



JANUARY 2023

Forest Health Update for Saint-Gaudens NHP: 2006 - 2022

The Northeast Temperate Network (NETN) forest health monitoring crew has been visiting the 21 NETN forest plots in Saint-Gaudens NHP (SAGA) for 16 years on an alternating 4-year cycle. Data collected over this period indicate that the park's forests are a reflection of a long-period of human use and influence.

Compared to other parks in the region, the forests in SAGA are relatively healthy. Canopy composition is diverse, and the forests are largely composed of native species. It is also one of the few parks in the Network that has invasive plants largely at a maintenance level. There are some concerning trends that threaten

the long-term viability of forests in SAGA, however.

The following is a summary of the most recent NETN findings, as well as a series of park maps that visually display forest health monitoring data. Please contact NETN staff with any questions about the park's forest health.

KEY FINDINGS

- Compared to other parks in the region, the forests in SAGA are relatively healthy. Canopy composition is diverse, and the forests are largely composed of native species.
- SAGA is also one of the few parks in the Network that has invasive plants largely at a maintenance level. As long as the park continues these efforts, invasive plants should remain under control.
- The dominance of hemlock is of concern since the recent detections of hemlock woolly adelgid (HWA) in the area. Hemlock stands also either lack regeneration or are dominated by beech regeneration, both of which raise concerns about the future of these stands.
- Deer impacts are **unsustainable** throughout the park and a long-term deer management program, including strategic fencing, culling, or both will be needed to allow the forest to sustain itself.



Summary of SAGA 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



Beech is the most dominant species in the tree regeneration layer in many park plots (Plot 15 pictured).

canopy is another type of regeneration debt that can be problematic if the species are invasive, like Norway maple, or suboptimal, including pest/disease prone species such as ash.

Forests in SAGA are experiencing **moderate regeneration debt**, both due to insufficient regeneration and compositional mismatch. Native canopy-forming regeneration was present in every plot in the most recent cycle, and larger seedlings and saplings were relatively widespread (Maps 1 & 2). However, most plots failed to meet the minimum targets of 0.25 seedlings/m² (~1,000 stems/acre), 0.14 saplings/m² (550 saplings/acre), and stocking index of 100 (Map 5).

Of concern is the finding that the most common tree species in the canopy (white pine, eastern hemlock, northern red oak, black birch, and red maple) are uncommon in the regeneration layer, which is dominated by American beech and subcanopy species. Subcanopy species are short-

stature trees, like striped maple and musclewood, which have a tree-like growth form but do not reach the full height of the canopy. With the detection of beech leaf disease (BLD; Map 9) in plots along the ravines above Blow-Me-Down Pond, the dominance of beech regeneration may change, as beech seedlings and saplings tend to be most severely impacted by BLD. This may make room for other tree species to regenerate, but equally could make room for invasive shrubs. NETN recommends park staff monitor these areas closely to ensure a native forest canopy is maintained.

Deer browse impacts are **medium or higher** for all but one out of 21 plots in the most recent survey (Map 6). Deer impacts at this level typically

prevent browse preferred species, particularly native conifers, from regenerating. Canada yew, a rare in shrub in SAGA that often grows in hemlock ravines, is a highly preferred browse species and is likely experiencing elevated browse pressure in the park. Declines in understory herbaceous diversity are also likely with deer impacts at

this level which, left unchecked, will lead to compositional shifts away from deer-preferred species such as hemlock and sugar maple, and loss in perennial wildflowers like trillium and bellworts. Given that hemlock regeneration is nearly absent in the park, this trend

may already be happening. Reducing deer browse impacts through strategic fencing, culling, or both would benefit the understory in SAGA.



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



Possible impacts from overabundant deer and invasive worms can be observed in some plots (plot 12 pictured).

Invasive Species

Invasive cover continues to be **relatively low** in SAGA, with 11 out of 21 plots having no invasive plant detections in the most recent survey (Maps 7 & 8). Where they were detected, their average percent cover was below 1% for all but plot 5, indicating that invasive species are largely at a maintenance level in the park. Since monitoring began in 2006 and through 2018, plot 5 has consistently had the highest invasive cover in the park, most of which were invasive shrubs. Based on the recent invasive removal efforts along the slope near plot 5, declines in invasive cover are anticipated when NETN samples again in 2023.

The most common species detected were Norway maple, exotic bush honeysuckle, Asian bittersweet, exotic bush honeysuckle, Japanese barberry, and burningbush, all of which are capable of dispersing and expanding rapidly. As long as the park continues their eradication efforts, NETN expects these species to largely remain at maintenance levels in the park.

In addition to invasive plants, invasive earthworms are also monitored in park plots. [Impacts from earthworms](#) include reduced leaf-litter and altered soil nutrient cycling, which can negatively impact regeneration and understory herbs and facilitate invasive species. The most commonly encountered species in the northeast are European nightcrawlers, which have been detected in 17 out of 21 plots in SAGA. More recently, species from East



Snake worm.

Asia have started invading eastern forests. Known as [snake worms](#), they can occupy much higher densities and cycle nutrients faster than the European worms, and thus can cause more severe understory impacts. While all plots were examined for snake worms in the most recent cycle, none were detected. However, it is possible they were overlooked, as distinguishing between snake worms and European nightcrawlers is difficult in the spring.

Forest Structure & Composition

The canopy layer in SAGA is **relatively diverse**, with a mix of white pine, hemlock, northern red oak, black birch, red maple, [sugar maple](#), [American beech](#), and others (Map 4). A diverse canopy promotes high response variability to stressors like pests, diseases, and [climate change](#). However, there are concerning trends in tree mortality and recruitment, and expanding pests/pathogens to keep an eye on. For example, while mortality has occurred across a range of tree species in the park, beech is the main species recruiting into tree size, and the most abundant canopy species in the park have all lost stem density since monitoring began. While loss in stem density as forests age is not necessarily problematic, the fact that beech is the main species recruiting into tree size is a concern.

Beech leaf disease (BLD) and beech bark disease (BBD) were the only two priority pests/pathogens detected in the most recent survey (Map 9). BBD has been in the area since the 1960s, and is therefore not a new concern. BLD, on the other hand,



Coarse woody debris levels continue to improve throughout the park (Plot 11 pictured).

is a new disease that has spread rapidly across the northeast in recent years. Being such a new disease, the long-term impacts of and potential treatments for BLD remain unknown. The main impact of BLD appears to be widespread mortality to seedlings and saplings. Mortality of canopy trees from BLD appears to be less drastic, although BLD infestations where BBD is already present could cause more dramatic impacts.

While NETN has yet to detect hemlock woolly adelgid (HWA) in SAGA, it has been detected in multiple towns in Sullivan County. As winters become milder from climate change, spread and impacts from HWA are likely to increase in the park. Similarly, emerald ash borer (EAB) has also been detected in Sullivan County, but not yet in the park. SAGA does not have a large [ash](#) component in the canopy, and so is less of a concern here than parks with a larger ash component.

Of the most common canopy species in SAGA, red maple, sugar maple, and northern red

oak are the species predicted to have the greatest ability to cope with climate change according to the latest [Climate Change Tree Atlas](#) (version 4) under the high emissions scenario (RCP 8.5). In contrast, white pine is predicted to have fair and hemlock poor coping ability under high emissions scenarios. Hemlock's poor coping ability is largely due to hemlock woolly adelgid (HWA). Combining these predictions with the current lack of conifer regeneration in the understory, the composition of the forests in SAGA will likely shift towards a more hardwood dominated canopy in the future. The primary concerns related to these shifts are the impacts to the hemlock-dominated ravines. Conifer cover on slopes helps reduce flooding and erosion from spring melt and provides year-round shade for streams. Knowing that hemlock may decline in the coming decades, promoting white pine regeneration on the slopes may help minimize impacts from hemlock dieback. However, climate change and

other stressors may overwhelm white pine's ability to adapt over longer time scales.

[Coarse woody debris](#) has increased slightly in volume throughout the park (Map 12), with 12 out of 21 plots **meeting or exceeding** the minimum threshold of 20 – 50 m³/ha of dead wood proposed by Müller and Bütler (2010) as needed to support the range of taxa dependent on dead wood habitat (Map 13).

For more information

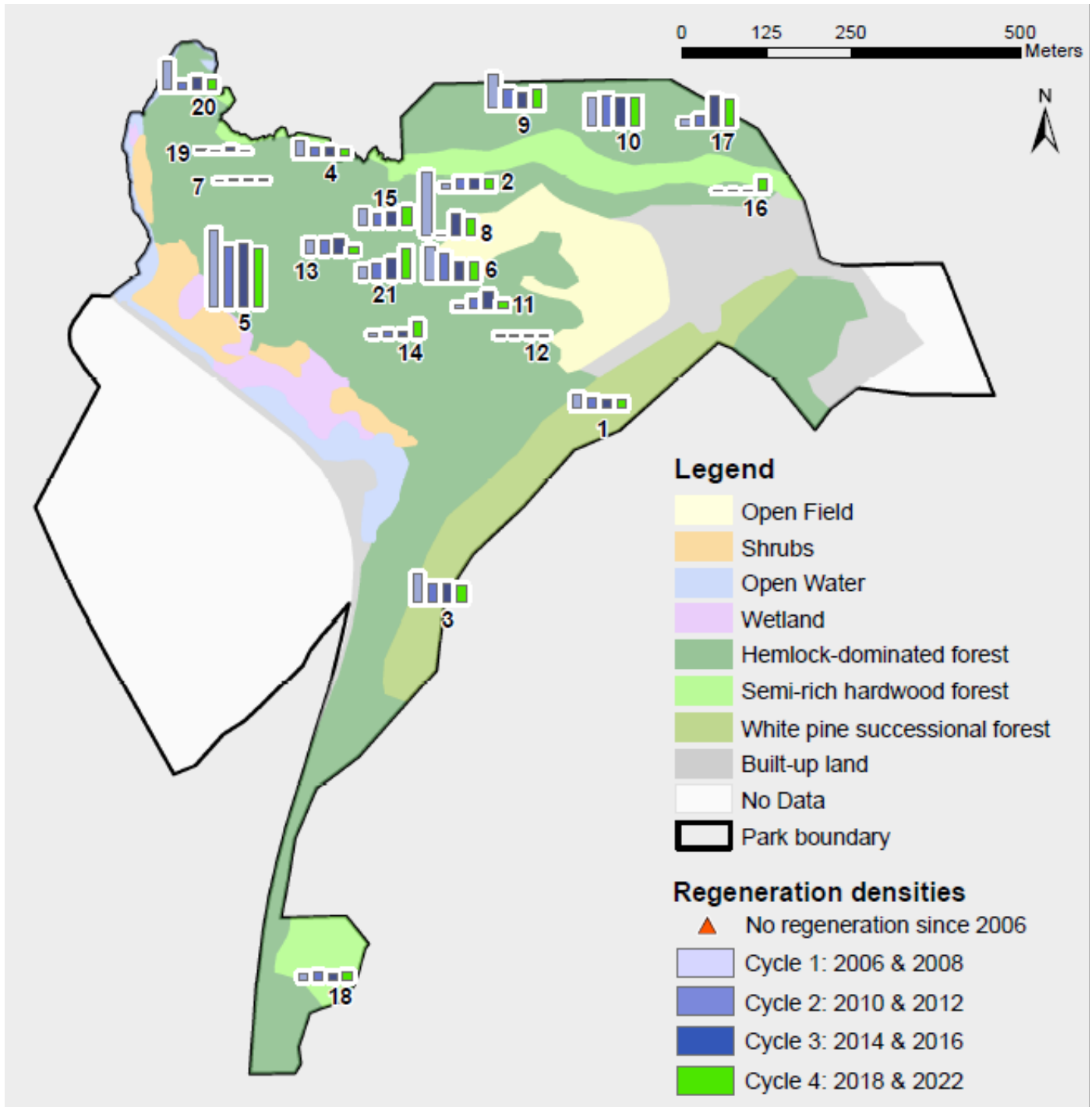
The [NETN website](#) is chock full of information related to park forest health as well as all the other long-term monitoring programs. Like all of NETN's parks, SAGA has its own [web page](#) providing a convenient one-stop shopping place for all things SAGA related.

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, including seedlings and saplings, observed in forest plots sampled from 2006-2022. Plots are sampled in an alternating panel, with plots 1-10 sampled in 2006, 2010, 2014, and 2018, and plots 11-21 sampled in 2008, 2012, 2016, and 2022. Densities range from 0 to 1.3 stems/m² and only include canopy-forming species. Densities are lower than the 2018 report because ash (*Fraxinus* spp.) are no longer considered canopy-forming. Note the unit change from the 2018 report to match manuscript in review. Plot 8 data are missing in 2010.

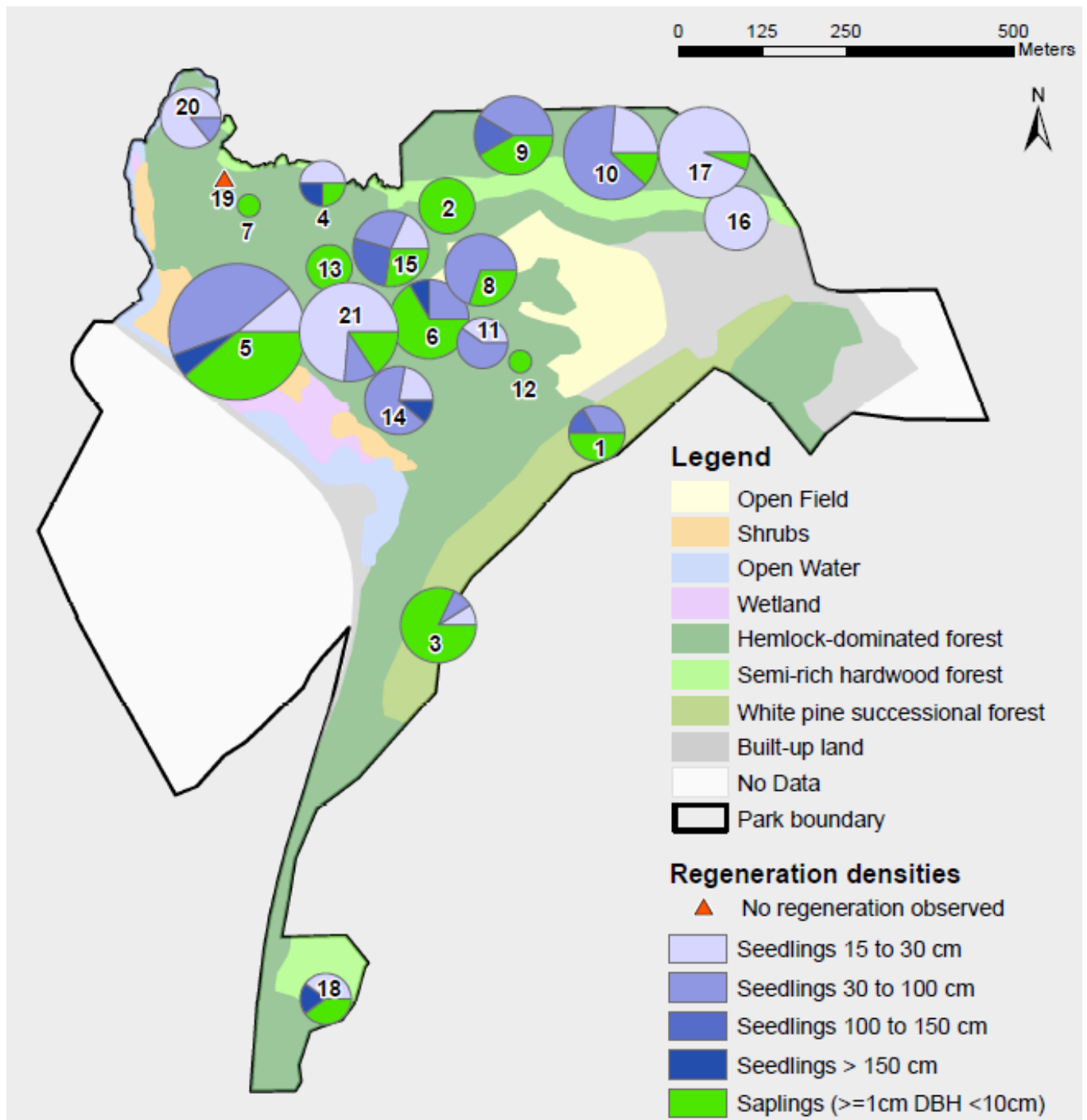
MAP 1: TREE REGENERATION: MONITORING CYCLE



PARK MONITORING MAPS

Trends in tree regeneration by size class in forest plots from the most recent survey cycle (2018 and 2022). Plots are sampled in an alternating panel, with plots 1-10 sampled in 2018, and plots 11-21 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 6.8 stems/m² and only include native canopy-forming species.

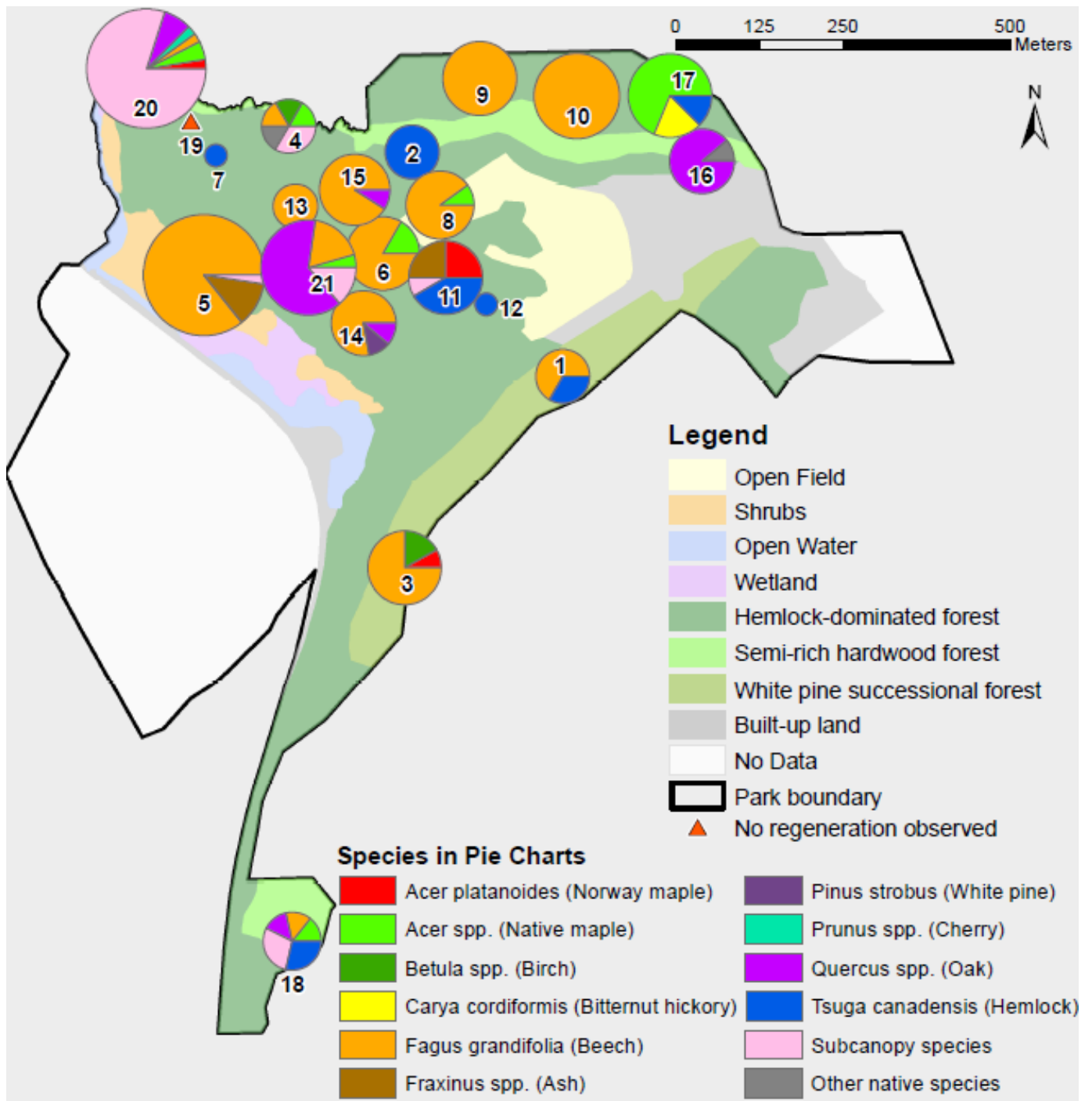
MAP 2: TREE REGENERATION: SIZE CLASS



PARK MONITORING MAPS

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 are sampled in an alternating panel, with plots 1-10 sampled in 2018, and plots 11-21 sampled in 2022. Pie size is proportional to the total plot-level regeneration (plot-level density range: 0 to 1.1 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. Note that striped maple (*A. pensylvanicum*) is included in the subcanopy group.

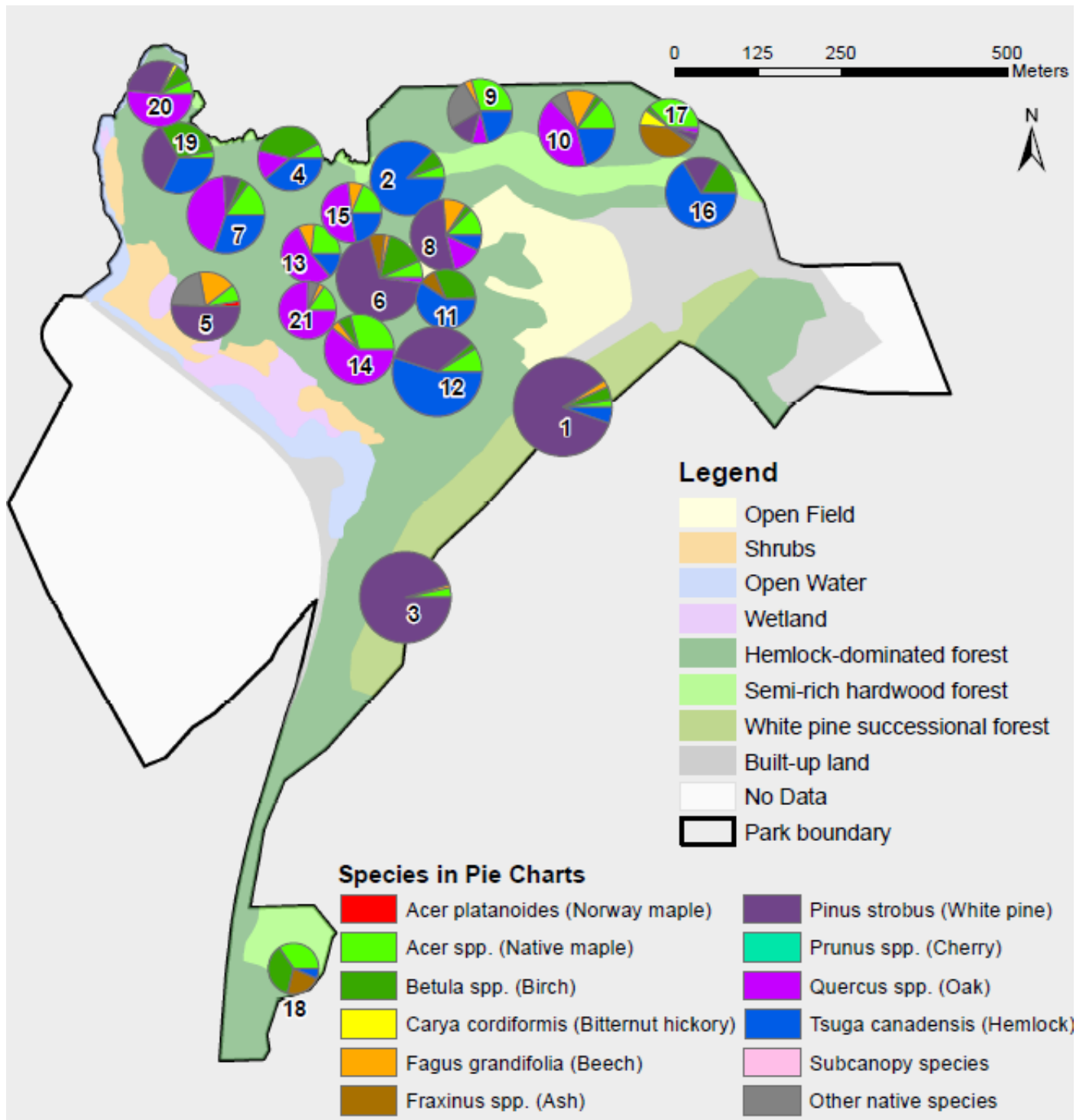
MAP 3: TREE REGENERATION: COMPOSITION



PARK MONITORING MAPS

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 1-10 sampled in 2018, and plots 11-21 sampled in 2022. Pie size is proportional to the total plot-level basal area (range: 22.0 to 82.6 m²/hectare). Pies may be shifted from actual plot location to prevent overlap.

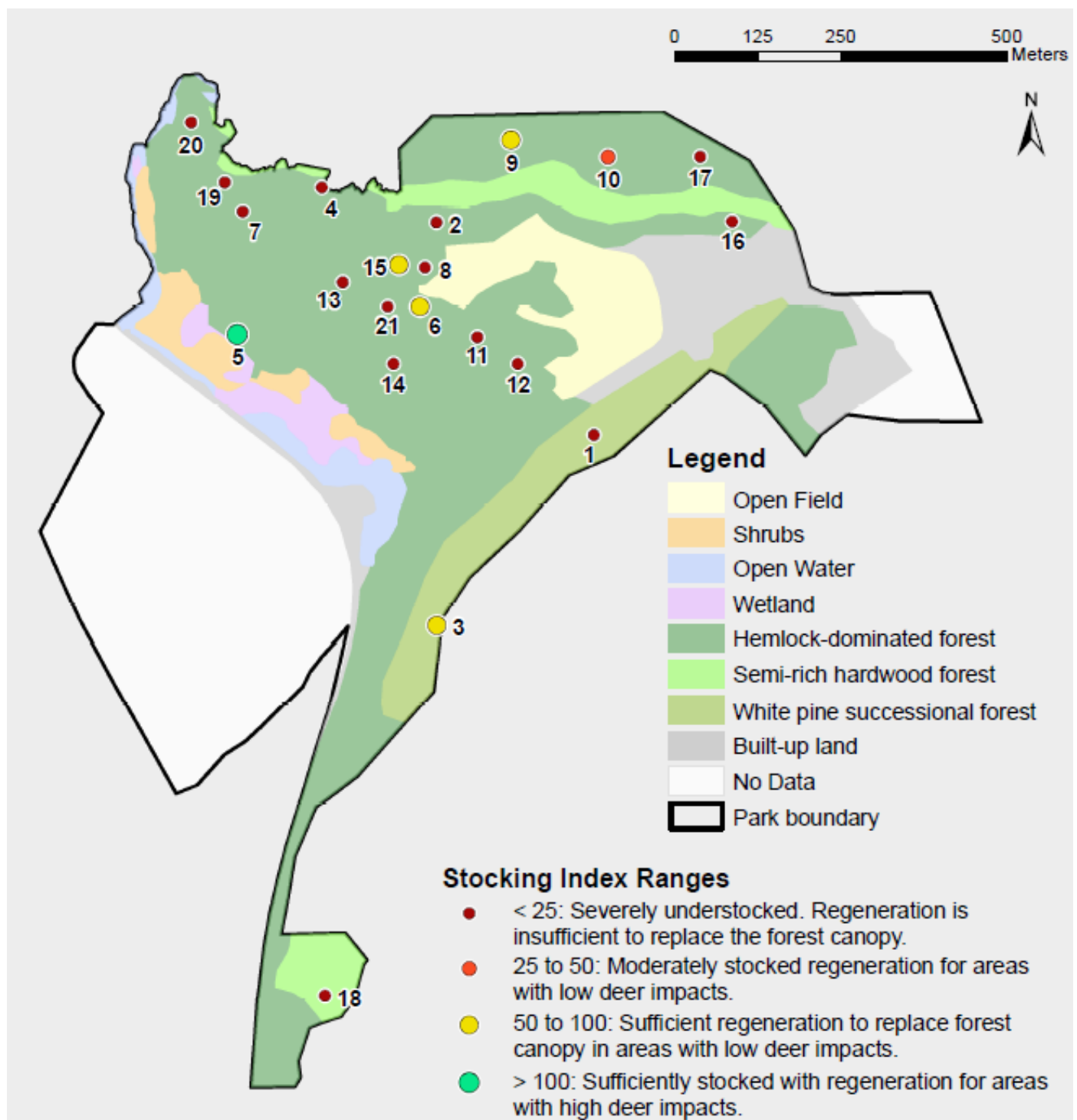
MAP 4: TREE CANOPY: COMPOSITION



PARK MONITORING MAPS

Trends the regeneration stocking index for the most recent survey cycle (2018 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 regen 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 0-145).

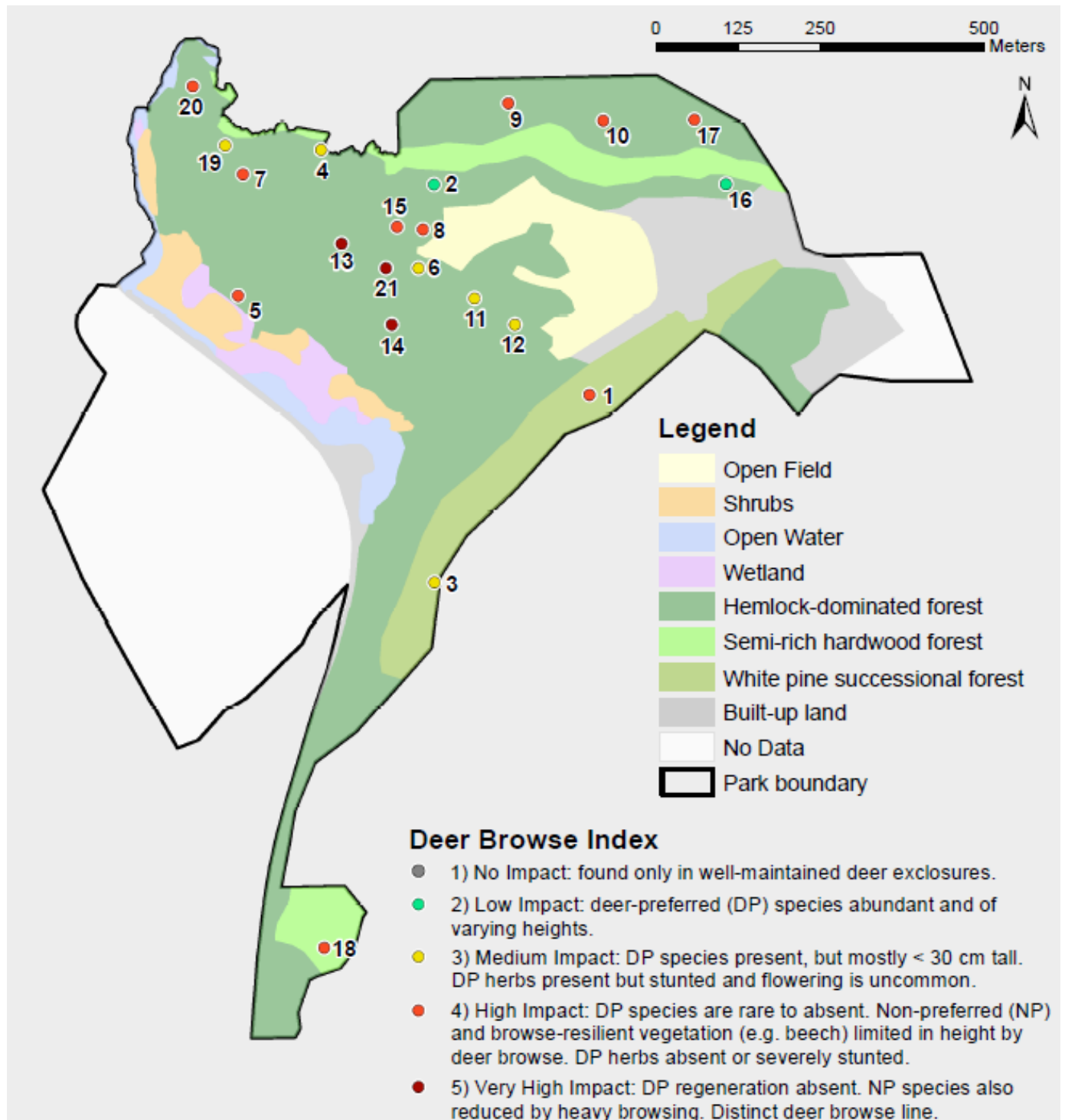
MAP 5: TREE REGENERATION: STOCKING INDEX



PARK MONITORING MAPS

Index of deer browse impacts observed in forest plots in the most recent 4 years of sampling (2018 & 2022). Plots are sampled in an alternating panel, with plots 1-10 sampled in 2018 and plots 11-21 sampled in 2022. Deer browse impacts are assessed on a scale of 1-5, with 1 representing no impact and 5 representing severe impacts.

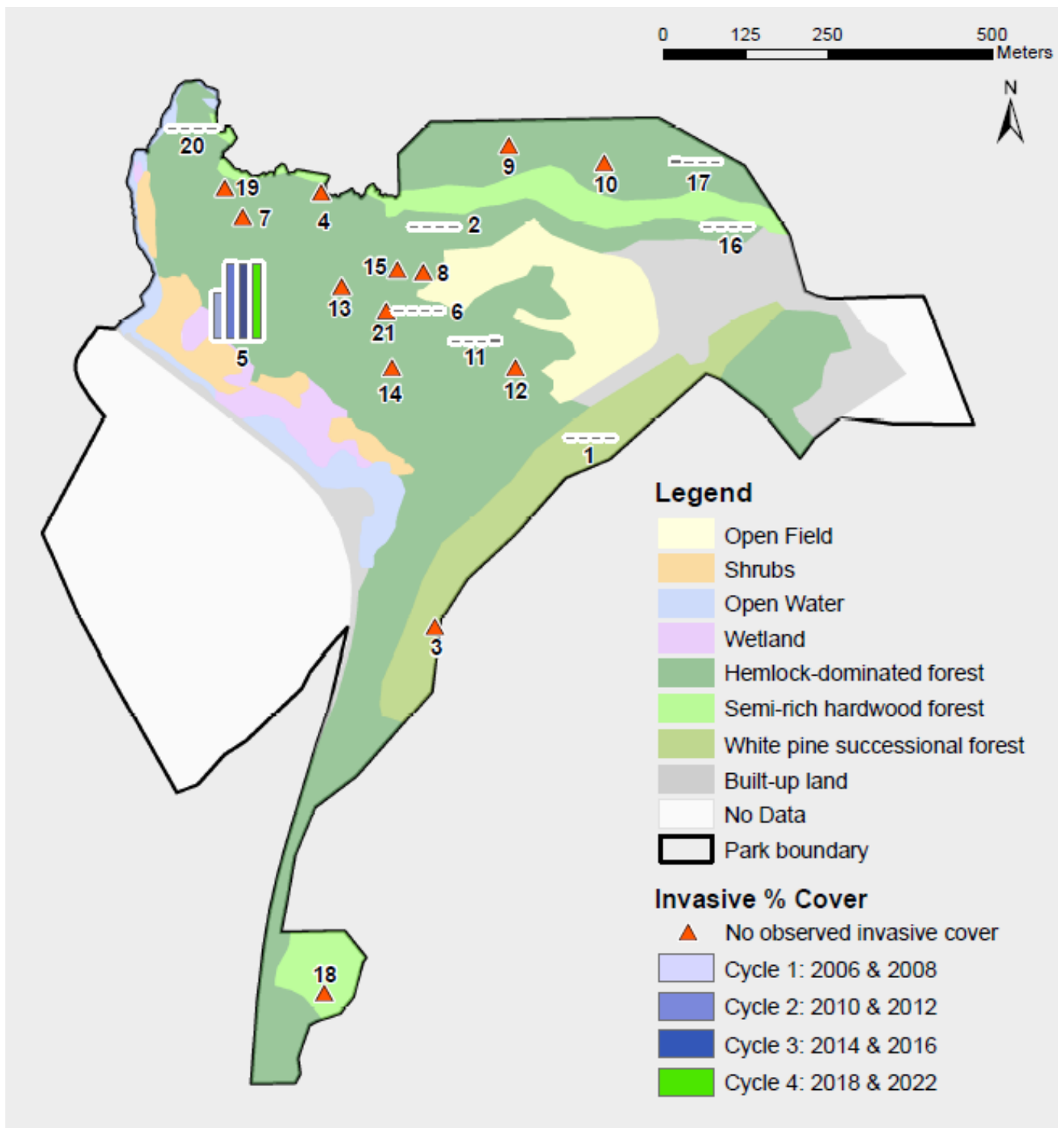
MAP 6: DEER BROWSE IMPACTS



PARK MONITORING MAPS

Trends in percent cover of invasive species observed in plots sampled from 2006-2022. Plots are sampled in an alternating panel, with plots 1-10 sampled in 2006, 2010, 2014, and 2018, and plots 11-21 sampled in 2008, 2012, 2016, and 2022. Average invasive cover ranges from 0 to 22.2%.

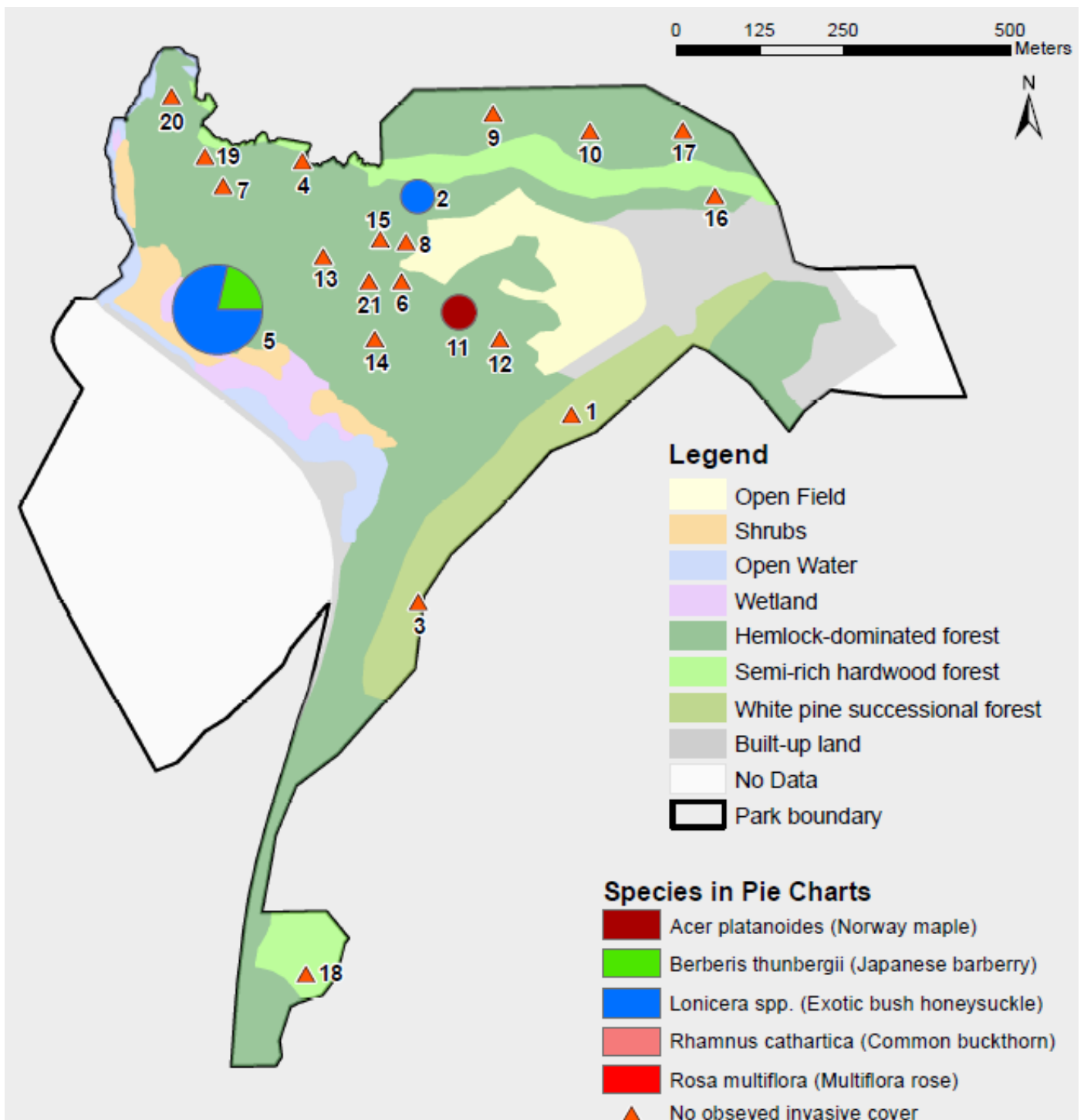
MAP 7: INVASIVES % COVER BY CYCLE



PARK MONITORING MAPS

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 1-10 sampled in 2018 and plots 11-21 sampled in 2022. Pie size is proportional to total invasive cover (range: 0 to 22.2%), and location may be shifted to prevent overlap.

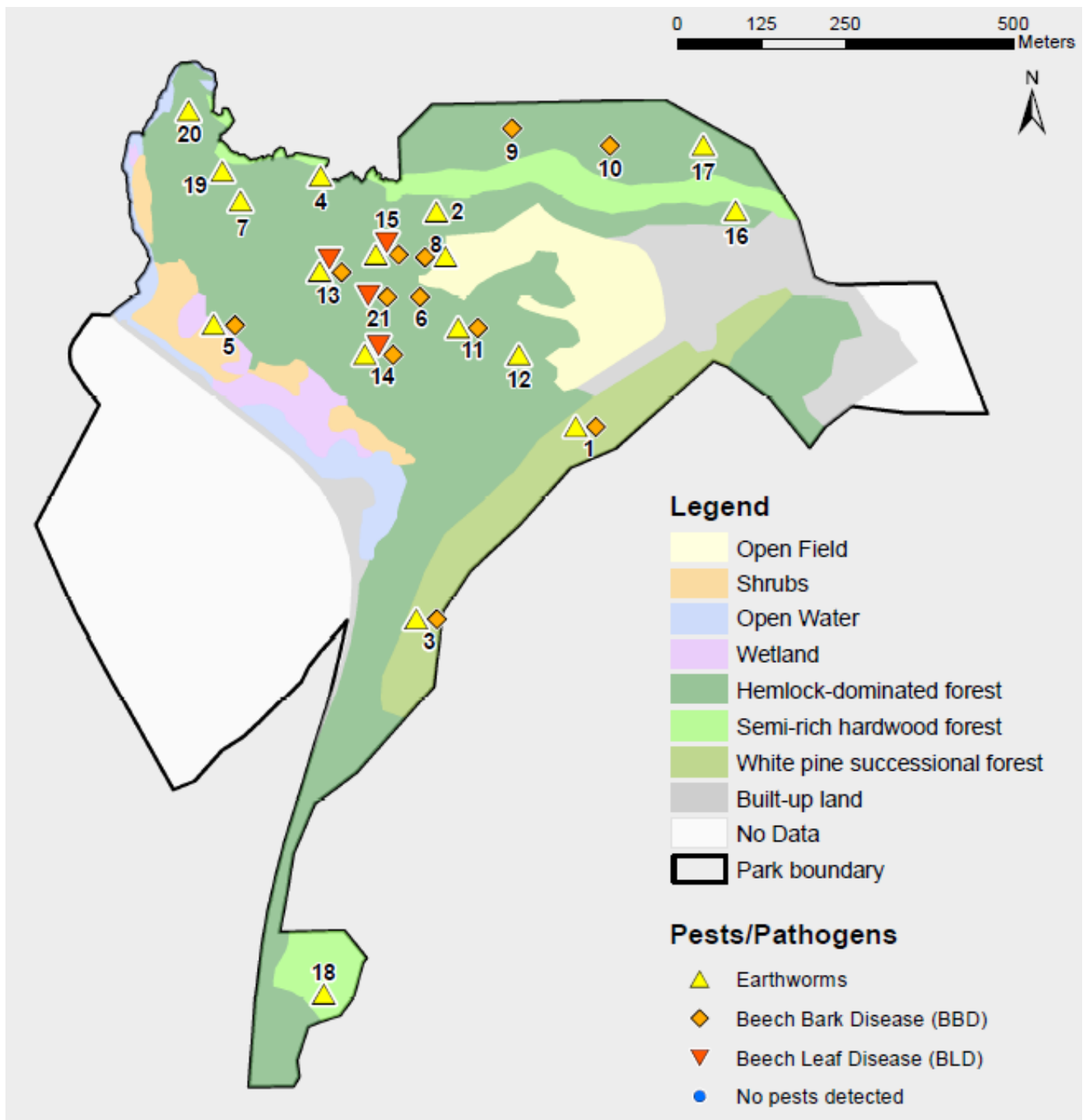
MAP 8: INVASIVES % COVER BY SPECIES



PARK MONITORING MAPS

Priority pest and pathogen detections in forest plots sampled from 2018-2022. Plots are sampled in an alternating panel with plots 1-10 sampled in 2018 and plots 11-21 sampled in 2022. Plots with multiple pests present (1, 3, 8, etc.) have multiple symbols. Note that BLD may be more widespread than map indicates, as plots 1-10 were sampled prior to the first detection in 2022.

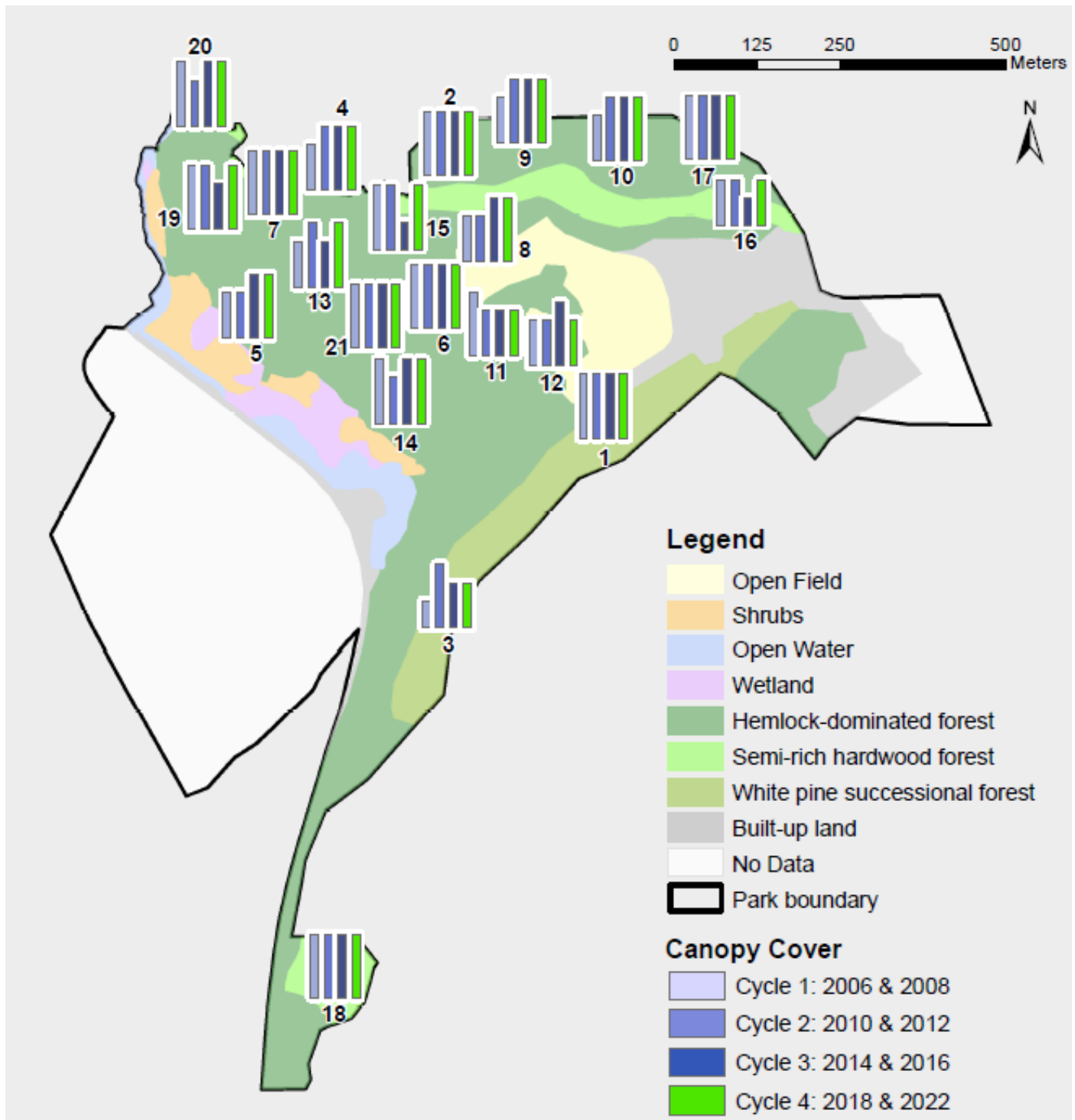
MAP 9: FOREST PEST/PATHOGEN DETECTIONS



PARK MONITORING MAPS

Trends in tree canopy cover in forest plots sampled from 2006-2022. Plots are sampled in an alternating panel, with plots 1-10 sampled in 2006, 2010, 2014, 2018 and plots 11-21 sampled in 2008, 2012, 2016, and 2022. Canopy cover ranges from 25 - 50% to >75%.

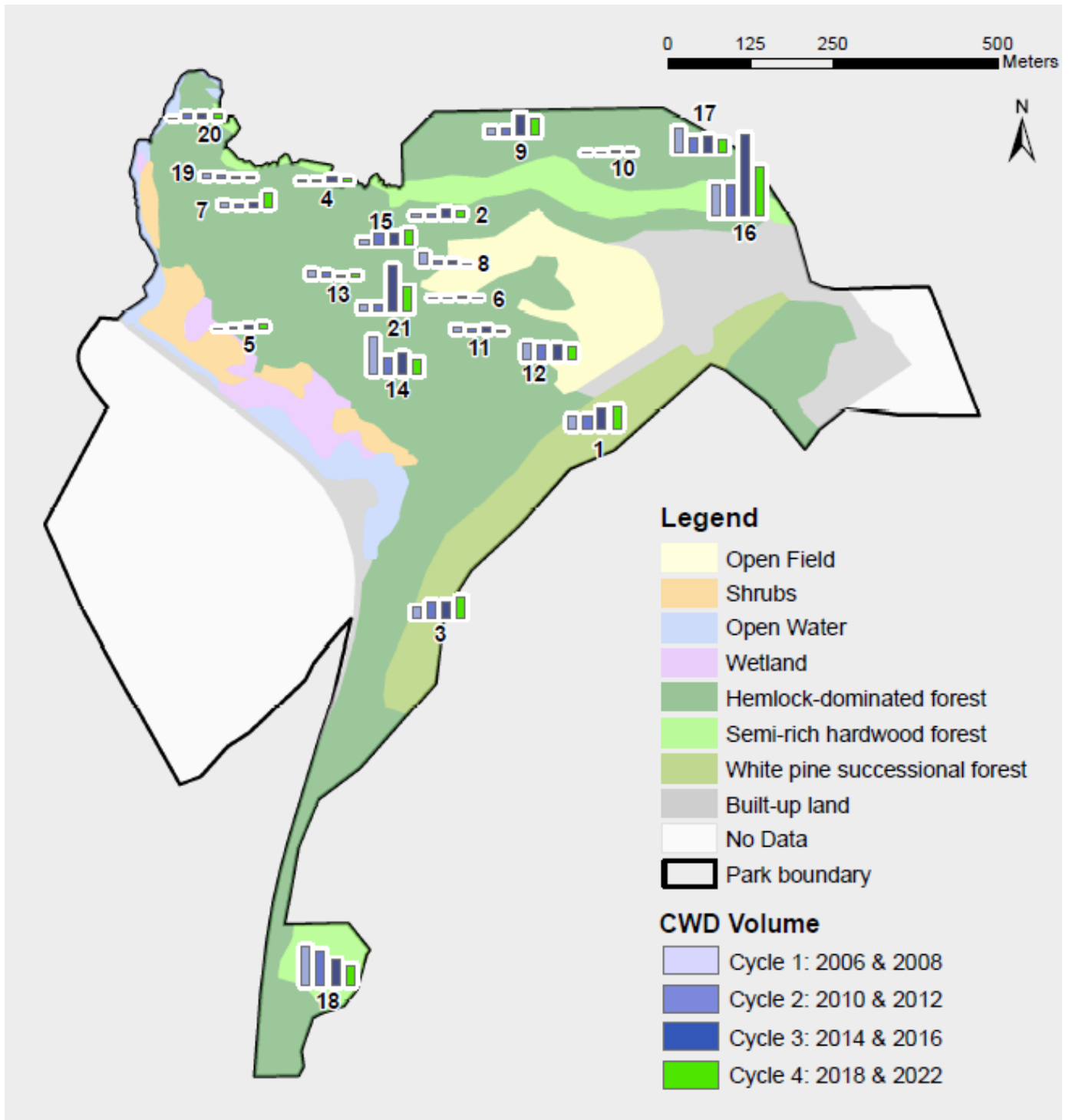
MAP 10: CANOPY COVER BY CYCLE



PARK MONITORING MAPS

Trends in Coarse Woody Debris (CWD) volume observed in plots sampled from 2006-2022. Plots are sampled in an alternating panel, with plots 1-10 sampled in 2006, 2010, 2014, and 2018, and plots 11-21 sampled in 2008, 2012, 2016, and 2022. CWD volume ranges from 0 to 288.7 m³/ha (4,126.6ft³/ac).

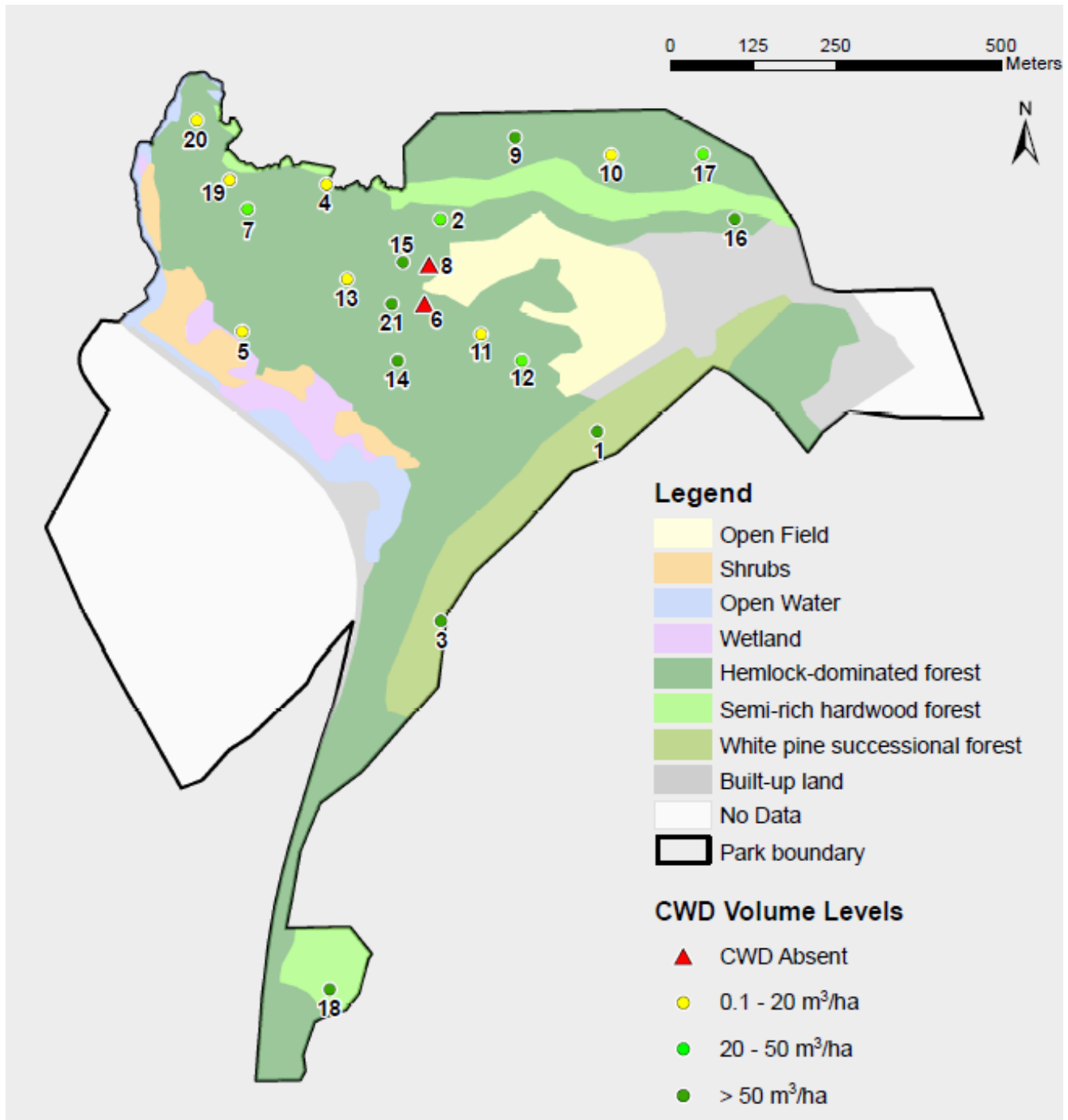
MAP 11: CWD BY CYLCE



PARK MONITORING MAPS

Coarse woody debris volume (m³/ha) for the most recent survey cycle (2018 and 2022). Plots 1-10 were sampled in 2018 and plots 11-21 were sampled in 2022. Volumes range from 0 to 289 m³/ha (4,127 ft³/ac). Plots are color coded by volume to indicate whether they meet the 20-50 m³/ha (285.8-714.6 ft³/ac) threshold in Müller and Bütler (2010).

MAP 12: CWD RATINGS



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 [Schoodic 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.

Kate Miller kathryn_miller@nps.gov
Plant Ecologist - Forest Health Protocol Lead

Camilla Seirup camilla_seirup@nps.gov
Biological Technician - Crew Leader

Aaron Weed aaron_weed@nps.gov
NETN Program Manager

Adam Kozlowski adam_kozlowski@nps.gov
Data Manager

Ed Sharron ed_sharron@nps.gov
Science Communication Specialist



ACADIA NP • APPALACHIAN NST • BOSTON HARBOR ISLANDS NRA • MARSH-BILLINGS-ROCKEFELLER NHP • MINUTE MAN NHP
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