

Invasive Plant Species and Habitat Management Plan for Bluestone National Scenic River

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July 2020

Executive Summary

This management plan:

- 1) summarizes the status of invasive plant species in Bluestone National Scenic River,
- 2) determines park-specific priorities for invasive species management, and
- 3) provides detailed recommendations for the implementation of invasive species management in the park.

Invasive Plant Species and Habitat Management Plan for

Bluestone National Scenic River

Invasive exotic plants threaten the natural resources of Bluestone National Scenic River (BLUE). These nonnative species compete with native plant species, dramatically change plant communities, and degrade wildlife habitat. Since invasive plants are inherently difficult to control, the management of these species and their effects on park vegetation is challenging.

This management plan was created using the Invasive Plant Species and Habitat Management Planning Process developed by Art Gover at Penn State's Wildland Weed Management Unit (Gover 2016). This planning process is based on several important principles:

- Parks have finite resources that can only be directed to a small portion of potential natural resource needs.
- Use park-specific data to make informed strategic decisions with limited resources. Strategic management is effective by protecting natural resources without wasted effort.
- Protecting the best sites within a park maximizes the benefit to park natural resources per person-hour expended on invasive species management.
- Inaction is more harmful than action. The decision NOT to manage invasive plant species has continued and increasingly negative impacts on the park's natural resources.

Long-term forest health monitoring in BLUE shows that at least one invasive species is present in 90.0% of the park's monitoring plots. While multiflora rose (*Rosa multiflora*) is the most abundant invasive species, Japanese stiltgrass (*Microstegium vimineum*) is the fastest spreading invasive species in the park, covering an additional 1 hectare (2.5 acres) within the park every year (Miller et al. 2020). A summary of the invasive species information from BLUE is shown in Figures 2 and 3, and Tables 1 and 2.

The Invasive Plant Species and Habitat Management Planning Process involves three steps: define habitat management zones, prioritization, and prescription.

Define Habitat Management Zones

To determine which areas of the park are more important to preserve, the park Biologist and two Plant Ecologists from the Eastern Rivers and Mountains Inventory and Monitoring Network met to delineate Habitat Management zones within BLUE (Figure 1). Habitat management zones are discrete areas of the park that are ecologically or culturally valuable and where invasive species management is operationally feasible.

We considered vegetation types present in the park, the integrity (or lack of disturbance) of the plant communities, the resource value to the park in terms of natural and cultural stewardship, and the presence of rare plants, animals, and natural communities in the park. Habitat Management Zones for BLUE were determined based on the vegetation map (Vanderhorst et al. 2008) and data on the status of invasive plant species in the park. Invasive species data was collected from the vegetation classification and mapping project (Vanderhorst et al. 2008), data collected at long-term forest health monitoring plots as part of the Eastern Rivers and Mountains (ERMN) Inventory and Monitoring Network (Perles et al. 2014, for current data see <https://www.nps.gov/im/ermn/vegetation-soils.htm>), and data collected as part of the Invasive Species Early Detection / Rapid Response Program coordinated by ERMN.

Figures 2, 3, and 4, and Tables 1 and 2 show a snapshot of the invasive species data used to define the habitat management zones in BLUE.

Prioritization

We then used a prioritization tool (Gover 2016) housed in an excel workbook to prioritize which habitat management zones and which invasive species should be managed in order to maximize the benefit to park natural resources. First, for each habitat management zone, we assigned a Stewardship Index based on the ecological value of the zone's vegetation, and an Outreach Index that captured the value of the zone to the park's interpretation goals. Using the workbook, we then evaluated the level of infestation of each known invasive plant species, the potential impacts of those invasive species on the habitats, the difficulty of managing those invasives, and the restoration effort required in each habitat. The resulting prioritization matrix (Table 3) provides strategic direction for managers to protect the best sites within a park.

The highest priority zones in BLUE are along the riparian corridor (Upper, Middle, Lower, and Little Bluestone) and the Successional Fields at the northeastern end of the park. Invasive shrubs such as autumn olive (*Elaeagnus umbellata*), Japanese barberry (*Berberis thunbergii*), multiflora rose (*Rosa multiflora*), privet (*Ligustrum* spp.), shrub honeysuckles (*Lonicera* spp.), and wineberry (*Rubus phoenicolasius*) are the species prioritized for removal in these zones. Three other species that were ranked as high management priorities include Japanese hops (*Humulus japonicus*), Japanese knotweed (*Polygonum cuspidatum*), and tree of heaven (*Ailanthus altissima*).

Prescription

Last, we described how strategic invasive species management will be implemented in the park. The prescription specifies: **who** will be doing the work, **how** the invasives will be managed, and **when** the management should be conducted for only the habitat management zones that were identified as priorities and for only those invasive species that were identified as priorities. See Tables 4 and 5 for the prescription for BLUE.

Nearly all invasive management prescriptions in BLUE require a Certified Applicator, someone who has completed the required West Virginia Department of Agriculture trainings to use herbicides. In addition to conducting the treatments themselves, Certified Applicators can supervise non-

credentialed applicators as long as they are in direct contact at the work site. Certified Applicators can be park staff, NPS Invasive Plant Team members, or contractors.

Strategic Management Protects Park Resources

Invasive species management is crucial to protecting the park's rare species and natural communities in the riparian corridors along the Bluestone and Little Bluestone Rivers. Inaction will result in declines in the park's native flora, degraded wildlife habitat, and ultimately, the loss of native plant communities within the park. The strategic prescriptions presented in this report direct scarce resources to the areas of the park where invasive species management will most benefit the park's cultural and natural resources.

This plan will be updated every 4 years, after all the park's forest health monitoring plots have been revisited. The latest monitoring data and new observations from the Invasive Species Early Detection / Rapid Response Program will be incorporated into the updated plan. However, the excel workbook prioritization tool can be updated at any time (e.g., new invasive species found, land parcel newly acquired by the park, etc), in order to evaluate evolving management priorities.

Literature Cited

- Gover, A. 2016. Introduction to the Habitat and Invasive Species Mangement Planning Process. Pennsylvania State University Wildland Weed Management. (<https://plantscience.psu.edu/research/projects/wildland-weed-management>).
- Miller, K.M., McGill, B.J., Weed, A. S., Seirup, C.E., Comiskey, J.A., Matthews, E.R., Perles, S.J., and J. P. Schmit. 2020. Long-term trends indicate that invasive plants are pervasive and increasing in eastern national parks. *In press*.
- Perles, S., J. Finley, D. Manning, and M. Marshall. 2014. Vegetation and soil monitoring protocol for the Eastern Rivers and Mountains Network, Version 3. Natural Resource Report NPS/ERMN/NRR—2014/758. National Park Service. Fort Collins, Colorado.
- Vanderhorst, J. P., B. P. Streets, J. Jeuk, and S. C. Gawler. 2008. Vegetation Classification and Mapping of Bluestone National Scenic River, West Virginia. Technical Report NPS/NER/NRTR—2008/106. National Park Service. Philadelphia, PA.

Figure 1.
Invasive species habitat
management zones in Bluestone
National Scenic River.

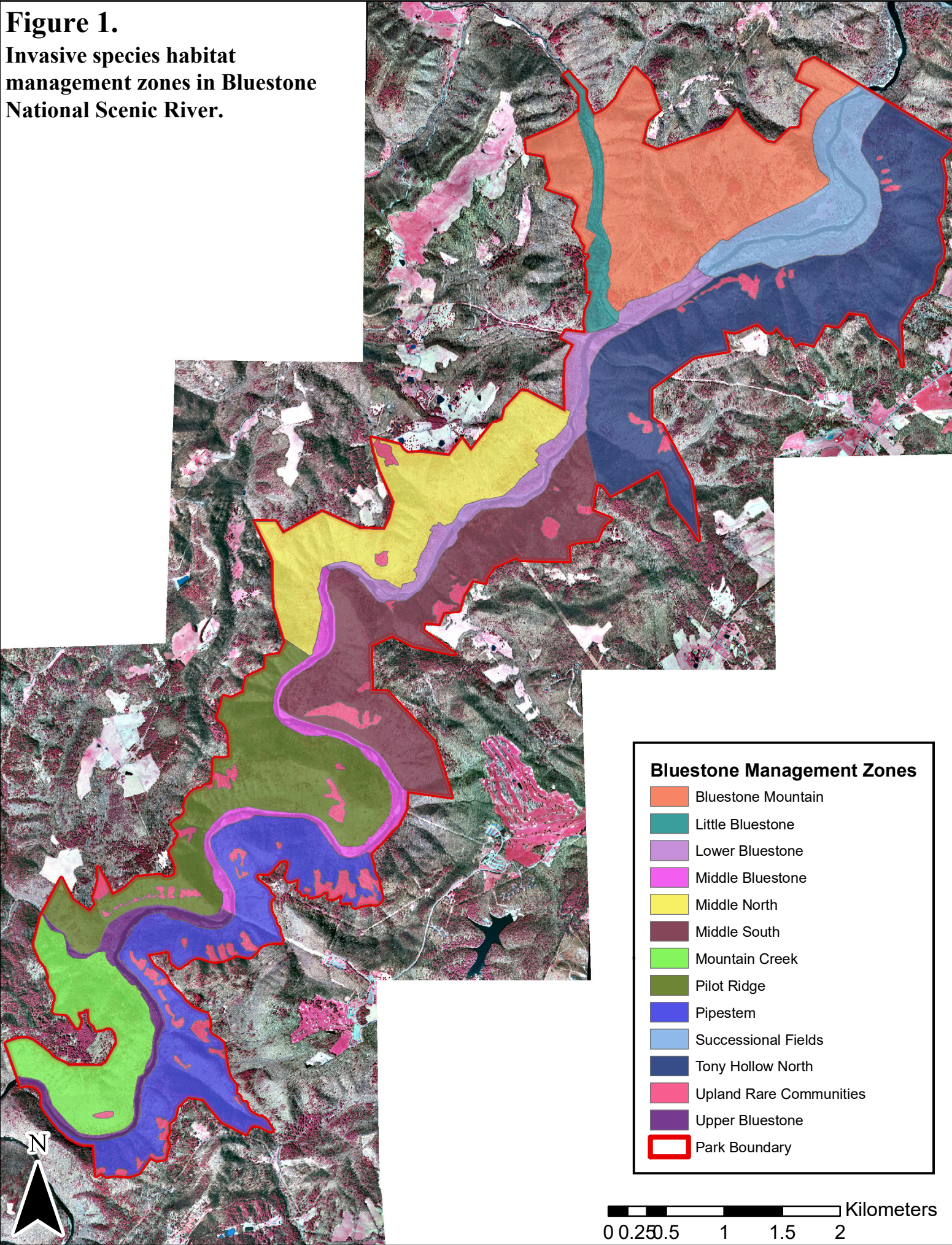


Figure 2 Average Invasive Species Percent Cover by Cycle

Trends in percent cover of invasive species observed in quadrats in forest health monitoring plots sampled from 2007-2018. Each plot is sampled on a 4-year cycle. Average invasive cover among quadrats with each plot ranges from 0 to 35%. See Table 1 for percent cover values.

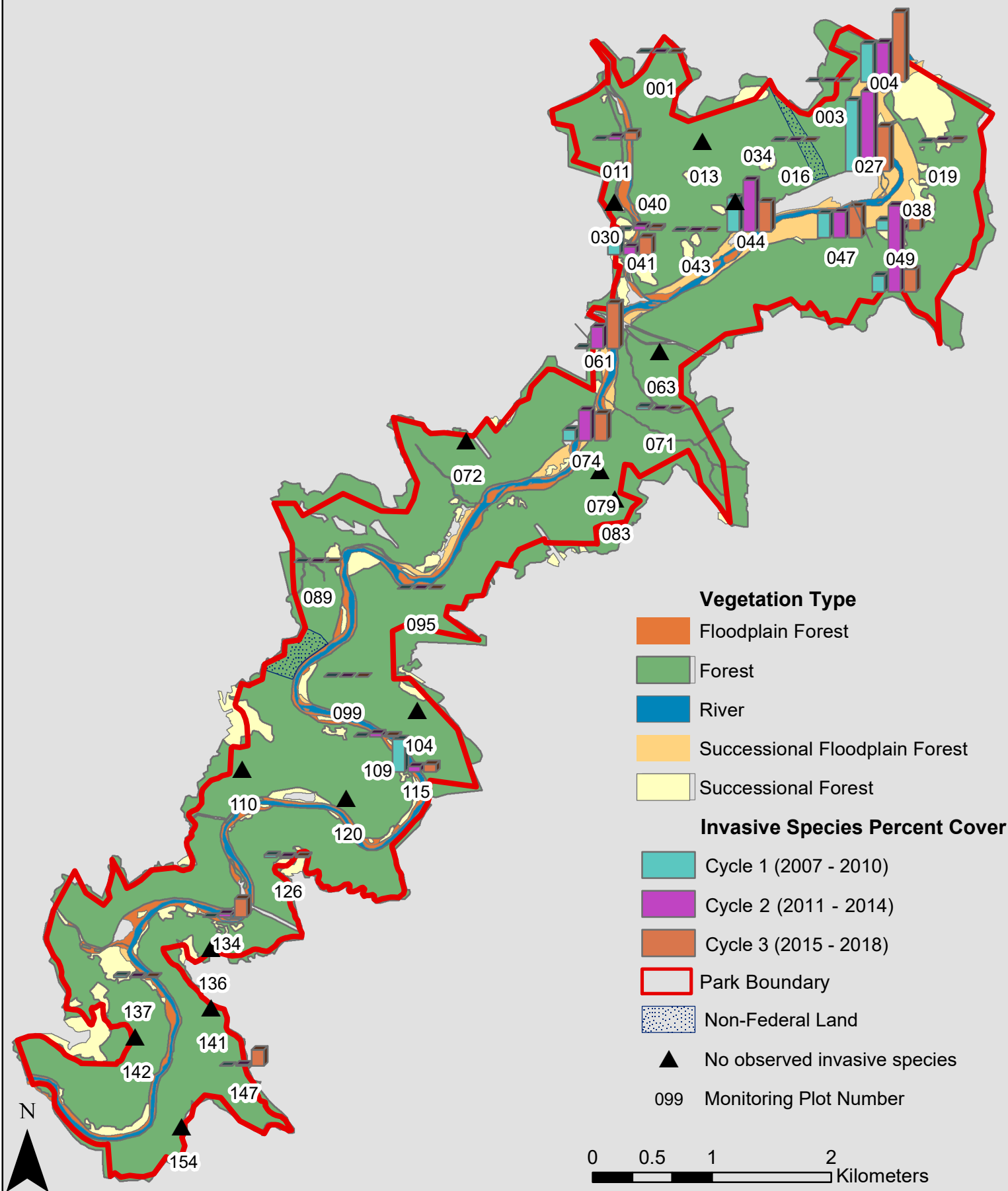


Figure 3

Percent Cover by Invasive Species

Percent cover by invasive species observed in quadrats in forest health monitoring plots during the most recent completed survey (cycle 3; 2014-2018). Larger circles represent higher cover of invasives.

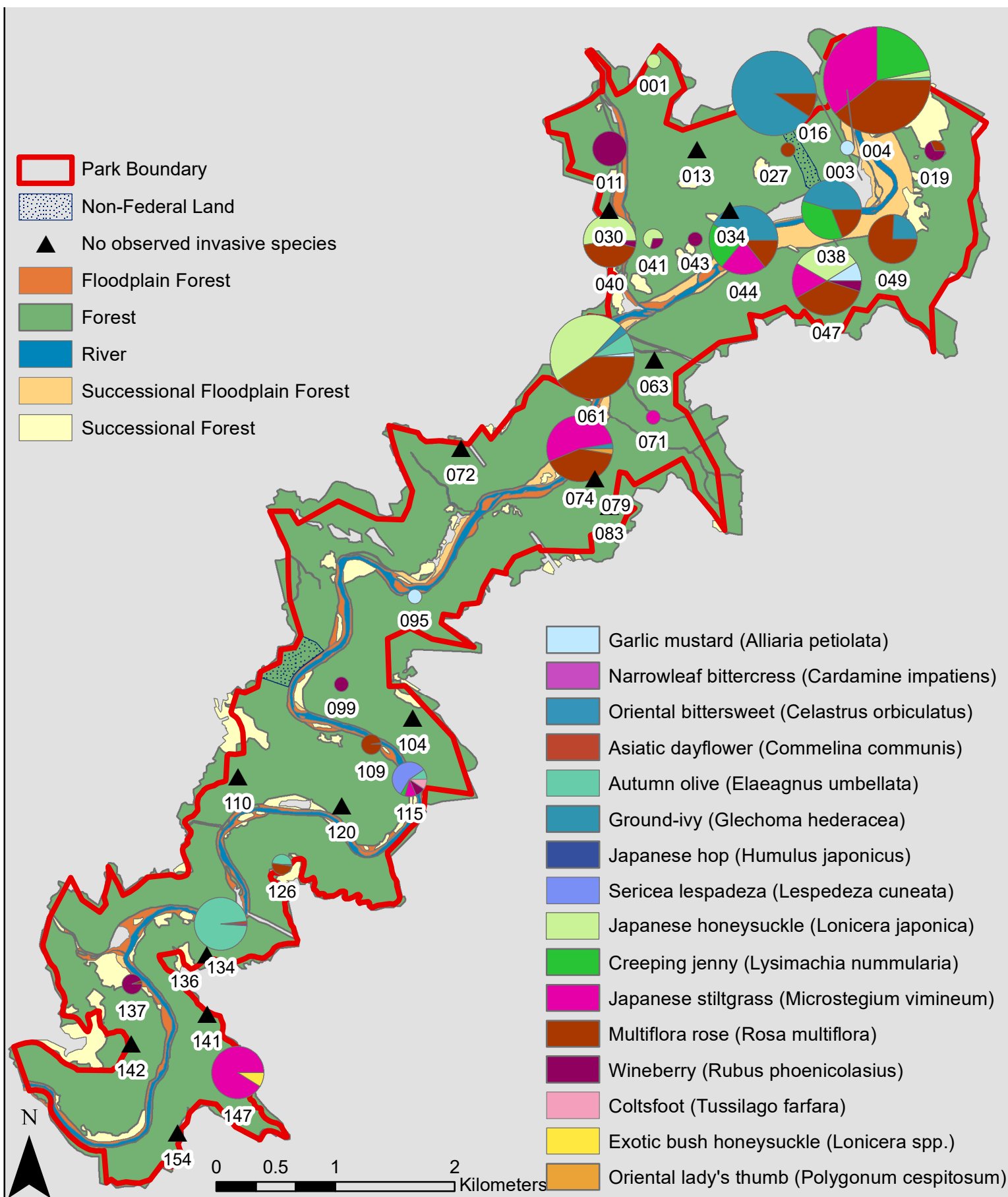


Table 1. Number of invasive species detected in each forest health monitoring plot and average percent cover of all invasive species observed in quadrats by plot and cycle. Cycle 1 spans 2007 - 2010; Cycle 2 spans 2011 - 2014; and Cycle 3 spans 2015 - 2018.

Plot	Average Percent Cover of Invasives			Number of Invasive Species		
	Cycle 1	Cycle 2	Cycle 3	Cycle 1	Cycle 2	Cycle 3
1	0.01	0.01	0.01	1	1	2
3	0.01	0	0.02	5	4	3
4	15.73	16.13	28.51	4	10	8
11	0.29	1.46	3.13	1	3	3
13	0	0	0	0	2	2
16	0	0	0.01	0	3	2
19	0	0.63	0.92	1	2	2
27	28.93	32.63	18.33	4	7	8
30	0	0	0	2	0	1
34	0	0	0	0	0	0
38	6.54	35.25	9.18	5	6	3
40	9.53	3.27	7.18	5	6	5
41	0	1.75	1.00	1	5	3
43	0	0.01	0.02	0	1	2
44	13.88	21.03	12.28	7	6	7
47	9.98	10.48	12.83	7	7	6
49	4.11	2.28	6.06	2	3	3
61	0.43	8.74	18.48	4	8	8
63	0	0	0	1	0	2
71	1.04	0.01	0.03	2	2	3
72	0	0	0	0	0	1
74	4.42	12.42	11.03	7	5	5
79	--	--	0	--	--	1
83	0	0	0	1	0	0
89	0.01	0	0	2	2	2
95	0	0	0.01	0	1	2
99	0	0	0.01	0	0	1
104	0	0	0	1	0	1
109	0.29	1.47	0.64	2	4	4
110	0	0	0	0	0	0
115	13.33	2.33	3.13	13	8	11
120	0	0	0	2	3	1
126	1.00	0.43	0.61	3	3	4
134	0.01	1.36	7.42	1	7	12
136	0	0	0	0	0	1
137	0.71	0.29	0.31	3	3	4
141	0	0	0	0	0	0
142	0	0	0	0	0	0
147	0.13	0.55	6.67	2	3	3
154	0	0	0	2	1	2

Table 2. Percent of forest health monitoring plots containing specific invasive species by cycle.

Latin Name	Common Name	Cycle 1 (2007 – 2010)	Cycle 2 (2011 – 2014)	Cycle 3 (2015 – 2018)
<i>Ailanthus altissima</i>	tree of heaven	0.0%	0.0%	5.0%
<i>Alliaria petiolata</i>	garlic mustard	17.9%	25.6%	27.5%
<i>Berberis thunbergii</i>	Japanese barberry	0.0%	0.0%	2.5%
<i>Cardamine impatiens</i>	narrowleaf bittercress	7.7%	7.7%	10.0%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	0.0%	5.1%	2.5%
<i>Commelina communis</i>	Asiatic dayflower	2.6%	0.0%	2.5%
<i>Elaeagnus umbellata</i>	autumn olive	12.8%	23.1%	22.5%
<i>Glechoma hederacea</i>	ground ivy	15.4%	23.1%	20.0%
<i>Hesperis matronalis</i>	dames rocket	2.6%	0.0%	5.0%
<i>Humulus japonicus</i>	Japanese hop	5.1%	5.1%	2.5%
<i>Lespedeza cuneata</i>	sericea lespedeza	2.6%	0.0%	2.5%
<i>Ligustrum</i> sp.	privet	2.6%	2.6%	7.5%
<i>Ligustrum vulgare</i>	European privet	0.0%	2.6%	0.0%
<i>Lonicera japonica</i>	Japanese honeysuckle	10.3%	15.4%	15.0%
<i>Lonicera maackii</i>	Amur honeysuckle	0.0%	0.0%	2.5%
<i>Lonicera morrowii</i>	Morrow's honeysuckle	17.9%	17.9%	15.0%
<i>Lonicera</i> sp. Exotic	honeysuckle	2.6%	10.3%	2.5%
<i>Lysimachia nummularia</i>	creeping jenny	17.9%	15.4%	17.5%
<i>Microstegium vimineum</i>	Japanese stiltgrass	10.3%	23.1%	30.0%
<i>Polygonum caespitosum</i>	Oriental ladythumb	10.3%	10.3%	7.5%
<i>Rosa multiflora</i>	multiflora rose	64.1%	56.4%	72.5%
<i>Rubus phoenicolasius</i>	wine raspberry	25.6%	43.6%	45.0%
<i>Schedonorus phoenix</i>	tall fescue	2.6%	0.0%	0.0%
<i>Securigera varia</i>	crownvetch	2.6%	7.7%	0.0%
<i>Tussilago farfara</i>	coltsfoot	0.0%	0.0%	2.5%
<i>Verbascum thapsus</i>	common mullein	0.0%	2.6%	0.0%

Figure 4.
Presence of invasive species in
Bluestone National Scenic River.

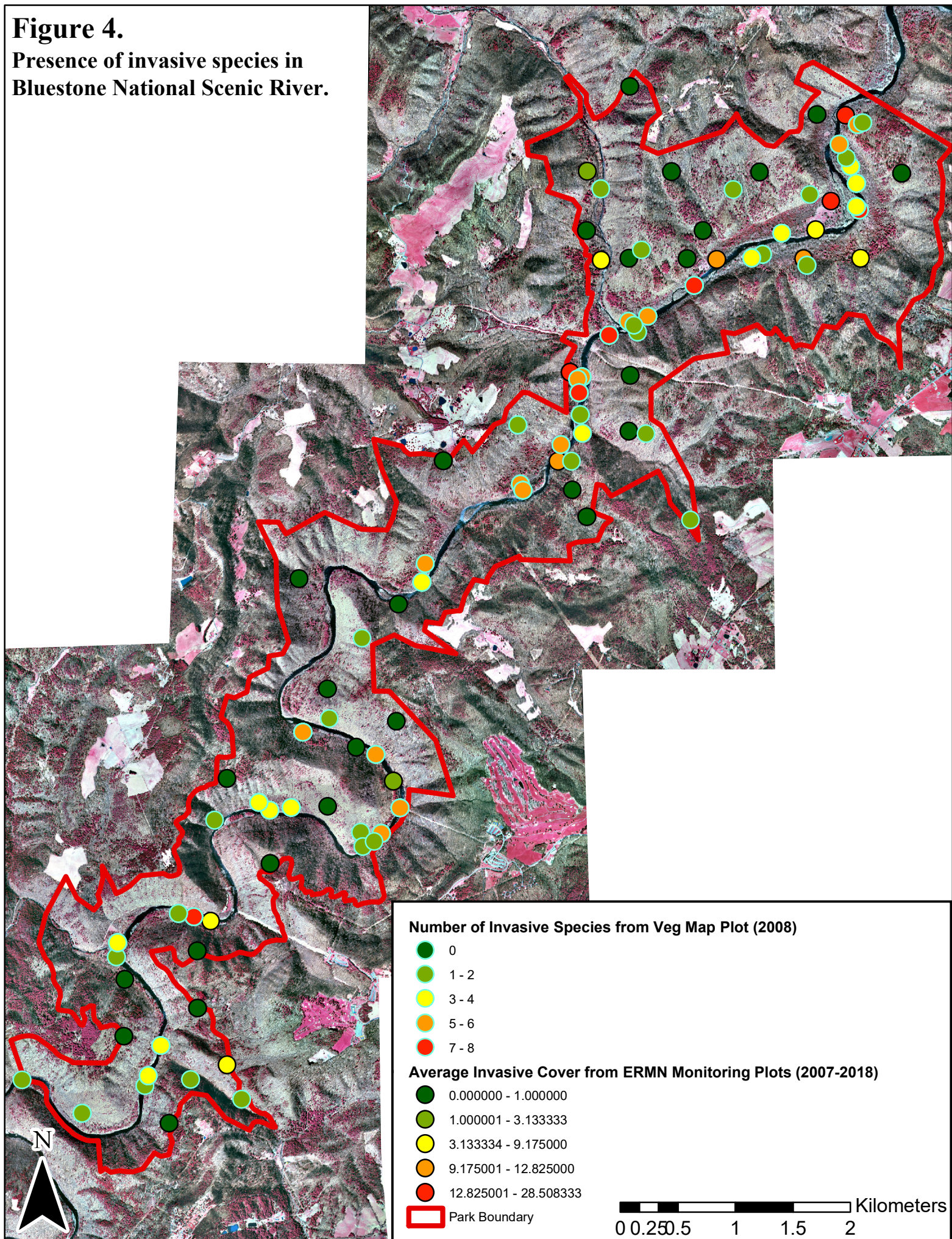


Table 3. Prioritization matrix for invasive species management in Bluestone National Scenic River. Higher numbers indicate higher priorities for invasive species management. Priority habitat management zones are highlighted in green.

Habitat Management Zone Name	Pilot Ridge	Successional Fields	Bluestone Mountain	Tony Hollow North	Pipestem	Lower Bluestone	Mountain Creek	Middle Bluestone	Middle North	Middle South	Upper Bluestone	Little Bluestone	Upland Rare Communities
Habitat Type	MF	YF	MF	MF	MF	RC	MF	RC	MF	MF	RC	RC	MF
Stewardship Index	1	2	1	1	1	2	1	2	1	1	2	2	2
Outreach Index	1	1	1	1	1	1	1	1	1	1	1	2	1
Priority Species													
Japanese hops	0	6	0	0	0	0	0	0	0	0	8	0	0
Japanese stiltgrass	6	5	0	6	4	7	0	7	0	0	7	7	0
dames rocket	0	7	0	0	0	0	0	0	0	0	7	0	0
garlic mustard	6	7	6	0	6	7	6	7	0	6	7	0	0
sericea lespedeza	0	0	0	0	0	0	0	6	0	0	0	0	0
autumn olive	0	8	7	7	7	8	0	0	0	0	6	0	0
Japanese barberry	0	8	0	0	0	0	0	0	0	0	0	0	0
multiflora rose	5	7	7	7	7	6	7	8	7	7	0	8	8
privet	0	6	0	0	0	8	0	8	0	0	0	0	0
shrub honeysuckle	0	0	7	0	7	0	7	0	0	0	8	0	8
wineberry	0	7	7	7	7	8	7	0	7	7	8	8	0
tree-of-heaven	0	0	0	7	0	0	0	0	0	0	8	0	0
Japanese honeysuckle	0	5	6	0	0	5	0	0	0	0	0	7	0
Oriental bittersweet	0	6	0	0	0	0	0	7	0	0	0	0	0
Chinese yam	0	7	0	0	0	0	0	0	0	0	7	7	0
Japanese knotweed	0	8	0	0	0	0	0	0	0	0	8	0	0

Habitat Type:
MF = Mature Forest
YF = Young forest
RC = Riparian Corridor

Stewardship Index:
0 = highly disturbed site
1 = intermediate disturbance
2 = high ecological integrity

Outreach Index:
0 = work will go unnoticed outside park staff
1 = work will visibly promote park's mission
2 = outside groups willing to contribute & support work

Highest Priority

High Priority

Medium Priority

Lower Priority

Table 4. Prescription for invasive species management for priority invasive species in priority habitat zones in Bluestone National Scenic River.

Priority Rank	Habitat Management Zone	Priority Species	Lead Worker	Method	Comments
8	Successional Fields	autumn olive	Certified Applicator	Cut	collaborate with DNR
8	Successional Fields	autumn olive	Certified Applicator	Stump-aqueous	
8	Successional Fields	autumn olive	Certified Applicator	Foliar-Specialized	
8	Successional Fields	Japanese barberry	Certified Applicator	Foliar-Broadleaf	
8	Successional Fields	Japanese knotweed	Staff	Biocontrol	
7	Successional Fields	dames rocket	Volunteer	Pull	
7	Successional Fields	garlic mustard	Volunteer	Pull	
7	Successional Fields	multiflora rose	Certified Applicator	Masticate	collaborate with DNR
7	Successional Fields	multiflora rose	Certified Applicator	Foliar-Broadleaf	
7	Successional Fields	wineberry	Certified Applicator	Foliar-Broadleaf	
7	Successional Fields	Chinese yam	Certified Applicator	Foliar-Broadleaf	
6	Successional Fields	Japanese hops	Certified Applicator	Foliar-Broadleaf	
6	Successional Fields	privet	Certified Applicator	Cut	collaborate with DNR
6	Successional Fields	privet	Certified Applicator	Stump-aqueous	
6	Successional Fields	Oriental bittersweet	Certified Applicator	Cut	
6	Successional Fields	Oriental bittersweet	Certified Applicator	Stump-aqueous	
5	Successional Fields	Japanese stiltgrass	Certified Applicator	Foliar-Specialized	
5	Successional Fields	Japanese honeysuckle	Certified Applicator	Cut	
5	Successional Fields	Japanese honeysuckle	Certified Applicator	Stump-aqueous	
5	Successional Fields	Japanese honeysuckle	Certified Applicator	Foliar-Specialized	
5	Successional Fields	All species	Staff	Bare-root planting	
8	Lower Bluestone	autumn olive	Certified Applicator	Cut	
8	Lower Bluestone	autumn olive	Certified Applicator	Stump-aqueous	
8	Lower Bluestone	autumn olive	Certified Applicator	Foliar-Specialized	
8	Lower Bluestone	privet	Certified Applicator	Cut	
8	Lower Bluestone	privet	Certified Applicator	Stump-aqueous	
8	Lower Bluestone	wineberry	Certified Applicator	Foliar-Broadleaf	
7	Lower Bluestone	Japanese stiltgrass	Certified Applicator	Foliar-Specialized	
7	Lower Bluestone	garlic mustard	Volunteer	Pull	
6	Lower Bluestone	multiflora rose	Certified Applicator	Foliar-Broadleaf	
5	Lower Bluestone	Japanese honeysuckle	Certified Applicator	Cut	
5	Lower Bluestone	Japanese honeysuckle	Certified Applicator	Stump-aqueous	
8	Middle Bluestone	multiflora rose	Certified Applicator	Foliar-Broadleaf	
8	Middle Bluestone	privet	Certified Applicator	Cut	
8	Middle Bluestone	privet	Certified Applicator	Stump-aqueous	
7	Middle Bluestone	Japanese stiltgrass	Certified Applicator	Foliar-Specialized	
7	Middle Bluestone	garlic mustard	Volunteer	Pull	
7	Middle Bluestone	Oriental bittersweet	Certified Applicator	Cut	
7	Middle Bluestone	Oriental bittersweet	Certified Applicator	Stump-aqueous	
6	Middle Bluestone	sericea lespedeza	Certified Applicator	Foliar-Broadleaf	
8	Upper Bluestone	Japanese knotweed	Staff	Biocontrol	
8	Upper Bluestone	Japanese hops	Certified Applicator	Foliar-Broadleaf	
8	Upper Bluestone	shrub honeysuckle	Certified Applicator	Cut	
8	Upper Bluestone	shrub honeysuckle	Certified Applicator	Stump-aqueous	
8	Upper Bluestone	wineberry	Certified Applicator	Foliar-Broadleaf	
8	Upper Bluestone	tree-of-heaven	Certified Applicator	Stem-hack	
7	Upper Bluestone	Chinese yam	Certified Applicator	Foliar-Broadleaf	
7	Upper Bluestone	Japanese stiltgrass	Certified Applicator	Foliar-Specialized	
7	Upper Bluestone	dames rocket	Volunteer	Pull	
7	Upper Bluestone	garlic mustard	Volunteer	Pull	
6	Upper Bluestone	autumn olive	Certified Applicator	Cut	
6	Upper Bluestone	autumn olive	Certified Applicator	Stump-aqueous	
6	Upper Bluestone	autumn olive	Certified Applicator	Foliar-Specialized	
8	Little Bluestone	multiflora rose	Certified Applicator	Foliar-Broadleaf	
8	Little Bluestone	wineberry	Certified Applicator	Foliar-Broadleaf	
7	Little Bluestone	Chinese yam	Certified Applicator	Foliar-Broadleaf	
7	Little Bluestone	Japanese stiltgrass	Certified Applicator	Foliar-Specialized	
7	Little Bluestone	Japanese honeysuckle	Certified Applicator	Cut	
7	Little Bluestone	Japanese honeysuckle	Certified Applicator	Stump-aqueous	
7	Little Bluestone	Japanese honeysuckle	Certified Applicator	Foliar-Broadleaf	
8	Upland Rare Communities	multiflora rose	Certified Applicator	Foliar-Broadleaf	
8	Upland Rare Communities	shrub honeysuckle	Certified Applicator	Cut	
8	Upland Rare Communities	shrub honeysuckle	Certified Applicator	Stump-aqueous	
8	Upland Rare Communities	shrub honeysuckle	Certified Applicator	Foliar-Broadleaf	

Lead Worker	Description of Lead Worker
<i>Volunteer</i>	As a <i>lead</i> worker, volunteers are limited to manual methods, and whatever equipment they are qualified/permited to use. Volunteers may not apply pesticides unless a Certified Applicator is present.
<i>Staff</i>	This is a park employee, but one without pesticide applicator credentials.
<i>Registered Technician</i>	This is a park employee who has completed the required annual training sanctioned by the PA Department of Agriculture (PDA). A Registered Technician can apply pesticides autonomously, in operations in which they have been trained, but they may not supervise non-credentialed applicators.
<i>Certified Applicator</i>	This is a park employee who has passed the Core and Category 23 Pesticide Applicator exams, and is <i>licensed</i> . A Certified Applicator may apply autonomously, and may also supervise other non-credentialed applicators as long they are on-site.
<i>Contractor</i>	A blanket term describing any individual or company paid to execute work.

Method	Description of Invasive Species Management Method
<i>Pull</i>	Remove plant from soil by pulling or digging it from the soil using manual equipment.
<i>Cut</i>	Remove top growth using hand-held or motorized tools. Typically directed towards woody plants, including vines.
<i>Masticate</i>	Refers to the use of forestry mower (e.g. FECON) to remove woody vegetation. Specifically, this refers to devices with a horizontal axle, and armored, fixed-teeth that shred woody stems, and can also reduce stump tissue.
<i>Brush Hog</i>	This refers to a mower used for infrequent cutting of little-managed vegetation, or "field mowing", distinct from the "finish" mowing of turfgrass. "Brush Hog" is not proprietary ("Bush Hog" is), and is also a definition in the <i>Wikipedia</i> .
<i>Targeted Removal</i>	Removal of specific woody stems, to modify edge habitat or create residual trees. Semantically, this is distinct from "thinning", which is a silvicultural practice to improve desirable tree growth, and it is also distinct from "selective cut" which is a commonly used as euphemism for the silvicultural malpractice known as "high-stemming".
<i>Tillage</i>	Soil disruption, typically with a tractor-drawn implement. Useful to thin dense monotypic stands of warm-season grasses or goldenrods to release or introduce other species. With the availability of no-till seed drills, tillage is rarely needed for seedbed preparation.
<i>Biological Control</i>	Classical biological control is the release of an organism that impacts one specific host. This is most commonly accomplished with insects. In Pennsylvania, the purple loosestrife beetle and mile-a-minute weevil have been released to specifically suppress those weeds.
<i>Foliar-AirStrike</i>	An herbicide application to target plant foliage. 'AirStrike' is a label for <i>glyphosate</i> plus <i>triclopyr</i> , a non-selective mixture used for most spot treatments.
<i>Foliar-Broadleaf</i>	An herbicide application to target plant foliage. 'Broadleaf' is a label for <i>triclopyr</i> plus <i>2,4-D</i> is a selective mixture to control broadleaved weeds without injuring grasses.
<i>Foliar-Specialized</i>	An herbicide application to target plant foliage. 'Specialized' refers to any herbicide or mixture that is not 'AirStrike' or 'Broadleaf', and is used for a specific target species. Examples include <i>quizalofop-P</i> to treat Japanese stiltgrass, or <i>aminopyralid</i> or <i>aminocyclopyrachlor</i> to treat Canada thistle.
<i>Stem-hack</i>	Woody species can be stem-treated. Hack and squirt is a concentrated mixture applied to fresh, spaced cuts made in the bark.
<i>Stem-basal</i>	Woody species can be stem-treated. Basal bark is an oil-based mixture applied to the lower portion of intact stems.
<i>Stump-aqueous</i>	Non-suckering woody plants can be cut and stump-treated to prevent regrowth. Water-based mixtures can be applied to freshly-cut stumps.
<i>Stump-oil</i>	Non-suckering woody plants can be cut and stump-treated to prevent regrowth. Oil-based mixtures can also be applied to previously cut stumps by treating the remaining bark as well.
<i>PRE</i>	A preemergent herbicide can be applied to prevent annual species, such as Japanese stiltgrass or mile-a-minute, from germinating.
<i>Monitor</i>	Systematic review of site to detect target species, whether new infestation or remnants from previous operation.
<i>Bare-root Planting</i>	Installing individual plants that have been dug from the soil, exposing their roots. A common technique with woody plants, where a 1-year old plant is dug in the late winter while dormant, and planted as soon as possible.
<i>Container Planting</i>	Plants are grown in containers ('pots'), rather than in the field. In this method the roots are intact, and planting can occur at any time.
<i>Live Stake Planting</i>	Live stakes are cuttings from certain woody species that will root and grow when simply stuck in moist soil in the early spring.
<i>Warm-season Seeding</i>	Warm- vs. Cool-season is a common reference to grasses. It is an issue because the "season" of the grass determines its seeding time. Warm-season grasses are seeded in the spring or dormant season, while cool-season grasses can also be fall-seeded.
<i>Cool-season Seeding</i>	Warm- vs. Cool-season is a common reference to grasses. It is an issue because the "season" of the grass determines its seeding time. Cool-season grasses are seeding in the spring, fall, or dormant season, while warm-season are not fall-seeded.
<i>Prescribed Fire</i>	Use of planned fire to remove existing aboveground plant material. Converts existing biomass to ash, providing elements such as potassium and phosphorous; and removes accumulated plant litter at ground level, improving habitat structure for ground nesting birds and small mammals.

Table 5. Calendar of management actions for priority invasive species and habitat zones.

[illegible]

Table 5 (continued). Calendar of management actions for priority invasive species and habitat zones

[illegible]



Invasive Plant Trend Analysis

Summary of Invasive Species Status and Trends for Bluestone National Scenic River

from

Miller, K.M., McGill, B.J., Weed, A. S., Seirup, C.E., Comiskey, J.A., Matthews, E.R., Perles, S.J., and J. P. Schmit. 2020. Long-term trends indicate that invasive plants are pervasive and increasing in eastern national parks. In press.

Status

In the most recent cycle in Bluestone National Scenic River (BLUE; 2015-2018), at least one invasive species was detected in 90.0% of plots, and on average, 30.8% of quadrats had at least one invasive species and average total invasive cover was 3.7% (Table 1). The shrub guild was the most abundant guild in BLUE, found in 82.5% of plots, and averaging 17.3% quadrat frequency, and 1.4% quadrat cover (Figure 1). The most abundant invasive species in BLUE was multiflora rose (*Rosa multiflora*), occurring in 72.5% of plots, and averaging 1.1% cover. Creeping charlie (*Glechoma hederacea*) was the second most abundant invasive species, occurring in 20.0% of plots, and averaging 0.7 % cover. The next three most abundant invasive species in BLUE were Japanese stiltgrass (*Microstegium vimineum*), Japanese honeysuckle (*Lonicera japonica*), and moneywort (*Lysimachia nummularia*).

Trends

There were a total of 6 significant trends in invasive abundance in BLUE. There were no significant trends in total invasive abundance. The invasive graminoid guild was 3.0 times more likely to occur in a plot in subsequent cycles. Graminoid quadrat frequency increased significantly by 3.7% per cycle. Graminoid average cover increased significantly by 0.4% per cycle. Japanese stiltgrass (*Microstegium vimineum*) was 2.1 times more likely to occur in a plot in subsequent cycles. Japanese stiltgrass (*Microstegium vimineum*) quadrat frequency increased significantly by <0.1% per cycle. Japanese stiltgrass (*Microstegium vimineum*) average cover increased significantly by 0.3% per cycle.

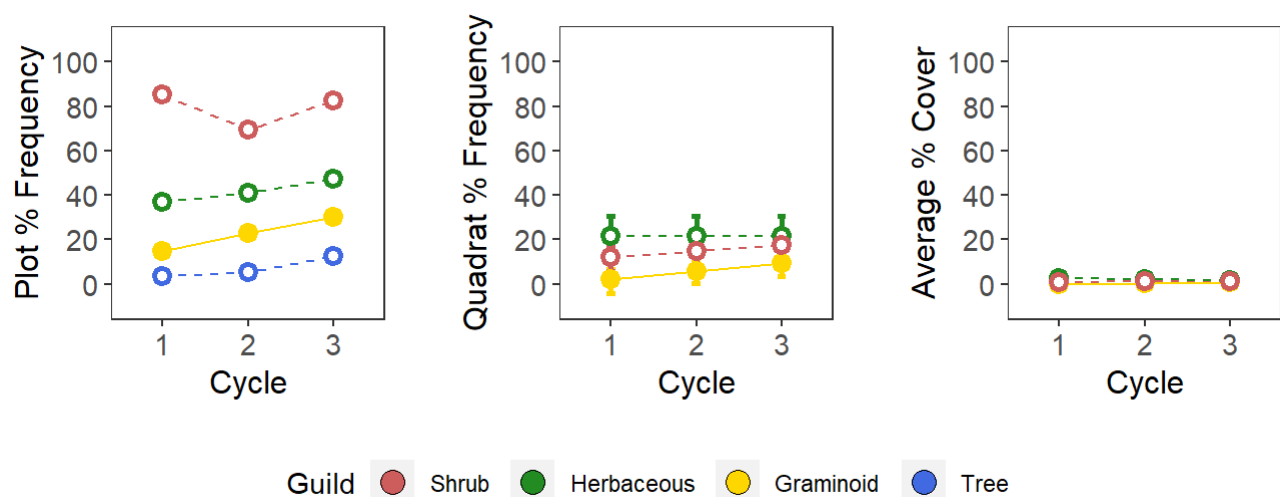


Figure 1. Trends by guild and cycle in BLUE. Solid symbols and lines indicate significant trends. Error bars are 95% confidence intervals.