

Invasive Plant Species and Habitat Management Plan for New River Gorge National River

Ana Casillas, Doug Manning, and Stephanie Perles

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Executive Summary

This management plan:

- 1) summarizes the status of invasive plant species in New River Gorge National River,
- 2) recommends the riparian zone around the New River and its tributaries as the top priority for invasive species management, and
- 3) provides guidance for the implementation of invasive species management in the park.

Invasive Plant Species and Habitat Management Plan for

New River Gorge National River

Invasive exotic plants threaten the natural resources of New River Gorge National River (NERI). 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 NERI shows that invasive species occur most frequently in certain areas of the park: disturbed areas such as recovering mined lands, and along the riparian corridor of the New River and its tributaries. More than half (55%) of the park's forest health monitoring plots contain no invasive plant species, and the park-wide average cover of invasive plants is low (1.8%). In fact, in a recent analysis, NERI was in the top 4 least invaded parks out of 39 eastern national parks studied (Miller et al. 2020).

Where invasive species do occur in the park, they are slowly spreading, by 0.1% cover per year. However, no significant trends are observed in plot frequency – a measure of the rate at which invasive plants are spreading to new sites within the park (Miller et al. 2020). The most abundant invasive species in NERI are multiflora rose (*Rosa multiflora*), creeping charlie (*Glechoma hederacea*), Japanese honeysuckle (*Lonicera japonica*), Japanese stiltgrass (*Microstegium vimineum*), and Japanese knotweed (*Polygonum cuspidatum*). A summary of the invasive species information from NERI 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 (ERMN) met to delineate habitat management zones in NERI (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 the vegetation types present in the park (Vanderhorst et al. 2007), the integrity (or lack of disturbance) of the plant communities, natural and cultural resource value to the park, and the presence of rare plants, animals and natural communities. Habitat management zones were also based on invasive species data collected from the vegetation classification and mapping project (Vanderhorst et al. 2007), ERMN long-term forest health monitoring plots (Perles et al. 2014), ERMN monitoring of rare riparian prairie communities (Perles et al. 2018), and the Invasive Species Early Detection / Rapid Response Program coordinated by ERMN (Keefer et al. 2010). 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 NERI.

Prioritization

Covering over 29,000 hectares, the park's size presents an additional challenge for invasive species management. The prioritization tool was developed for smaller protected areas (<2,000 hectares) with smaller habitat management zones. For NERI, the prioritization process provided an opportunity to synthesize park-specific data on invasive species to inform the park's priorities and strategies for invasive species management.

From the data sources listed above, 59 invasive species were known to occur in the park. We narrowed the focus to 36 invasive species that could have the greatest negative impacts on the park's flora. These species were entered into a prioritization tool housed in an excel workbook to rank 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 the park to protect the best sites within a park.

Since most invasive species occur in the riparian zone around the New River and its tributaries, areas which contain the park's peak native plant biodiversity (Vanderhorst et al. 2007), the highest priority habitat management zones in NERI are the Upper New and Lower New. Within these zones, rare plant communities and concentrations of rare plant species should be the priority focus for invasive species management.

The tool highlighted as priorities three other zones (Terry to Cunard, Cunard to North End, and Babcock to North End) at the park's northern end which host the vast majority of park visitors. The

impacts of invasive species are likely worse in these three zones compared to other sections of the park, as invasive species are introduced and spread by humans through foot traffic, boats, fire wood, and domestic animals. Additionally, park resources negatively impacted by invasive species are also most visible to park visitors in these zones.

Prescription

New River Gorge National River is too large and complex to provide a detailed prescription for each priority invasive species and habitat management zone as part of this plan. Instead, we propose the following general invasive species management strategy:

1. Robust invasive species early detection and rapid response program which identifies and eliminates new invading species before they become widespread.
2. Use of approved biocontrols for species that are abundant in patches (e.g. Japanese knotweed and tree-of-heaven).
3. Targeted removal of invasives from the riparian zone along the New River and its tributaries, focused primarily on concentrations of rare plants and communities.

Strategic Management Protects Park Resources

Invasive species management is crucial to protecting the park's rare species and natural communities in the riparian corridor of the New River and its tributaries. Inaction will result in declines in state-rare plant species and the loss of rare plant communities in the park. The strategic prescriptions presented in the report direct scarce resources to the areas of the park where invasive species management will most benefit the park's 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

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Figure 1. Invasive species habitat management zones in New River Gorge National River

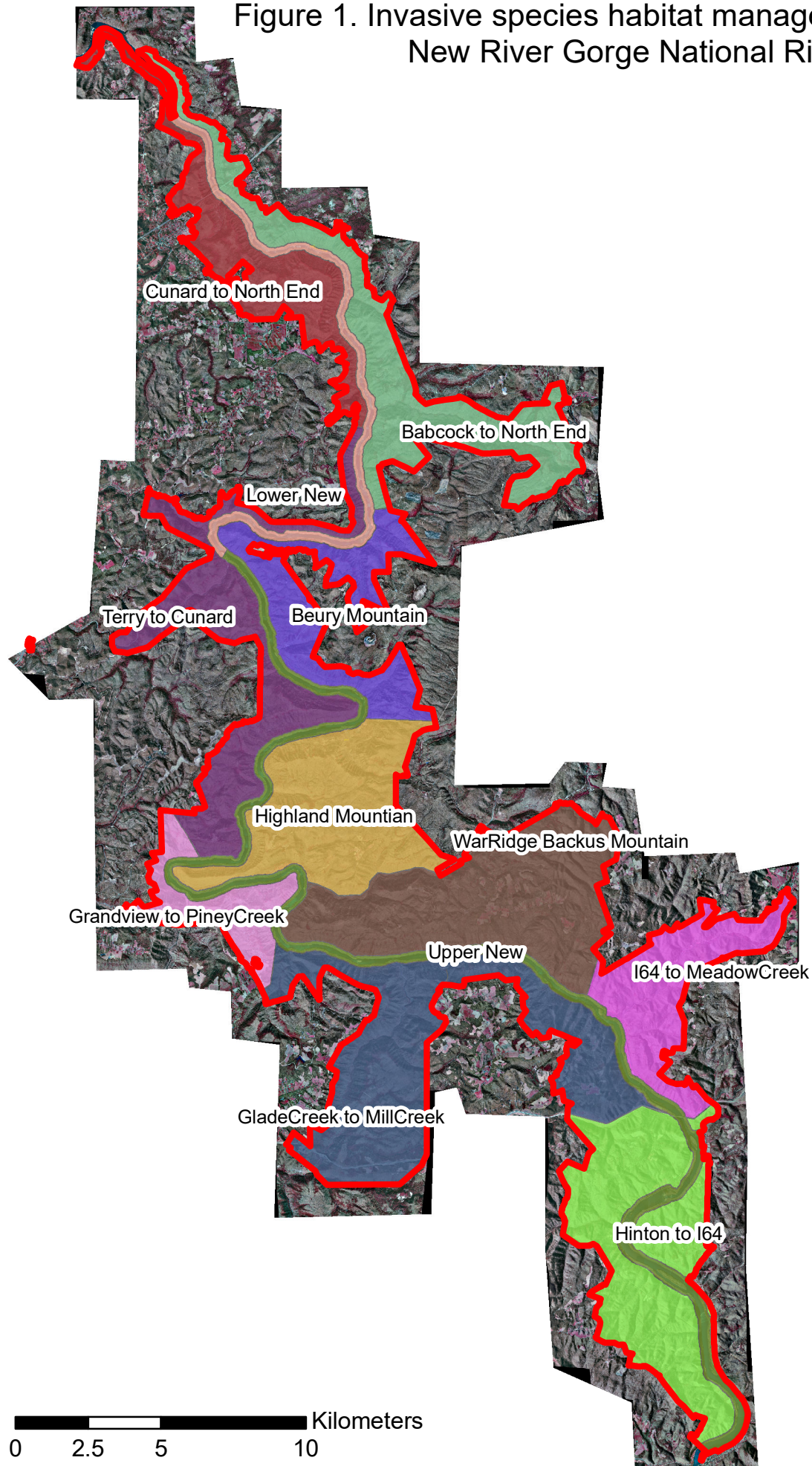


Figure 2 Average Invasive Percent Cover by Cycle

Trends in percent cover of invasive species observed in quadrats for plots sampled from 2007-2018. Each plot is sampled on a 4-year cycle. Average invasive cover among quadrats within each plot ranges from 0 to 64%. See Table 1 for percent cover values.

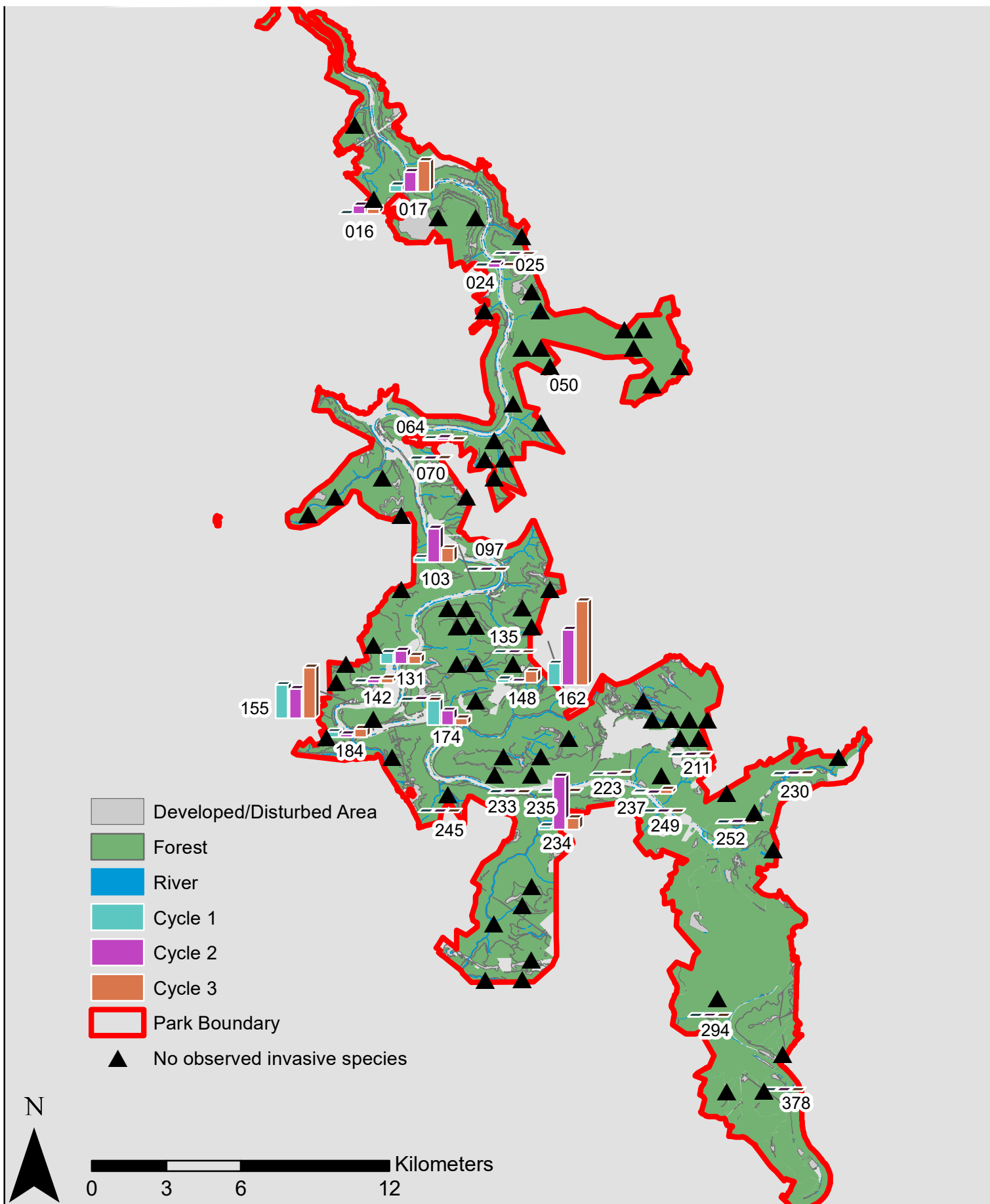


Figure 3 Percent Cover by Invasive Species

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.

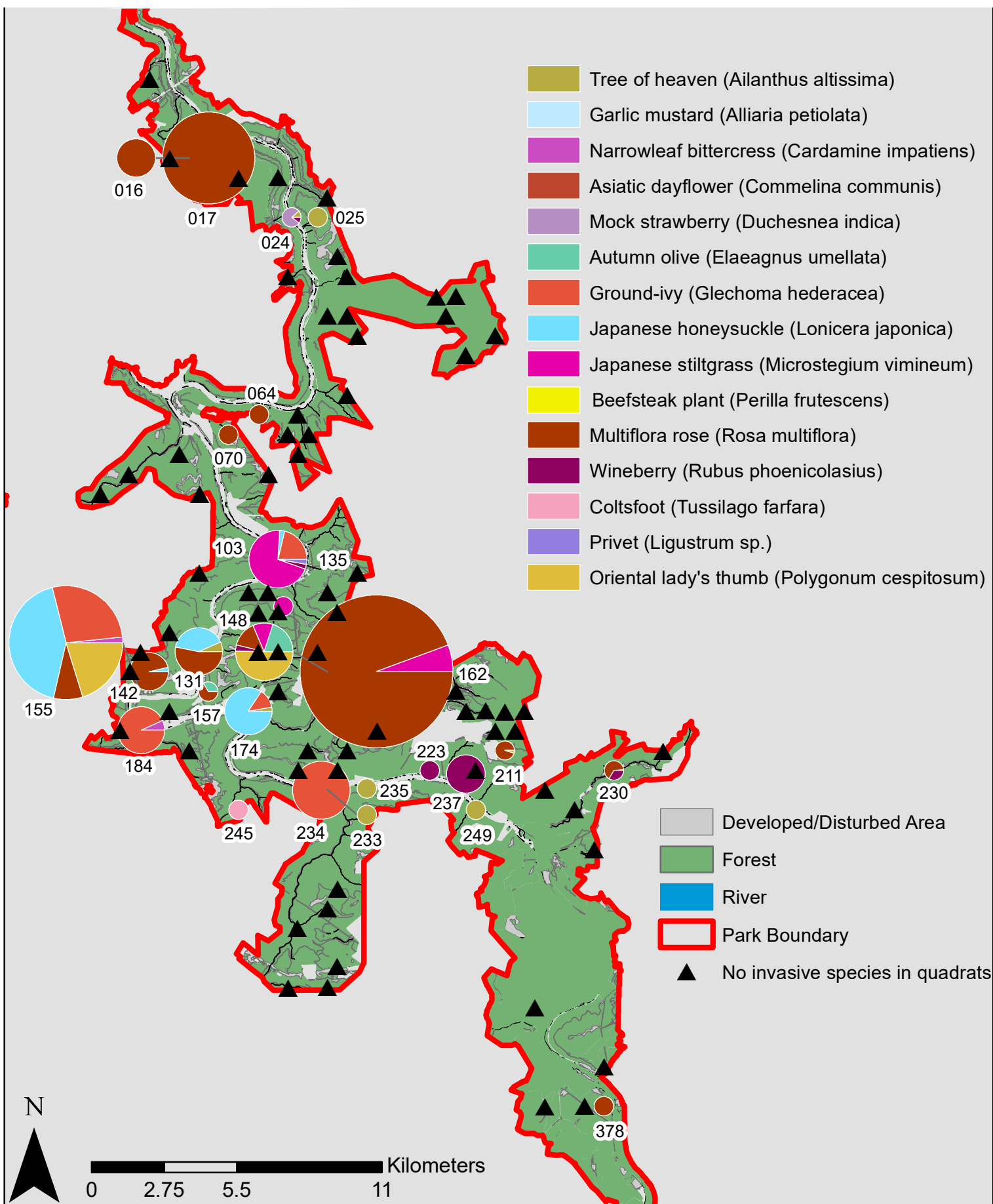


Table 1. Number of invasive species detected in each forest health monitoring plot and average percent cover of all invasive species observed in quadrats by plot and cycle. Cycle 1 spans 2007-2010; Cycle 2 spans 2011-2014; Cycle 3 spans 2015-2018; Cycle 4 includes only 2019 thus far. Plots not sampled in a cycle indicated by '—'.

Plot	Average Percent Cover of Invasives				Number of Invasive Species			
	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 1	Cycle 2	Cycle 3	Cycle 4
3	0	0	0	--	0	0	0	--
15		0	0	--	--	0	0	--
16	0	6.29	3.93	9.96	1	1	3	1
17	4.88	15.08	23.30	--	2	4	3	--
19	0	0	0	0	0	0	0	0
22	0	0	0	--	0	0	0	--
24	0.90	3.32	1.22	--	5	6	7	--
25	0	0	0.01	--	1	0	1	--
29	0	0	0	--	2	1	2	--
30	0	0	0	0	0	0	1	0
31	0	0	0	--	1	1	1	--
39	0	0	0	--	0	0	0	--
40	0	0	0	--	0	0	0	--
43	0	0	0	--	0	0	0	--
44	0	0	0	--	0	0	0	--
47	0	0	0	--	0	0	0	--
50	0	0	0	--	0	0	0	--
52	0	0	0	0	0	0	0	0
54	0	0	0	--	1	2	0	--
58	0	0	0	0.01	0	0	2	2
62	0	0	0	--	0	0	0	--
64	1.06	1.90	0.32	--	2	2	2	--
65	0	0	0	--	1	1	2	--
70	0	0.01	0.13	--	1	1	1	--
71	0	0	0	--	1	1	1	--
72	0	0	0	--	0	0	0	--
75	0	0	0	--	0	0	0	--
78	0	0	0	--	0	1	1	--
81	0	0	0	--	0	0	2	--
86	0	0	0	--	1	1	2	--
89	0	0	0	--	1	1	1	--
91	0	0	0	--	0	0	0	--
97	0	0.02	0	--	1	2	2	--
100	0	0	0	0	0	0	0	0
103	3.25	25.30	10.57	--	7	8	10	--
106	0	0	0	0	0	0	0	0
109	0	0	0	--	0	0	0	--
110	0	0	0	--	0	0	0	--
111	0	0	0	0	0	0	0	0
117	0	0	0	0	0	0	0	0
118	0	0	0	0	0	0	0	0
121	--	--	0	--	--	--	0	--

Table 1 (continued). 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; Cycle 3 spans 2015-2018; Cycle 4 includes only 2019 thus far. Plots not sampled in a cycle indicated by ‘—’.

	Average Percent Cover of Invasives				Number of Invasive Species			
	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 1	Cycle 2	Cycle 3	Cycle 4
122	0	0	0	--	0	0	0	--
129	0	0	0	--	0	0	0	--
131	8.08	9.89	5.94	--	8	8	7	--
133	0	0	0	--	0	0	0	--
134	0	0	0	--	0	0	0	--
135	0	0	0.01	0	0	0	1	0
136	0	0	0	0	0	0	0	0
140	0	0	0	--	0	0	0	--
142	0.67	2.79	3.48	--	3	6	5	--
148	2.41	0.71	8.32	--	4	5	6	--
155	25.19	22.13	38.34	--	7	7	8	--
157	0.05	0.44	0.03	--	3	3	2	--
159	0	0	0	0	0	0	0	0
162	16.53	42.31	63.77	--	5	5	3	--
165	0	0	0	0	0	0	0	0
171	0	0	0	--	0	0	0	--
174	20.23	10.88	5.06	--	5	7	6	--
179	0	0	0	--	0	0	0	--
180	0	0	0	--	0	0	0	--
181	0	0	0	0	0	0	0	1
182	0	0	0	--	0	0	0	--
183	0	0	0	--	1	1	5	--
184	4.05	2.35	6.50	--	6	6	6	--
190	0	0	0	--	0	0	0	--
193	0	0	0	--	0	0	0	--
194	0	0	0	--	0	0	0	--
198	0	0	0	0	0	0	0	0
203	0	0	0	0	0	0	0	0
205	0	0	0	--	0	0	0	--
211	0.31	0.59	0.93	--	2	2	3	--
215	0	0	0	--	2	1	1	--
216	0	0	0	--	1	2	1	--
218	0	0	0	0	0	0	0	0
223	0.01	0.02	1.23	--	2	2	3	--
225	0	0	0	--	0	0	0	--
230	0.13	0.65	0.90	--	1	4	5	--
232	0	0	0	0.29	0	0	1	1
233	0.02	0.29	0.14	--	1	2	4	--
234	2.43	40.06	8.56	--	4	6	7	--
235	0.29	0.03	0.29	--	3	3	2	--
237	1.05	0.30	3.23	--	1	1	4	--
240	0	0	0	--	0	0	0	--

Table 1 (continued). 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; Cycle 3 spans 2015-2018; Cycle 4 includes only 2019 thus far. Plots not sampled in a cycle indicated by ‘—’.

	Average Percent Cover of Invasives				Number of Invasive Species			
	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 1	Cycle 2	Cycle 3	Cycle 4
245	0	0	0.01	--	0	0	1	--
249	0	0	0.02	--	1	4	3	--
252	0	0.29	0	--	0	1	0	--
253	0	0	0	0	0	0	1	0
264	0	0	0	--	0	0	0	--
270	0	0	0	--	0	0	0	--
274	0	0	0	--	0	0	0	--
276	0	0	0	--	0	0	0	--
287	0	0	0	--	0	0	0	--
288	0	0	0	--	1	1	0	--
289	0	0	0	--	0	0	0	--
291	0	0	0	--	1	2	1	--
294	0	0.14	0	--	0	3	1	--
299	0	0	0	--	0	0	0	--
301	0	0	0	--	0	0	0	--
303	0	0	0	--	1	2	2	--
317	--	0	0	--	--	0	0	--
378	--	0.13	0.13	--	--	2	3	--

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

Latin Name	Common Name	Cycle1 (2007 - 2010)	Cycle2 (2011 - 2014)	Cycle3 (2015 - 2018)
<i>Acer platanoides</i>	Norway maple	0.0%	0.0%	1.0%
<i>Ailanthus altissima</i>	tree of heaven	8.2%	11.9%	14.7%
<i>Alliaria petiolata</i>	garlic mustard	1.0%	3.0%	2.9%
<i>Berberis thunbergii</i>	Japanese barberry	0.0%	1.0%	0.0%
<i>Cardamine impatiens</i>	narrowleaf bittercress	8.2%	7.9%	6.9%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	0.0%	1.0%	1.0%
<i>Commelina communis</i>	Asiatic dayflower	1.0%	1.0%	2.0%
<i>Dioscorea oppositifolia</i>	Chinese yam	1.0%	1.0%	0.0%
<i>Duchesnea indica</i>	Indian strawberry	3.1%	4.0%	3.9%
<i>Elaeagnus umbellata</i>	autumn olive	7.1%	7.9%	11.8%
<i>Euonymus alatus</i>	burningbush	0.0%	0.0%	1.0%
<i>Glechoma hederacea</i>	ground ivy	7.1%	5.0%	5.9%
<i>Ligustrum sp.</i>	privet	1.0%	2.0%	2.0%
<i>Ligustrum vulgare</i>	European privet	1.0%	1.0%	0.0%
<i>Lonicera japonica</i>	Japanese honeysuckle	6.1%	9.9%	8.8%
<i>Lonicera morrowii</i>	Morrow's honeysuckle	0.0%	1.0%	2.0%
<i>Lonicera sp. Exotic</i>	honeysuckle	0.0%	3.0%	0.0%
<i>Lysimachia nummularia</i>	creeping jenny	0.0%	0.0%	1.0%
<i>Microstegium vimineum</i>	Japanese stiltgrass	3.1%	5.0%	9.8%
<i>Paulownia tomentosa</i>	princesstree	2.0%	2.0%	2.0%
<i>Perilla frutescens</i>	beefsteakplant	0.0%	0.0%	1.0%
<i>Polygonum caespitosum</i>	Oriental ladythumb	6.1%	3.0%	2.9%
<i>Polygonum cuspidatum</i>	Japanese knotweed	2.0%	2.0%	2.0%
<i>Polygonum persicaria</i>	spotted ladythumb	0.0%	3.0%	0.0%
<i>Rosa multiflora</i>	multiflora rose	26.5%	29.7%	31.4%
<i>Rubus phoenicolasius</i>	wine raspberry	7.1%	12.9%	17.6%
<i>Spiraea japonica</i>	Japanese meadowsweet	0.0%	0.0%	1.0%
<i>Tussilago farfara</i>	coltsfoot	0.0%	0.0%	1.0%

Figure 4. Presence of invasive species in New River Gorge National River.

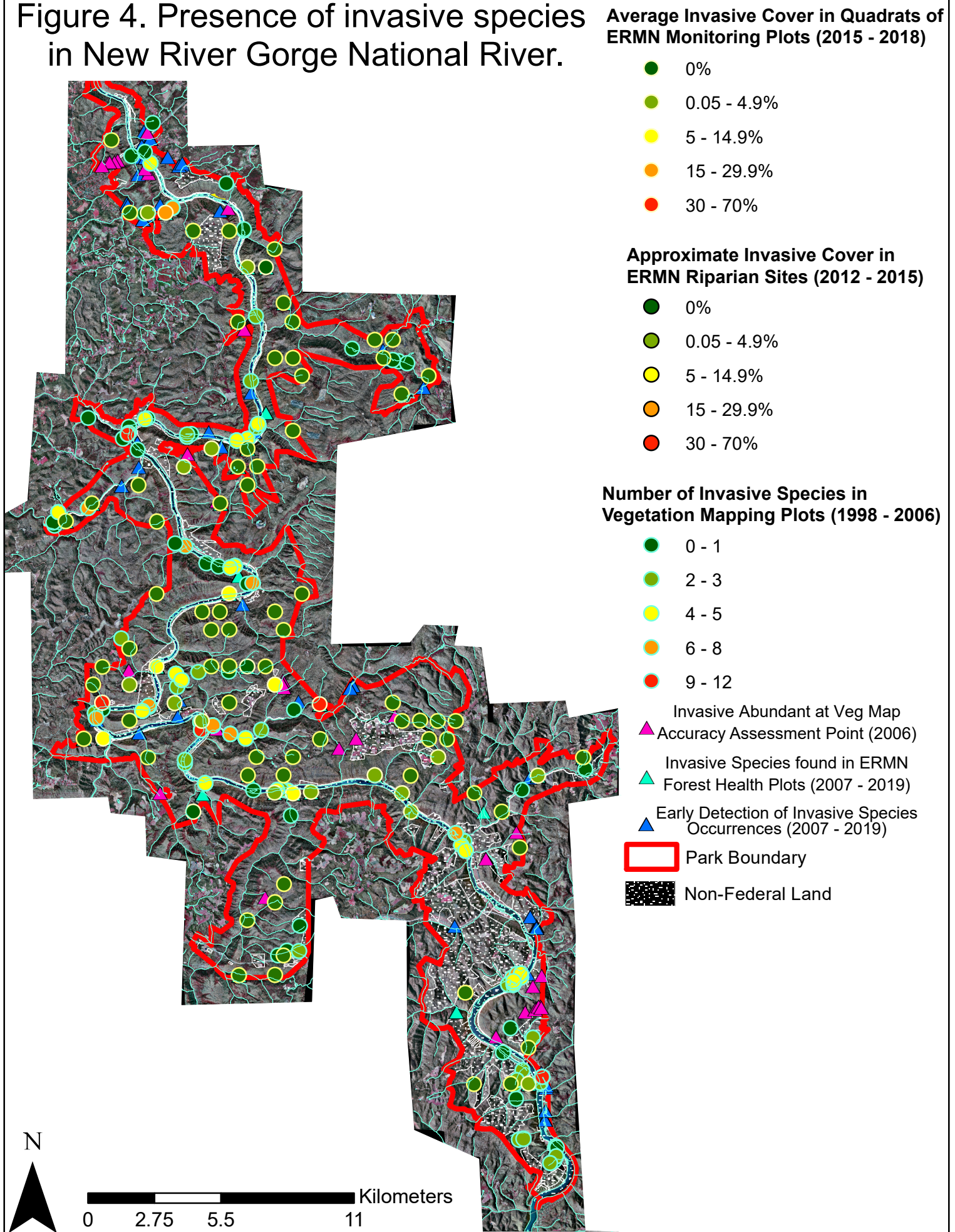


Table 3. Prioritization matrix for invasive species management in New River Gorge National River. Higher numbers indicate higher priority species and habitat zones for invasive species management.

HMZ Name	Cunard to North End	Babcock to North End	Terry to Cunard	Beury Mountain	Highland Mountain	Grandview to Piney Creek	War Ridge Backus Mountain	I64 to Meadow Creek	Glade Creek	Hinton to I64	Lower New	Upper New
Habitat Type	MF	MF	MF	MF	MF	MF	MF	MF	MF	MF	RC	RC
Stewardship Index	1	1	1	1	1	1	1	1	1	1	2	2
Outreach Index	2	2	2	1	1	1	1	1	2	1	2	2
Spec. Prior. 0-1	2	3	4	5	6	7	8	9	10	11	12	13
Japanese stiltgrass	7	7	7	6	6	0	6	0	7	6	8	8
dames rocket	0	0	0	0	0	0	0	0	0	0	0	8
garlic mustard	0	0	0	6	0	0	0	0	7	0	0	8
Japanese knotweed	6	0	6	0	0	5	5	0	0	5	8	8
Johnsongrass	0	0	0	0	0	0	0	0	7	0	0	0
Chinese silvergrass	7	0	0	0	0	0	0	0	0	0	0	0
purple loosestrife	0	0	0	0	0	0	0	0	0	0	7	7
sericea lespedeza	0	0	0	0	5	0	0	0	0	0	7	7
yellow flag iris	0	0	0	0	0	0	0	0	0	6	0	8
autumn olive	0	8	8	7	7	7	7	7	0	7	9	9
butterfly bush	0	0	0	0	0	0	0	0	0	0	0	9
callery pear	8	0	0	0	0	0	0	0	0	0	0	0
empress tree	8	8	8	0	7	0	0	0	0	0	9	0
Japanese barberry	8	8	0	0	7	0	0	0	0	7	9	9
Japanese spiraea	0	0	0	0	0	0	0	7	0	0	0	0
mimosa	0	0	0	0	0	0	0	0	0	7	9	9
multiflora rose	8	8	8	7	7	7	7	7	8	7	9	9
Norway maple	8	0	0	0	0	0	0	0	0	0	0	0
privet	0	0	8	0	0	0	0	0	0	0	0	9
shrub honeysuckle	8	8	0	0	0	7	7	0	0	0	9	9
wineberry	0	8	8	7	7	7	7	7	8	7	9	9
winged euonymus	8	0	0	0	0	0	0	0	0	0	0	0
tree-of-heaven	7	7	7	0	6	6	6	0	7	6	8	8
Japanese honeysuckle	7	0	7	0	0	6	6	6	7	6	8	8
kudzu	7	7	0	0	0	0	6	0	0	0	0	8
Oriental bittersweet	7	0	0	6	0	0	0	0	0	0	8	0
narrow-leaf bittercress	8	8	8	7	0	7	7	0	8	7	9	9
Oriental lady's thumb	0	8	8	7	7	7	7	7	0	7	9	9
creeping jenny	0	0	0	0	0	0	0	7	0	7	9	9
Japanese hops	0	0	0	0	0	0	0	0	0	0	0	9
spotted lady's thumb	0	0	0	0	0	0	0	7	8	0	0	9
sweet autumn virgins bower	0	0	0	0	0	0	0	0	0	0	0	9
creeping charlie	8	0	8	0	7	7	7	0	8	7	9	9
Indian strawberry	8	8	0	7	7	7	0	0	0	0	9	0
Chinese yam	0	0	0	0	7	0	0	0	0	0	9	9

Habitat Type: MF = Mature Forest, RC = Riparian Corridor.

Stewardship Index: 0 = disturbed site significantly impacted by invasive species; 1 = intermediate level of ecological disturbance; 2 = HMZ has high ecological value, resembles intact ecosystem, includes critical water quality areas regardless of the level of invasive impact.

Outreach Index: 0 = management efforts will go unnoticed outside of park staff; 1 = work done in zone visibly promotes the Park's mission; 2 = outside groups or agencies are interested in supporting work in this zone due to high outreach value.