



INVENTORY & MONITORING DIVISION

Northeast Temperate Network

JANUARY 2023

Forest Health Update for Morristown NHP: 2007 - 2022

The Northeast Temperate Network (NETN) forest health monitoring crew has been visiting the 29 NETN forest plots in Morristown NHP (MORR) for 15 years on an alternating 4-year cycle. Two of the plots are located in a large deer enclosure (14 and 25). Plot 14 specifically was established to monitor

changes in the deer enclosure, but is not part of the sample design and therefore not included in these park summary statistics. Compared to other parks in the network, the forests in MORR are in significant trouble. Decades of regeneration failure have led to much of the park forest to a state of collapse. Invasive shrub

thickets continue to increase while canopy tree species decline. The following is a further summary of the most recent findings, as well as a series of park maps that visually display forest health monitoring data. Please contact NETN staff with any questions.

KEY FINDINGS

- Compared to other parks in the Network, the forests in MORR are in a **high state of peril**.
- Invasive shrub thickets are increasingly replacing areas that were once closed canopy forest.
- The presence of beech leaf disease (BLD) and absence of an effective treatment threatens the long-term persistence of beech, one of the few canopy species regenerating in MORR.
- Deer impacts are **unsustainable** throughout the park and a long-term deer management program will be needed to allow the forest to sustain itself.
- Reducing invasive shrubs to 10-20% cover and maintaining it for 5 to 10 years could give tree seedlings time enough to regenerate before invasive shrubs can expand and choke them out.



Summary of MORR Forest Health

Tree Regeneration and Deer

An abundant regeneration layer containing tree seedlings and saplings of varying sizes and composed of species found in the canopy is an important component of a healthy, stable forest. When forests lack sufficient regeneration, or the species composition in

the regeneration layer does not match that of the canopy, we call this a "regeneration debt". In its most severe form, there is a complete lack of regeneration which, if allowed to persist, can ultimately lead to forest loss.

Compositional mismatch between the species in the regeneration layer and the



Little to no regeneration is being observed in many forest health plots (Plot 28 pictured) in the park.

canopy is another type of regeneration debt that can be problematic if the species in the regeneration layer are invasive, like tree-of-heaven, or suboptimal, including pest/disease prone species such as ash and beech.

Forests in MORR are experiencing **severe regeneration debt**. While there are some positive trends in seedling density over time, these are primarily driven by increases in the plots in and around the large deer enclosure (Map 1). Where present, seedlings tend to be restricted to the smallest height classes (Map 2), except for the two plots in the deer enclosure. In the 2022 survey, only 8 out of 29 plots met the target of 0.25 seedlings/m², and only 1 out of 29 plots met the target of 0.14 saplings/m². Note that these targets were established as part of a regional regeneration study currently in review, and roughly match the MORR Vegetation and White-tailed Deer Management Plan targets for seedlings and saplings.

The **regeneration stocking index**, which quantifies whether current seedling and sapling densities are sufficient to restock a forest canopy, continues to be **severely understocked** in 23 out of 29 plots in MORR (Map 5). High deer impacts also continue to be observed throughout MORR, with all but four plots rated **high or very high for deer browse impacts** in the most recent surveys (2019 and 2022; Map 6). Browse rates at this level will continue to prevent browse-preferred seedlings from establishing and growing into larger size classes.

Equally concerning is the composition of the regeneration layer. Beech is the dominant native canopy-forming species regenerating in MORR (Map 3). The recent arrival of beech leaf

disease (BLD), which causes high mortality for seedling and sapling-sized beech and was only first detected by NETN in 2022, will likely result in declines in beech regeneration over time.

Subcanopy short-stature species are the next most abundant regenerating trees in MORR. These include flowering dogwood, sassafras, and blackhaw. White ash has joined that list since emerald ash borer usually kills it before it can reach beyond the subcanopy layer of a forest. In contrast, species currently dominant in the canopy, including tulip poplar, oaks, and birch are rare in the regeneration layer (Map 4).

Invasive Species

The most recent survey shows that invasive species cover **continues to be high** in



White-tailed deer continue to have high impacts throughout the park.

MORR, with an average cover of 38%, they are more than double that of native species (15%). Every forest plot had at least one invasive species, and 23 out of 29 plots had five or more invasive species. Shrubs are the most abundant invasive species category in MORR, particularly Japanese barberry, multiflora rose, and wine raspberry (Map 8). While invasive shrub cover was already abundant in MORR when monitoring began, **invasive shrubs have continued to increase significantly in cover by 6% over each 4-year cycle.** Even though Japanese barberry was already the most abundant invasive species in MORR since monitoring began in 2007 (found in 90% of plots), it still manages to increase significantly in cover by 3% per cycle. Pointedly, plots with the greatest invasive shrub cover also tend to have low canopy cover, and little to no tree regeneration (e.g., 2, 5, 17, and 19), indicating that these invasive shrubs are suppressing regeneration.

In addition to increases in invasive shrub cover, a number of less common invasive woody species increased in plot frequency over time, including Japanese aralia, Asian bittersweet, burningbush, oriental photinia, and Siebold's arrowwood. While these species are all a concern given their demonstrated invasion across eastern forests, the three most abundant shrubs, namely Japanese barberry, multiflora rose, and wine raspberry, pose the greatest threats to forest regeneration and understory diversity in MORR.

In addition to invasive plants, NETN monitors invasive earthworms in park plots. [Impacts from earthworms](#) include reduced leaf-litter and altered soil nutrient cycling, which can negatively impact



Japanese barberry continues to flourish in the park.

regeneration and understory herbs, and can facilitate invasive species. The most commonly encountered earthworms in the northeast are European nightcrawlers, which have been **detected in every plot** in MORR. More recently, earthworms from East Asia have started invading eastern forests. Known as "[crazy snake worms](#)", they can occupy at much higher densities and cycle nutrients faster than the European worms, and thus cause more severe impacts to the understory. It is



Crazy snake worm

important to note that snake worms have only been on NETN's radar for a few years, and 2019 was the first year we began looking for them in MORR. We definitively detected snake worms in three plots (2, 4, and 14). It is possible that they are present in more plots, as distinguishing between snake worms and European nightcrawlers is difficult in the spring.

Forest Structure & Composition

Compromised as they are, MORR's forests still have considerably more complex older forest structure (large trees,

snags, coarse woody debris) [than surrounding unprotected forests](#). In addition, tree cores collected near NETN forest plots 1 – 15 indicate that several stands are relatively historic for the region, with plots 9, 10, 12, and 14 having trees originating between 1801 and 1867. The canopy layer in MORR is also fairly diverse, with a mix of tulip poplar, [oak species](#), beech, black birch, [white ash](#), hickory species, maple species, and others (Map 4). A diverse canopy promotes high response variability to stressors such as pests, diseases, and [climate change](#). Taken together, the long history of protection in MORR has resulted in regionally older and more diverse forests, and their continued protection and management is important beyond the boundaries of the park.

That said, if tree mortality and recruitment patterns continue, canopy diversity and structure will decline over time. Ash in particular has experienced severe mortality in the most recent cycle due largely to emerald ash borer (Map 9). Many of the most abundant species in the canopy have also experienced elevated mortality since monitoring began, and



Plots with the lowest canopy cover (Plot 19 pictured) have little to no observed tree regeneration and the highest invasive species cover.

mortality rates heavily outweigh recruitment rates. In fact, beech is the only tree species in MORR that has increased in stem density over time, whereas all other tree species were either stable or declined in density over time. Now that beech leaf disease is present throughout MORR (Map 9), this trend may be reversed. While overall basal area has continued to increase in MORR over time, gains are almost entirely through incremental stem growth of remaining trees, especially from tulip poplar and beech.

After regeneration failure persists for decades, as has occurred in MORR, declines in the density of small diameter trees are often a **signal of impending forest loss**. This signal is apparent in MORR,

where the density of small trees (i.e., trees < 20 cm diameter at breast height) has declined over time and the shape of the diameter distribution is linear rather than the expected log-linear or exponential curve. In fact, **forest loss is already underway**. When monitoring began in 2007, all but two plots had over 50% canopy cover, and most (19 out of 29 plots) had over 75% canopy cover (Map 10). In the years following, several severe winter storms and Hurricane Sandy have caused a number of canopy openings, and in the most recent cycles ash has died back due to emerald ash borer. Now, four out of 29 plots have less than 50% canopy cover. Moreover, the plots with the lowest canopy cover (2, 5, 17, 19, and 20) had little to no observed

regeneration in the most recent cycle and have the highest invasive species cover (Maps 8 & 9).

For more information

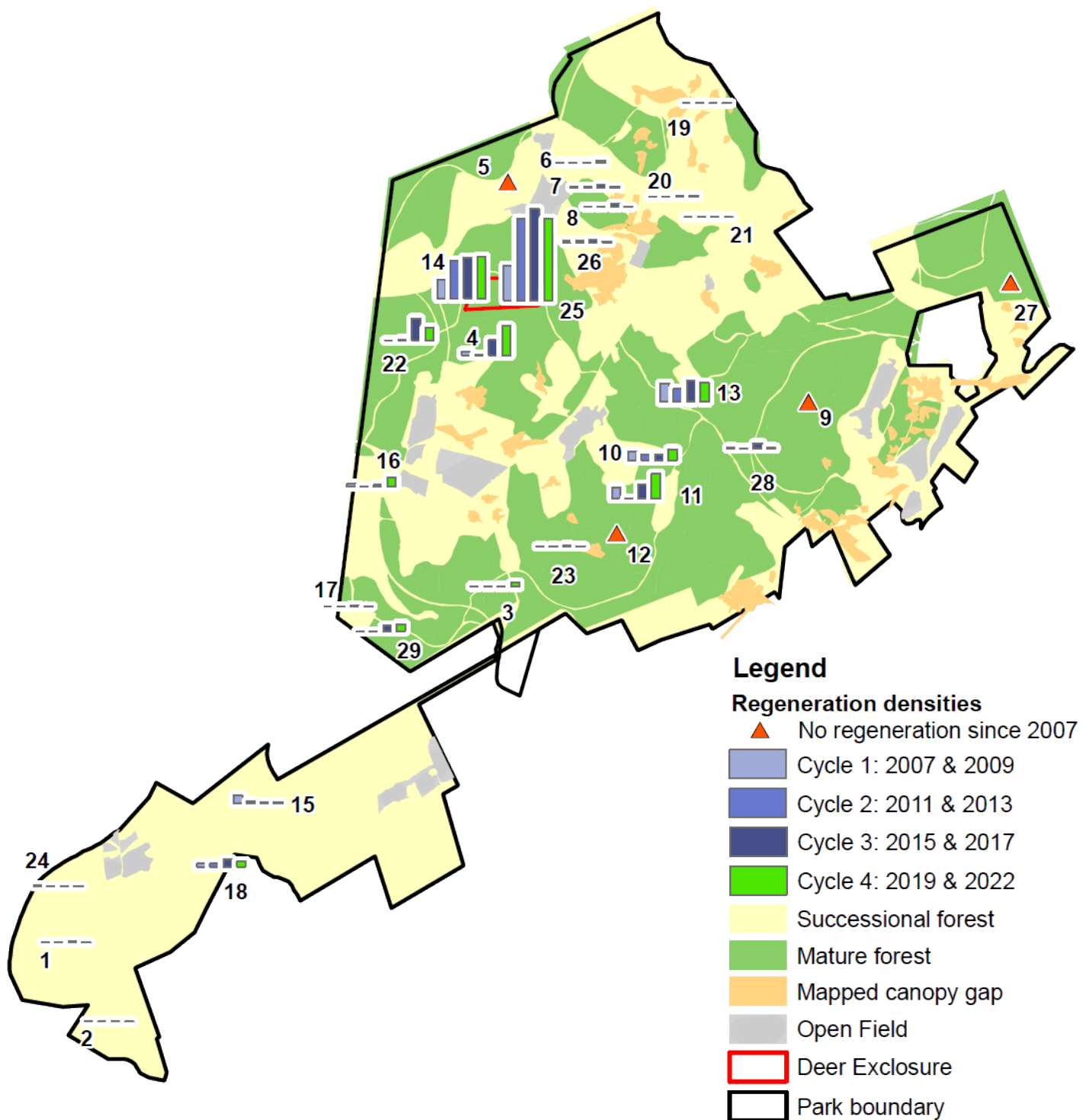
The [NETN website](#) is chock full of information related to park forest health as well as all the other long-term monitoring programs. Like all of NETN's parks, MORR has its own [web page](#) providing a convenient one-stop shopping place for all things MORR related.

The recently launched [Resilient Forests Initiative](#) contains many useful resources and insights about the current and future efforts to help regional national parks manage forest health challenges by raising awareness of threats and fostering collaboration.

PARK MONITORING MAPS

Trends in tree regeneration stem densities, including seedlings and saplings, in forest plots sampled from 2007-2022. Plots are sampled in an alternating panel, with plots 1-15 sampled in 2007, 2011, 2015, and 2019, and plots 16-29 sampled in 2009, 2013, 2017, and 2022. Densities range from 0 to 3.1 stems/m², and only include native canopy-forming species.

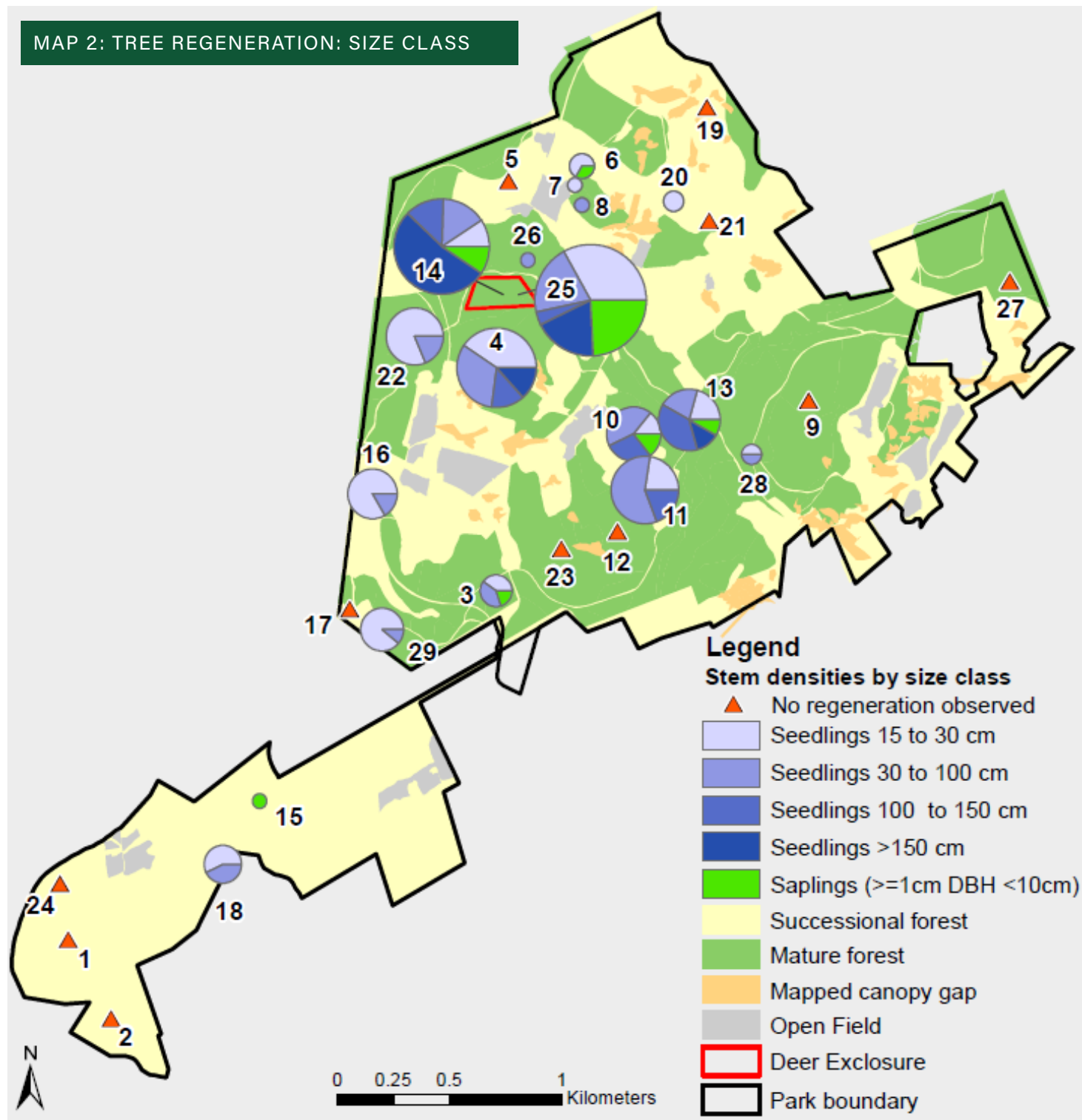
MAP 1: TREE REGENERATION: MONITORING CYCLE



PARK MONITORING MAPS

Trends in tree regeneration by size class in forest plots from the most recent survey cycle (2019 and 2022). Plots are sampled in an alternating panel, with plots 1-15 sampled in 2019, and plots 16-29 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 2.7 stems/m² and only include native canopy-forming species.

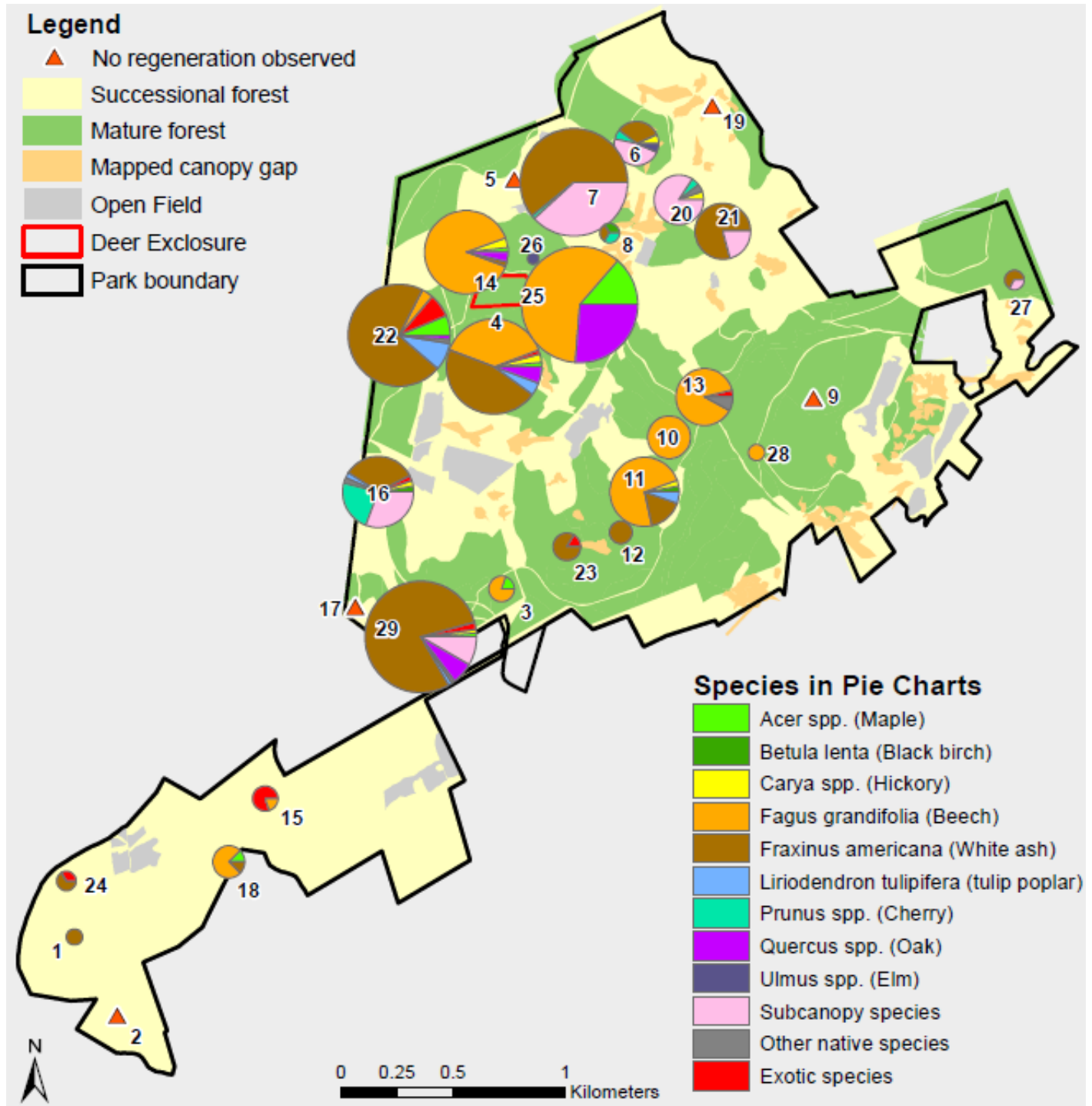
MAP 2: TREE REGENERATION: SIZE CLASS



PARK MONITORING MAPS

The map below shows 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 1-15 sampled in 2019, and plots 16-29 sampled in 2022. Pie size is proportional to the total plot-level regeneration density (plot-level density range: 0 to 2.75 stems/m²). Pies may be shifted from actual location to prevent overlap.

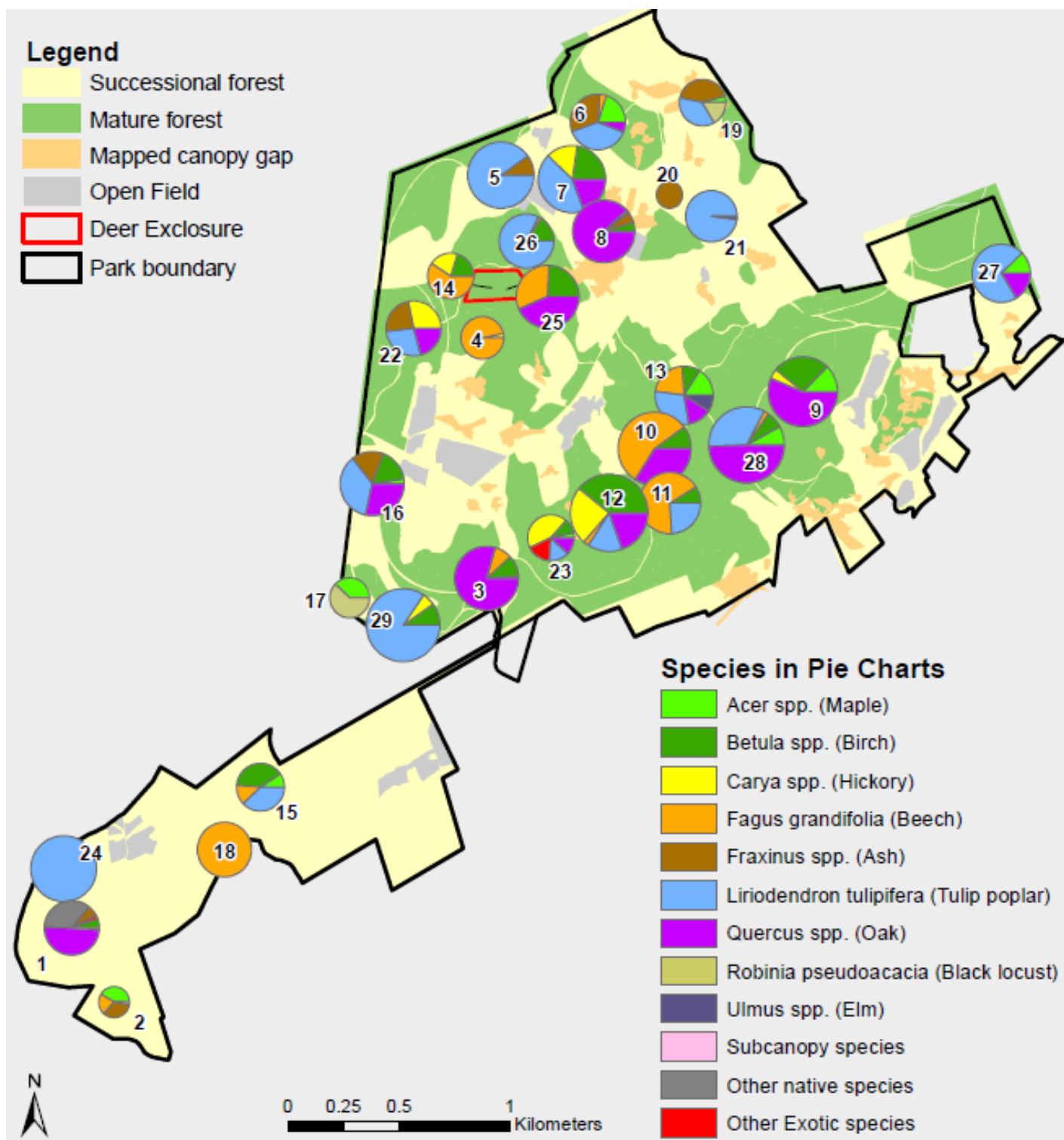
MAP 3: TREE REGENERATION: COMPOSITION



PARK MONITORING MAPS

The map below shows 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 1-15 sampled in 2019, and plots 16-29 sampled in 2022. Pie size is proportional to plot-level basal area (range: 5.8 to 50.4 m²/ha). Pies may be shifted from actual location to prevent overlap.

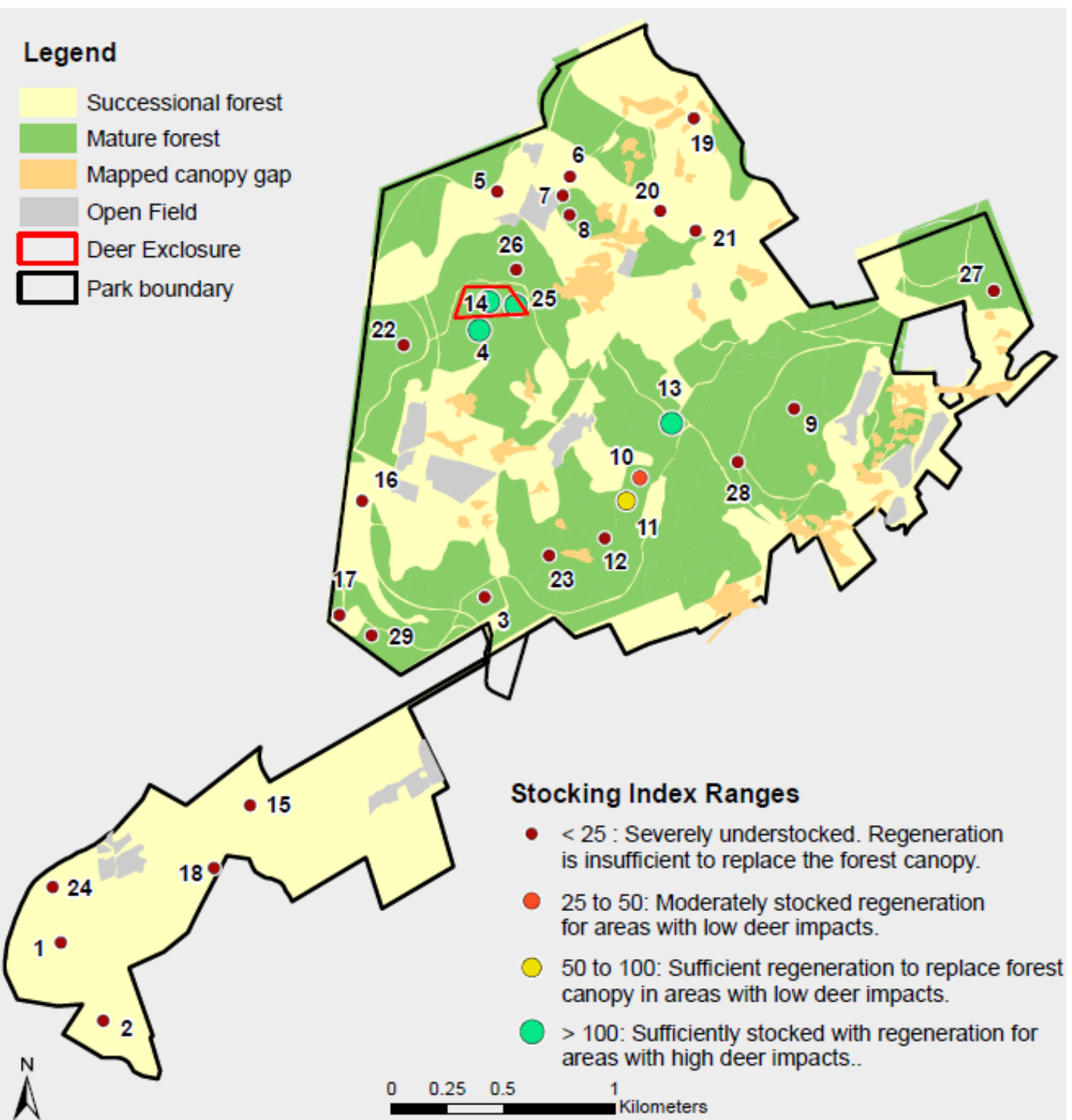
MAP 4: TREE CANOPY: COMPOSITION



PARK MONITORING MAPS

The map below shows trends in the regeneration stocking index for the most recent survey cycle (2019 and 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 0-769).

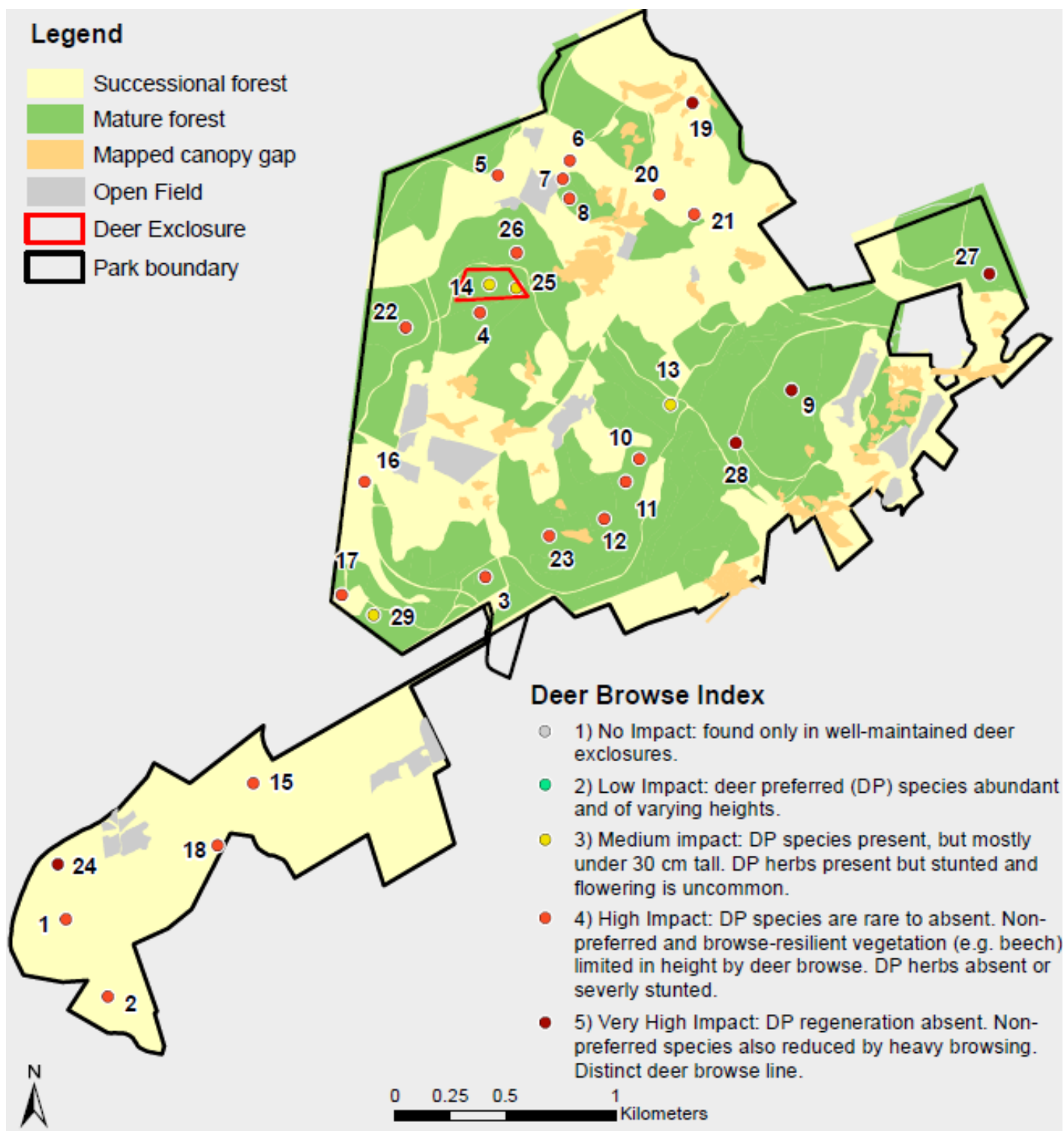
MAP 5: TREE REGENERATION: STOCKING INDEX



PARK MONITORING MAPS

The map below shows trends in the index of deer browse impacts observed in forest plots in the most recent survey cycle (2019 and 2022). Plots are sampled in an alternating panel, with plots 1-15 sampled in 2019 and plots 16-29 sampled in 2022. Deer browse impacts are assessed on a scale of 1-5, with 1 representing no impact and 5 representing severe impacts.

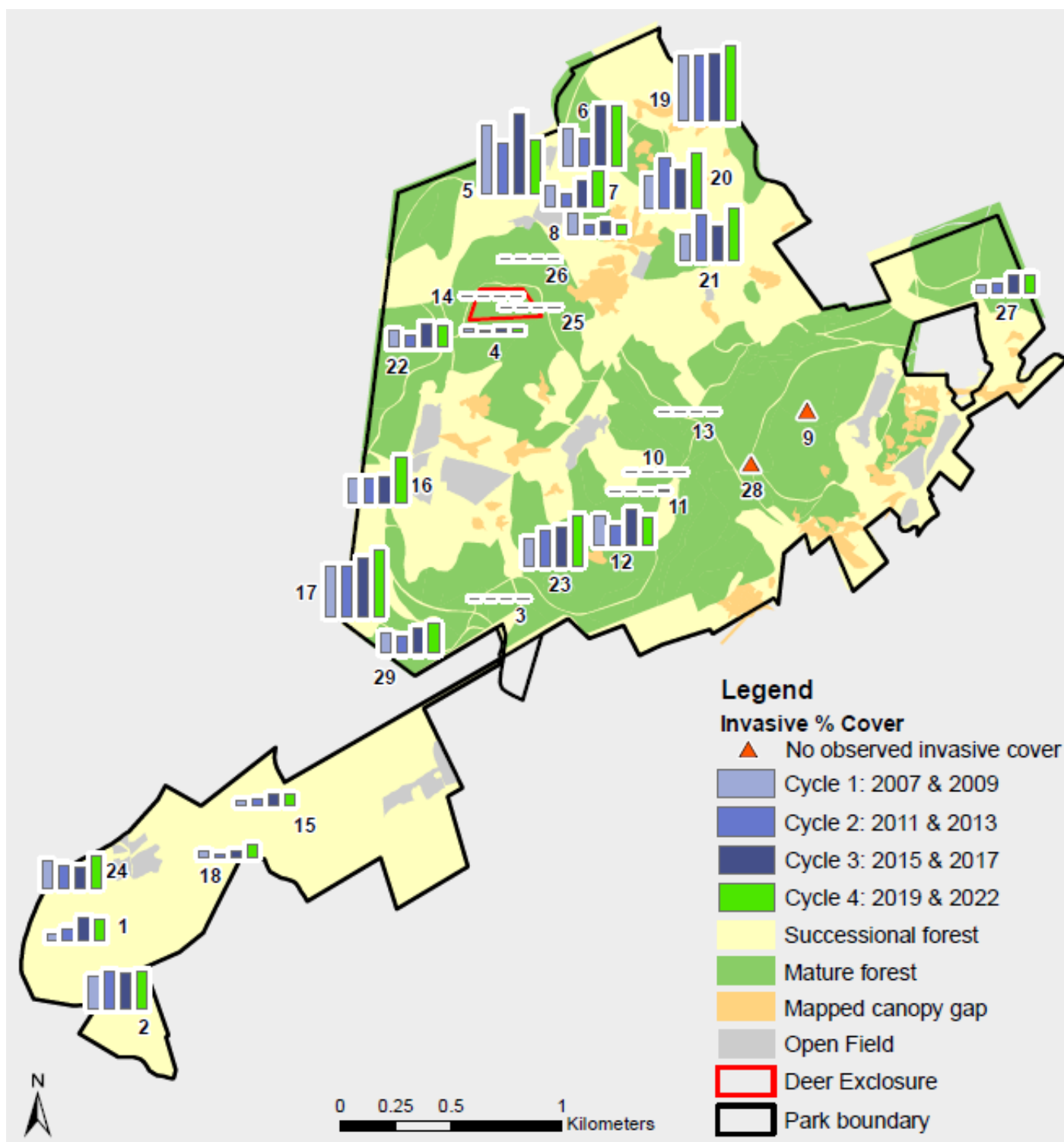
MAP 6: DEER BROWSE IMPACTS



PARK MONITORING MAPS

The map below shows trends in percent cover of invasive species observed in quadrats for plots sampled from 2007-2022. Plots are sampled in an alternating panel, with plots 1-15 sampled in 2007, 2011, 2015, and 2019 and plots 16-29 sampled in 2009, 2013, 2017, and 2022. Average invasive cover ranges from 0 to >100%. See Table 2 for % cover values.

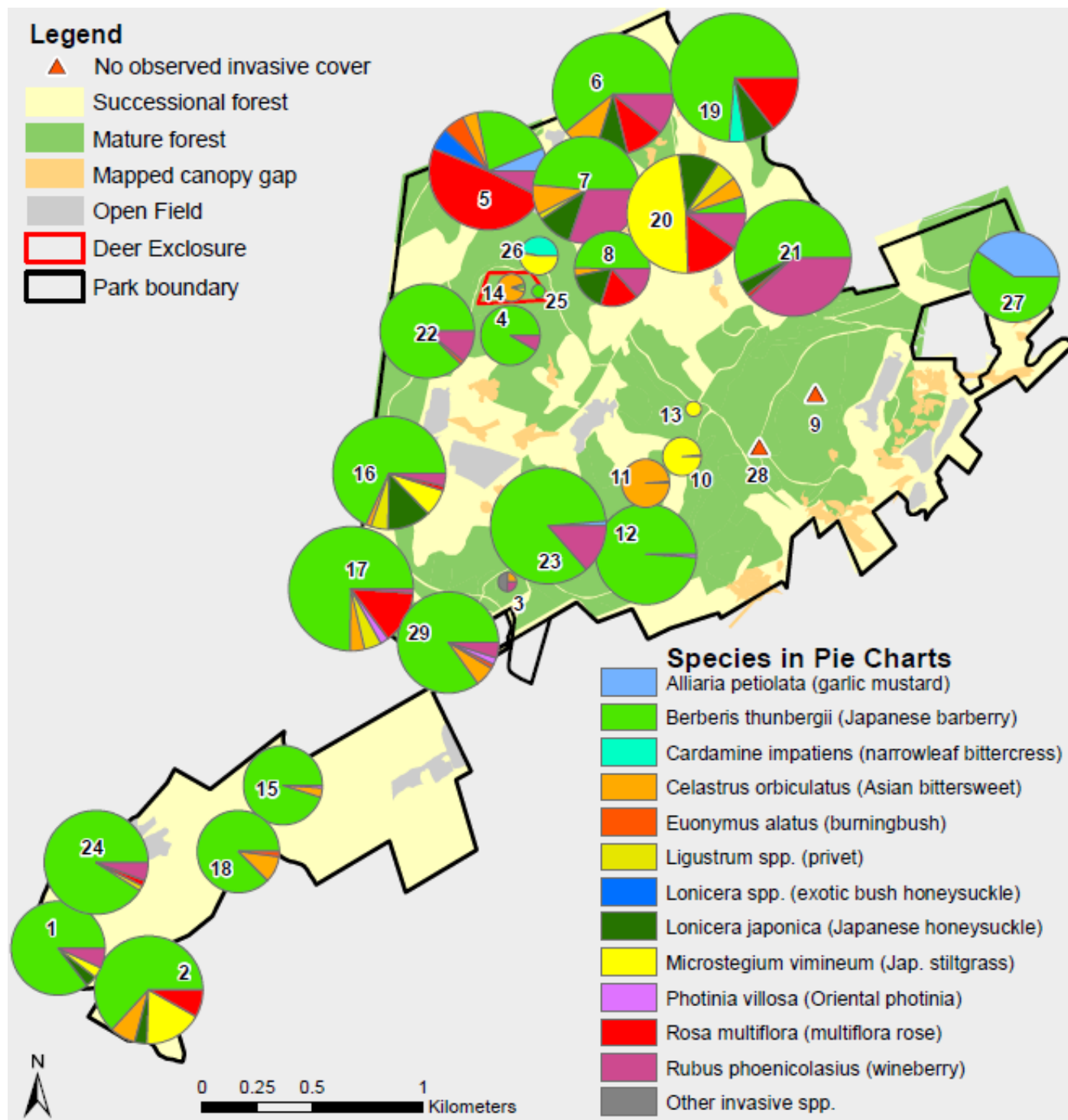
MAP 7: INVASIVES % COVER BY CYCLE



PARK MONITORING MAPS

The map below shows 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 1-15 sampled in 2019 and plots 16-29 sampled in 2022. Pie size is proportional to total invasive cover (range: 0 to >100%), and location may be shifted to prevent overlap.

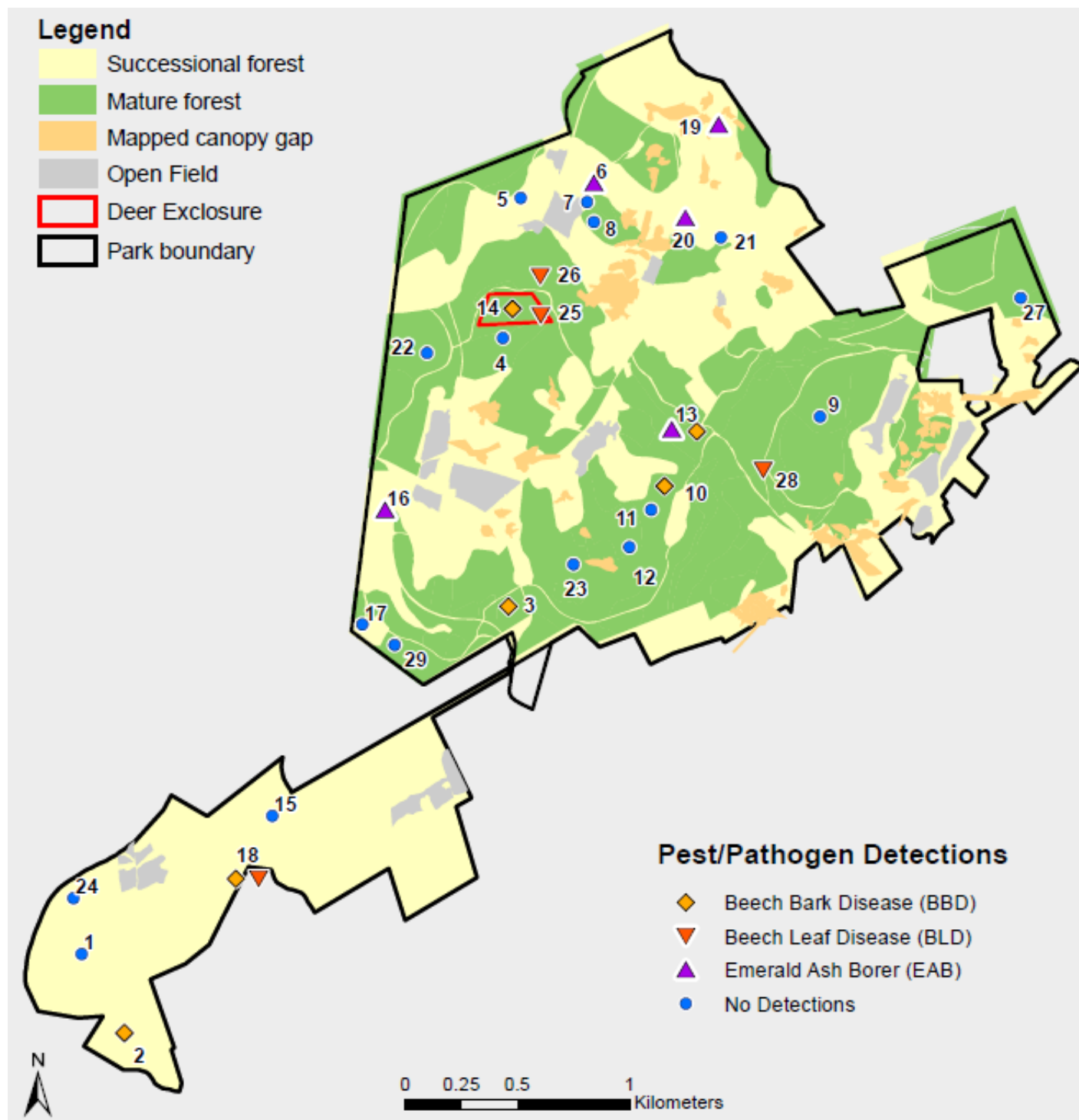
MAP 8: INVASIVES % COVER BY SPECIES



PARK MONITORING MAPS

The map below shows trends priority pest and pathogen detections in forest plots sampled from 2019-2022. Plots are sampled in an alternating panel, with plots 1-15 sampled 2019, and plots 16-29 sampled in 2022. Plots with multiple pests present (i.e., 13 and 18) have multiple symbols. Note that BLD may be more widespread than the map indicates, as plots 1-15 were sampled prior to the first detection of BLD.

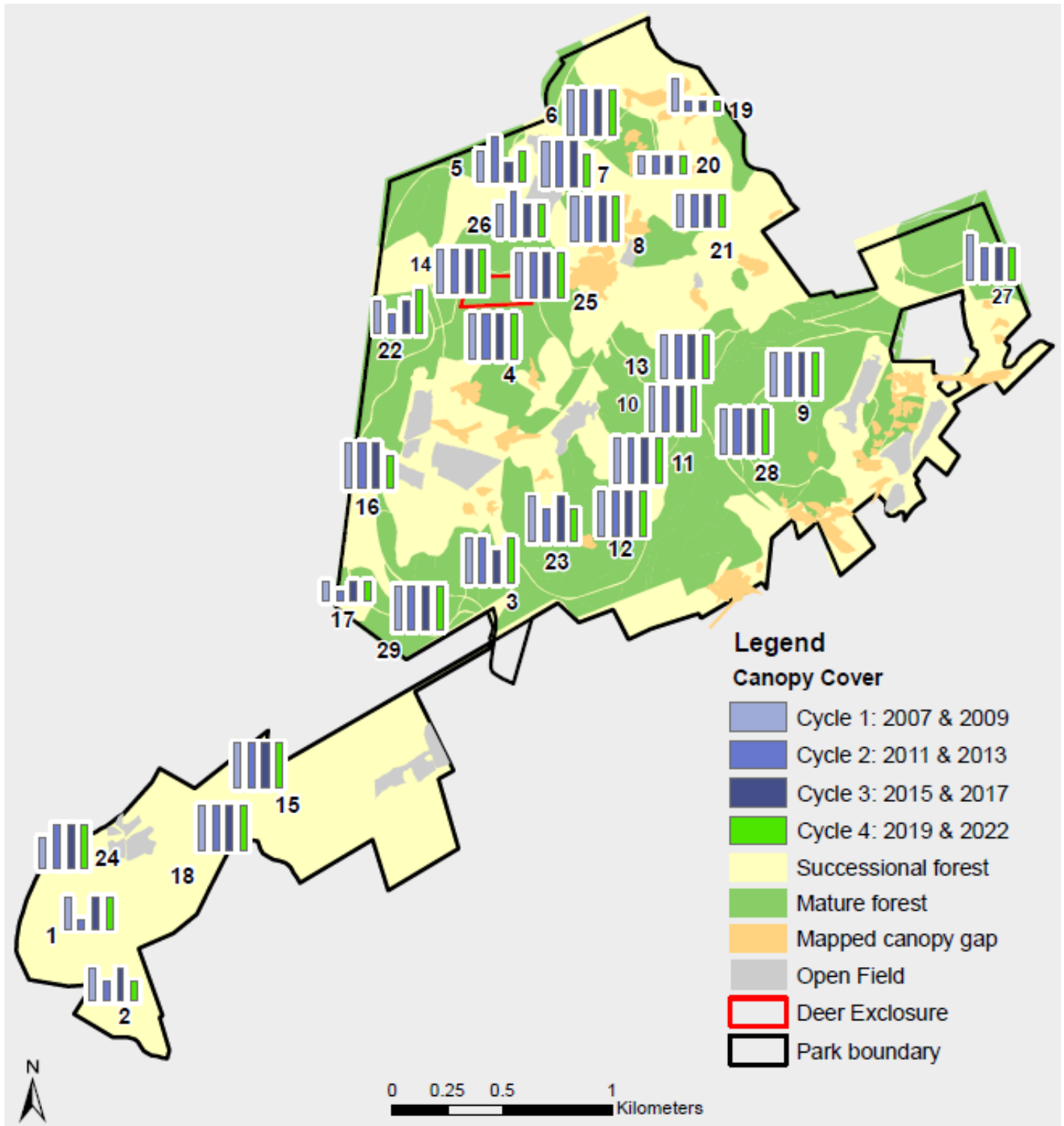
MAP 9: FOREST PEST/PATHOGEN DETECTIONS



PARK MONITORING MAPS

The map below shows trends in tree canopy cover in forest plots sampled from 2007-2022. Plots are sampled in an alternating panel, with plots 1-15 sampled in 2007, 2011, 2015, and 2019, and plots 16-29 sampled in 2009, 2013, 2017, and 2022. Canopy cover ranges from 10 - 25% to >75%.

MAP 10: CANOPY COVER BY CYCLE



NETN FOREST HEALTH MONITORING STAFF

The NETN forest health monitoring crew is made up of a dedicated group of seasonal technicians (with support from the [Schoddic Institute](#)). It is lead by NETN biological technician Camilla Seirup. Protocol lead is NETN plant ecologist Kate Miller, who also analyzed the data and created the maps in this brief.

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