



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 Mammoth Cave National Park (MACA) 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 Mammoth Cave National Park 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 Mammoth Cave National Park's 2019 invasive species early detection list.

Table 1. 2019 Invasive species early detection list for Mammoth Cave National Park.

Scientific Name	Common Name
<i>Euonymus fortunei</i>	Winter creeper
<i>Euonymus alatus</i>	Winged burning bush
<i>Lonicera maackii</i>	Amur honeysuckle
<i>Pyrus calleryana</i>	Callery/Bradford pear
<i>Agrilus planipennis</i>	Emerald ash borer

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 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.

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[*Agrilus planipennis* Fairmaire]




Fig. 1 UGA1241011 Fig. 2 UGA 5016058

Problem: A native of Asia,^{1,2,4} emerald ash borer (EAB) infests and kills North American ash species (*Fraxinus* sp.) including green, white, black and blue ash. Damage is caused by the larvae, which feed in the cambium between the bark and wood, producing galleries that eventually girdle and kill branches and entire trees.^{1,2}

Identification: Adults are roughly 7.5 to 13.5 mm long (¾ to ½ in)^{3,5} with metallic green wing covers (Fig. 1) and a coppery red or purple abdomen (Fig. 2).^{3,4} Larvae reach a length of 26 to 32 mm long (1 to 1 ¼ in),³ are white to cream-colored and dorso-ventrally flattened.²

Signs and Symptoms: Irregular holes excavated by woodpeckers feeding on pre-pupal larvae (Fig. 3) may be the first sign of infestation.^{1,2} After at least one year of infestation, D-shaped exit holes (3–4 mm in diam., ~½ in.) in the outer bark of the branches and trunk (Fig. 4) indicate adult emergence.^{1,2} Adults may be visible from late May through September,³ but are most common in June and July.^{2,3} Vertical bark fissures (Fig. 5), crown dieback (Fig. 6) and epicormic




Fig. 3 UGA 1372003 Fig. 4 UGA 1523072




Fig. 5 UGA 5016053 Fig. 6 UGA 1301042

sprouting and suckering are also prevalent.^{1,2} When the bark is removed from infested trees, distinct, larval tunnels or galleries that etch the outer sapwood and phloem are readily visible on the trunk and branches (Fig. 7).²



Fig. 7 UGA 5147090



Fig. 9 UGA 5016041



Fig. 10 UGA 5022085

Similar Species: Adult EAB beetles are generally larger and a brighter green than native North American species of *Agrilus*,⁴ like the bronze birch borer.³ The six-spotted tiger beetle and caterpillar hunter are larger in size, are both predators of other insects, and are ground dwelling.³



Fig. 8 UGA 2133022

Above (Fig. 8): six-spotted tiger beetle *Cicindela sexguttata* Fabricius

Upper left (Fig. 9): bronze birch borer *Agrylus anxius* Gory

Lower left (Fig. 10): caterpillar hunter *Calosoma scrutator* Fabricius

Figure 1. Field identification card for emerald ash borer (*Agrilus planipennis*) at Mammoth Cave National Park.

Overview and Background Continued

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 Mammoth Cave National Park, 13 non-native species have been found through 2020 that are new to the park’s list, some are considered invasive. Several of these species are ranked by CUPN as high-priority invasive species. 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. Many are also listed in Kentucky’s 2013 state list of Exotic Invasive Plants (https://www.se-eppc.org/ky/KYEPPC_2013list.pdf). For species observed within the past few years, many were documented on iNaturalist.

1. European privet (*Ligustrum vulgare*) was found in 2014 by CUPN forest vegetation monitoring crews. It is not a CUPN high-priority species but is listed as a severe threat in Kentucky.
2. Common reed (*Phragmites australis*) was first found in 2015 by CUPN forest vegetation monitoring crews in a wetland area near Sloan’s Pond. The population was treated by NPS Invasive Plant Management Teams (IPMTs) but continues to survive. It is not a CUPN high-priority species but is listed as a severe threat in Kentucky.
3. Winged burning bush (*Euonymus alatus*) was first found in 2014 by the Nature Conservancy (TNC). It was probably widespread in the park but was not officially documented within the park boundary until then. It is a CUPN high-priority invasive species

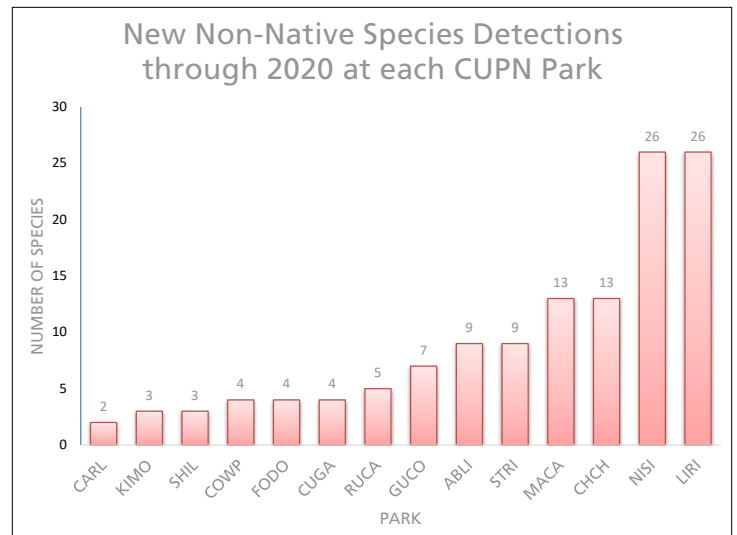


Figure 3. Number of new non-native species detections through 2020 at each CUPN park.

and is listed as a severe threat in Kentucky. A large individual was documented in October 2020 in Cedar Sink, and an observation was made in iNaturalist (see <https://www.inaturalist.org/observations/62047057>). The individual and its offspring were treated and removed by MACA park staff.

4. Callery pear (*Pyrus calleryana*; Figure 4) was first found in 2011 by NPS IPMTs and have been found in more locations since. Some individuals have been treated and removed by MACA Science and Resource Management (S&RM). It is a CUPN high-priority species and is ranked as a severe threat in Kentucky. Several observations have been made of the species in iNaturalist (see <https://www.inaturalist.org/observations/29522756>).
5. Rose-of-Sharon (*Hibiscus syriacus*) was found in 2015 by MACA staff. It is not a CUPN high-priority species but is listed on Kentucky’s list as a “watch” species. It has not been observed or well-documented in Kentucky, but has invaded native plant communities in neighboring states.
6. Bridalwreath spiraea (*Spiraea prunifolia*) was first found in 2014 by Kentucky State Nature Preserves ecologists. It is a common landscape plant that is clonal but invasive. It is not a CUPN high-priority species or listed in Kentucky.
7. Amur honeysuckle (*Lonicera maackii*) was first found in 2018 by a public citizen and an observation was made in iNaturalist (see <https://www.inaturalist.org/observations/12301866>). A separate population was observed in 2019 and has since been treated and removed by MACA S&RM (see <https://www.inaturalist.org/observations/23064349>). It is a CUPN high-priority species and is ranked as a severe threat in Kentucky.
8. White mulberry (*Morus alba*) was found in 2018 by CUPN forest vegetation monitoring crews. It is not a CUPN high-priority species but is listed as a significant threat in Kentucky.

Results Continued

9. Mariana maiden fern (*Macrothelypteris torresiana*) was first found in 2018 by a public citizen and an observation was made on iNaturalist (see <https://www.inaturalist.org/observations/29052196>). Additional populations were observed within the park boundary on iNaturalist. It is an increasingly invasive fern. It is not a CUPN high-priority species or listed in Kentucky (yet).
10. Grey field-speedwell (*Veronica polita*) was found in 2019 by two public citizens and observations made on iNaturalist for both (see <https://www.inaturalist.org/observations/21719630> and <https://www.inaturalist.org/observations/22098626>). It is a common weed in open areas and lawns. It is not a CUPN high-priority species or listed in Kentucky.
11. Fortune's holly-fern (*Cyrtomium fortunei*) was found in 2020 and an observation was made in iNaturalist (see <https://www.inaturalist.org/observations/58858422>). Most of the plants in the population were pulled by MACA staff, but some remain. It is not highly invasive and is not a CUPN high-priority species or listed in Kentucky.
12. Silverleaf cinquefoil (*Potentilla argentea*) was found in 2020, and an observation was made on iNaturalist (see <https://www.inaturalist.org/observations/40985806>). It is naturalized in many areas of the northern United States. It is not a CUPN high-priority species or listed in Kentucky.
13. Liriope (*Liriope muscari*) was found in 2020, and an observation was made on iNaturalist (see <https://www.inaturalist.org/observations/58532238>). It is naturalized across much of the eastern United States. It is not a CUPN high-priority species or listed in Kentucky.

Invasive Species Treatments

Mammoth Cave National Park utilizes the expertise of the NPS Invasive Plant Management Teams (IPMTs), the Nature Conservancy (TNC), and park natural resource staff to treat invasive species populations. Based on available data from 2002–2020, the following species have been treated at the park by IPMTs, TNC, and MACA park staff:

1. Japanese honeysuckle (*Lonicera japonica*)
2. bull thistle (*Cirsium vulgare*)
3. Callery/Bradford pear (*Pyrus calleryana*; Figure 4)
4. johnsongrass (*Sorghum halepense*)
5. sericea lespedeza (*Lespedeza cuneata*)
6. princess tree (*Paulownia tomentosa*)
7. beefsteakplant (*Perilla frutescens*)
8. garlic mustard (*Alliaria petiolata*)
9. lesser burdock (*Arctium minus*)



Figure 4. Large Callery pear tree (*Pyrus calleryana*) in a field at Mammoth Cave National Park in July 2019. Photo by Clare Bledsoe from iNaturalist (<https://www.inaturalist.org/observations/29522756>).

10. non-native fescues (*Festuca* spp.)
11. Chinese yam (*Dioscorea polystachya*)
12. tree-of-heaven (*Ailanthus altissima*; Figure 5)
13. multiflora rose (*Rosa multiflora*)
14. white poplar (*Populus alba*)
15. kudzu (*Pueraria montana*)
16. common reed (*Phragmites australis*)
17. Japanese/Chinese wisterias (*Wisteria* spp.)
18. oriental bittersweet (*Celastrus orbiculatus*)
19. Chinese privet (*Ligustrum sinense*)
20. autumn olive (*Elaeagnus umbellata*)
21. winged burning bush (*Euonymus alatus*)
22. silktree mimosa (*Albizia julibrissin*)
23. crown vetch (*Securigera varia*)
24. yellow sweetclover (*Melilotus officinalis*)
25. Nepalese browntop (*Microstegium vimineum*)
26. spotted knapweed (*Centaurea stoebe*)
27. giant foxtail (*Setaria faberi*)
28. lesser periwinkle (*Vinca minor*)
29. common mullein (*Verbascum thapsus*)
30. rose-of-sharon (*Hibiscus syriacus*)
31. fortune's holly-fern (*Cyrtomium fortunei*)
32. mariana maiden fern (*Macrothelypteris torresiana*)

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.



Figure 5. A MACA employee alongside a large cut and treated stump of tree-of-heaven (*Ailanthus altissima*) in 2007. NPS photo.

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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