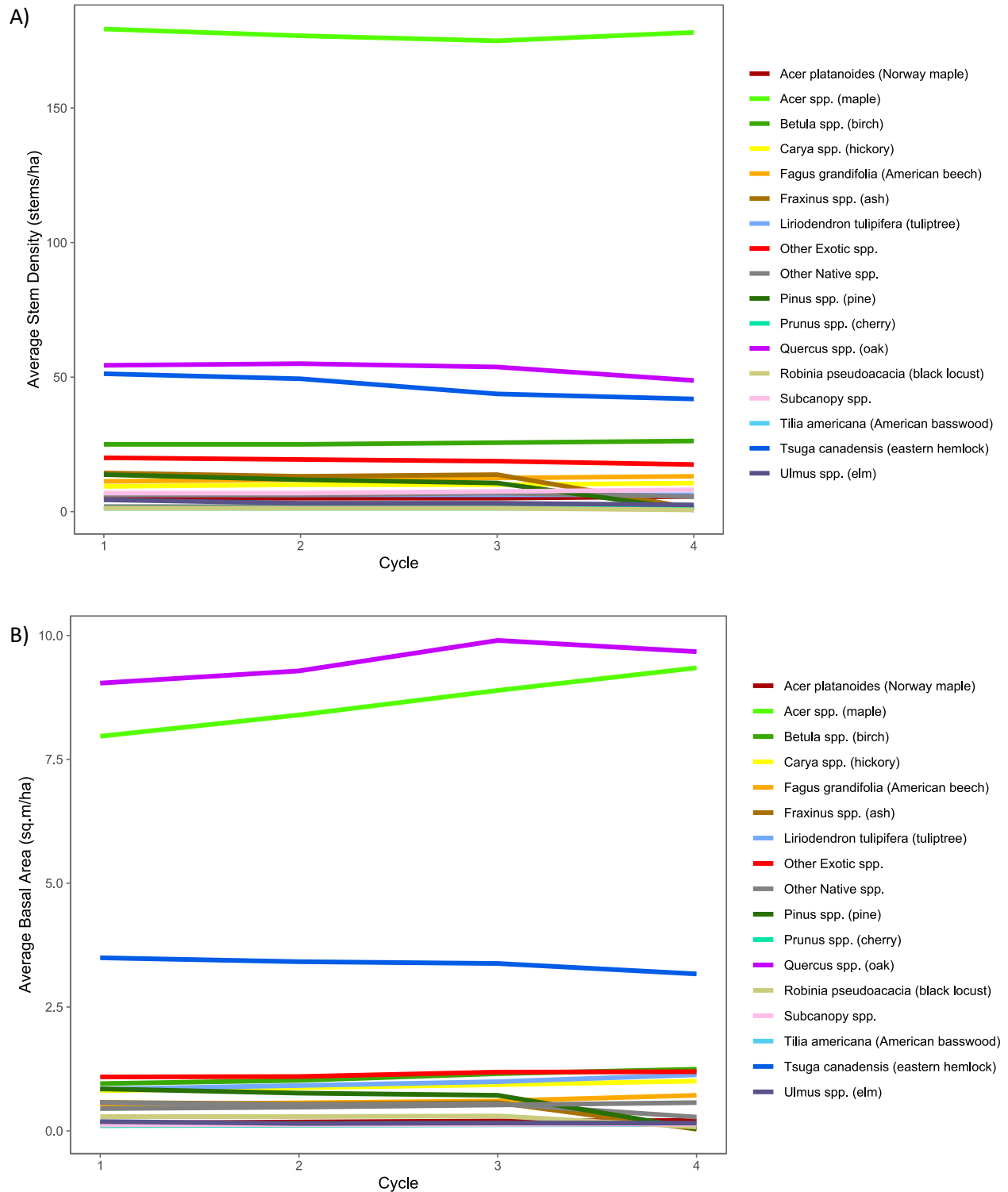


Figure 3. Change in stem density (A) and basal area (B) by species and cycle in Roosevelt-Vanderbilt National Historic Sites. Cycle 1 = 2006 – 2009; Cycle 2 = 2010 – 2013; Cycle 3 = 2014 – 2017; Cycle 4 = 2018 – 2022.