

Invasive species trends in eastern national park forests

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Introduction

The National Park Service Inventory and Monitoring Division (NPS IMD) has been monitoring forest health in a network of permanent forest monitoring plots spanning five networks and 39 eastern national parks (Fig. 1). Permanent plots are randomly located and are sampled on a 4-year rotation. Each plot has been sampled at least 3 times, with a few exceptions. Here we present preliminary findings regarding trends in invasive plants over the last 12 years of monitoring.

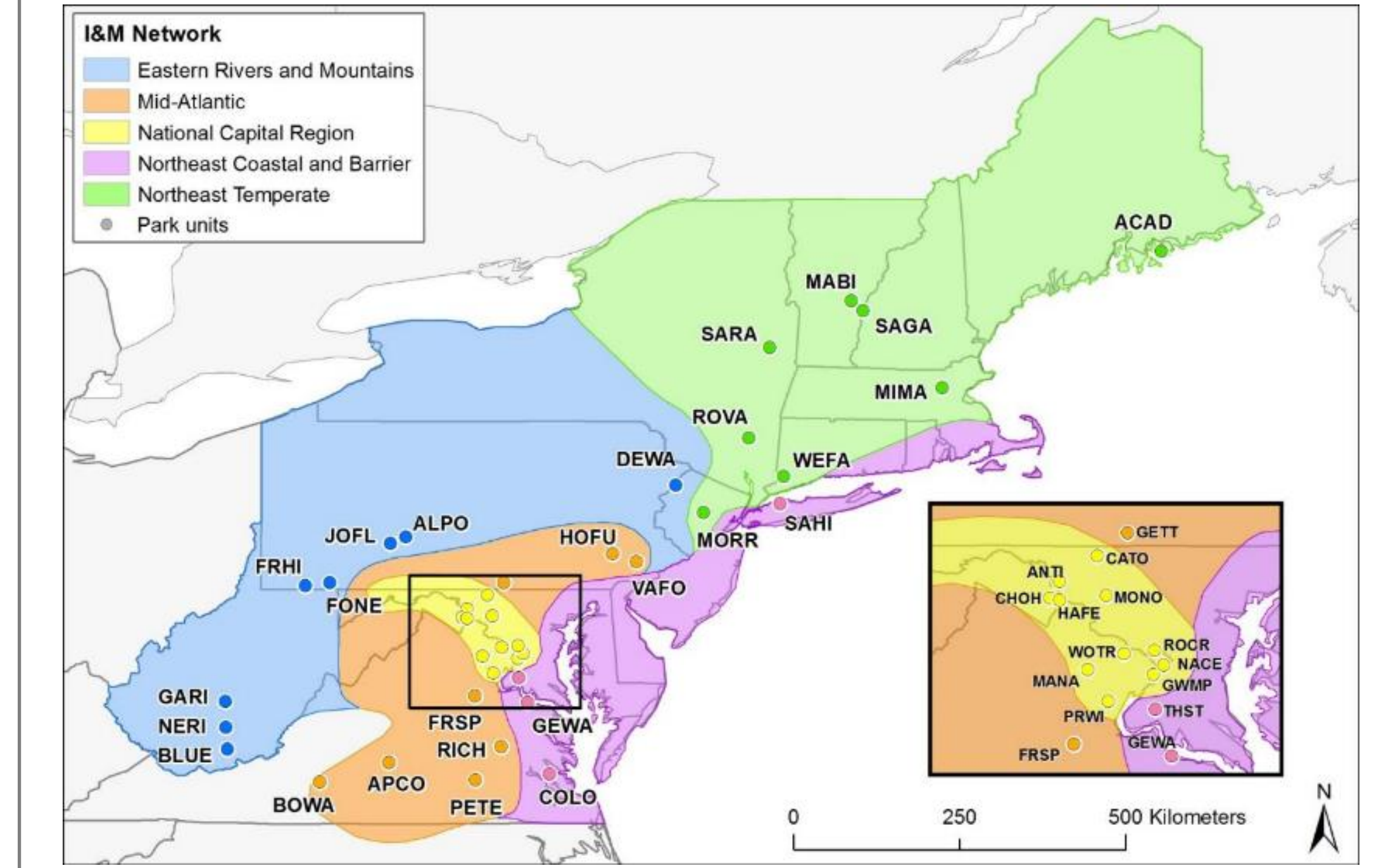


Figure 1. Networks and parks included in the study.

Methods

We used mixed effects models to determine how invasive plant abundance is changing over time. Each park was modeled individually at the following scales:

- Plot % Frequency:** proportion of plots per park with an invasive species present.
- Quadrat % Frequency:** % of 1m² quadrats with an invasive species present per plot.
- Average % Cover:** average percent cover of invasive species in 1m² quadrats.

Trends were assessed by species, guild (trees, shrubs/vines, graminoids, herbs) and overall invasives.

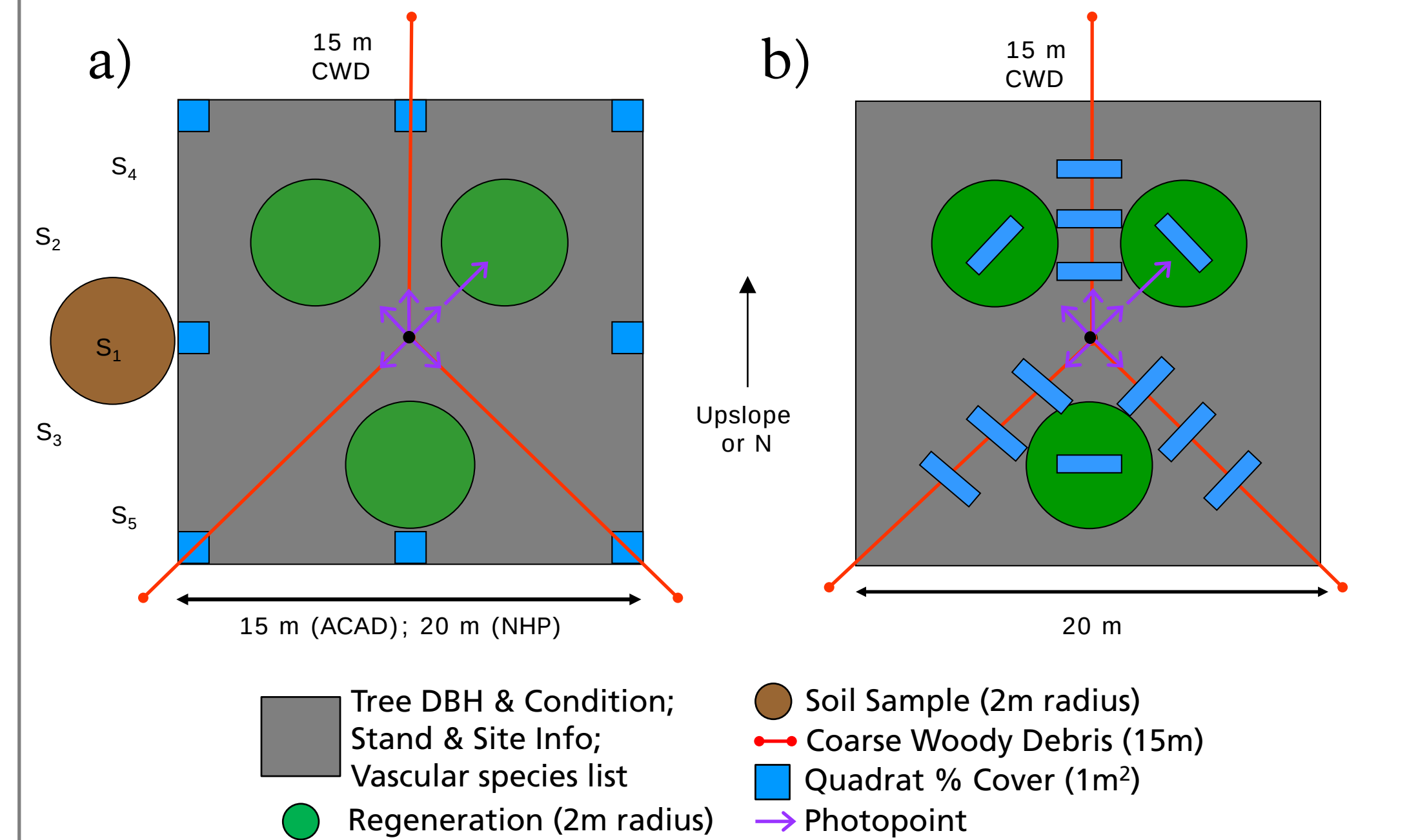


Figure 2. Example diagrams of forest monitoring plots for a) Northeast Temperate Network, and b) Mid-Atlantic Network. While plot designs vary among networks, data are collected consistently.

Park-level invasion status

- Least invaded parks:
 - Acadia National Park (ME)
 - Marsh-Billings Rockefeller NHP (VT)
 - Fredericksburg & Spotsylvania NMP (VA)
- Most invaded parks:
 - Monocacy National Battlefield (MD)
 - Antietam National Battlefield (MD)
 - Friendship Hill National Historic Site (PA)
- In 35 of 39 parks, >50 % of plots were invaded
- In 21 of 39 parks, >50% of quadrats were invaded
- In 10 of 39 parks, Average % Cover of invasives was >20%

Results

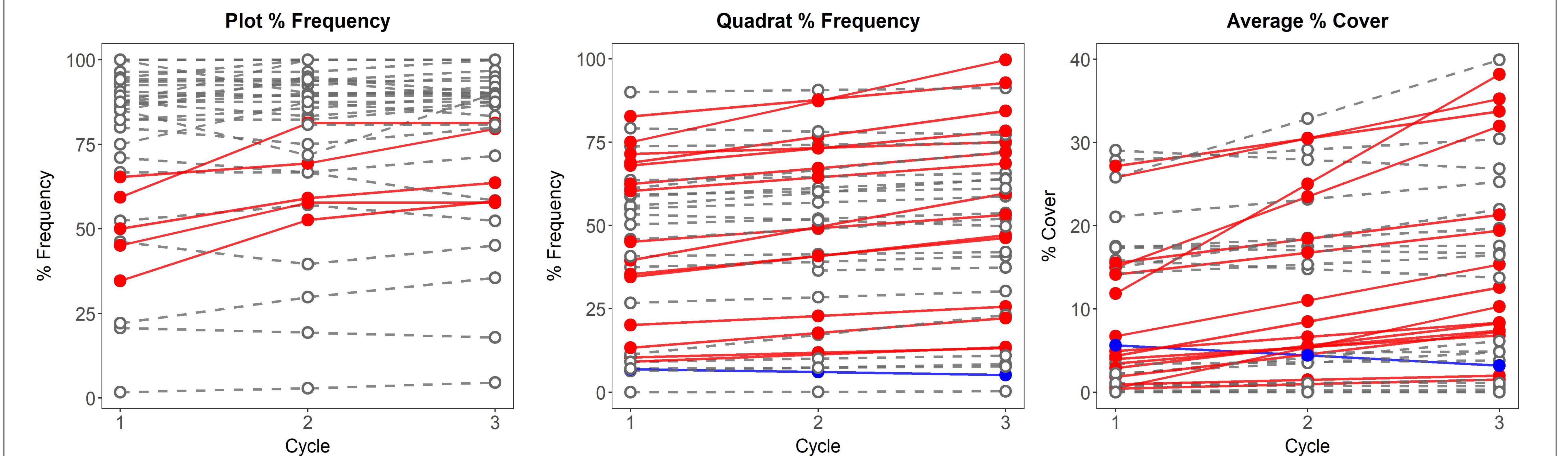


Figure 3. Trends in overall invasive plants for all network parks. Cycle 1 was 2007-2010; cycle 2 was 2011-2014; cycle 3 was 2015-2018. Solid red lines indicate a significant increase. Solid blue lines indicate a significant decrease. Dotted grey lines indicate no significant trend. Plot % Frequency shows actual plot frequency, whereas Quadrat % Frequency and Average % Cover show modeled trends.



Figure 5. Progression of invasive shrub expansion in MORR plot 021. Species include Japanese barberry (*Berberis thunbergii*), Japanese honeysuckle (*Lonicera japonica*) and wineberry (*Rubus phoenicolasius*).

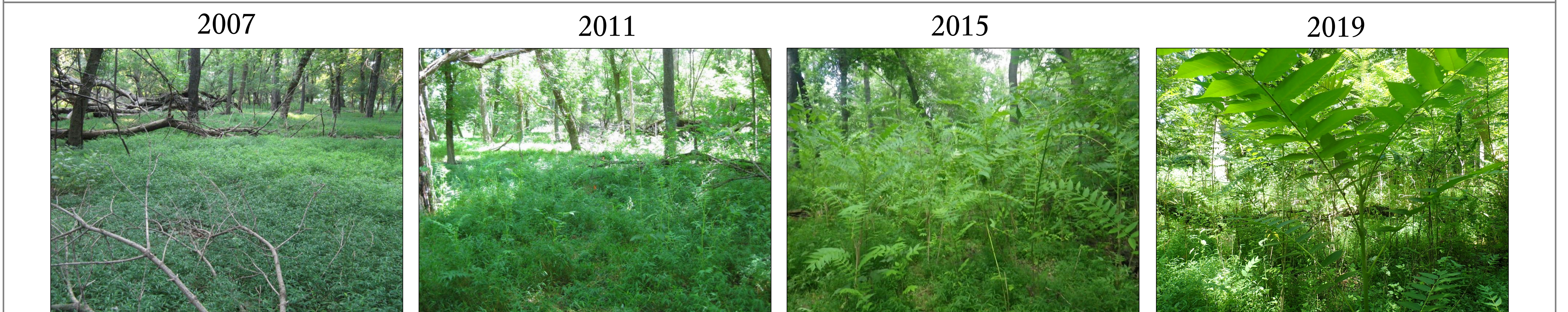


Figure 6. Progression of tree of heaven (*Ailanthus altissima*) expansion in what was previously a monoculture of dense Japanese stiltgrass (*Microstegium vimineum*) on VAFO plot 042.

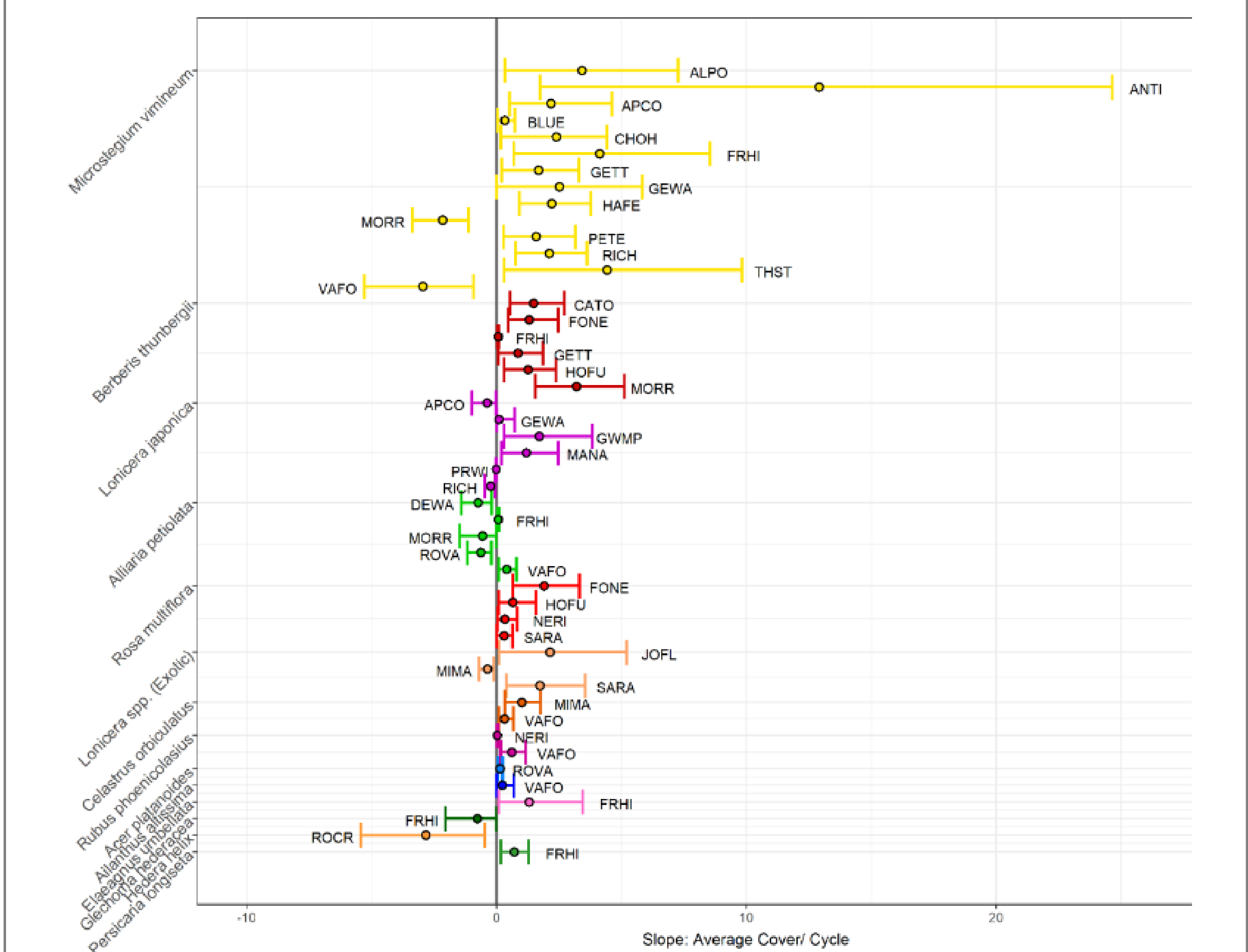


Figure 4. Significant trends in species Average % Cover by park across three cycles of monitoring. Circles indicate the slope and error bars are 95% empirical confidence intervals. The greater the distance from zero, the steeper the slope, and the greater the change over 12 years.

Management recommendations

- Japanese stiltgrass was the most aggressive invader, and should be high priority for management.
- Invasive shrubs were also aggressive invaders. Given the added risk to human health from black-legged ticks, invasive shrubs should be a high management priority.
- Areas where invasive shrubs are present and canopy gaps are likely (e.g., EAB) should be high priority areas to treat.
- Deer reduction may help reduce Japanese stiltgrass's competitive advantage.

Summary of trends

- Invasive plants are widespread and increasing in abundance:
 - 30 parks had a least one significant increasing trend
 - Only 2 parks showed overall declines: MABI and PRWI
- Japanese stiltgrass (*Microstegium vimineum*):
 - Most common: in 85% of parks and 34% of plots.
 - Most number of significant increases.
 - Steepest (largest) observed increase: +13% cover/cycle in ANTI
- Invasive shrubs:
 - Most common guild, especially in northern parks.
 - Second most number of significant increases.
 - Can increase at the expense of Japanese stiltgrass.

Next steps

- Examine underlying drivers behind the trends presented.
- Assess how invasive plants are impacting native species, including tree regeneration and native plant diversity.

Conclusions

- Invasive plants in eastern parks are overwhelmingly increasing in abundance over time.
- Reversing these trends requires a long-term commitment.
- Meanwhile, the cost to manage and the cost to the ecosystem continues to increase over time.
- This cost of “Deferred Management” requires service-wide attention and long-term funding to address.