

Forest Data Summaries for Marsh-Billings-Rockefeller NHP: 2006-2018

Background

Summaries are based on data collected in Northeast Temperate Network (NETN) long-term forest monitoring plots. There are 24 NETN forest plots in MABI. Each plot is sampled on an alternating 4-year cycle, with plots 1-12 sampled in 2006, 2010, 2014, and 2018, and plots 12-24 sampled in 2008, 2012, and 2016. Within each forest plot, tree and stand measurements, including an assessment of deer browse impact, are made within 20 x 20 m square plots. Tree regeneration is tallied by size class within three 2-m radius circular microplots within each square plot. Coarse woody debris (CWD) is assessed using line intersect sampling along three 15-m transects originating at plot center. Understory diversity is monitored within eight 1-m² quadrats, and soil samples are obtained from a location adjacent to the plot. Plots are permanently marked and measured at the same location every cycle. For a more detailed description of the forest monitoring protocol, including background information, field methods, and sample design, refer to the NETN forest monitoring protocol.

This document provides summaries and interpretations of forest health to help inform park staff of any potential issues detected by NETN forest monitoring. This report has been updated to include results from the 6/5-6/11/2018 survey, which is the first of two panels in Cycle 4. Note that summaries are considered preliminary until after the 2018 data are thoroughly checked and certified at the end of the field season.

Summary

Overall, forest vegetation in MABI is relatively healthy, particularly when compared to other parks in NETN. The understory is largely composed of native species, and where present, invasive species are at low levels (see Maps 7 & 8). Overall regeneration densities are sufficiently stocked for areas with low deer browse (see Map 4), and represent a range of seedling size classes (see Map 2). Coarse woody debris volume has increased over time, with the majority of plots in MABI meeting minimum volume thresholds (see Maps 11 & 12). There are, however, several potential issues that warrant concern. Deer impacts are moderate (see Map 3) and may be increasing, particularly near the boundaries of the park. Regeneration in roughly half of the plots in MABI are dominated by beech (*Fagus grandifolia*), white ash (*Fraxinus americana*), and low canopy species (see Map 5). In addition, several priority invasive species have increased in frequency over time (see Table 4). Silvicultural activities have affected 14 out of 24 plots (58% of plots) since monitoring began in 2006 (see Tables 2 & 5). The regeneration layer response to harvesting largely depends on the regeneration that was present prior to harvesting. Most notably, the abundance of *Rubus* spp. has increased dramatically in roughly half of plots affected by harvesting, and may suppress tree regeneration over time (see Map 10).

Interpretation of Maps

Map 1. Tree Regeneration by Cycle

Tree regeneration is mixed across the park. Some plots have seen a sharp increase in regeneration densities (plots 6, 17, and 19) between Cycle 1 (2006 & 2008) and the most recent survey (2016 & 2018), while a few have decreased (plots 14 and 23). Roughly half of plots have had stable, but low regeneration densities over the last 3 to 4 cycles.

Map 2. Regeneration by Size Class

Healthy forests typically have tree seedlings and saplings of varying sizes, whereas forests with impacts from deer browse tend to be dominated by seedlings less than 30 cm (~1 ft) tall. MABI appears to have a good range of size classes represented, although eight plots (33%) lack saplings (Table 1).

Map 3. Index of Deer Browse Impacts: 2016 & 2018

The index of deer browse impacts (DBI) is a 1 to 5 scale that qualitatively assesses deer impacts to a plot. A DBI value of 1 describes a forest understory in the complete absence of deer and a value of 5 corresponds to an understory experiencing very high deer impacts (i.e. deer-preferred tree regeneration

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and herbaceous species are absent and even on non-preferred species are browsed). Mean DBI scores above 3.5 indicate that forest plots have sustained such heavy browse that the understory composition has shifted from browse-preferred woody and herbaceous species (e.g., sugar maple and liliaceous herbs) to browse-resistant or non-preferred species (e.g., beech, ferns and invasive species). The average DBI in Cycle 3 was 3.0, medium impact. This value is up from the Cycle 2 (2010 & 2012) average of 2.5, low impact, suggesting that deer impacts are potentially increasing. In addition, the 12 plots sampled in Cycle 4 (2018) averaged 3.25 for DBI, whereas the same group of plots in Cycle 3 (2014) averaged a DBI of 2.92. Plots with high DBI scores tend to be near the park boundary.

Map 4. Regeneration Stocking Index: 2016 & 2018

The regeneration stocking index quantifies whether current seedling and sapling densities are sufficient to restock a forest canopy, and only includes canopy-forming tree species. The index is a weighted sum of native seedling and sapling densities where larger size classes are weighted higher in the calculation. Areas with high deer impacts require a stocking index of 100 to be sufficiently stocked to replace the forest canopy. Based on the most recent sampling period (2016 & 2018), six out of 21 plots (28%) are sufficiently stocked for areas with high deer impacts, and 15 out of 21 plots (72%) are sufficiently stocked for areas with low deer impacts. Nine out of 24 plots (37%) are severely understocked (Table 1). However, three of those plots (5, 10, and 20) are dominated by mature hemlock (*Tsuga canadensis*), which typically have low regeneration rates.

Timber harvesting, which has occurred on fourteen out of 24 plots since monitoring began (Table 2), has influenced stocking index trends. Plots that had a high stocking index before a harvest (stocking index > 50) decreased, whereas plots that had low stocking index before harvest (stocking index < 50) generally increased in this index. Of the three plots that were cut before cycle 2 (plots 2, 11, and 17), all three had a higher stocking index two cycles post-harvest than immediately after the harvest.

Map 5. Regeneration Composition

Sugar maple (*Acer saccharum*) makes up 33% of seedling and sapling densities in MABI. Sugar maple seedlings between 15 cm and 100 cm tall are also behind the regeneration increases in plots 6, 17, and 19 (Map 1& 2). Low canopy species (i.e. hophornbeam (*Ostrya virginiana*) and striped maple (*Acer pensylvanicum*)) make up another 23% of the regeneration layer. The presence of native low canopy trees does not indicate an outright problem, as these species contribute to overall forest diversity and structure. However, striped maple and other browse-resistant low canopy species have been shown to increase in areas with high deer densities to the point where the regeneration of other tree species is suppressed. We recommend monitoring the relative abundance of low canopy species in MABI in anticipation of this potential future concern. Ash and beech make up nearly a third (23% and 8%, respectively) of the regeneration in MABI. The health of both these species is threatened - ash by emerald ash borer (EAB) and beech by beech bark disease (BBD). Eastern hemlock (*Tsuga canadensis*) and oak (*Quercus* spp.) each make up only about 2% of seedlings and saplings.

Map 6. Tree Composition by Basal Area

Basal area, which is a common metric to assess tree abundance, is the cross-sectional area occupied by each species (based on the diameter at breast height) on a plot, converted to m²/ha. Plots with a high basal area have larger and/or more trees than plots with a low basal area. Plot basal area in MABI is relatively similar across plots compared to other parks, although composition varies considerably among plots. The most abundant species in the regeneration layer, sugar maple, is also the most abundant species in the canopy at 33%. Sugar maple is therefore likely to remain a dominant part of the forest in MABI into the near future. The second most abundant species, however, eastern hemlock, is only a small percentage of the regeneration layer. Low regeneration rates and the likelihood of future hemlock woolly adelgid (HWA) infestation suggest that hemlock may decline in importance over time. Native pines are also

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relatively abundant in the canopy (23%), but not well represented in the regeneration layer. On the other hand, ash and beech, currently occupy only 9% of the canopy based on basal area, but make up almost a third of total regeneration. These factors indicate that future forest composition may shift away from hemlock and potentially towards ash, beech, and low canopy species.

Map 7 + 8. Priority Invasive Species % Cover by Cycle and Composition

There are very few priority invasive species present in MABI forest plots. Only four species were detected in quadrats in the most recent survey cycle (2016 & 2018), and therefore given cover estimates (Map 8): common buckthorn (*Rhamnus cathartica*), exotic bush honeysuckle (*Lonicera* spp.), garlic mustard (*Alliaria petiolata*), and Japanese barberry (*Berberis thunbergii*). The highest average cover found for a priority invasive in MABI was 0.5% for common buckthorn, detected in plot 4 in 2018 (Map 7). More priority invasive species were detected at the plot level (Table 3), with nearly half of the plots having at least one priority invasive species present (Table 4). In addition, the number of plot detections of exotic bush honeysuckle and common buckthorn doubled between Cycle 2 and Cycle 3.

Map 9. Earthworms: Presence or Absence

Earthworms are present in 14 out of 24 plots. Interestingly, we have not detected earthworms in the plots closest to the mansion and grounds. Snake worms (*Amyntas agrestic*) were not detected in the plots sampled in 2018 (1-12), which is the first survey after they were detected in MABI. However, the timing of sampling in MABI is not ideal for distinguishing snake worms from the more common European earthworms (family: Lumbricidae), and the snake worm may have been undetected.

Map 10. *Rubus* spp. Cover by Cycle

Rubus spp. (blackberries and raspberries) are common in disturbed areas with lots of light. Their percent cover has increased dramatically on certain plots after silviculture events: particularly on plots 2, 6, 12, 17, and 24. Most species of *Rubus* are native and are a natural part of the landscape. However, *Rubus* spp. cover has become so dense in several of the plantations that tree regeneration may be suppressed (e.g. average cover of *Rubus* spp. on plot 24 is 91%).

Map 11 + 12. Coarse Woody Debris Levels and by Cycle

Coarse woody debris (CWD) volume has increased from 33.7 m³/ha (481.6 ft³/ac) in Cycle 1 to 46.7 m³/ha (667.4 ft³/ac) in Cycle 3. Mean CWD volume is even higher for the first 12 plots sampled in Cycle 4 (2018), averaging 50.1 m³/ha (716.0 ft³/ac). A recent review of temperate and boreal forest organisms that are dependent on dead wood found a threshold of 20-50 m³/ha (285.8-714.6 ft³/ac) of CWD volume was required to support a broad suite of these species (Müller and Bütler 2010). Using these thresholds, 18 out of 24 plots in MABI meet this minimum requirement, with 10 plots even exceeding the 50 m³/ha threshold. Results indicate that MABI's continued commitment to retain and/or enhance CWD during forestry operations has been effective, and that most forest plots in the park meet minimum CWD thresholds. It is important to note, however, that very large CWD pieces, which are important habitat for species like American marten and black bears, may still be lacking in MABI. We just are not aware of any published thresholds for temperate forests that can be used for comparison.

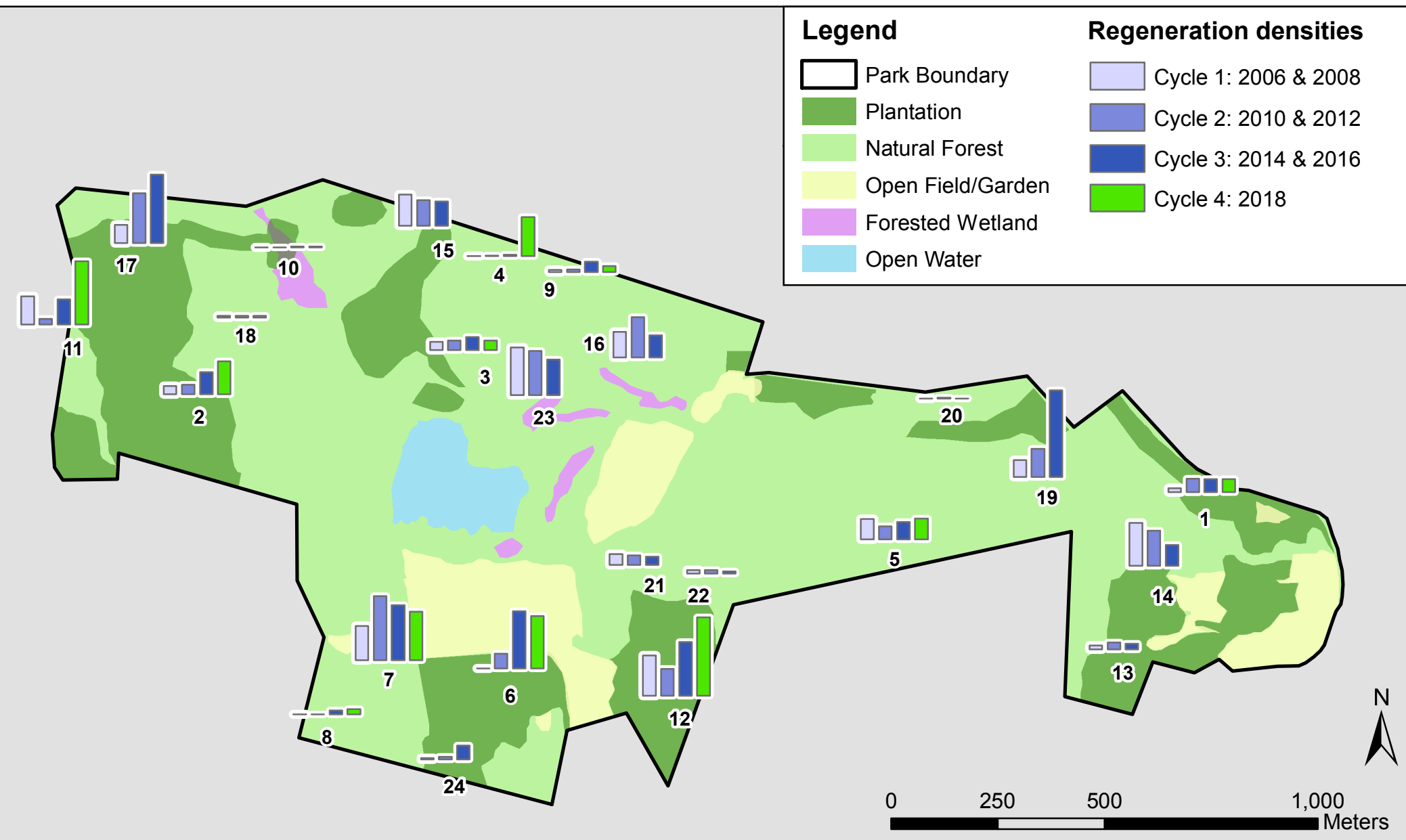
Table 5. Status of standing trees over time

More than half of the 24 plots in MABI have been harvested since monitoring began in 2006, with most harvesting occurring between the Cycle 2 and Cycle 3 survey cycle. Plots in plantations were harvested more frequently than natural stands, and more basal area was typically harvested from plantations (average: 13.3 m²/ha; range 3.5-22.5 m²/ha) than natural stands (average: 9.0 m²/ha; range: 2.4-19.0 m²/ha). Plot live basal area ranges from 11.7 to 50.8 m²/ha and dead basal area ranges from 0 to 6.7 m²/ha for the most recent survey cycle (2016 & 2018), with similar between natural stands and plantations. Both frequency and basal area of tree recruits are more frequent in plantations than natural stands.



Map 1. Regeneration by Cycle

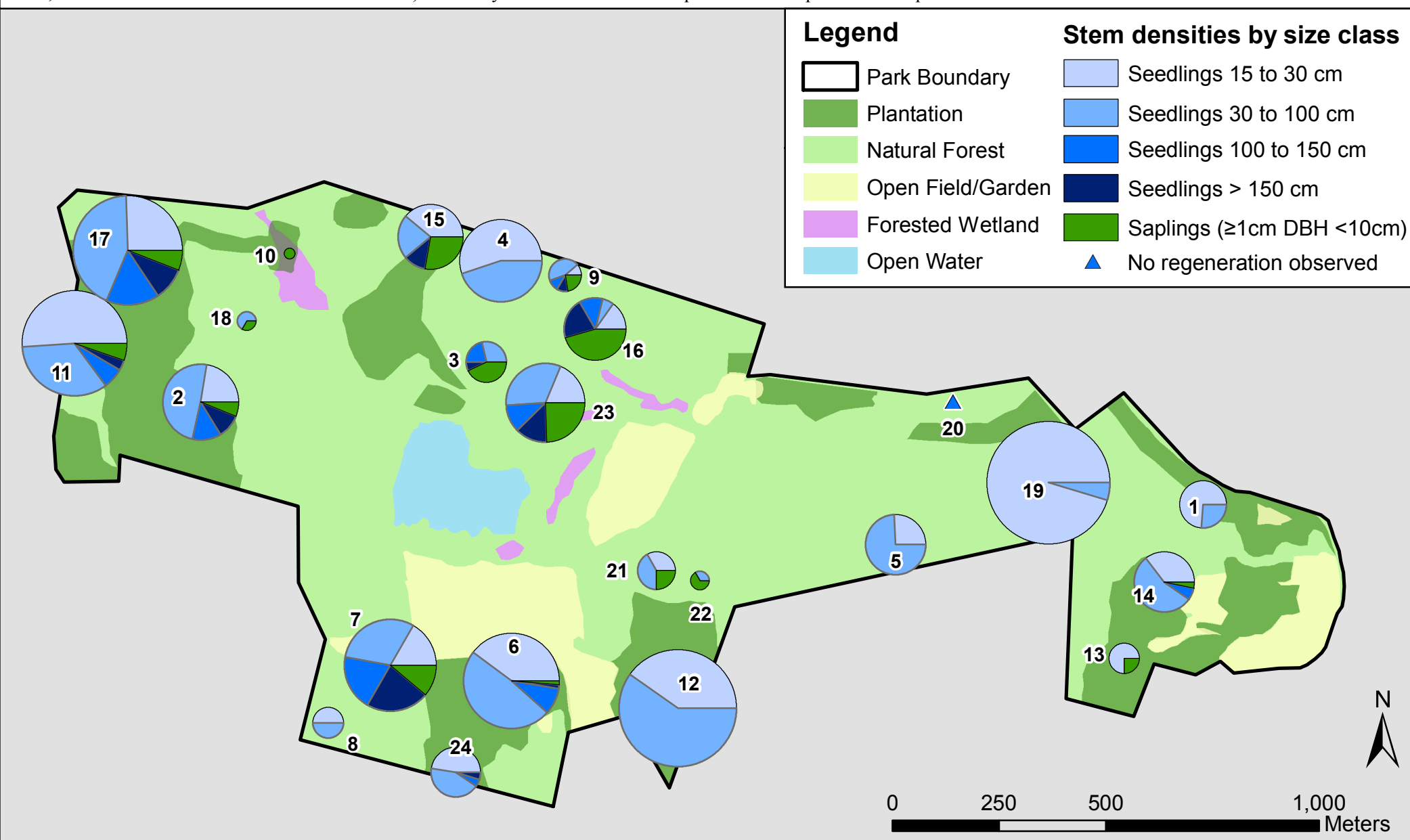
Trends in tree regeneration stem densities, including seedlings and saplings, observed in forest plots sampled from 2006-2018. Each plot is sampled on a 4-year cycle in an alternating panel, with plots 1-12 sampled in 2006, 2010, 2014, and 2018, and plots 13-24 sampled in 2008, 2012, and 2016. Densities range from 0 to 34,218 stems/hectare. Date: 6/18/2018.





Map 2. Regeneration by Size Class

Trends in tree regeneration stem densities by size class observed in forest plots in the most recent 4 years of sampling (2016 & 2018). Each plot is sampled on a 4-year cycle in an alternating panel, with plots 1-12 sampled in 2018, and plots 13-24 sampled in 2016. Pie size is proportional to the total plot-level regeneration (plot-level density range: 0 to 30,770 stems/hectare for an individual size class). Pies may be shifted from actual plot location to prevent overlap. Date: 6/18/2018.



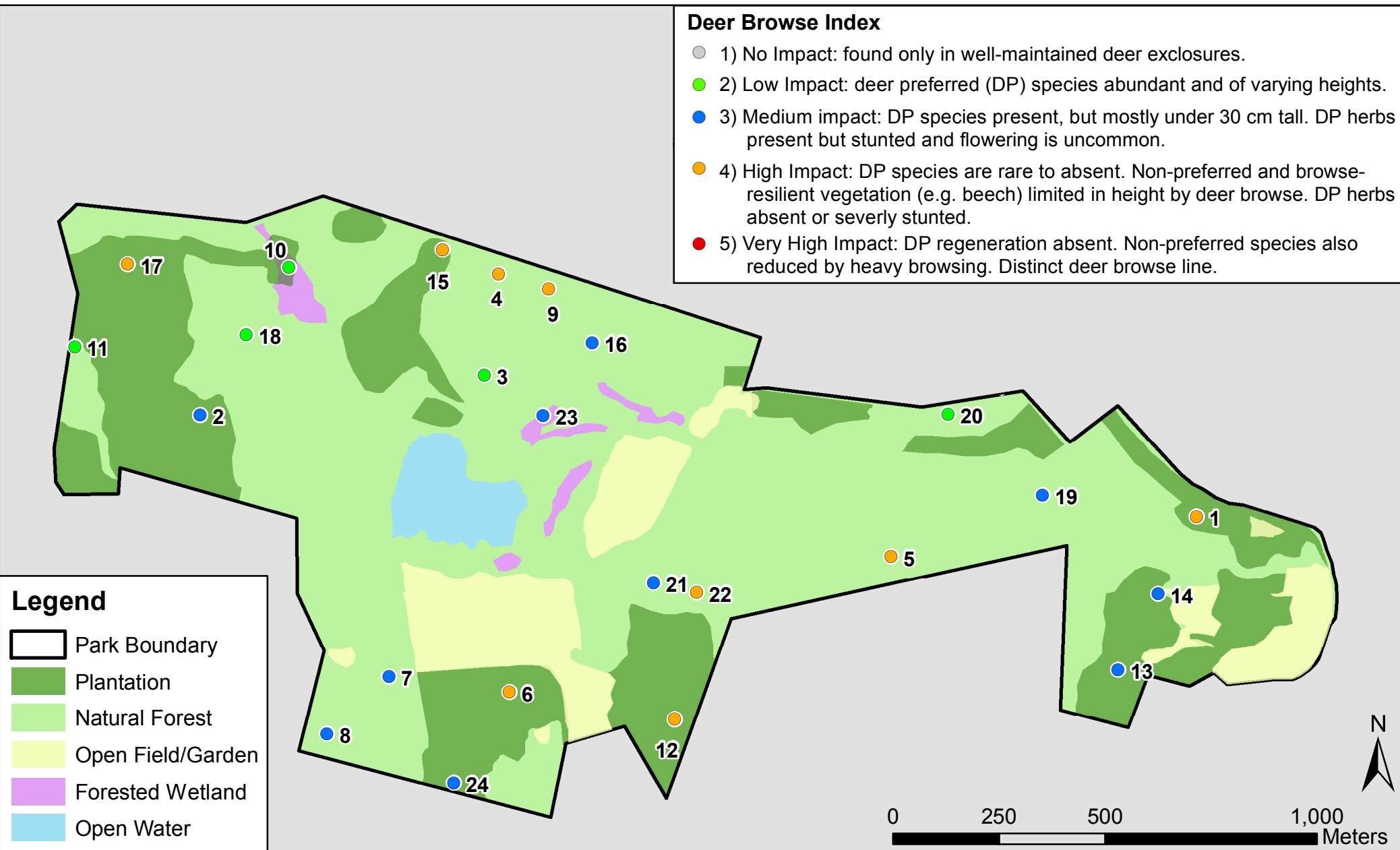


Map 3. Index of Deer Browse Impacts: 2016 & 2018

Index of deer browse impacts observed in forest plots in the most recent 4 years of sampling (2016 & 2018). Each plot is sampled on a 4-year cycle, with plots 1-12 sampled in 2018 and plots 13-24 sampled in 2016. Deer browse impacts are assessed on a scale of 1-5, with 1 representing no impact and 5 representing severe impacts. Date: 6/18/2018.

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.





Map 4. Regeneration Stocking Index: 2016 & 2018

Trends in the regeneration stocking index for the most recent 4 years of sampling (2016 & 2018). The index is a weighted sum of seedling and sapling densities where larger seedling size classes get higher weights. The stocking index is averaged over three 2-m radius microplots per forest plot (range 0-359). See Table 1 for plot-level stocking index values. Date: 6/18/2018.

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.

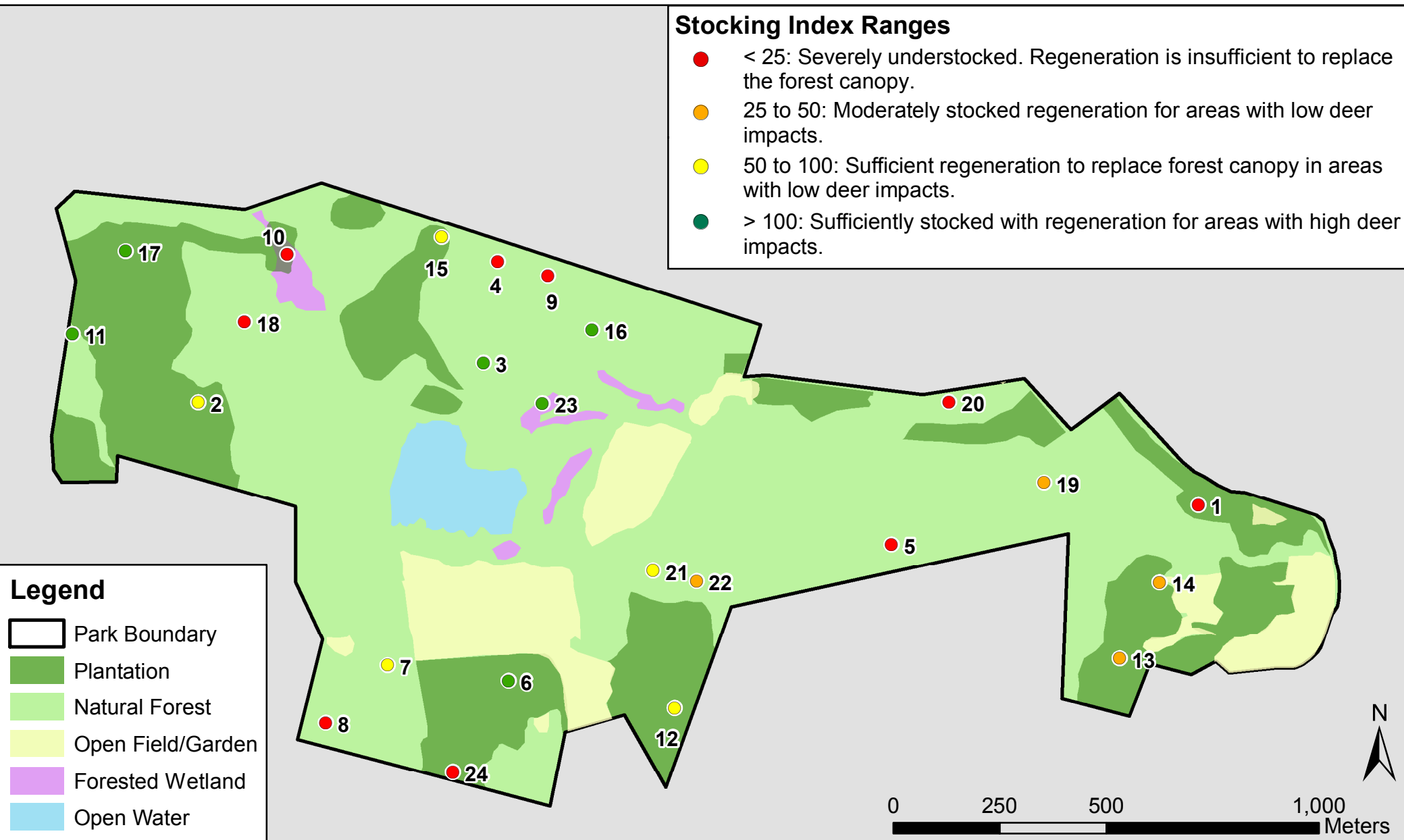


Table 1. Average plot-level seedling and sapling stem densities per hectare and stocking index by cycle. Cycle 1 = 2006 & 2008; Cycle 2 = 2010 & 2012; Cycle 3 = 2014 & 2016; Cycle 4 = 2018 only. Plots are sampled in alternating years, with Panel 1 sampled the first year, and Panel 2 sampled the second year. The stocking index qualifies whether current regeneration densities are sufficient to restock a forest canopy, and only includes native canopy-forming tree species. The index is a weighted sum of seedling and sapling densities where larger seedling classes get higher weights. Green fields are plots that have a stocking index >100, sufficient to replace a forest canopy in areas of high deer impacts. Color coding matches the Regeneration Stocking Index map. See Table 2 for plot harvesting history.

Plot	Panel	Seedlings per hectare				Saplings per hectare				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	1591.5	5305.2	5039.9	5039.9	0.0	0.0	0.0	0.0	2.0	9.3	10.0	8.0
2	1	795.8	2917.8	8223.0	12201.9	2387.3	795.8	530.5	795.8	51.0	18.0	21.0	99.0
3	1	3183.1	2652.6	3448.4	2122.1	0.0	1061.0	1591.5	1591.5	44.0	130.7	177.3	137.3
4	1	0.0	265.3	530.5	15385.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	23.7
5	1	7162.0	4774.6	6631.5	8223.0	795.8	265.3	265.3	0.0	0.0	0.0	0.0	0.0
6	1	0.0	5835.7	22547.0	20424.9	0.0	0.0	0.0	265.3	0.0	7.3	57.0	115.7
7	1	13528.2	25199.5	20955.4	16976.5	0.0	0.0	795.8	2122.1	3.0	22.3	44.3	68.7
8	1	0.0	0.0	1591.5	2122.1	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.7
9	1	795.8	1061.0	3713.6	1856.8	0.0	0.0	265.3	530.5	1.0	7.3	18.0	19.0
10	1	0.0	0.0	0.0	0.0	0.0	0.0	265.3	265.3	0.0	0.0	16.7	16.7
11	1	9549.3	1856.8	9284.0	23608.0	1591.5	265.3	530.5	1326.3	120.0	20.0	70.0	172.3
12	1	15915.5	10610.3	21220.7	31035.2	0.0	0.0	0.0	0.0	20.0	13.3	42.3	62.3
13	2	1326.3	2122.1	1591.5		265.3	530.5	530.5		50.3	52.0	34.7	
14	2	16446.0	13528.2	7957.7		530.5	265.3	265.3		53.3	45.7	37.0	
15	2	7692.5	5039.9	6896.7		4509.4	5039.9	2652.6		51.7	57.0	54.3	
16	2	7427.2	10345.1	4774.6		2652.6	5570.4	3978.9		190.3	425.7	296.3	
17	2	1856.8	19098.6	25464.8		5305.2	530.5	1591.5		334.7	43.7	359.0	
18	2	0.0	0.0	530.5		795.8	795.8	265.3		33.3	33.3	1.3	
19	2	5835.7	10610.3	34218.3		795.8	530.5	0.0		41.3	38.3	44.3	
20	2	0.0	265.3	0.0		0.0	0.0	0.0		0.0	0.3	0.0	
21	2	4244.1	2917.8	2387.3		0.0	795.8	795.8		72.0	60.7	51.0	
22	2	795.8	795.8	265.3		530.5	530.5	530.5		35.0	34.7	34.0	
23	2	15119.7	13793.4	10610.3		3713.6	3713.6	3448.4		417.0	387.3	308.3	
24	2	530.5	1061.0	5570.4		0.0	0.0	0.0		1.0	2.3	15.3	

Table 2. Harvesting history of plots in MABI. Each plot with an X was harvested within the 4 years preceeding the year that the plot was sampled. Plots in Panel 1 were sampled in 2006, 2010, 2014, and 2018. Plots in Panel 2 were sampled in 2008, 2012, and 2016. Panel 2 plots have not yet been sampled in Cycle 4.

Plot	Panel	Cycle 1 (2006-2009)	Cycle 2 (2010-2013)	Cycle 3 (2014-2017)	Cycle 4 (2018)
1	1				X
2	1		X		X
3	1				
4	1			X	
5	1				
6	1			X	
7	1			X	X
8	1			X	X
9	1			X	
10	1				
11	1		X		
12	1			X	
13	2				
14	2				
15	2			X	
16	2				
17	2		X		
18	2			X	
19	2			X	
20	2				
21	2				
22	2				
23	2				
24	2	X		X	



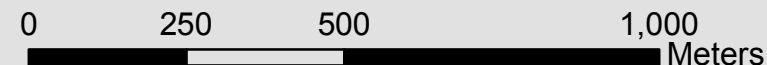
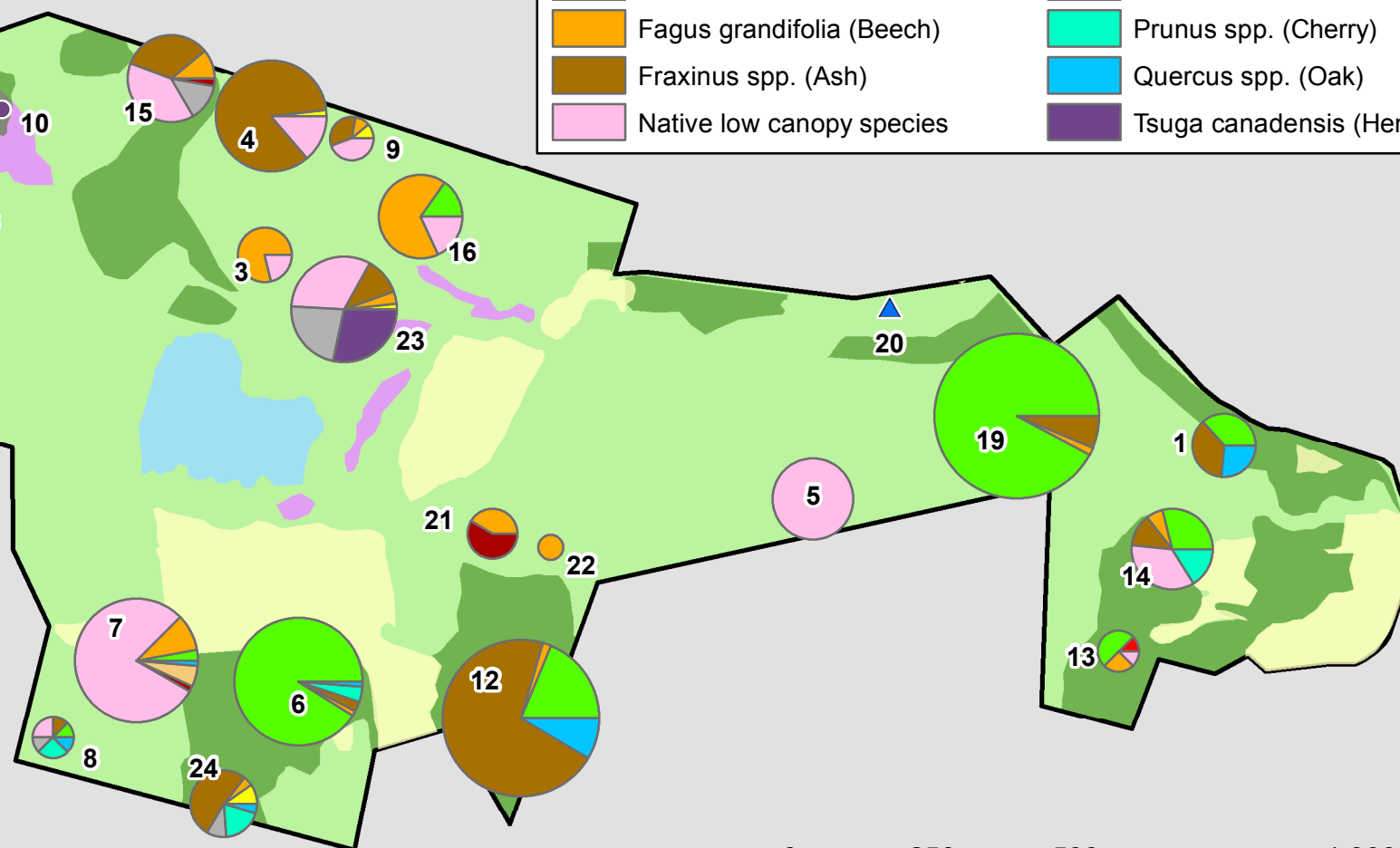
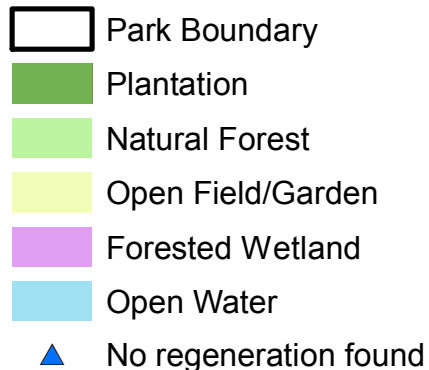
Map 5. Regeneration Composition

Trends in tree regeneration, including seedlings and saplings, by species group observed in forest plots in the most recent survey cycle (2016 & 2018). Each plot is sampled on a 4-year cycle in an alternating panel, with plots 1-12 sampled in 2018, and plots 13-24 sampled in 2016. Pie size is proportional to the total plot-level regeneration (plot-level density range: 0 to 34,218 stems/hectare). Pies may be shifted from actual plot location to prevent overlap. Maple (*Acer* spp.) group does not include Norway maple (*Acer platanoides*), striped maple (*Acer pensylvanicum*), or mountain maple (*Acer spicatum*). The latter two species are included in the low canopy species group. Date: 6/18/18.

Species in Pie Charts



Legend

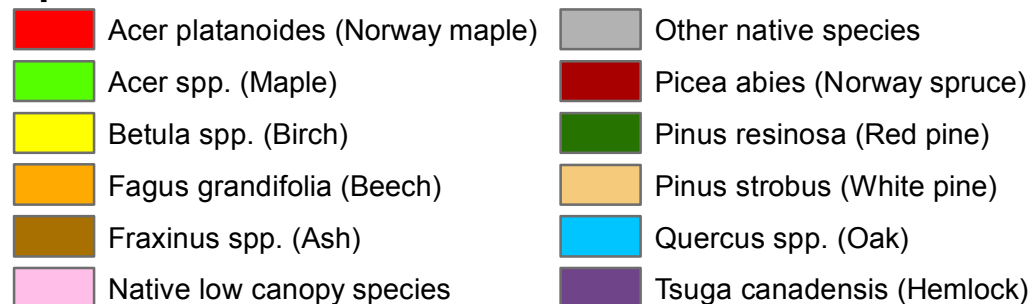




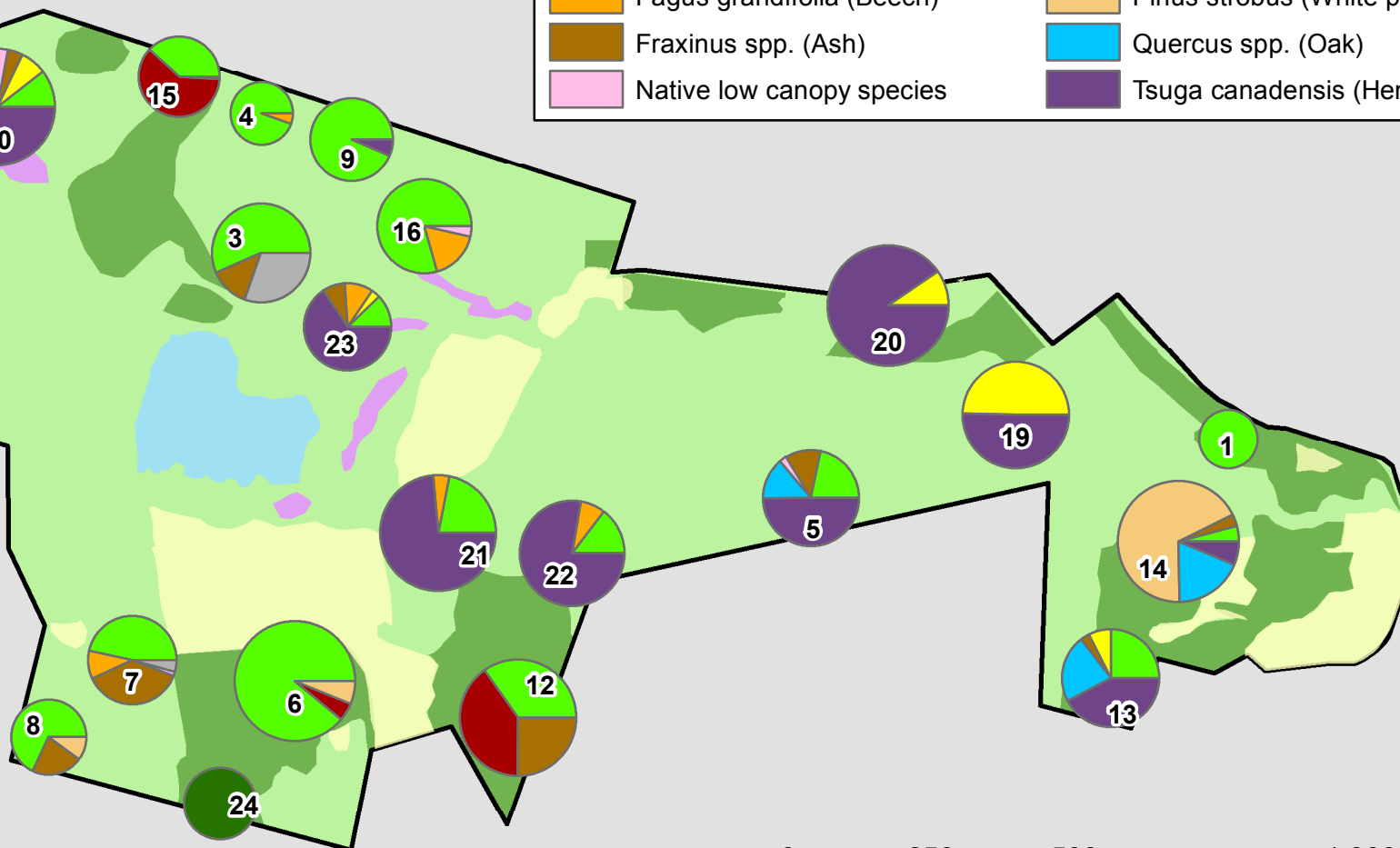
Map 6. Canopy Tree Composition

Trends in tree composition, by species group, observed in forest plots in the most recent survey cycle (2016 & 2018). Each plot is sampled on a 4-year cycle in an alternating panel, with plots 1-12 sampled in 2018, and plots 13-24 sampled in 2016. Pie size is proportional to the total plot-level basal area (basal area range: 11.7 to 50.5 m²/hectare). Pies may be shifted from actual plot location to prevent overlap. Date: 6/18/18.

Species in Pie Charts



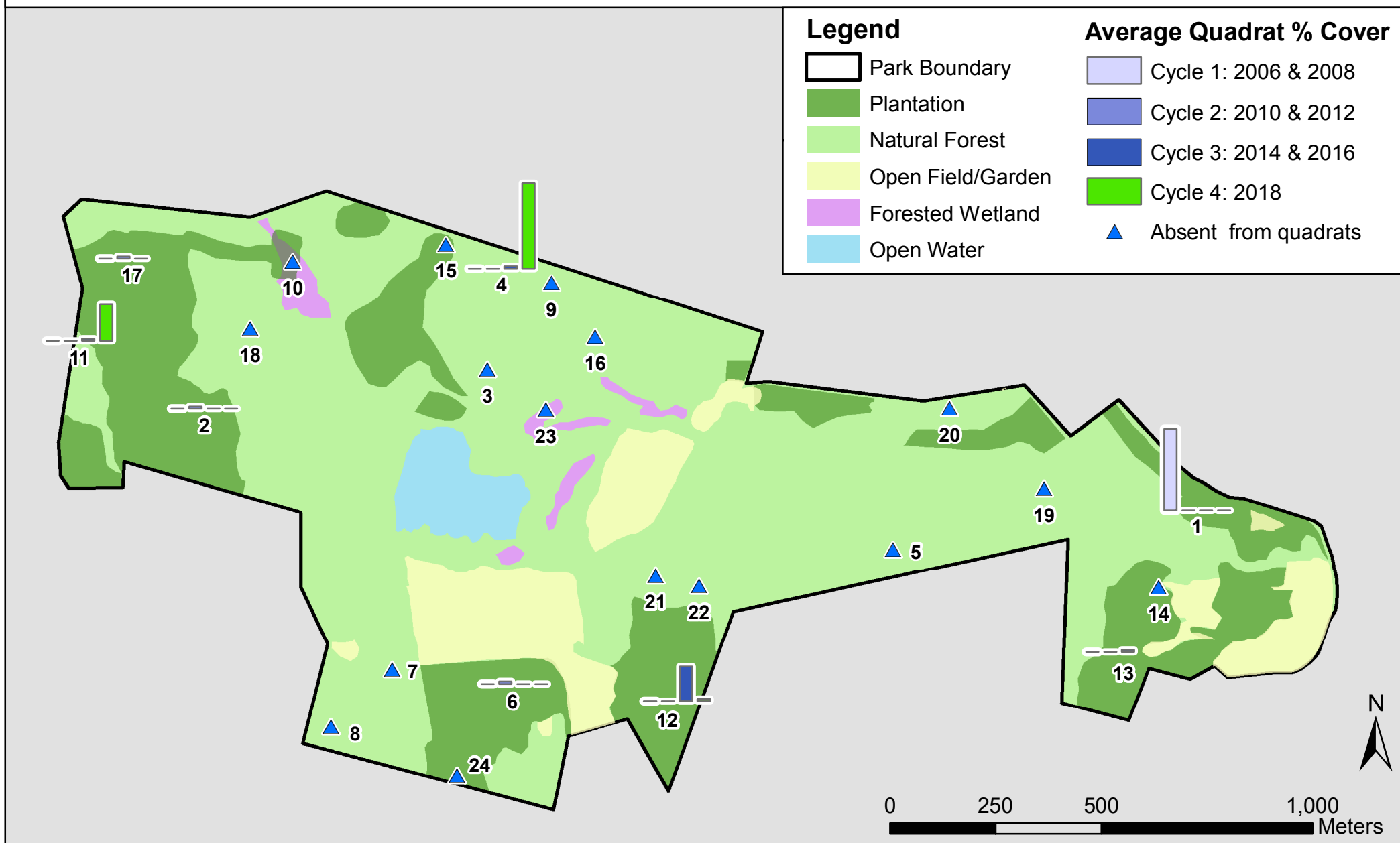
Legend





Map 7. Priority Invasive Species % Cover by Cycle

Trends in percent cover of priority invasive species observed in plots sampled from 2006-2018. Each plot is sampled on a 4-year cycle in an alternating panel, with plots 1-12 sampled in 2006, 2010, 2014, and 2018, and plots 13-24 sampled in 2008, 2012, and 2016. Average priority invasive species cover ranges from 0 to 0.5%. Date: 6/18/2018.





Map 8. Priority Invasive Species Composition

Priority invasive species composition observed in forest plots in the most recent 4 years of sampling (2016 & 2018). Each plot is sampled on a 4-year cycle in an alternating panel, with plots 1-12 sampled in 2018, and plots 13-24 sampled in 2016. Pie size is proportional to the average cover found in quadrats (cover range: 0 to 0.43%). Pies may be shifted from actual plot location to prevent overlap. Date: 6/18/2018.

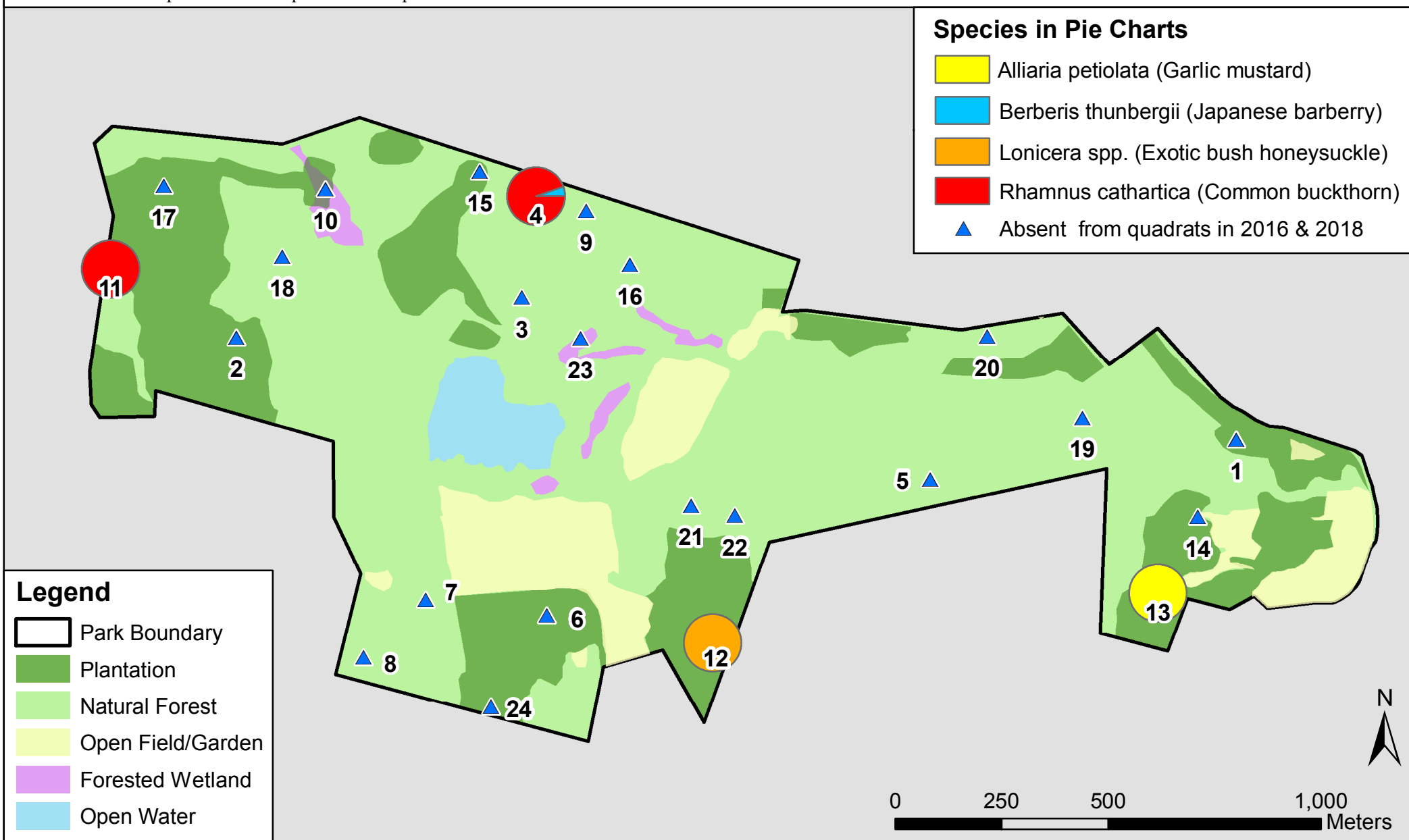


Table 3. Invasive species detections in MABI plots in the most recent survey cycle. GPS Coordinates are in NAD83 UTM Zone 18N

Plot	Year	X Coord	Y Coord	Latin Name	Common
1	2018	699991	4834089	<i>Daphne mezereum</i>	paradise plant
1	2018	699991	4834089	<i>Solanum dulcamara</i>	climbing nightshade
2	2018	697640	4834329	<i>Cirsium vulgare</i>	bull thistle
2	2018	697640	4834329	<i>Lonicera</i> spp.	exotic bush honeysuckle
2	2018	697640	4834329	<i>Solanum dulcamara</i>	climbing nightshade
3	2018	698310	4834423	<i>Lonicera</i> spp.	exotic bush honeysuckle
4	2018	698344	4834661	<i>Berberis thunbergii</i>	Japanese barberry
4	2018	698344	4834661	<i>Lonicera</i> spp.	exotic bush honeysuckle
4	2018	698344	4834661	<i>Rhamnus cathartica</i>	common buckthorn
4	2018	698344	4834661	<i>Tussilago farfara</i>	coltsfoot
6	2018	698369	4833675	<i>Hesperis matronalis</i>	dames rocket
6	2018	698369	4833675	<i>Lonicera</i> spp.	exotic bush honeysuckle
7	2018	698085	4833712	<i>Hesperis matronalis</i>	dames rocket
7	2018	698085	4833712	<i>Rhamnus cathartica</i>	common buckthorn
8	2018	697939	4833577	<i>Lonicera</i> spp.	exotic bush honeysuckle
8	2018	697939	4833577	<i>Rhamnus cathartica</i>	common buckthorn
9	2018	698462	4834627	<i>Solanum dulcamara</i>	climbing nightshade
9	2018	698462	4834627	<i>Verbascum thapsus</i>	flannel mullein
11	2018	697344	4834490	<i>Berberis thunbergii</i>	Japanese barberry
11	2018	697344	4834490	<i>Lonicera</i> spp.	exotic bush honeysuckle
11	2018	697344	4834490	<i>Rhamnus cathartica</i>	common buckthorn
11	2018	697344	4834490	<i>Solanum dulcamara</i>	climbing nightshade
12	2018	698759	4833611	<i>Cirsium vulgare</i>	bull thistle
12	2018	698759	4833611	<i>Lonicera</i> spp.	exotic bush honeysuckle
12	2018	698759	4833611	<i>Solanum dulcamara</i>	climbing nightshade
13	2016	699806	4833728	<i>Acer platanoides</i>	Norway maple
13	2016	699806	4833728	<i>Alliaria petiolata</i>	garlic mustard
13	2016	699806	4833728	<i>Euonymus</i> spp.	burningbush
13	2016	699806	4833728	<i>Lonicera</i> spp.	exotic bush honeysuckle
13	2016	699806	4833728	<i>Rhamnus cathartica</i>	common buckthorn
14	2016	699900	4833907	<i>Euonymus</i> spp.	burningbush, winged burningbush
14	2016	699900	4833907	<i>Lonicera</i> spp.	exotic bush honeysuckle
14	2016	699900	4833907	<i>Rhamnus cathartica</i>	common buckthorn
15	2016	698212	4834719	<i>Euonymus</i> spp.	burningbush
15	2016	698212	4834719	<i>Lonicera</i> spp.	exotic bush honeysuckle
15	2016	698212	4834719	<i>Verbascum thapsus</i>	flannel mullein
16	2016	698565	4834500	<i>Verbascum thapsus</i>	flannel mullein
17	2016	697469	4834685	<i>Solanum dulcamara</i>	climbing nightshade
19	2016	699628	4834140	<i>Lonicera</i> spp.	exotic bush honeysuckle
20	2016	699405	4834331	<i>Celastrus orbiculatus</i>	oriental bittersweet
20	2016	699405	4834331	<i>Solanum dulcamara</i>	climbing nightshade
23	2016	698449	4834327	<i>Solanum dulcamara</i>	climbing nightshade
24	2016	698238	4833461	<i>Berberis vulgaris</i>	common barberry
24	2016	698238	4833461	<i>Lonicera</i> spp.	exotic bush honeysuckle

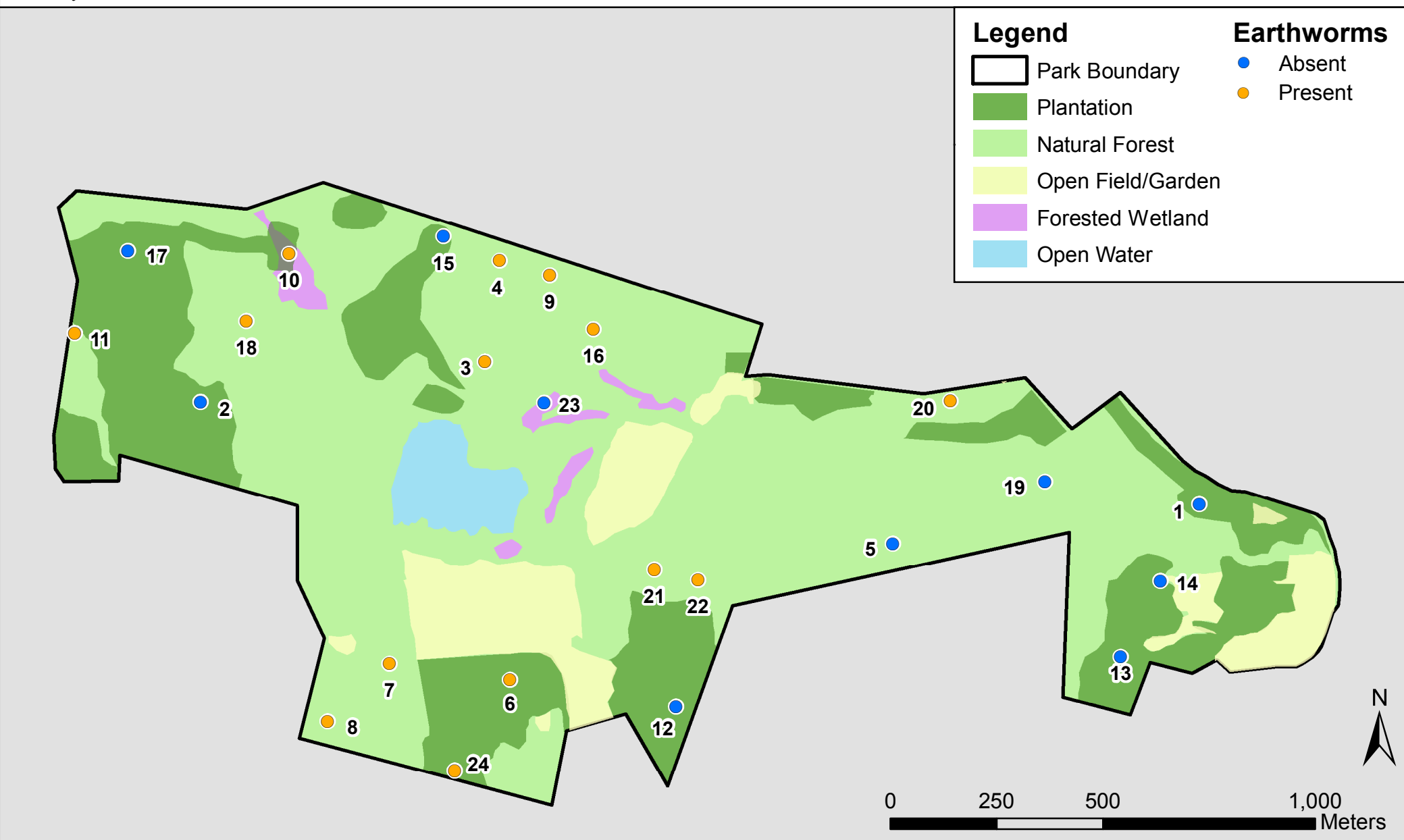
Table 4. Number of plots where exotic species were detected by cycle. Cycle 1 = 2006 & 2008; Cycle 2 = 2010 & 2012; Cycle 3 = 2014 & 2016; Cycle 4 = 2018. Species list includes all exotic vascular plant species that are capable of dominating Northeastern US forest habitats, and does not include all exotic species detected in MABI forest plots. Priority invasive species are bolded. Note that only one half of plots have been sampled in Cycle 4, with a maximum plot count of 12 instead of 24.

Latin Name	Common Name	Cycle 1	Cycle 2	Cycle 3	Cycle 4
<i>Acer platanoides</i>	Norway maple	0	0	1	0
<i>Alliaria petiolata</i>	garlic mustard	0	0	2	0
<i>Berberis thunbergii</i>	Japanese barberry	1	0	0	2
<i>Berberis vulgaris</i>	common barberry	4	6	3	0
<i>Celastrus orbiculatus</i>	oriental bittersweet	0	1	1	0
<i>Cirsium vulgare</i>	bull thistle	0	1	0	2
<i>Clematis terniflora</i>	sweet autumn virginsbower	0	1	0	0
<i>Daphne mezereum</i>	paradise plant	1	0	1	1
<i>Euonymus</i> spp.	burningbush	1	1	3	0
<i>Hesperis matronalis</i>	dames rocket	2	1	2	2
<i>Larix decidua</i>	European larch	1	1	1	1
<i>Lonicera</i> spp.	exotic bush honeysuckle	5	5	11	7
<i>Picea abies</i>	Norway spruce	7	5	5	4
<i>Pinus sylvestris</i>	Scots pine	2	3	2	1
<i>Rhamnus cathartica</i>	common buckthorn	2	4	8	4
<i>Solanum dulcamara</i>	climbing nightshade	2	4	7	5
<i>Tussilago farfara</i>	coltsfoot	0	0	1	1
<i>Verbascum thapsus</i>	flannel mullein	3	3	5	1
<i>Vinca minor</i>	periwinkle	0	1	0	0



Map 9. Earthworms: Presence or Absence

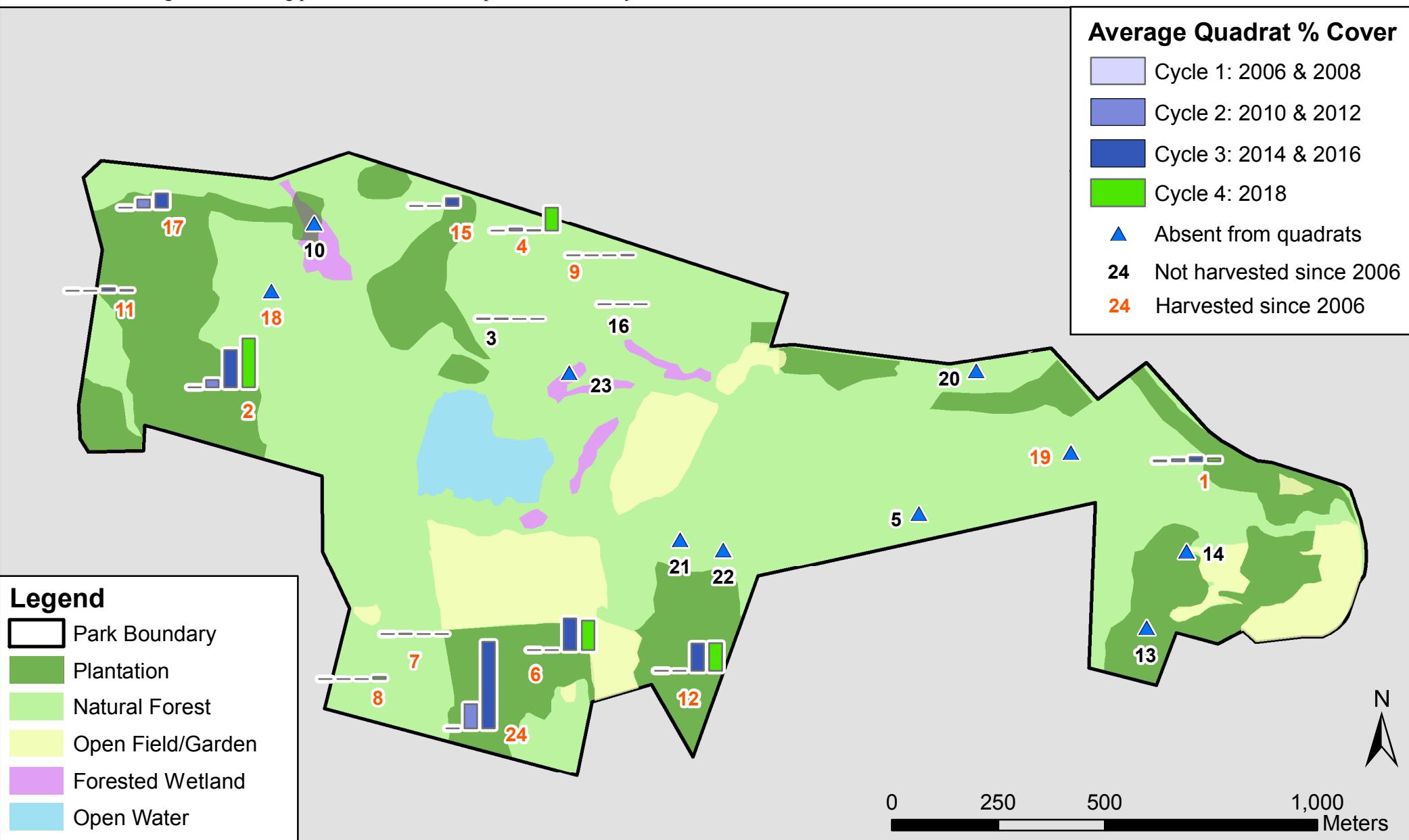
Presence or absence of earthworms detected on forest plots. Each plot is sampled on a 4-year cycle in an alternating panel, with plots 1-12 sampled in 2018 and plots 13-24 sampled in 2016. For this analysis, earthworm presence on a plot was considered permanent once detected. For instance, if earthworms were observed on a plot in Cycle 2, but not in Cycle 3, earthworms are still considered 'Present'. Date: 6/18/2018.





Map 10. Rubus spp. Cover by Cycle

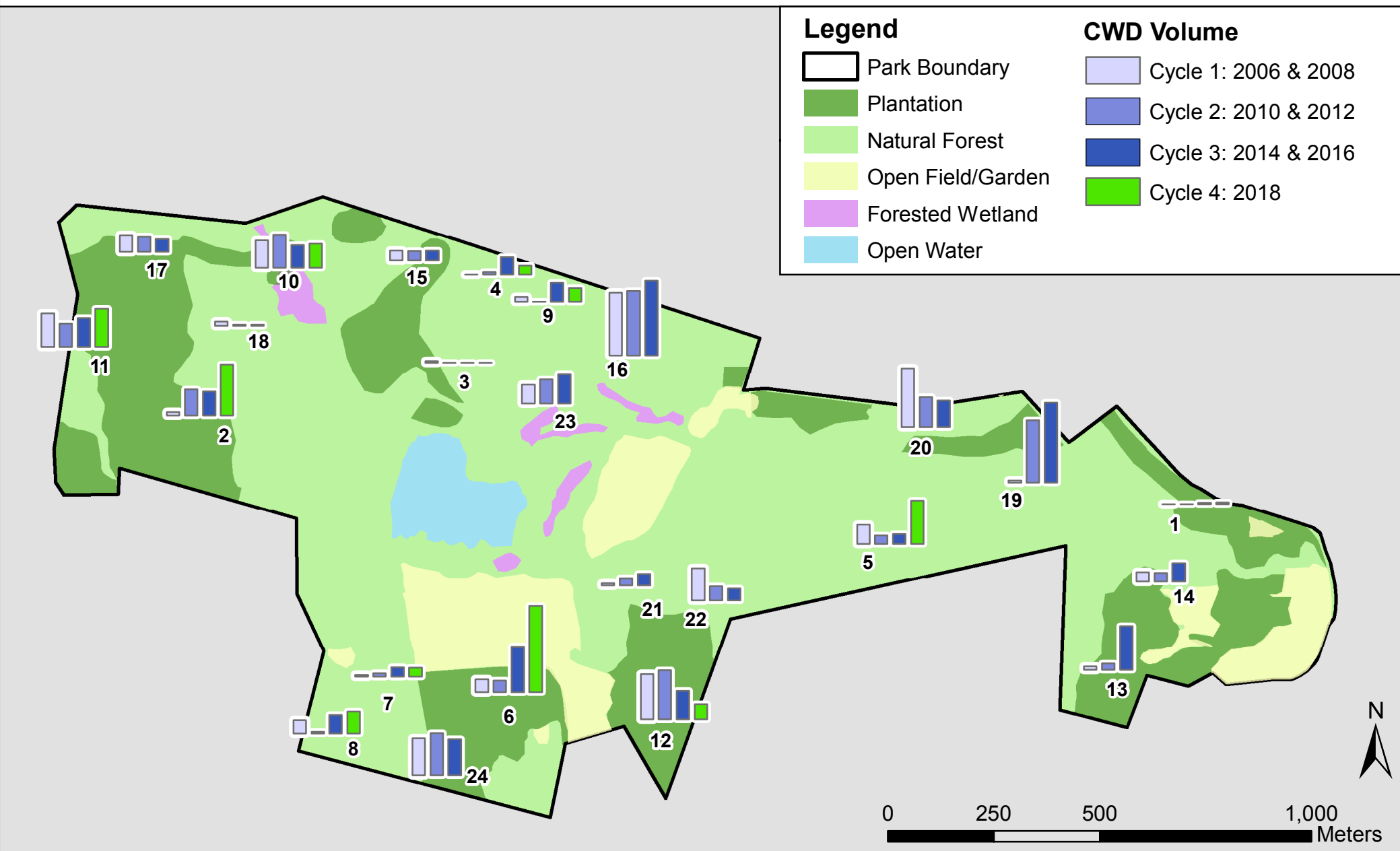
Trends in *Rubus* spp. (blackberries and raspberries) observed in forest plots sampled from 2006-2018. Each plot is sampled on a 4-year cycle in an alternating panel, with plots 1-12 sampled in 2006, 2010, 2014, and 2018, and plots 13-24 sampled in 2008, 2012, and 2016. % cover ranges from 0 to 91%. Plot numbers are labeled in orange if the plot was harvested during the monitoring period. See Table 2 for plot harvest history. Date: 6/18/2018.





Map 11. Coarse Woody Debris by Cycle

Trends in Coarse Woody Debris (CWD) volume observed in plots sampled from 2006-2018. Each plot is sampled on a 4-year cycle in an alternating panel, with plots 1-12 sampled in 2006, 2010, 2014, and 2018, and plots 13-24 sampled in 2008, 2012, and 2016. CWD volume ranges from 0 to 165.7 m³/ha (2,368.1 ft³/ac). Date: 6/18/2018.





Map 12. Coarse Woody Debris Levels: 2016 & 2018

Coarse woody debris volume (m^3/ha) for the most recent 4 year survey cycle (2016 & 2018). Plots 1-12 were sampled in 2018, and plots 13-24 were sampled in 2016. Volumes range from 0 to 165.7 $\text{m}^3/\text{hectare}$ (2,368.1 ft^3/ac). Plots are color coded by volume to indicate whether they meet the 20-50 m^3/ha (285.8-714.6 ft^3/ac) threshold in Müller & Bütler (2010). Date: 6/18/2018.

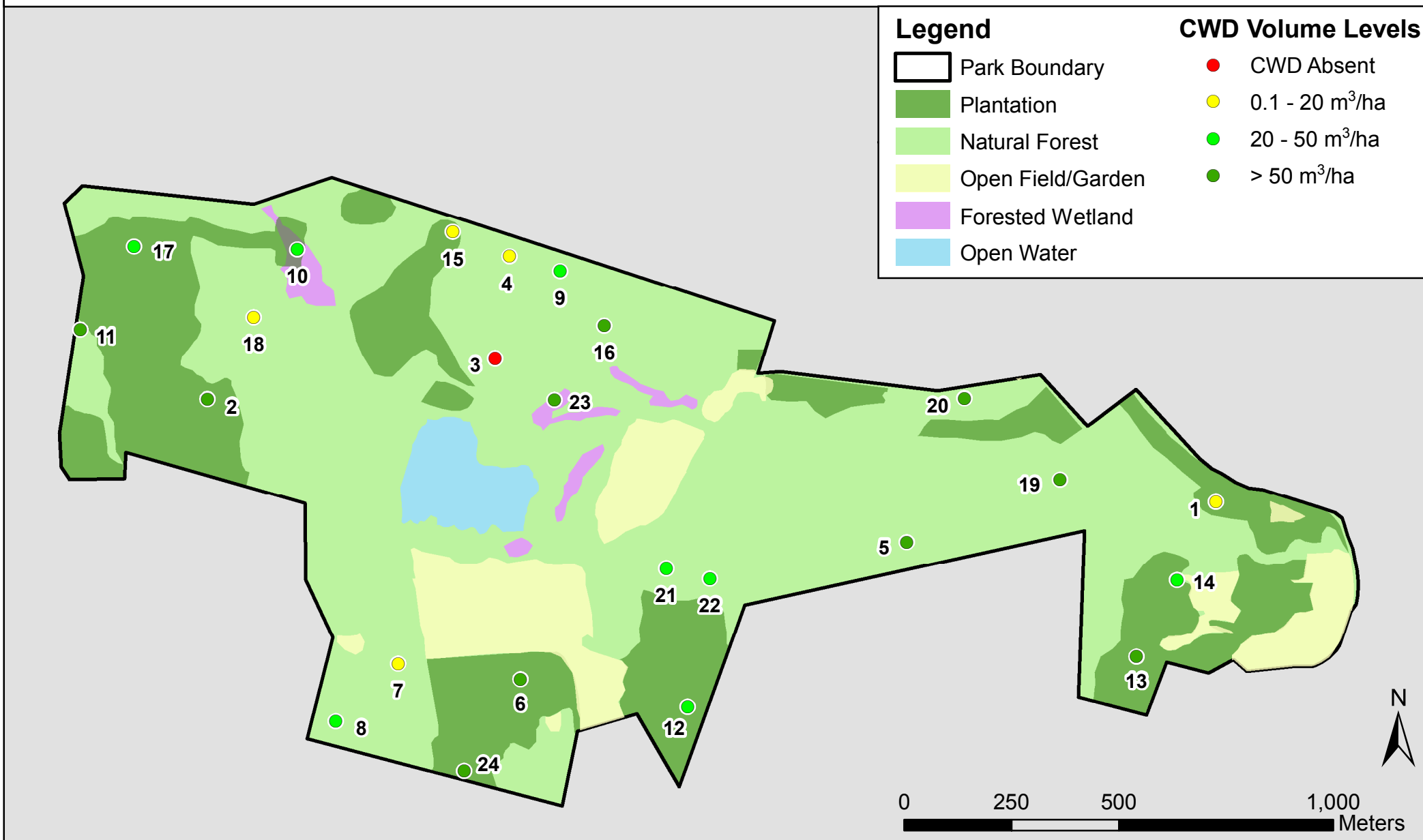


Table 5. Status of standing trees in each plot in MABI. Harvested BA is based on the most recently taken DBH measurements for trees that were harvested. Trees that reach 10 cm DBH in a given cycle are considered Recruits.

Plot	Panel	Cycle	Stand Type	Basal Area (m ² /ha)				# Stems/plot			
				Alive	Dead	Harvested	Recruit	Alive	Dead	Harvested	Recruit
1	1	1	Plantation	16.7	0.0	0.0	0.0	6	0	0	0
1	1	2		17.4	0.0	0.0	0.0	6	0	0	0
1	1	3		18.1	0.0	0.0	0.0	6	0	0	0
1	1	4		11.7	0.0	7.1	0.0	3	0	3	0
2	1	1	Plantation	46.9	3.2	0.0	0.0	10	3	0	0
2	1	2		32.1	0.0	19.4	0.0	5	0	8	0
2	1	3		34.0	0.0	0.0	0.7	5	0	0	3
2	1	4		11.9	0.0	15.0	1.2	3	0	4	5
3	1	1	Natural	29.3	0.0	0.0	0.0	13	0	0	0
3	1	2		30.0	0.0	0.0	0.0	13	0	0	0
3	1	3		32.1	0.0	0.0	0.0	13	0	0	0
3	1	4		33.7	0.3	0.0	0.0	12	1	0	0
4	1	1	Natural	27.8	0.2	0.0	0.0	13	1	0	0
4	1	2		29.0	0.2	0.0	0.0	12	1	0	0
4	1	3		12.3	0.0	17.3	0.0	6	0	6	0
4	1	4		13.6	0.0	0.0	0.0	6	0	0	0
5	1	1	Natural	30.9	1.4	0.0	0.0	24	1	0	0
5	1	2		31.7	0.3	0.0	0.0	23	1	0	0
5	1	3		32.5	0.6	0.0	0.0	21	1	0	0
5	1	4		31.9	0.5	0.0	0.0	19	1	0	0
6	1	1	Plantation	81.0	2.4	0.0	0.0	20	5	0	0
6	1	2		81.7	2.7	0.0	0.0	18	4	0	0
6	1	3		47.7	1.8	3.5	0.0	8	4	6	0
6	1	4		50.0	1.6	0.0	0.0	8	3	0	0
7	1	1	Natural	22.6	0.0	0.0	0.0	34	0	0	0
7	1	2		25.4	0.0	0.0	0.4	34	0	0	2
7	1	3		26.1	0.0	3.7	0.0	27	0	10	0
7	1	4		27.1	0.0	2.7	0.0	22	0	5	0
8	1	1	Natural	39.9	4.1	0.0	0.0	35	5	0	0
8	1	2		36.9	4.8	0.0	0.0	31	7	0	0
8	1	3		19.1	5.1	19.0	0.2	21	8	9	1
8	1	4		19.3	2.3	4.5	0.0	19	3	7	0
9	1	1	Natural	33.0	0.0	0.0	0.0	19	0	0	0
9	1	2		32.8	0.0	0.0	0.0	18	0	0	0
9	1	3		22.2	0.0	11.5	0.0	10	0	8	0
9	1	4		23.7	0.0	0.0	0.0	10	0	0	0
10	1	1	Plantation	43.1	3.2	0.0	0.0	27	4	0	0
10	1	2		42.9	1.5	0.0	0.2	25	4	0	1
10	1	3		45.5	2.1	0.0	0.0	27	5	0	0
10	1	4		46.5	2.1	0.0	0.0	25	4	0	0
11	1	1	Plantation	51.8	0.0	0.0	0.0	24	0	0	0
11	1	2		42.9	0.2	9.5	0.2	20	1	3	1
11	1	3		41.6	3.2	0.0	0.0	20	2	0	0
11	1	4		38.1	4.8	0.0	0.5	18	2	0	2
12	1	1	Plantation	49.7	1.3	0.0	0.0	29	2	0	0
12	1	2		52.1	1.9	0.0	0.0	28	3	0	0
12	1	3		42.7	1.0	16.4	0.0	22	1	9	0
12	1	4		46.9	0.9	0.0	0.0	22	1	0	0

Table 5. Status of standing trees in each plot in MABI. Harvested BA is based on the most recently taken DBH measurements for trees that were harvested. Trees that reach 10 cm DBH in a given cycle are considered Recruits.

Plot	Panel	Cycle	Stand Type	Basal Area (m ² /ha)				# Stems/plot			
				Alive	Dead	Harvested	Recruit	Alive	Dead	Harvested	Recruit
13	2	1	Plantation	36.0	1.3	0.0	0.0	18	1	0	0
13	2	2		36.0	1.2	0.0	0.2	17	1	0	1
13	2	3		32.9	1.2	0.0	0.0	16	1	0	0
14	2	1	Plantation	46.9	1.8	0.0	0.0	22	3	0	0
14	2	2		49.4	2.1	0.0	0.0	21	4	0	0
14	2	3		50.8	2.7	0.0	0.2	19	5	0	1
15	2	1	Plantation	39.1	2.3	0.0	0.0	14	3	0	0
15	2	2		42.1	2.2	0.0	0.4	14	3	0	2
15	2	3		22.3	4.2	22.5	0.2	9	3	8	1
16	2	1	Natural	33.8	0.7	0.0	0.0	14	1	0	0
16	2	2		31.8	4.3	0.0	0.2	14	2	0	1
16	2	3		30.1	3.4	0.0	0.7	13	2	0	3
17	2	1	Plantation	50.8	1.6	0.0	0.0	24	1	0	0
17	2	2		32.9	1.4	18.7	1.5	13	1	11	7
17	2	3		36.0	1.4	0.0	0.8	20	1	0	3
18	2	1	Natural	26.4	4.2	0.0	0.0	27	4	0	0
18	2	2		29.0	4.2	0.0	0.0	28	4	0	0
18	2	3		19.4	2.3	10.5	0.0	16	3	11	0
19	2	1	Natural	44.6	2.0	0.0	0.0	13	1	0	0
19	2	2		39.5	2.4	0.0	0.0	12	1	0	0
19	2	3		39.1	2.4	2.4	0.0	8	1	4	0
20	2	1	Natural	44.7	6.7	0.0	0.0	14	2	0	0
20	2	2		47.8	5.8	0.0	0.0	14	1	0	0
20	2	3		50.5	0.0	0.0	0.0	14	0	0	0
21	2	1	Natural	43.3	0.5	0.0	0.0	12	2	0	0
21	2	2		45.0	0.3	0.0	0.0	12	1	0	0
21	2	3		46.4	0.0	0.0	0.0	12	0	0	0
22	2	1	Natural	34.2	1.6	0.0	0.0	16	1	0	0
22	2	2		35.9	1.6	0.0	0.2	16	1	0	1
22	2	3		38.2	0.0	0.0	0.0	17	0	0	0
23	2	1	Natural	23.6	0.0	0.0	0.0	17	0	0	0
23	2	2		24.7	0.0	0.0	0.6	17	0	0	3
23	2	3		26.4	0.0	0.0	0.0	20	0	0	0
24	2	1	Plantation	23.7	0.0	0.0	0.0	12	0	0	0
24	2	2		24.7	0.0	0.0	0.0	12	0	0	0
24	2	3		18.0	0.0	7.8	0.0	7	0	5	0