

Invasive Plant Species and Habitat Management Plan for Gauley River National Recreation Area

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July 2020

Executive Summary

This management plan:

- 1) summarizes the status of invasive plant species in Gauley River National Recreation Area,
- 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

Gauley River National Recreation Area

Invasive exotic plants threaten the natural resources of Gauley River National Recreation Area (GARI). 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 GARI shows that at least one invasive species is present in nearly 60% of the park's monitoring plots. Furthermore, invasives are 5 times more likely to occur in a monitoring plot during the next sampling visit (Miller et al. 2020). Each year, invasive species are spreading to an additional 900 m² of the park, with the largest increases observed in multiflora rose (*Rosa multiflora*), wineberry (*Rubus phoenicolasius*), and Japanese stiltgrass (*Microstegium vimineum*). A summary of the invasive species information from GARI 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 GARI (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, 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 GARI were determined based on the vegetation map (Vanderhorst et al 2010) and data on the status of invasive plant species in the park. Invasive species data were collected from the vegetation classification and mapping project (Vanderhorst et al 2010), ERMN long-term forest health monitoring plots (Perles et al 2014, for current data see <https://www.nps.gov/im/ermn/vegetation-soils.htm>), and 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 GARI.

Prioritization

We then used a prioritization tool 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 the park to protect the best sites within a park.

The highest priority habitat management zone in GARI is the Riparian Zone, which contains several rare plant communities that provide habitat for numerous rare plant species. Invasive shrubs such as multiflora rose, wineberry, autumn olive (*Elaeagnus umbellata*), and shrub honeysuckles (*Lonicera* spp.) are top priority for treatment. Other important management targets in the riparian zone include tree-of-heaven (*Ailanthus altissima*), Japanese knotweed (*Polygonum cuspidatum*), and Japanese honeysuckle (*Lonicera japonica*).

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 GARI.

Nearly all invasive management prescriptions in GARI 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 park's rare species and natural communities in the riparian corridor along Gauley River. Inaction will result in declines in federally- and state-rare plant species and 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

- Gover, A. 2016. Introduction to the Habitat and Invasive Species Management 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, Z. Arcaro, and S. C. Gawler. 2010. Vegetation Classification and Mapping of Gauley River National Recreation Area, West Virginia. Technical Report NPS/NER/NRTR—2010/148. National Park Service. Philadelphia, PA

Figure 1.
Invasive species habitat management zones in Gauley River National Recreation Area

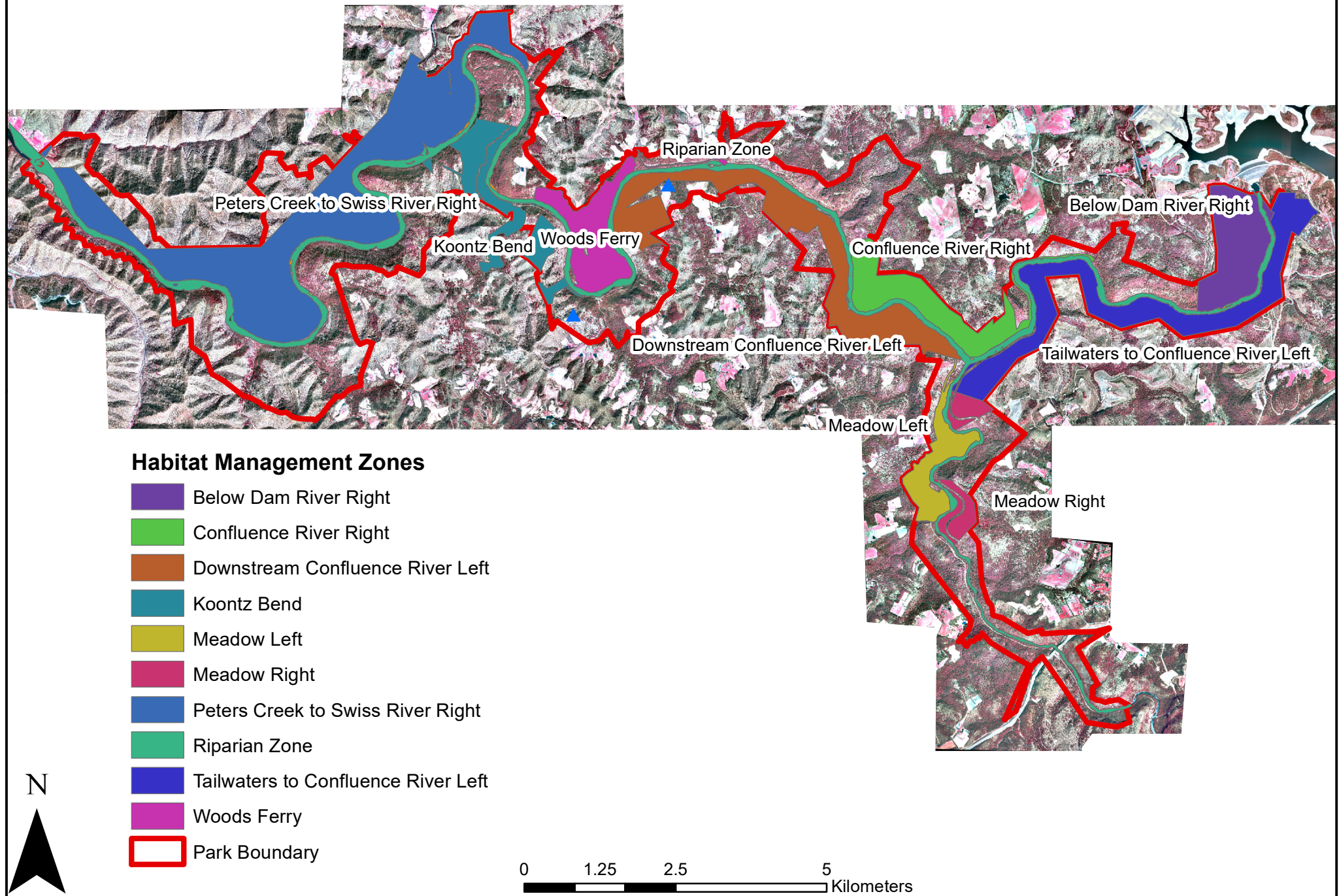


Figure 2. Average Invasive Species Percent Cover by Cycle

Trends in percent cover of invasive species observed in quadrats in forest monitoring 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 25%. See Table 1 for percent cover values.

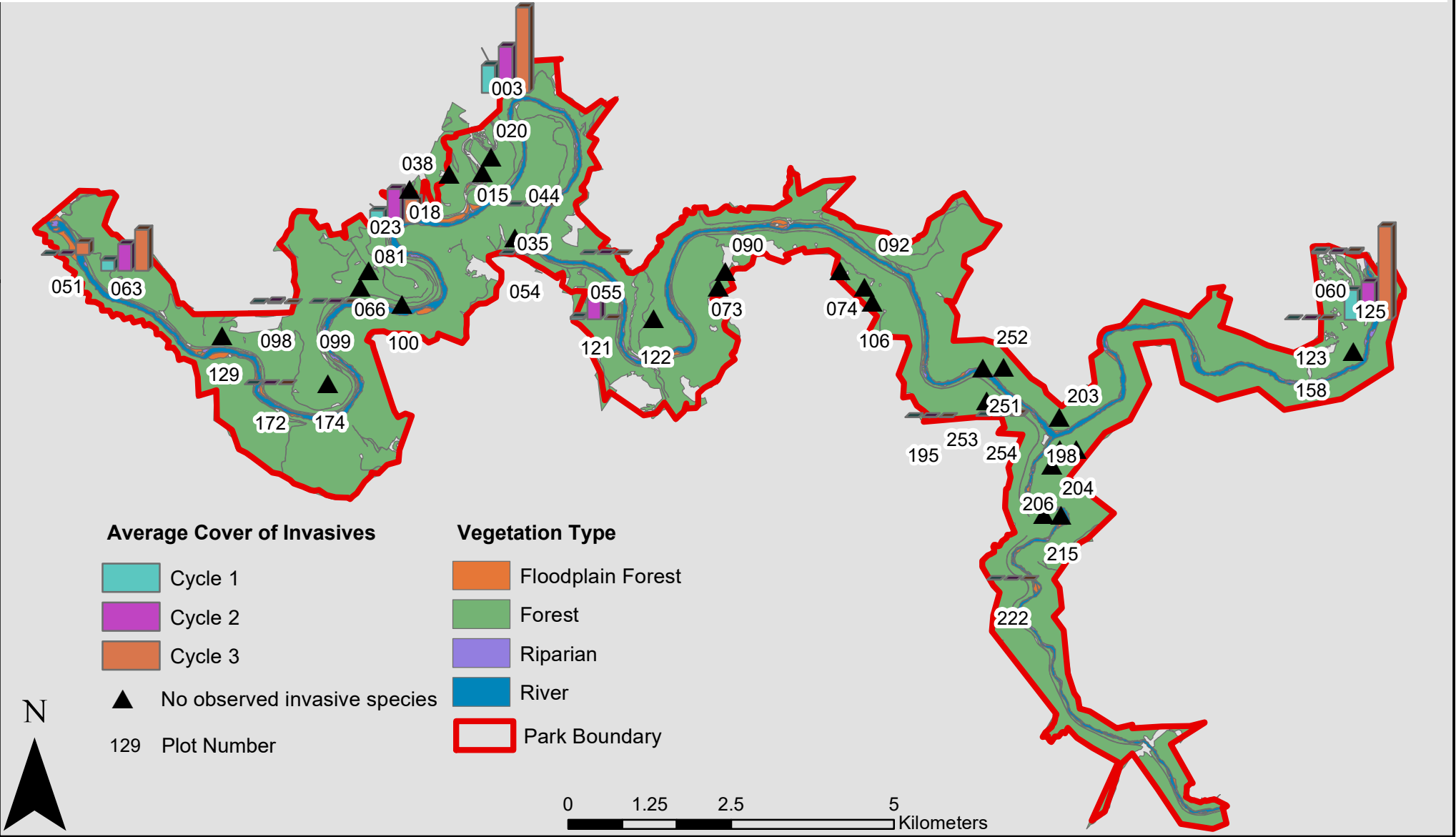


Figure 3. Percent Cover by Invasive Species

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.

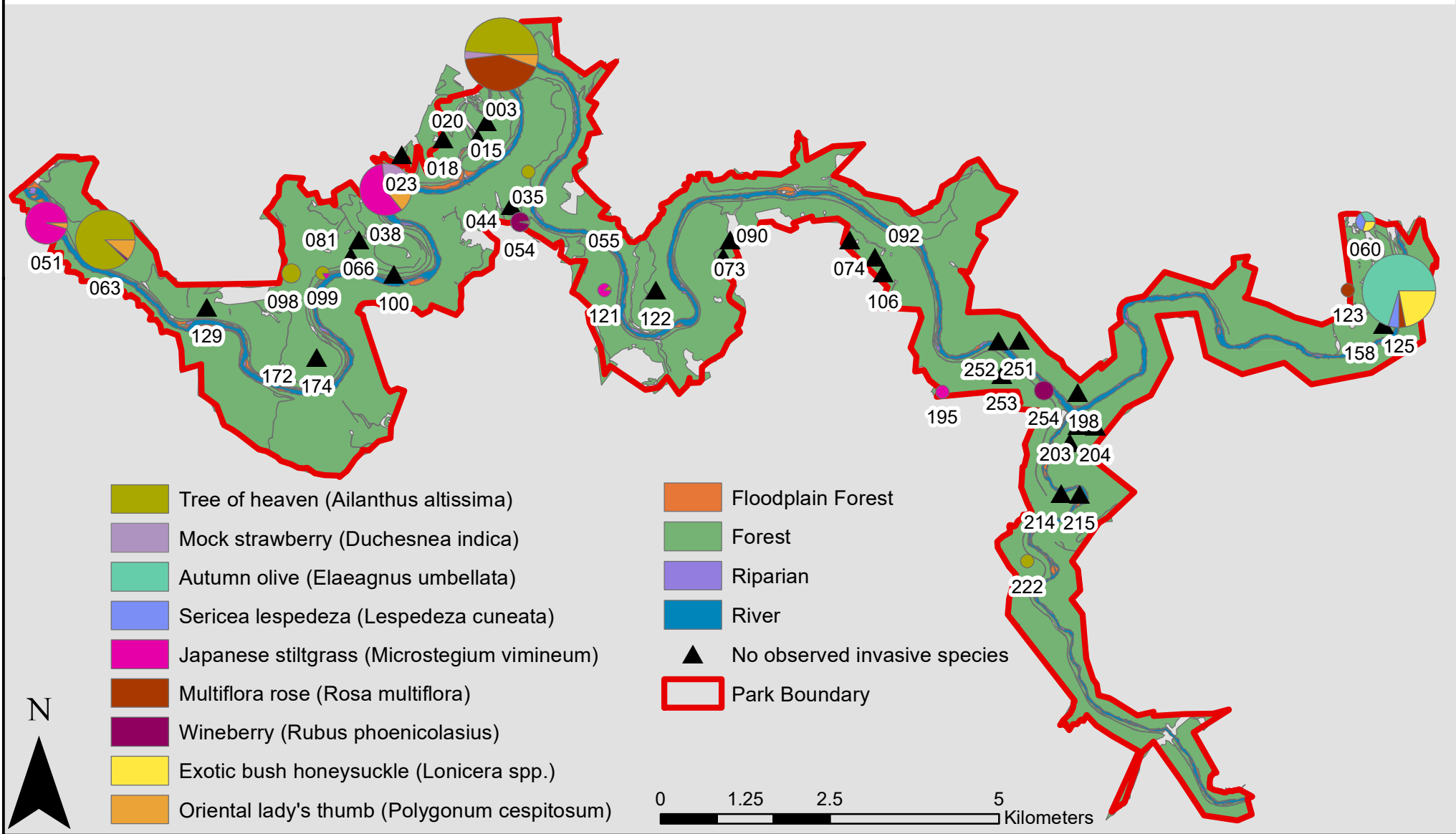


Figure 4. Abundance of invasive species in Gauley River National Recreation Area.

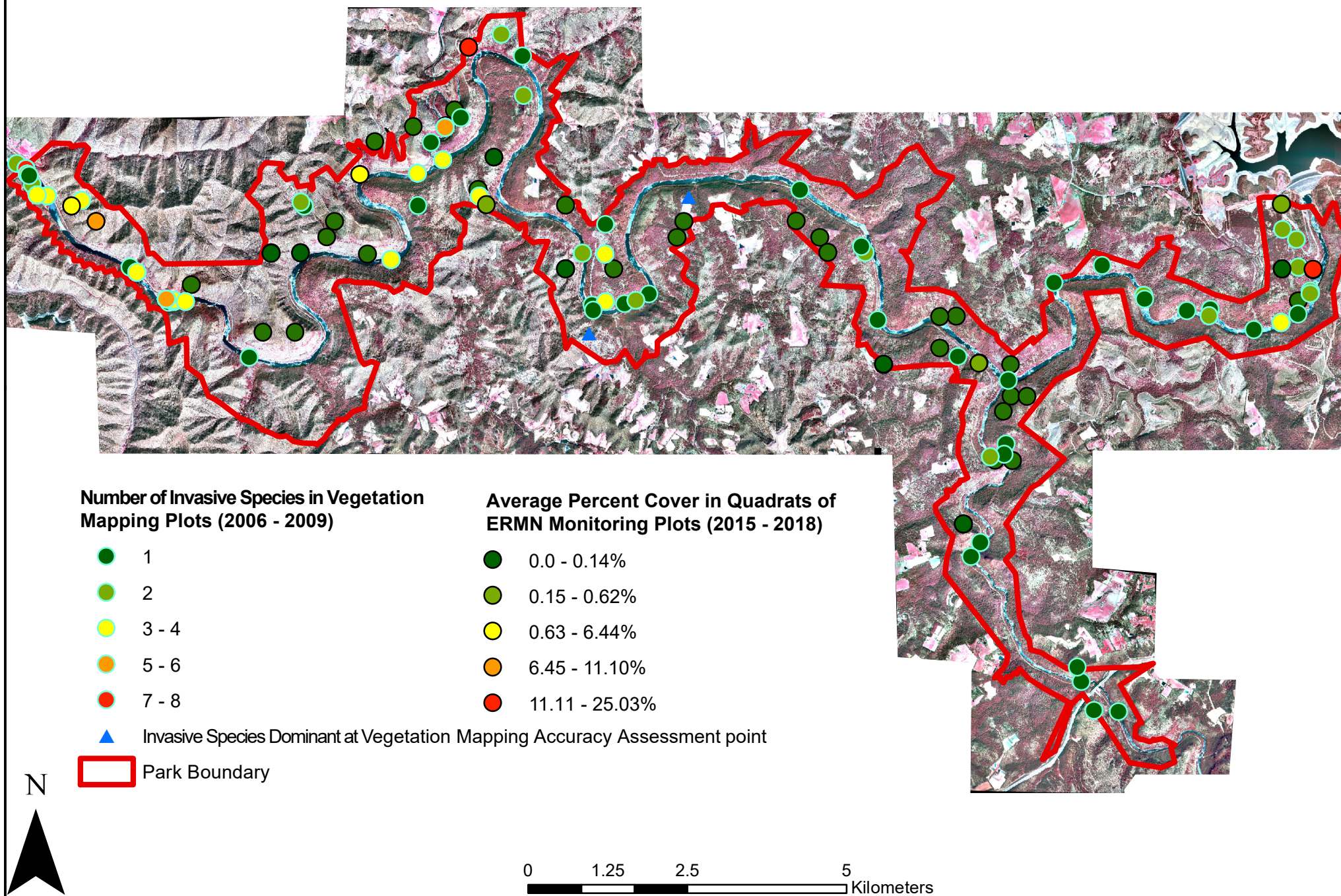


Table 1. Number of invasive species detected in each forest health monitoring plot and average percent cover of all invasive species observed in quadrats by plot and cycle. Cycle 1 spans 2007 - 2010; Cycle 2 spans 2011 - 2014; and Cycle 3 spans 2015 – 2018. Cycle 4 includes only plots sampled in 2019 and has not yet been completed. 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	7.31	12.38	22.91	12.46	4	6	7	7
15	0	0	0	--	0	0	2	--
18	0	0	0	--	0	0	0	--
20	0	0	0	--	0	0	1	--
23	0	0	0	--	0	0	0	--
35	0	0	0.01	--	0	1	3	--
38	3.27	9.09	6.44	--	5	6	5	--
44	0	0	0	--	0	0	1	--
51	0.01	0.15	3.28	0.075	1	5	4	6
54	0	0	0.31	0.125	0	3	6	2
55	0	0.01	0	0	0	1	1	1
60	0.5	0.19	0.43	--	5	4	6	--
63	2.81	7.1	11.09	--	2	3	5	--
66	0	0	0	0	0	0	0	0
73	0	0	0	--	1	1	1	--
74	0	0	0	--	0	0	0	--
81	0	0	0	0	0	1	1	0
90	0	0	0	--	0	1	0	--
92	0	0	0	0	0	0	0	0
98	0.13	0.43	0.03	--	2	3	4	--
99	0.03	0.02	0.05	--	3	3	3	--
100	0	0	0	--	0	1	1	--
106	0	0	0	--	0	0	0	--
121	0.63	5.35	0.14	--	3	4	4	--
122	0	0	0	0	0	0	1	1
123	0.01	0.01	0.01	--	2	2	1	--
125	7.96	10.08	25.03	--	3	6	4	--
129	0	0	0	0	0	0	0	0
158	0	0	0	0	0	1	1	1
172	0	0.01	0	--	0	2	1	--
174	0	0	0	--	0	0	0	--
195	0	0.01	0.02	--	0	2	1	--
198	0	0	0	0	0	0	0	0
203	0	0	0	--	0	0	0	--
204	--	--	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.

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
206	0	0	0	--	0	0	0	--
214	0	0	0	0	0	0	0	0
215	0	0	0	--	0	0	0	--
222	0	0	0.01	--	0	0	3	--
251	--	--	0	--	--	--	0	--
252	--	--	0	--	--	--	0	--
253	--	--	0	--	--	--	0	--
254	--	--	0.63	--	--	--	1	--

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>Rosa multiflora</i>	multiflora rose	21.1%	31.6%	34.9%
<i>Ailanthus altissima</i>	tree of heaven	13.2%	34.2%	27.9%
<i>Microstegium vimineum</i>	Japanese stiltgrass	7.9%	15.8%	23.3%
<i>Rubus phoenicolasius</i>	wine raspberry	2.6%	7.9%	18.6%
<i>Elaeagnus umbellata</i>	autumn olive	10.5%	15.8%	14.0%
<i>Polygonum caespitosum</i>	Oriental ladythumb	7.9%	7.9%	11.6%
<i>Duchesnea indica</i>	Indian strawberry	5.3%	7.9%	9.3%
<i>Lonicera morrowii</i>	Morrow's honeysuckle	5.3%	2.6%	7.0%
<i>Lespedeza cuneata</i>	sericea lespedeza	2.6%	2.6%	4.7%
<i>Lonicera japonica</i>	Japanese honeysuckle	0.0%	0.0%	4.7%
<i>Lonicera sp. Exotic</i>	honeysuckle	0.0%	5.3%	2.3%
<i>Anthoxanthum odoratum</i>	sweet vernalgrass	0.0%	2.6%	0.0%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	0.0%	2.6%	0.0%
<i>Morus alba</i>	white mulberry	0.0%	2.6%	0.0%
<i>Paulownia tomentosa</i>	princesstree	2.6%	5.3%	0.0%
<i>Polygonum persicaria</i>	spotted ladythumb	0.0%	2.6%	0.0%

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

Habitat Management Zone Name	Peter Creek to Swiss	Riparian Zone	Koontz Bend	Woods Ferry	Downstream Confluence	Confluence	Meadow Right	Meadow Left	Tailwaters to Confluence	Below Dam
Habitat Type	MF	RC	MF	MF	MF	MF	MF	MF	MF	MF
Stewardship Index	2	2	1	1	1	1	2	2	1	1
Outreach Index	1	2	1	1	1	1	1	1	1	1
Priority Species										
Japanese stiltgrass	5	7	4	0	4	0	0	0	0	4
Japanese knotweed	6	9	0	0	0	0	0	0	0	7
sericea lespedeza	6	7	0	0	0	0	0	0	0	5
autumn olive	6	10	7	0	7	0	0	0	0	5
multiflora rose	8	10	7	7	7	0	8	8	0	5
shrub honeysuckle	0	10	7	0	0	0	0	0	0	7
wineberry	8	10	7	7	7	0	0	8	0	7
tree-of-heaven	6	9	7	7	7	0	0	8	0	7
Japanese honeysuckle	7	9	6	0	0	0	0	0	0	0
Spotted lady's-thumb	7	0	0	0	0	0	0	0	0	0
Oriental lady's-thumb	7	8	6	6	0	0	0	7	0	6
garlic mustard	7	0	0	0	0	0	0	0	0	0
empress tree	8	0	0	0	0	0	0	0	0	0
white mulberry	8	0	7	0	0	0	0	0	0	7
Oriental bittersweet	7	0	0	0	0	0	0	0	0	0
Japanese barberry	0	0	0	0	0	0	0	0	0	7
privet	0	0	0	0	0	0	0	0	0	7

Highest Priority
High Priority
Medium Priority
Lower Priority

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.

Table 4. Prescription for invasive species management for priority invasive species in priority habitat zones in Gauley River National Recreation Area.

Priority Rank	Habitat Management Zone	Priority Species	Lead Worker	Method	Comments
10	Riparian Zone	autumn olive	Certified Applicator	Cut	
10	Riparian Zone	multiflora rose	Certified Applicator	Stem-hack	
10	Riparian Zone	shrub honeysuckle	Certified Applicator	Stem-hack	
10	Riparian Zone	wineberry	Certified Applicator	Pull	
9	Riparian Zone	Japanese knotweed	Staff	Biocontrol	Potentially targeted removal as well in rare communities
9	Riparian Zone	tree-of-heaven	Certified Applicator	Stem-hack	
9	Riparian Zone	Japanese honeysuckle	Certified Applicator	Targeted Removal	
9	Riparian Zone	privet	Certified Applicator	Stem-hack	
8	Riparian Zone	Oriental lady's-thumb	Certified Applicator	Pull	
7	Riparian Zone	Japanese stiltgrass	Certified Applicator	Pull	
7	Riparian Zone	sericea lespedeza	Certified Applicator	Foliar-Broadleaf	
8	Peter Creek to Swiss	multiflora rose	Certified Applicator	Foliar-Broadleaf	
8	Peter Creek to Swiss	wineberry	Certified Applicator	Foliar-Broadleaf	
8	Peter Creek to Swiss	empress tree	Certified Applicator	Stem-hack	
8	Peter Creek to Swiss	white mulberry	Certified Applicator	Stem-hack	
7	Peter Creek to Swiss	Japanese honeysuckle	Certified Applicator	Foliar-Broadleaf	
7	Peter Creek to Swiss	Spotted lady's-thumb	Certified Applicator	Pull	
7	Peter Creek to Swiss	Oriental lady's-thumb	Certified Applicator	Pull	
7	Peter Creek to Swiss	garlic mustard	Staff	Pull	
8	Meadow Right	multiflora rose	Certified Applicator	Foliar-Broadleaf	
8	Meadow Left	multiflora rose	Certified Applicator	Foliar-Broadleaf	
8	Meadow Left	wineberry	Certified Applicator	Foliar-Broadleaf	
8	Meadow Left	tree-of-heaven	Certified Applicator	Stem-hack	
7	Meadow Left	Oriental lady's-thumb	Certified Applicator	Pull	
7	Koontz Bend	autumn olive	Certified Applicator	Stem-hack	
7	Koontz Bend	multiflora rose	Certified Applicator	Foliar-Broadleaf	
7	Koontz Bend	shrub honeysuckle	Certified Applicator	Stump-aqueous	
7	Koontz Bend	wineberry	Certified Applicator	Foliar-Broadleaf	
7	Koontz Bend	tree-of-heaven	Certified Applicator	Stem-hack	
7	Koontz Bend	empress tree	Certified Applicator	Stem-hack	
7	Woods Ferry	multiflora rose	Certified Applicator	Foliar-Broadleaf	
7	Woods Ferry	wineberry	Certified Applicator	Foliar-Broadleaf	
7	Woods Ferry	tree-of-heaven	Certified Applicator	Stem-hack	
7	Downstream Confluence	autumn olive	Certified Applicator	Stem-hack	

Table 4. Prescription for invasive species management for priority invasive species in priority habitat zones in Gauley River National Recreation Area.

7	Downstream Confluence	multiflora rose	Certified Applicator	Foliar-Broadleaf	
7	Downstream Confluence	wineberry	Certified Applicator	Foliar-Broadleaf	
7	Downstream Confluence	tree-of-heaven	Certified Applicator	Stem-hack	
7	Below Dam	Japanese knotweed	Certified Applicator	Biocontrol	
7	Below Dam	shrub honeysuckle	Certified Applicator	Stump-aqueous	
7	Below Dam	wineberry	Certified Applicator	Foliar-Broadleaf	
7	Below Dam	tree-of-heaven	Certified Applicator	Stem-hack	
7	Below Dam	empress tree	Certified Applicator	Stem-hack	
7	Below Dam	Japanese barberry	Certified Applicator	Spray-Foliar	

Highest Priority

High Priority

Medium Priority

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

[illegible]



Invasive Plant Trend Analysis

Summary of Invasive Species Status and Trends for Gauley River National Recreation Area

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 Gauley River National Recreation Area (GARI; 2015-2018), at least one invasive species was detected in 58.1% of plots, and on average, 13.6% of quadrats had at least one invasive species and average total invasive cover was 1.6% (Table 1). The shrub guild was the most abundant guild in GARI, found in 51.2% of plots, and averaging 5.4% quadrat frequency, and 0.8% quadrat cover (Figure 1). The most abundant invasive species in GARI was tree-of-heaven (*Ailanthus altissima*), occurring in 27.9% of plots, and averaging 0.5% cover. Multiflora rose (*Rosa multiflora*) was the second most abundant invasive species, occurring in 34.9% of plots, and averaging 0.2 % cover. The next three most abundant invasive species in GARI were oleaster (*Elaeagnus*), Japanese stiltgrass (*Microstegium vimineum*), and oriental lady's thumb (*Persicaria longiseta*).

Trends

There were a total of 6 significant trends in invasive abundance in GARI. An invasive species was 5.0 times more likely to occur in a plot in subsequent cycles. Quadrat frequency of total invasives increased significantly by 2.2% per cycle. Average cover of total invasives increased significantly by 0.6% per cycle. The invasive graminoid guild was 2.5 times more likely to occur in a plot in subsequent cycles. The invasive shrub guild was 3.0 times more likely to occur in a plot in subsequent cycles. Wineberry (*Rubus phoenicolasius*) was 3.5 times more likely to occur in a plot in subsequent cycles.

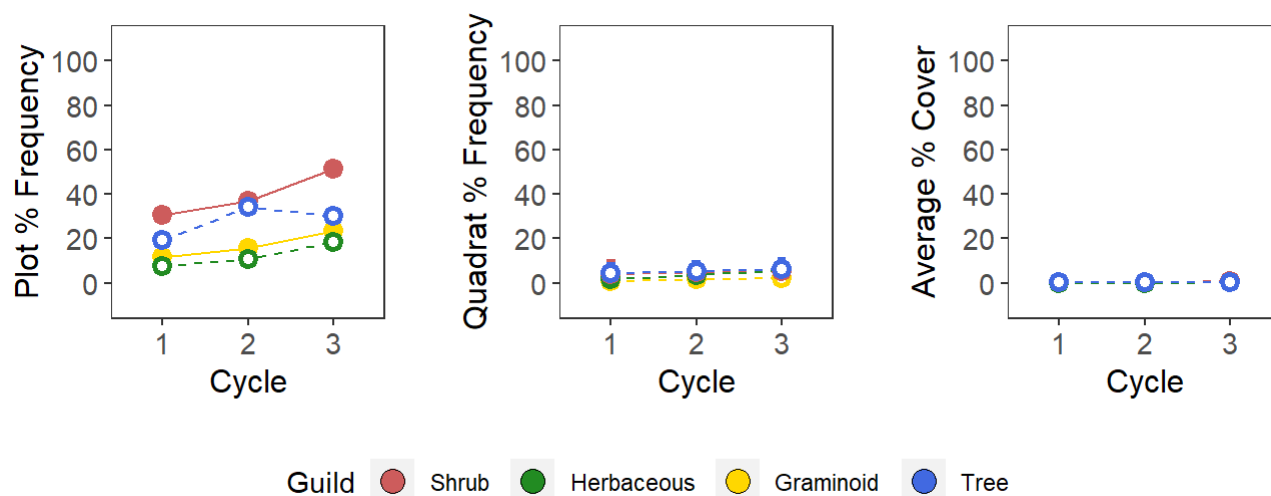


Figure 1. Trends by guild and cycle in GARI. Solid symbols and lines indicate significant trends. Error bars are 95% confidence intervals.