



JANUARY 2023

Forest Health Update for Weir Farm NHS: 2007 - 2022

The Northeast Temperate Network (NETN) forest health monitoring crew has been visiting the 10 NETN forest plots in Weir Farm NHS (WEFA) for 15 years on an alternating 4-year cycle. This brief is a summary of forest health analysis with focus on tree regeneration and recruitment, deer population impacts, invasive

plants and insects, tree species composition and condition, and tree mortality. Findings show that WEFA forests are regionally unique and complex, with ecological importance that extends well beyond park boundaries. But continued impacts from deer, invasive pests, and a lack of enough tree

regeneration pose significant concerns to their future.

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

- As with other parks in the Network, the forests in WEFA are in a **high state of peril**.
- The combined impacts of overabundant deer, invasive shrubs and exotic pests/pathogens, are severely impacting forest health to the point that forest loss is beginning to occur.
- Impacts are only likely to be exacerbated by climate change-fueled increased and more intense storms, resulting in further canopy loss.
- 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.
- Continued management of invasive shrubs and vines, is important to keep invasives from responding to canopy openings and choking out native regeneration.



Summary of WEFA 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



Not enough tree regeneration is being observed in many forest health plots (Plot 6 pictured) in the park.

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

Forests in WEFA are experiencing **severe regeneration debt**. While there are some positive trends in seedling density over time (Map 1), gains have largely been restricted to seedlings in the smallest size classes (Map 2) and the density of saplings significantly declined over time. In the most recent survey, only 4 out of 10 plots met the target of 0.25 seedlings/m², and no plots met the targets of 0.14 saplings/m² or a stocking index of 100 (Map 5). Note that these trends are more extreme than in the 2019 report because ash is no longer considered a native canopy-forming species now that emerald ash borer (EAB), which kills ash before they can reach the canopy, has a foothold in the park. Note that these targets were established as part of a regional

regeneration study currently in review.

The composition of the regeneration layer is also a concern. [Ash](#) species are the most abundant species in the regeneration layer (Map 3), and as noted, are unlikely to survive long enough to reach the canopy. On a positive note, [sugar maple](#) is the second most abundant species in the regeneration layer and is common in the canopy (Map 4). The latest Climate Change Tree Atlas (version 4) predicts sugar maple to only experience modest declines in the most southern portion of its range and to have a very good capacity to cope with climate change even under the high emissions scenario (RCP 8.5). Sugar maple is also shade tolerant and unlike oak species, does not require large canopy gaps

to successfully recruit into the canopy, and is therefore a good species to encourage in the regeneration layer. Other species common in the canopy, however, including blackbirch, tulip poplar, [oak](#), and hickory are rare to absent in the regeneration layer. If this pattern persists, the canopy will likely shift towards a more maple-dominated and less diverse canopy.



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

High deer impacts also continue to be observed throughout WEFA, with six out of ten plots rated high or very high for deer browse impacts in the most recent survey (Map 6).

Invasive Species

Invasive cover varies across the park, with the highest and most diverse cover north and west of Weir Pond (Map 8). The most common invasive species in WEFA are Japanese barberry, Asian bittersweet, burningbush, and narrowleaf bittercress



Japanese barberry and other woody invasives continue to be a problem in the park (plot 8 pictured).

(Map 8). Invasive woody species are of particular concern to forest health in WEFA, as these species can expand rapidly in response to canopy gaps, tend to persist once established, and can suppress native tree regeneration and understory diversity.

While Japanese stiltgrass is only found in two park plots, average cover of Japanese stiltgrass increased considerably in plot 8, which had no observable cover in 2017 and had increased to nearly 10% cover by 2022. Particularly, if deer impacts increase, Japanese stiltgrass can rapidly expand in cover and spread to other areas of the park. We encourage park managers to keep Japanese stiltgrass from invading new areas and from expanding in areas where abundance is currently low. In addition to treating with herbicide, installing boot scrapers at trail heads to keep hikers from transporting seeds, and cleaning off maintenance equipment between units may help reduce the spread of Japanese stiltgrass.

Forest Structure & Composition

Based on tree cores collected

near our plots, trees in WEFA are primarily 50 to 100 years old, with the oldest tree, a white oak near plot 5, dating back to 1879. Despite being relatively young, the forests in WEFA have more complex older forest structure, such as large trees and coarse woody debris, [than surrounding forests](#), and their continued protection and management is important beyond the boundaries of the park. The canopy layer in WEFA is also fairly diverse, with a mix of maple species, black birch, tulip poplar, oak species, and hickory species (Map 4). However, if tree mortality and recruitment patterns continue,



Emerald ash borer

canopy diversity will decline over time. Ash in particular has experienced severe mortality in the most recent cycle due largely to EAB

(Map 9). Many of the most abundant species in the canopy have also experienced elevated mortality since monitoring began in 2007, whereas [American beech](#) has primarily been the species recruiting to tree size.

Now that beech leaf disease is present in WEFA (Map 9), this trend may be reversed, as beech seedlings and saplings typically suffer the highest mortality from beech leaf disease. While overall basal area has continued to increase in WEFA over time, gains are largely through incremental stem growth of remaining trees, especially from black birch, oak and tulip poplar, rather than recruitment of new stems into the canopy.

For more information

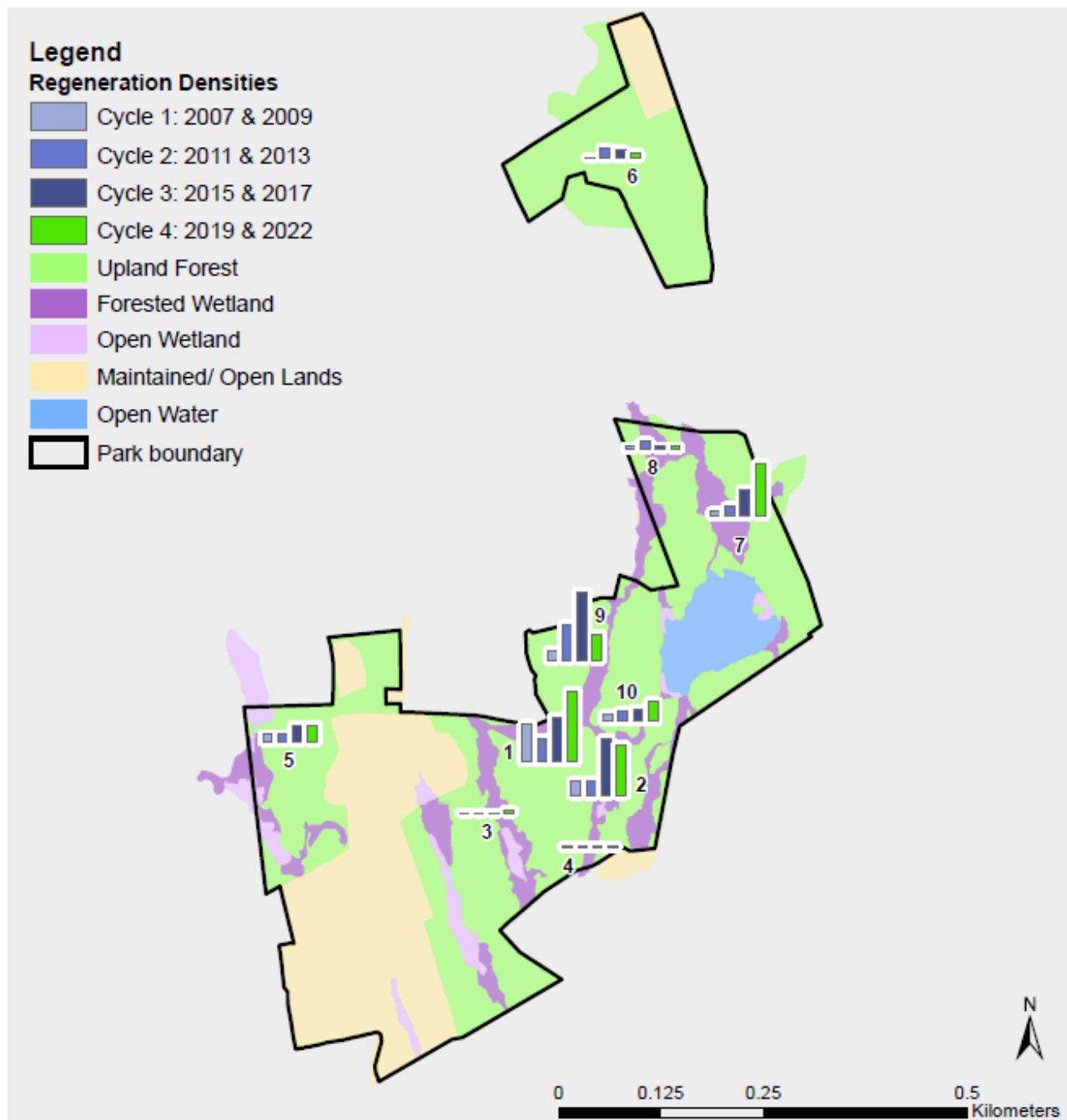
The [NETN website](#) is chock full of information related to park forest health as well as all the other long-term monitoring programs. Like all of NETN's parks, WEFA has its own [web page](#) providing a convenient one-stop shopping place for all things WEFA related.

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, in forest plots sampled from 2007- 2022. Plots are sampled in an alternating panel, with plots 1-5 sampled in 2007, 2011, 2015, and 2019, and plots 6-10 sampled in 2009, 2013, 2017, and 2022. Densities range from 0 to 0.8 stems/m², and only include native canopy-forming species.

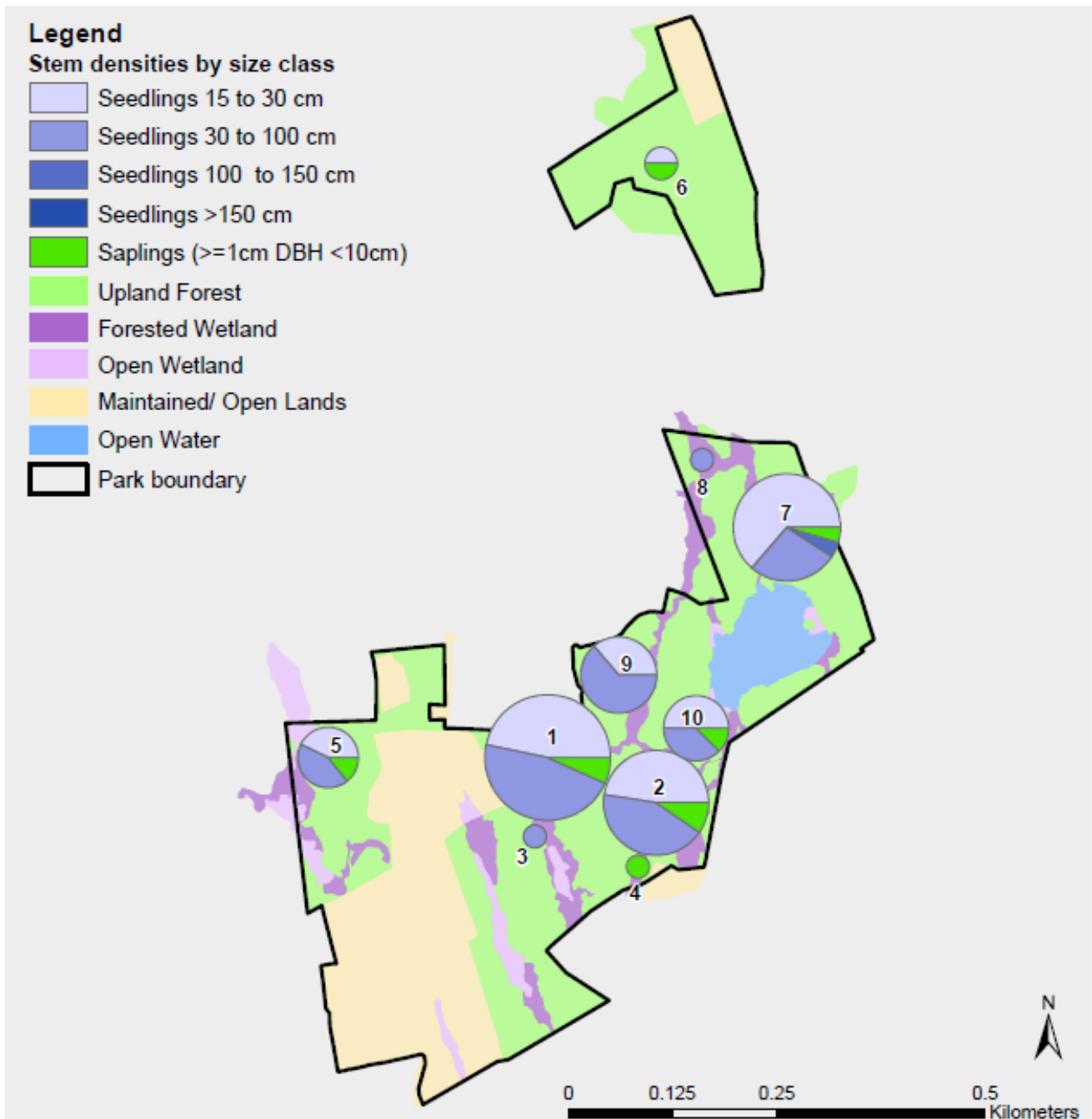
MAP 1: TREE REGENERATION: MONITORING CYCLE



PARK MONITORING MAPS

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 1-5 sampled in 2019, and plots 6-10 sampled in 2022. Pie size is proportional to plot-level regeneration, and location may be shifted to prevent overlap. Total densities range from 0.02 to 0.8 stems/m² and only include native canopy-forming species.

MAP 2: TREE REGENERATION: SIZE CLASS



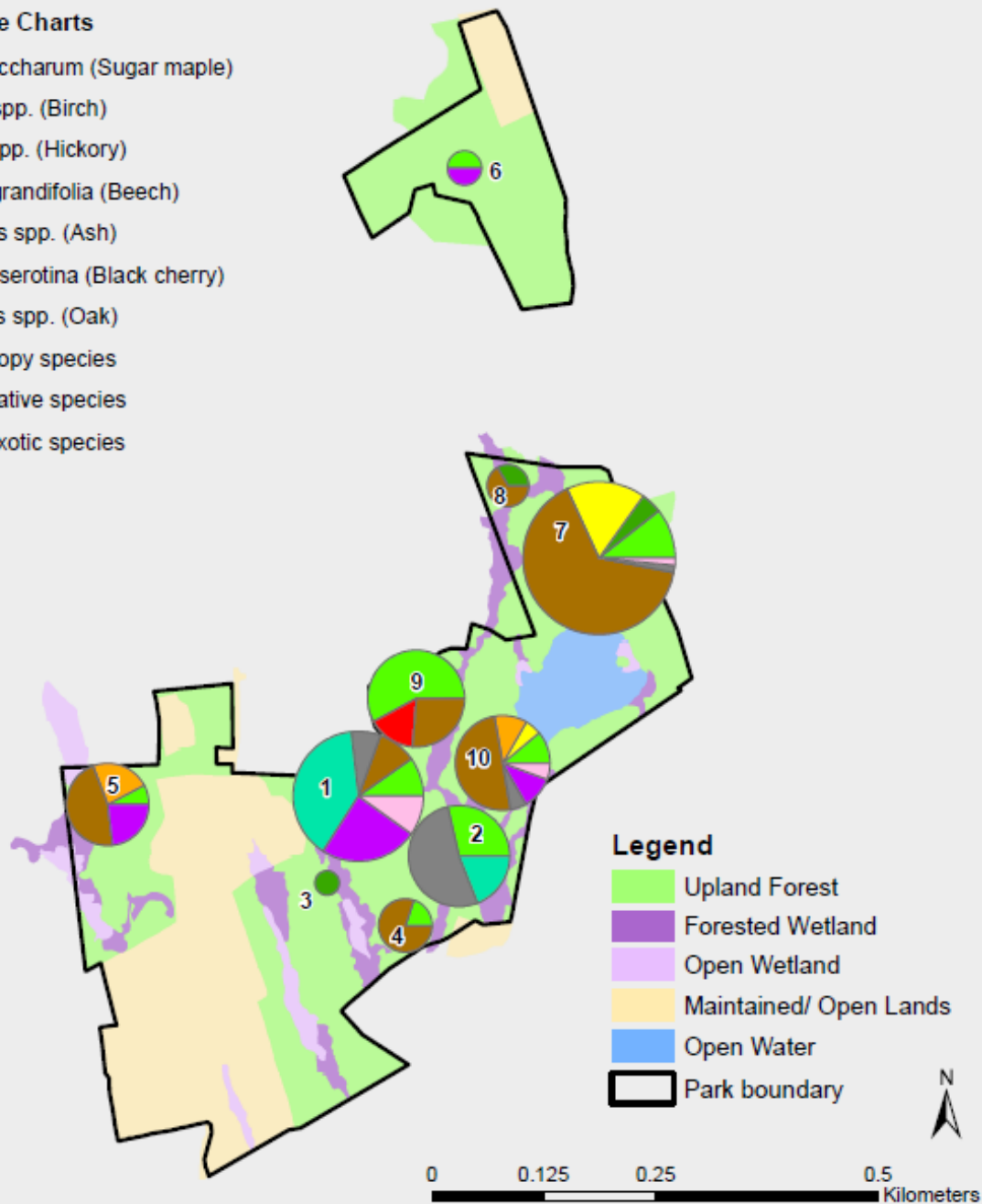
PARK MONITORING MAPS

Trends in tree regeneration, including seedlings and saplings, by species group observed in forest plots in the most recent survey cycle (2019 and 2022). Plots are sampled in an alternating panel, with plots 1-5 sampled in 2019 and plots 6-10 sampled in 2022. Each pie is proportional to the total plot-level regeneration (plot-level regeneration range: 0.02 to 1.7 stems/m²). Pies may be shifted from actual location to prevent overlap.

MAP 3: TREE REGENERATION: COMPOSITION

Species in Pie Charts

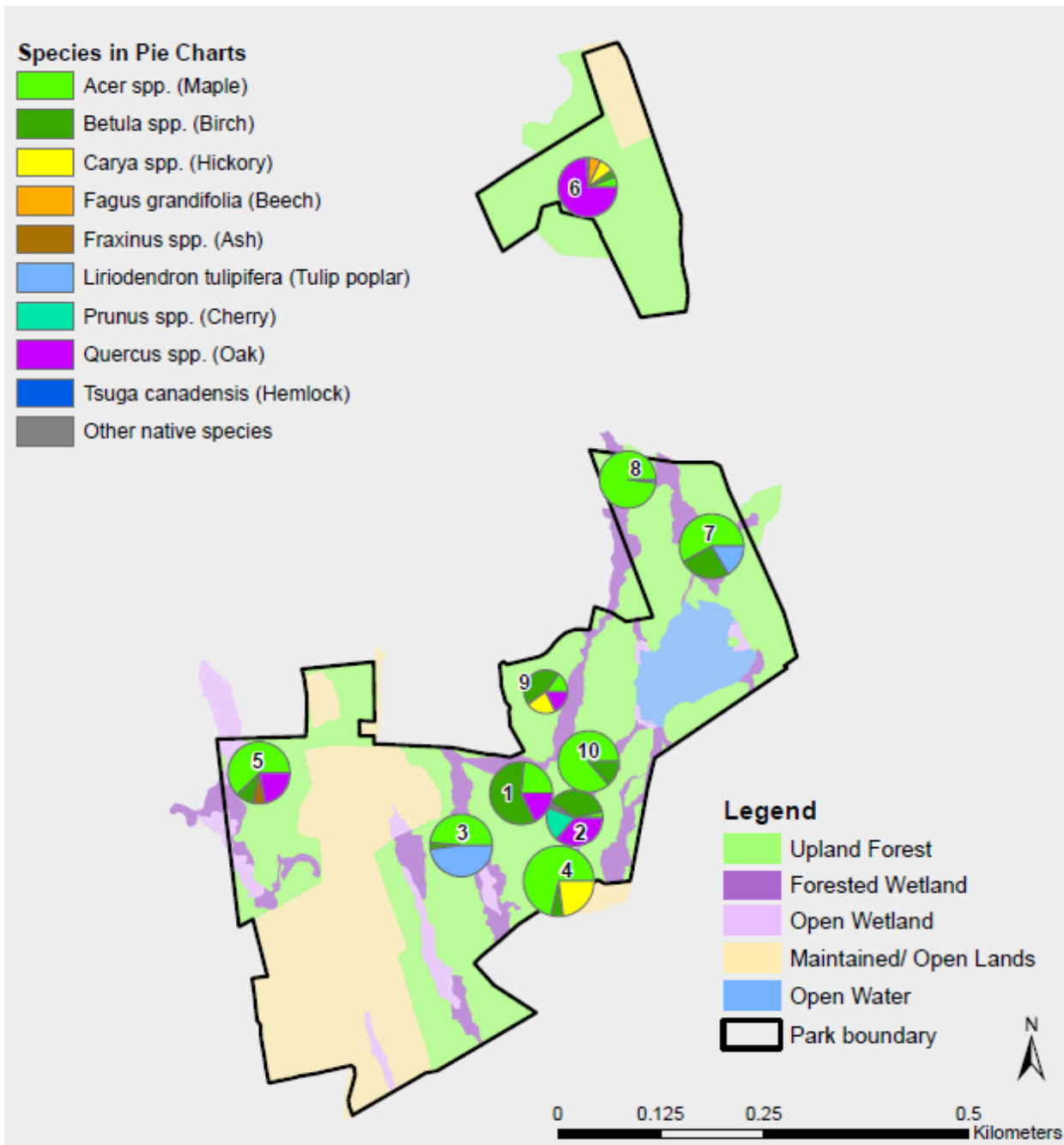
- *Acer saccharum* (Sugar maple)
- *Betula* spp. (Birch)
- *Carya* spp. (Hickory)
- *Fagus grandifolia* (Beech)
- *Fraxinus* spp. (Ash)
- *Prunus serotina* (Black cherry)
- *Quercus* spp. (Oak)
- Subcanopy species
- Other native species
- Other exotic species



PARK MONITORING MAPS

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 1-5 sampled in 2019 and plots 6-10 sampled in 2022. Pie size is proportional to the total plot-level basal area (range: 15.2 to 40.3 m²/ha). Pies may be shifted to prevent overlap.

MAP 4: TREE CANOPY: COMPOSITION



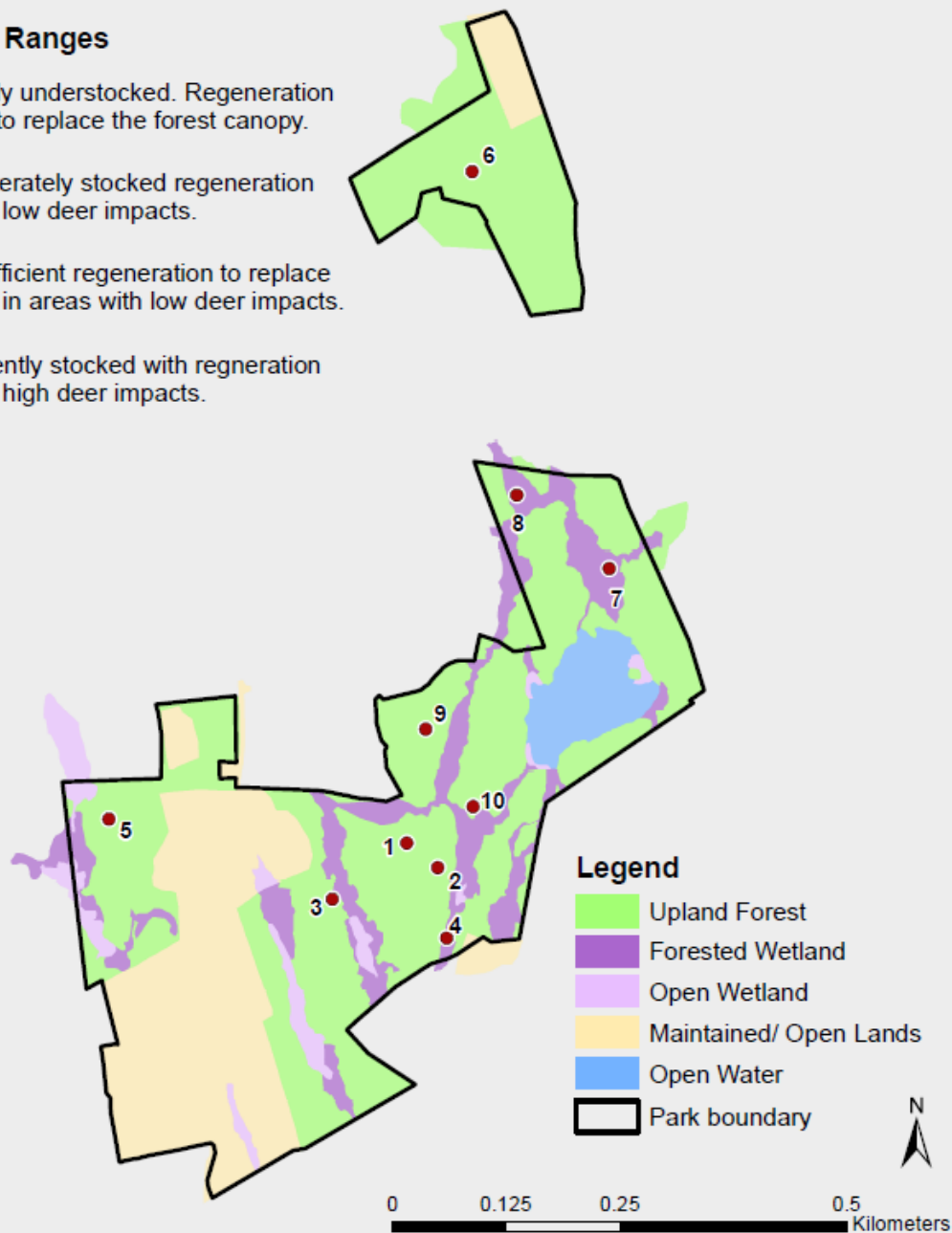
PARK MONITORING MAPS

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: 0-19.7)

MAP 5: TREE REGENERATION: STOCKING INDEX

Stocking Index Ranges

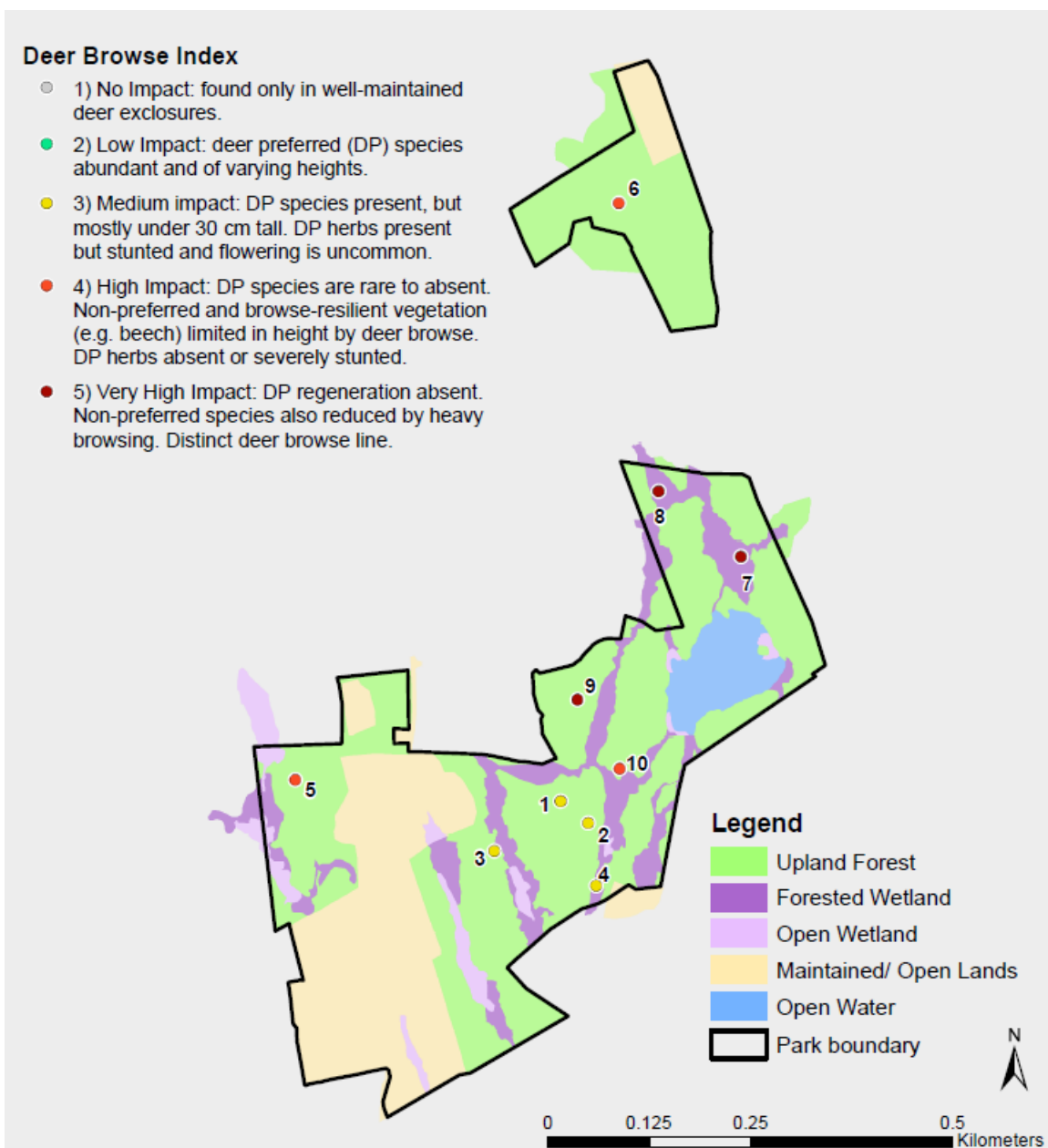
- < 25 : Severely understocked. Regeneration is insufficient to replace the forest canopy.
- 25 to 50: Moderately stocked regeneration for areas with low deer impacts.
- 50 to 100: Sufficient regeneration to replace forest canopy in areas with low deer impacts.
- > 100: Sufficiently stocked with regeneration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



PARK MONITORING MAPS

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 1-5 sampled in 2019 and plots 6-10 sampled in 2022.

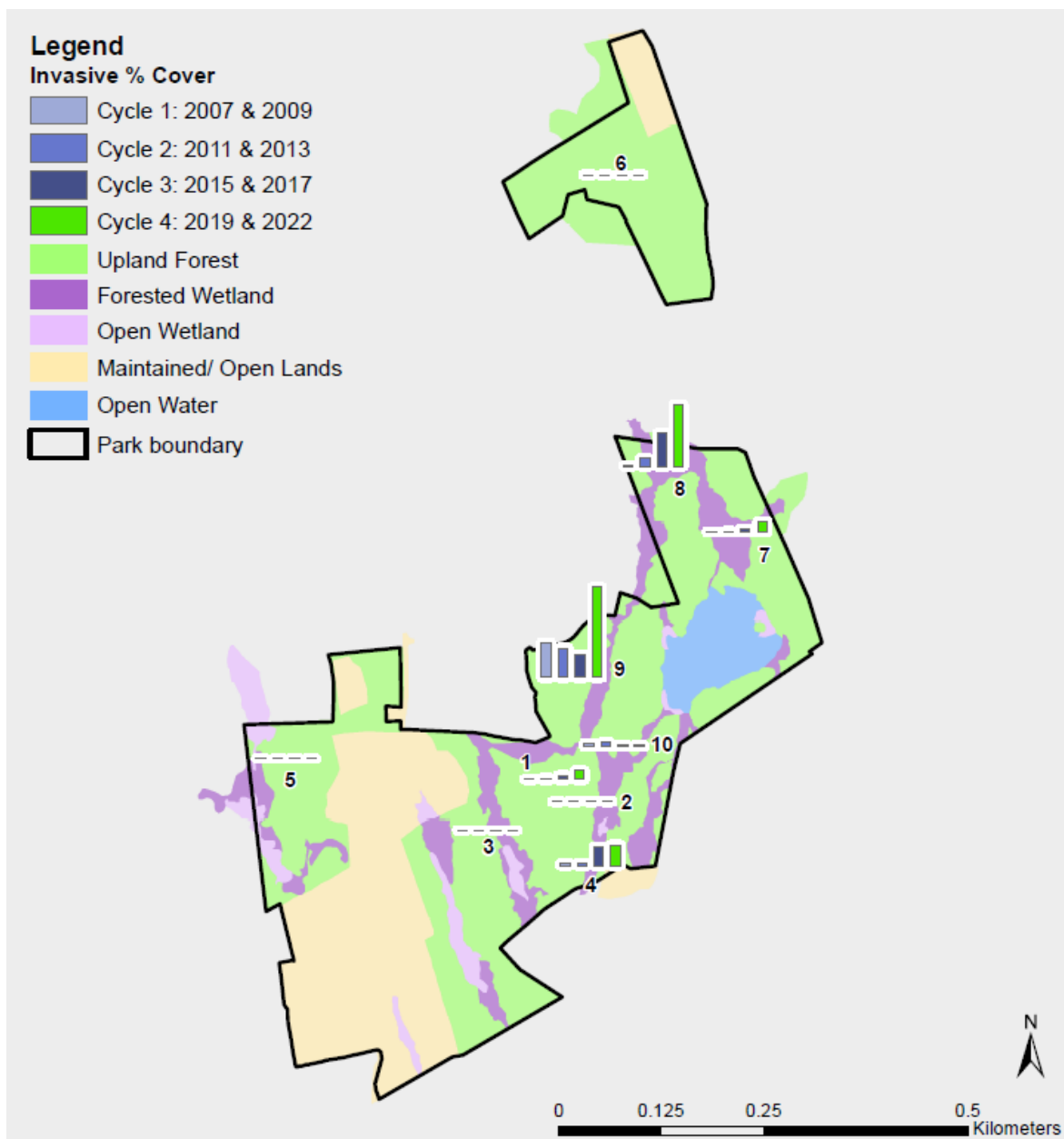
MAP 6: DEER BROWSE IMPACTS



PARK MONITORING MAPS

Trends in percent cover of invasive species observed in quadrats for plots samples from 2007-2022. Plots are sampled in an alternating panel, with plots 1-5 sampled in 2007, 2011, 2015, and 2019 and plots 6-10 sampled in 2009, 2013, 2017, and 2022.

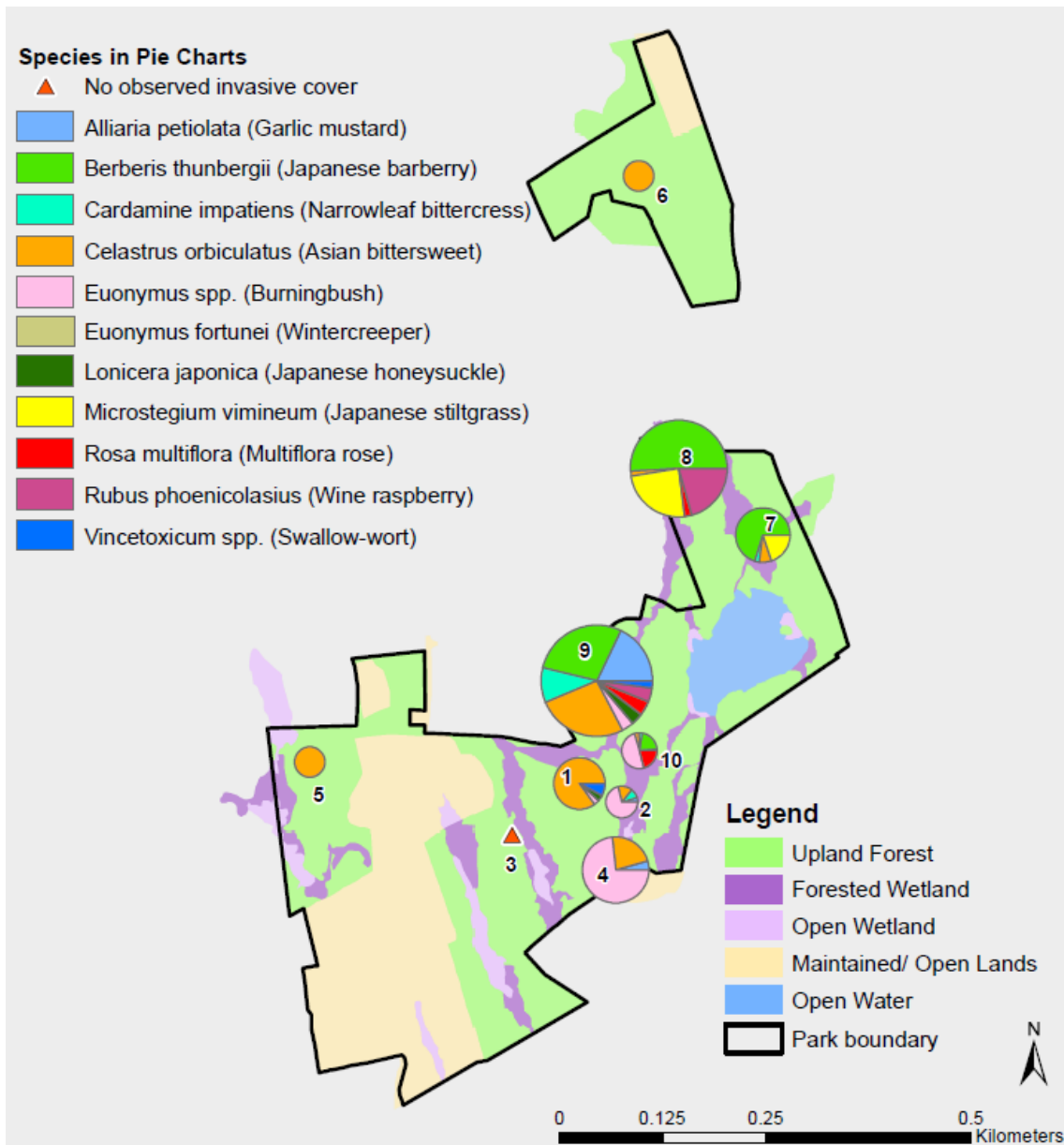
MAP 7: INVASIVES % COVER BY CYCLE



PARK MONITORING MAPS

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 1-5 sampled in 2019, and plots 6-10 sampled in 2022. Pie size is proportional to total invasive cover (range: 0 to 55.7%), and location may be shifted to prevent overlap.

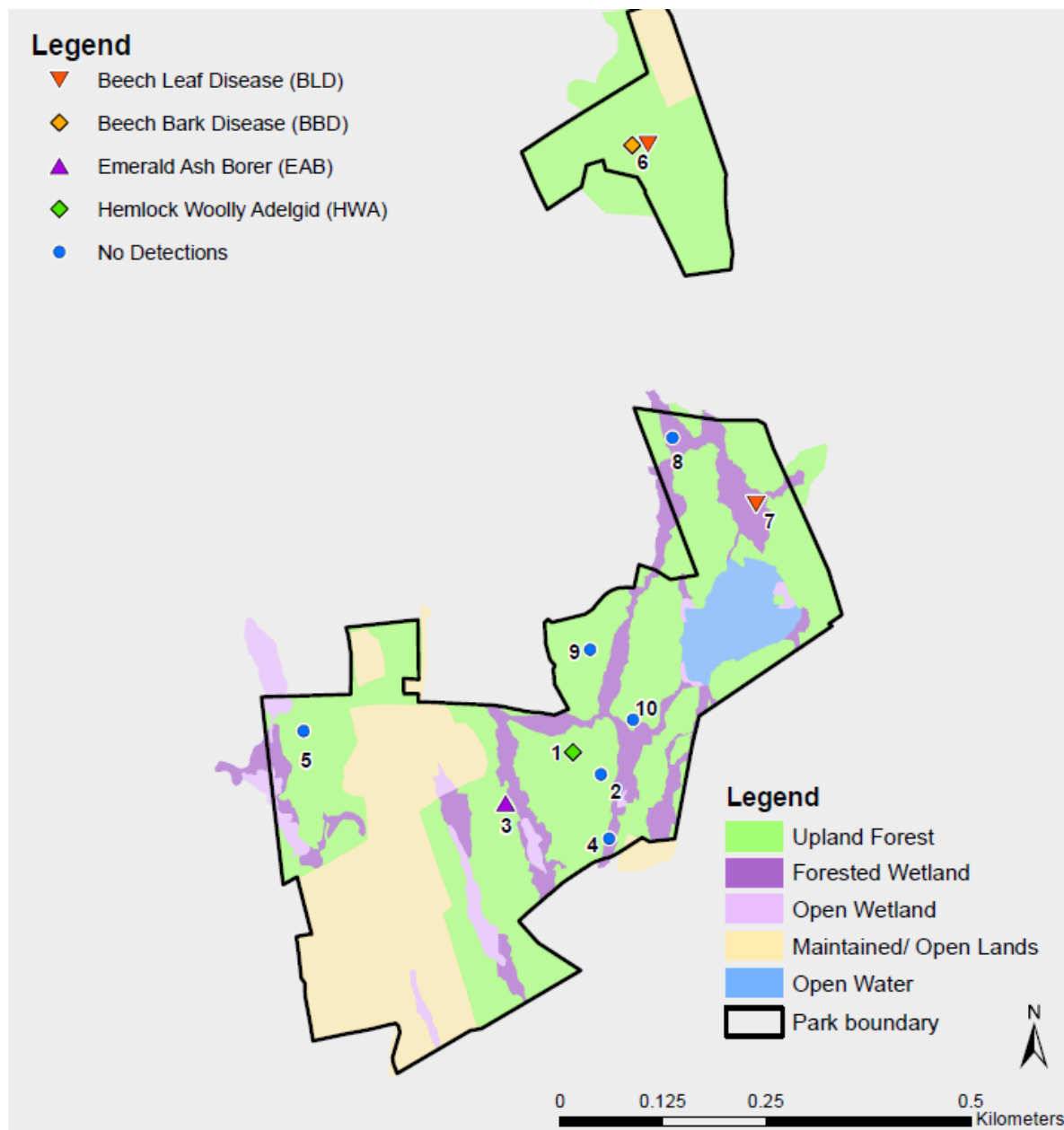
MAP 8: INVASIVES % COVER BY SPECIES



PARK MONITORING MAPS

Detections of priority forest pests in forest plots sampled during the most recent survey cycle (2019 & 2022). Plots are sampled in an alternating panel with plots 1-5 sampled in 2019 and plots 6-10 sampled in 2022. Plots with multiple pests present (e.g. 6) have multiple symbols. Note that BLD may be more widespread than map indicates, as plots 1-5 were sampled prior to the detection in 2022.

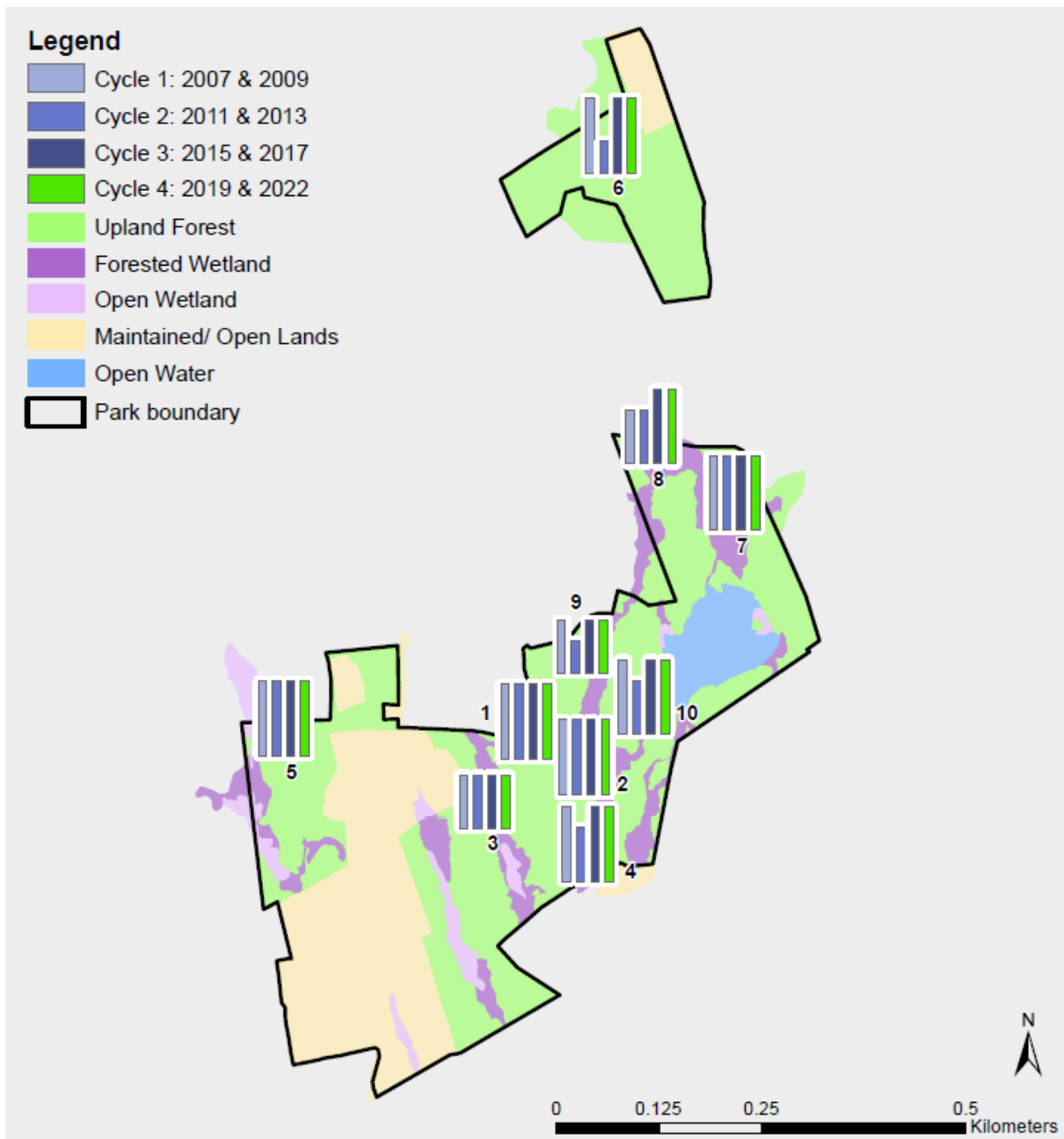
MAP 9: FOREST PEST/PATHOGEN DETECTIONS



PARK MONITORING MAPS

Trends in tree canopy cover in forest plots sampled from 2007-2022. Plots are sampled in an alternating panel, with plots 1-5 sampled in 2007, 2011, 2015, and 2019, and plots 6-10 sampled in 2009, 2013, 2017, and 2022. Canopy cover ranges from 25 - 50% 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 [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.

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