



Invasive Species Early Detection Report, 2011–2020

Overview and Background

Invasive species are one of the leading threats to the biodiversity and integrity of ecosystems worldwide. Known ecological impacts of invasive species include displacement of threatened and endangered species, altered structure and composition of terrestrial and aquatic communities, and reduction in overall species diversity. National parks are not immune from the effects of invasive species. At Ninety Six National Historic Site (NISI) there is a long history of human influence. Roads, trails, visitor use, and adjacent land use all affect the park and provide means of introducing and moving invasive species into and throughout the park. The Cumberland Piedmont Inventory and Monitoring Network (CUPN) assists Ninety Six National Historic Site with documenting invasive species through the implementation of an Invasive Species Early Detection (ISED) plan, detecting new invasive species populations in the park that are small and treatable, and disseminating the relevant information to the park's managers. If species are in the early stages of establishment, the costs of eradication are low and ecological damage can be minimized. When the ISED plan was implemented in 2014, a list of early detection species was created for the park and distributed to the park and CUPN staff. A field species identification guide was also created for the park at that time (Figure 1). From 2016–2019, the network annually updated the park's early detection list, utilizing presence and

location information from various sources including EDDMapS (Early Detection Distribution and Mapping Services, <https://www.eddmaps.org>), CUPN's forest vegetation monitoring (<https://www.nps.gov/im/cupn/forest-vegetation.htm>), and iNaturalist (<https://www.inaturalist.org>). See Table 1 for Ninety Six National Historic Site's 2019 invasive species early detection list.

Table 1. 2019 Invasive species early detection list for Ninety Six National Historic Site.

Scientific Name	Common Name
<i>Najas minor</i>	Brittleleaf naiad
<i>Nandina domestica</i>	Sacred bamboo
<i>Ardisia crenata</i>	Coral ardisia
<i>Carduus nutans</i>	Musk thistle
<i>Lonicera maackii</i>	Amur honeysuckle
<i>Lonicera tatarica</i>	Tatarian honeysuckle
<i>Pyrus calleryana</i>	Callery pear (Bradford pear)
<i>Lycorma delicatula</i>	Spotted lanternfly

Partnership with iNaturalist

In April 2015, the NPS and the California Academy of Sciences entered into a cooperative agreement that allows the NPS to use iNaturalist as a valuable information collection tool. iNaturalist is a user-friendly mobile application that allows anyone to record, photograph, and

JAPANESE CLIMBING FERN

Lygodium japonicum (Thunb.) Sw.



Fig. 1 UGA 5005022

Problem: Native to east Asia and Australia, Japanese climbing fern (JCF) was introduced to Florida as an ornamental plant in 1932.^{3,5} JCF forms dense ground mats that outcompete native vegetation and prevent germination of native plants.³ It also climbs trees creating "fire ladders" that carry fire upwards to scorch and damage tree and shrub canopies.⁵ In extreme situations shrub and canopy vegetation are shaded-out and displaced.^{3,4}

Habit: Perennial;⁷ climbing and twining, deciduous, viney⁷ fern.⁴

Reproduction: Wind and water-dispersed spores;^{3,4,5} vegetatively by rhizomes;^{1,6} self fertilizing.^{4,6}

Leaves (fronds): Opposite, divided into pinnae, ~18 to 23 cm (7 to 9 in) long,¹ triangular in outline (Fig. 2);⁵ articulate stalked (leaving wiry stalks when blade detached);³ each pinna is further divided into 2 to 3 leaflets or pinnules

(twice compound), hairy below with short curved hairs,² terminal lobes often dissected;³ fronds feathery in appearance (Fig. 3).⁶ light green turning tan to dark brown in winter.^{5,6}



Fig. 3

UGA 2122082



Fig. 4

UGA 1346033

Stems (rachises): Wiry, green to straw-colored or reddish, difficult to break;⁵ to 30 m (~100 ft).^{3,5}

Flowers (sporangia): Fertile pinnae with 2 rows of 4 to 8 sporangia (spore producing structures) along the margins (Fig. 4);^{1,3} the lobed edges are often curled under to partially cover the sporangia.³

Fruits/Seeds: Summer to fall; tiny spores.⁵

Habitat: Moist soils in sun or shade;^{3,6} edges of roadsides, water bodies, and woods,³ highway rights-of-way and open timber stands and plantations.⁵

Similar Species: Non-native Old World Climbing fern [*Lygodium microphyllum* (Cav.) R. Br.]' (OWCF) has unlobed, oblong leaflets that are glabrous or smooth and stalked (Fig. 5).^{3,6} American climbing fern [*L. palmatum* (Bernh.) Sw.]' (ACF) is distinguished by 4 to 7 palmately lobed finger-like fronds (Fig. 6).³ ACF does not spread to form extensive infestations like the non-native OWCF and JCF.⁵



Fig. 5

UGA 1461105

Fig. 6

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Figure 1. Field identification card for Japanese climbing fern (*Lygodium japonicum*) at Ninety Six National Historic Site.

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share nature observations instantly online. It is a very useful tool for obtaining information on invasive species detections within the park. iNaturalist can also assist with species identification through an algorithm based on images and location information, as well as allowing users with relevant expertise to identify species.

In 2018 the network began utilizing iNaturalist to collect data on non-native plant and animal observations by the public within all CUPN parks. A “project” containing observations for the network was created and can be found at <https://www.inaturalist.org/projects/nps-cumberland-piedmont-network-invasive-species> (Figure 2). Each species observation includes observation date, location, image(s), and other relevant information useful to park managers. Through this project, the network can download and manage non-native species observation data for all network parks and review, verify, and report observations new-to-park species and treatable populations of established invasive species for each park on an ongoing basis.



Figure 2. Banner for NPS Cumberland Piedmont Network Invasive Species iNaturalist project.

Results

New-to-Park Species Found through 2020

Figure 3 lists the number of new non-native species detections through 2020 at each CUPN park. At Ninety Six National Historic Site, 26 non-native species new to the park's list have been found through 2020, tying with Little River Canyon National Preserve for the most species in all CUPN parks. Many of these species are common in fields, lawns, and disturbed areas, and have likely been in the park for some time but not yet made it onto the park's official species list in NPSpecies. Most of the new species were documented as observations on iNaturalist. Two are ranked by the network as high-priority invasive species. This means they are highly invasive in CUPN parks, very common across CUPN forest vegetation monitoring plots, and should be targeted for removal if found in an early detection setting. Several are listed in South Carolina's 2014 state invasive plants list (https://www.se-eppc.org/southcarolina/SCEPPC_LIST2014finalOct.pdf).

1. Swordfern (*Macrothelypteris torresiana*) was found in 2011 by CUPN forest vegetation monitoring crews. It is becoming increasingly invasive in CUPN parks but is not a CUPN high-priority invasive species or listed in South Carolina (yet).
2. Wych elm (*Ulmus glabra*) was first found in 2011 by CUPN vegetation monitoring crews. It is not invasive and is not a CUPN

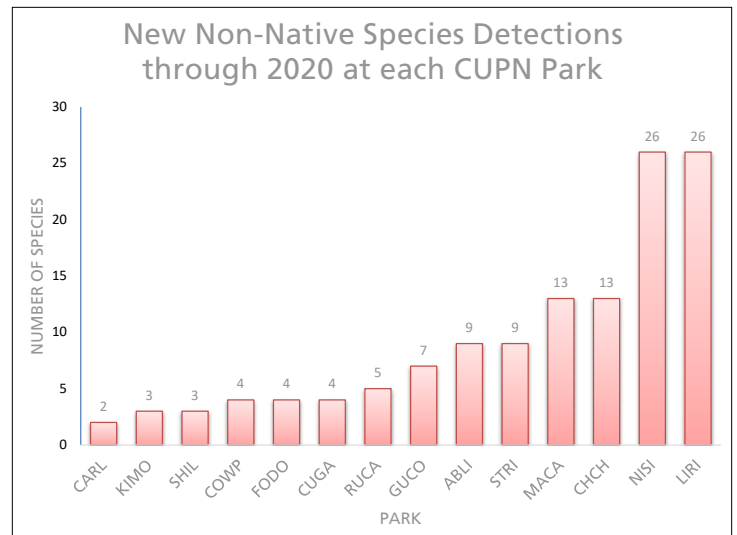


Figure 3. Number of new non-native species detections through 2020 at each CUPN park.

high-priority invasive species or listed in South Carolina.

3. Callery pear (*Pyrus calleryana*) was first found and treated in 2014 by NPS Invasive Plant Management Teams (IPMTs). It is a CUPN high-priority invasive species, listed as a significant threat in South Carolina, and is continuously treated at the park by IPMTs.
4. Heavenly bamboo (*Nandina domestica*) was found and treated in 2014 by NPS IPMTs. It is a CUPN high-priority invasive species and listed as a significant threat in South Carolina.
5. Amur honeysuckle (*Lonicera maackii*) was found and treated in 2014 by NPS IPMTs. It is a CUPN high-priority invasive species and listed as an alert species in South Carolina.
6. Tatarian honeysuckle (*Lonicera tatarica*) was found and treated in 2015 by NPS IPMTs. It is not a CUPN high-priority invasive species or listed in South Carolina. It may have been confused with another non-native honeysuckle, found primarily in the northern United States but not known from South Carolina.
7. Christmas berry (*Ardisia crenata*) was first found and treated in 2015 by NPS IPMTs. It can be invasive but is not a CUPN high-priority invasive species and not listed in South Carolina.
8. Chinese yam (*Dioscorea polystachya*) was found in 2016 by a public citizen and an observation was made on iNaturalist (see <https://www.inaturalist.org/observations/5290116>). It is a CUPN high-priority species and a significant threat in South Carolina.
9. Musk thistle (*Carduus nutans*) was first found in 2016 by a NISI park volunteer (see <https://www.inaturalist.org/observations/3279035>). It is not a CUPN high-priority invasive species but is listed as a significant threat in South Carolina.
10. Erect cinquefoil (*Potentilla recta*) was first found in 2016 by a NISI park volunteer (see <https://www.inaturalist.org/observations/6152373>). It is common in open and disturbed areas. It is not a CUPN high-priority species or listed in South

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Carolina.

11. Deptford pink (*Dianthus armeria*) was first found in 2016 by a NISI park volunteer (see <https://www.inaturalist.org/observations/3279051>). It is common in open fields and roadsides. It is not a CUPN high-priority species or listed in South Carolina.
12. English ivy (*Hedera helix*) was found in 2017 by CUPN forest vegetation monitoring crews. It is a CUPN high-priority invasive species and is ranked as a severe threat in South Carolina.
13. Japanese climbing fern (*Lygodium japonicum*) was found in 2017 by an NISI park volunteer and an observation was also made on iNaturalist (see <https://www.inaturalist.org/observations/8508725>). It is not a CUPN high-priority invasive species but is listed as a severe threat in South Carolina.
14. Japanese privet (*Ligustrum japonicum*) was found in 2017 by NPS IPMTs. It is not a CUPN high-priority invasive species but is listed as a significant threat in South Carolina.
15. Crimson clover (*Trifolium incarnatum*) was found in 2017 by a NISI park employee and an observation was made on iNaturalist (see <https://www.inaturalist.org/observations/5677225>). It is common in open fields and pastures. It is not a CUPN high-priority species or listed in South Carolina.
16. Japanese mazus (*Mazus pumilus*) was found in 2017 by a public citizen and an observation was made on iNaturalist (see <https://www.inaturalist.org/observations/5234331>). It is common in disturbed areas and is not a CUPN high-priority species or listed in South Carolina.
17. Lesser periwinkle (*Vinca minor*) was found in 2017 by a NISI park employee and an observation was uploaded to iNaturalist (see <https://www.inaturalist.org/observations/5233303>). It is a CUPN high-priority species and is listed as a significant threat in South Carolina.
18. Bridalwreath spiraea (*Spiraea prunifolia*) was found in 2017 by a public citizen and an observation was made on iNaturalist (see <https://www.inaturalist.org/observations/5139499>). It is not invasive and is not a CUPN high-priority species or listed in South Carolina.
19. Paraguayan purslane (*Portulaca amilis*) was found in 2017 by a public citizen and an observation was made on iNaturalist (see <https://www.inaturalist.org/observations/7277127>). It is common on roadsides and other disturbed areas. It is not a CUPN high-priority species or listed in South Carolina.
20. Asiatic dayflower (*Commelina communis*) was first found in 2017 by a NISI park employee and an observation was made on iNaturalist (see <https://www.inaturalist.org/observations/6467585>). It is common in wet forest edges. It is not a CUPN high-priority species or listed in South Carolina.



Amur honeysuckle (*Lonicera maackii*) infestation in a forest understory (photo courtesy of Chris Evans, University of Illinois, and Bugwood.org).

21. Orange day-lily (*Hemerocallis fulva*) was found in 2017 by a NISI park volunteer and an observation was uploaded to iNaturalist (see <https://www.inaturalist.org/observations/7012728>). It is very common along roadsides and ditches. It is not a CUPN high-priority species or listed in South Carolina.
22. Small carpetgrass (*Arthraxon hispidus*) was found in 2017 by a public citizen and an observation was uploaded to iNaturalist (see <https://www.inaturalist.org/observations/8375260>). It is common in wet areas. It is not a CUPN high-priority species or listed in South Carolina.
23. Vasey grass (*Paspalum urvillei*) was found in 2017 by a public citizen and an observation was uploaded to iNaturalist (see <https://www.inaturalist.org/observations/7298682>). It is invasive in grassland and riparian habitats. It is not a CUPN high-priority species but is listed as a significant threat in South Carolina.
24. Grape hyacinth (*Muscari neglectum*) was first found in 2017 by a NISI park employee and an observation was made on iNaturalist (see <https://www.inaturalist.org/observations/5204866>). It is not invasive and is not a CUPN high-priority invasive species or listed in South Carolina.
25. Bird's-eye speedwell (*Veronica persica*) was first found in 2017 by a NISI park employee and an observation was made on iNaturalist (see <https://www.inaturalist.org/observations/5089532>). It is primarily invasive in disturbed open areas but is not a CUPN high-priority invasive species or listed in South Carolina.
26. White mulberry (*Morus alba*) was found in 2019 by a NISI park employee and an observation was uploaded to iNaturalist (see <https://www.inaturalist.org/observations/24441738>). It is not a CUPN high-priority species but is listed as a significant threat in South Carolina.

Invasive Species Treatments

Ninety Six National Historic Site is a small park with limited management resources so it utilizes NPS Invasive Plant Management Teams (IPMTs) to treat invasive species populations. The IPMTs come to the park once per year. Park staff occasionally treat invasive species as well. Based on available data from 2015–2019, the following species were treated at Ninety Six National Historic Site:

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1. Amur honeysuckle (*Lonicera maackii*) was treated in 2014.
2. Tatarian honeysuckle (*Lonicera tatarica*) was treated in 2015.
3. Kudzu (*Puereria montana*) was treated in 2016, 2017, and 2018.
4. Chinese privet (*Ligustrum sinense*) was treated in 2016, 2017, 2018, and 2019.
5. Christmas berry (*Ardisia crenata*) was treated in 2015 and 2017.
6. Heavenly bamboo (*Nandina domestica*) was treated in 2017.
7. Callery pear (*Pyrus calleryana*) was treated in 2014, 2017, 2018, and 2019.
8. Autumn olive (*Elaeagnus umbellata*) was treated in 2017 and 2019.
9. Japanese honeysuckle (*Lonicera japonica*) was treated in 2016, 2017, and 2019.

10. Japanese wisteria (*Wisteria floribunda*) was treated in 2016, 2017, and 2018.
11. Japanese privet (*Ligustrum japonicum*) was treated in 2017.
12. Multiflora rose (*Rosa multiflora*) was treated in 2016, 2017, 2018, and 2019.
13. Bull thistle (*Cirsium vulgare*) was treated in 2017, 2018, and 2019.

Next Steps

- Invasive Species Early Detection Plan (ISED) update: the network will be substantially revising the ISED plan in FY2021, focusing on utilizing the project in iNaturalist as the main method of collecting ISED data.
- Data release: the network will provide the park with ISED data collected through 2020.
- Data monitoring: the network will ensure data from the iNaturalist project are routinely reviewed, verified, and provided to park managers as quickly as possible.

About the Cumberland Piedmont Network

In 1999, the National Park Service initiated a long-term ecological monitoring program, known as “Vital Signs Monitoring,” to provide the minimum infrastructure to allow more than 270 national park system units to identify and implement long-term monitoring of their highest-priority measurements of resource condition. The overarching purpose of natural resource monitoring in parks is to develop scientifically sound information on the current status and long-term trends in the composition, structure, and function of park ecosystems, and to determine how well current management practices are sustaining those ecosystems.

- The NPS Vital Signs Monitoring Program addresses five goals for all parks with significant natural resources:
- Determine the status and trends in selected indicators of the condition of park ecosystem,
- Provide early warning of abnormal conditions,
- Provide data to better understand the dynamic nature and condition of park ecosystems,
- Provide data to meet certain legal and congressional mandates, and
- Provide a means of measuring progress towards performance goals.

The Cumberland Piedmont Inventory and Monitoring Program is comprised of 14 national park units with diverse cultural and natural resources distributed across eight states (Alabama, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia) and six different physiographic regions.

The objectives for Cumberland Piedmont Network are centered around monitoring aquatic, cave, and terrestrial ecosystems at these parks. The network works closely with each park’s natural resource program to develop and implement long-term monitoring and provide sound scientific information to park managers.

About the NPS Inventory & Monitoring Division:

<https://www.nps.gov/im/index.htm>

Data Downloads via the Natural Resource Information Portal:

<http://irma.nps.gov>

CUPN Home Page:

<https://www.nps.gov/im/cupn/index.htm>

CUPN Reports & Publications:

<https://www.nps.gov/im/cupn/reports-publications.htm>

CUPN Invasive Species Early Detection (ISED) Page:

<https://www.nps.gov/im/cupn/invasive-species.htm>

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