STOP THE INVASION
PROTECT NEW YORK FROM INVASIVE SPECIES

NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation | Agriculture and Markets | Parks, Recreation and Historic Preservation

SPOTTED LANTERNFLY

Lycorma delicatula

What is the spotted lanternfly?

The spotted lanternfly (SLF) is an invasive pest from Asia that primarily feeds on tree of heaven (*Ailanthus altissima*) but can also feed on a wide variety of plants such as grapevine, hops, maple, walnut, fruit trees and others. This insect could impact New York's forests as well as the agricultural and tourism industries**.**

Identification

Nymphs are black with white spots and turn red before transitioning into adults. They can be seen as early as April. Adults begin to appear in July and are approximately 1 inch long and ½ inch wide at rest, with eye-catching wings. Their forewings are grayish with black spots. The lower portions of their hindwings are red with black spots, and the upper portions are dark with a white stripe. In the fall, adults lay 1-inch-long egg masses on nearly anything from tree trunks and rocks to vehicles and firewood. They are smooth and brownish-gray with a shiny, waxy coating when first laid.

Adult spotted lanternfly
Lawrence Barringer, Pennsylvania Department of Agriculture, Bugwood.org

Where are they located?

SLF were first discovered in Pennsylvania in 2014 and have since been found in New Jersey, Delaware and Virginia. As of spring 2018, New York has no infestations, though it's possible they are present in low numbers and have not been detected yet. Given the proximity of the Pennsylvania infestation, it is expected to be found in New York eventually.

What is the risk to NYS?

SLF pose a significant threat to New York's agricultural and forest health. Adults and nymphs use their sucking mouthparts to feed on the sap of more than 70 plant species. Feeding by sometimes-thousands of SLF stresses plants, making them vulnerable to disease and attacks from other insects. SLF also excrete large amounts of sticky "honeydew," which attracts sooty molds that interfere with plant photosynthesis, negatively affecting the growth and fruit yield of plants. New York's annual yield of apples and grapes, with a combined value of $358.4 million, could be impacted if SLF enters New York. The full extent of economic damage this insect could cause is unknown at this time.

Spotted lanternfly nymph
Lawrence Barringer, Pennsylvania Department of Agriculture, Bugwood.org

Although native insects also secrete honeydew, the size of SLF and the large populations that congregate in an area result in large accumulations of it. The sticky mess and the swarms of insects it attracts can significantly hinder outdoor activities. In Pennsylvania, where SLF populations are the densest, people can't be outside without getting honeydew on their hair, clothes, and other belongings.

How do they spread to new areas?

While SLF can jump and fly short distances, they spread primarily through human activity. They often hitch rides to new areas when they lay their eggs on vehicles, firewood, outdoor furniture, stone, etc. and are inadvertently transported long distances.

New (left) and old (right) egg masses
Kenneth R. Law, USDA APHIS PPQ, Bugwood.org

What are the signs of an infestation?

- Sap oozing or weeping from tiny open wounds on tree trunks, which appears wet and may give off fermented odors.
- One-inch-long egg masses that are brownish-gray, waxy and mud-like when new. Old egg masses are brown and scaly.
- Massive honeydew build-up under plants, sometimes with black sooty mold.

What is being done?

DEC is working with the NYS Department of Agriculture and Markets and the US Department of Agriculture to address SLF. Since it is less expensive and easier to deal with a pest before it becomes widespread, the goal is to find SLF early or prevent it from entering NY altogether.

A plan has been developed that describes how the agencies will prevent and detect SLF in New York. Extensive trapping surveys will be conducted in high-risk areas throughout the state as well as inspections of nursery stock, stone shipments, commercial transports, etc. from Pennsylvania. DEC and partner organizations encourage everyone to be on the lookout for this pest.

Wounds from SLF feeding are too small to spot without sap oozing out of them.
Pennsylvania Department of Agriculture, Bugwood.org

What can I do?

- Learn how to identify SLF.
- Inspect outdoor items such as firewood, vehicles, and furniture for egg masses.
- If you visit states with SLF, be sure to check all equipment and gear before leaving. Scrape off any egg masses. Visit www.agriculture.pa.gov for more information on SLF in PA.

If you believe you have found SLF in New York…

- Take pictures of the insect, egg masses and/or infestation signs as described above (include something for scale such as a coin or ruler).
- Note the location (address, intersecting roads, landmarks or GPS coordinates).
- Email the information to DEC (see below).
- Report the infestation to iMapInvasives at www.NYiMapInvasives.org.

Swarm of lanternflies on a tree
Lawrence Barringer, Pennsylvania Department of Agriculture, Bugwood.org

CONTACT INFORMATION

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Tree-of-Heaven

Ailanthus altissima

Origin: China & Taiwan

Introduction: 1784 (Philadelphia, PA)

Propagation: Through seed and via root sprouts; trees are capable of producing millions of seeds, and lateral roots can spread up to 90 ft from the parent trunk.

Dispersal: Seeds are dispersed by wind, water, and human activity.

Persistence: None

Life Cycle: Perennial

Description: A medium-to-large, deciduous, dioecious tree; stems and twigs are green-to-reddish brown and smooth where not covered in conspicuous lenticels; **trunks** feature thick, corky bark; **leaves**, which give off an offensive odor when crushed, are pinnately compound, with 10-40 lanceolate leaflets, each entire except for 2-4 distinctive rounded teeth near the base with 1-2 protruding glandular bumps; small, 5-petaled, yellow-to-red **flowers** borne in large panicles; **fruits** are samaras containing a single seed, turning an orange-to-pinkish color when mature.

Phenology: Plants generally break dormancy in April. Flowers bloom in June and July. Fruits mature from August to October; most seeds are dispersed in October and November, though some are retained and disperse through winter. Trees senesce in November.

Habitat: Urban areas, roadsides and right-of-ways, disturbed sites, grasslands, forest edges and openings, wetlands and riparian areas.

Look-alikes: Sumac species *(Rhus),* walnut and butternut *(Juglans),* and hickory species *(Carya).*

ECOLOGICAL IMPACTS

Tree-of-heaven grows and reproduces rapidly, forming dense root systems that choke out native plant species. These trees are extremely prolific seed producers and seeds are often dispersed in clumps, creating dense stands of seedlings. Tree-of-heaven also exudes allelopathic chemicals from its roots, which prohibits the growth of other plants. It is the preferred host tree of the spotted lanternfly, an emerging forest & agricultural pest that poses a serious threat to the wine & fruit industries.

INTEGRATED MANAGEMENT OPTIONS

Mechanical: Seedlings can be **pulled**, preferably when soil is moist; be sure to remove the entire root system. Cutting/mowing is not recommended, as doing so will stimulate roots to sprout, leading to a rapid & substantial increase in stem density. **Felling** large trees must always be combined with an herbicide treatment prior to cutting to kill root systems, which will otherwise undergo vigorous resprouting. Be mindful of the fact that removing any amount of forest canopy will alter the site in ways that make it more vulnerable to colonization by other invasive plant species. Long-term monitoring of such sites will likely be necessary until the canopy closes. Sweetgum *(Liquidambar styraciflua)* & sycamore *(Platanus occidentalis)* compete well with tree-of-heaven and can be grown to shade-out treatment sites.

Chemical: Apply a **broad-spectrum systemic herbicide** in mid-to-late summer as a foliar spray or using **basal bark method** (the cut-stem method is not recommended, as cutting triggers vigorous root sprouting in this species). Apply as a foliar spray on dense patches to kill off small plants, then apply herbicide to remaining trees and saplings as a basal bark spray during dry conditions from July through mid-October. For best results, make a deep cut before applying herbicide to stems. Wait at least 2 months after applying herbicide to fell trees. Note that broad-spectrum herbicides are nonselective and will also kill desirable plant species. Read labels and instructions thoroughly, follow all applicable laws and regulations, and wear protective gear when using herbicides. Monitor sites and repeat treatments annually until root systems have been exhausted.

Biological: A native vascular wilt fungus, *Verticillium nonalfalfae,* and a host-specific Asian weevil, *Eucryptorrhyncus brandti,* are currently being evaluated for use as biocontrol agents.

WINTER	SPRING
Broadcast sow treated sites with native seeds. Fell treated trees if necessary.	Pull seedlings when soil is moist. Plant sweetgum and sycamore saplings.
SUMMER	**FALL**
Apply herbicide as a foliar spray and/or using the basal bark method during active growth, from July through mid-October.	Apply herbicide no later than mid-October. Wait at least 2 months after treatment to fell trees. Plant sweetgum and sycamore saplings.

Mile-a-Minute Weed

Persicaria perfoliata

Origin: Eastern Asia

Introduction: Mid-1930s (Pennsylvania)

Propagation: Plants produce 10s to 1000s of seeds; shading decreases seed production.

Dispersal: Seeds are dispersed by frugivorous birds, mammals, ants, and by water, as fruits are quite buoyant.

Persistence: Seeds viable up to 7 years.

Life Cycle: Usually an annual.

Description: A glaucous, branching, herbaceous vine often found growing in thick mats; **stems** are green or reddish in color and covered in recurved spines, with conspicuous rounded leaf sheaths subtending each node; **leaves** are light green and decidedly triangular, with recurved spines on petioles and on the undersides of major leaf veins; small, white, inconspicuous **flowers** in terminal spikes; **fruits** are bright blue, iridescent, round, berrylike, and fleshy, each containing a single seed.

Phenology: Plants emerge in late March or April. Flowering occurs from early June through July. Fruits develop from mid-July through August and mature from September to November. Plants die in October after one or more frosts.

Habitat: Abandoned fields, grasslands, roadsides and right-of-ways, disturbed sites, forest edges & openings, wetlands, & riparian areas.

Look-alikes: Arrowhead tearthumb *(Persicaria sagittata),* halberd-leaf tearthumb *(Persicaria arifolia)*, and bindweed species *(Convolvulus).*

ECOLOGICAL IMPACTS

Mile-a-minute weed is an herbaceous vine that can grow up to 6 inches per day. It forms dense mats of tangled vines that overtop trees, shrubs, and herbaceous plants, smothering them with a dense, heavy carpet of foliage, reducing native plant diversity and abundance and degrading wildlife habitat. This vine is so aggressive that it is even capable of killing Japanese honeysuckle stands.

INTEGRATED MANAGEMENT OPTIONS

Mechanical: Mile-a-minute weed has a shallow root system; small populations can be destroyed with a **hoe** or **pulled** in early spring before spines harden (be sure to wear gloves). **Mowing** and **cutting** are very effective methods of controlling this species; cut multiple times over the growing season to prevent flowering and fruiting. Repeat treatments annually until the seed bank has been exhausted.

Chemical: A **broad-spectrum systemic herbicide** can be applied as a **foliar spray** in early spring when native plants are still dormant. Note that broad-spectrum herbicides are non-selective and will also kill desirable plant species. For extensive or long-term invasions, apply a **pre-emergent herbicide** to prevent seeds from germinating in the spring. A permit is usually required to apply herbicides in wetland and riparian areas. Read labels and instructions thoroughly, follow all applicable laws and regulations, and wear protective gear when using herbicides. Chemical treatments are most effective when combined with mechanical methods. Repeat treatments annually as necessary.

Biological: Managed **grazing** using **goats** or **sheep** has a similar effect to mowing. The Asiatic stem-boring weevil *(Rhinocomimus latipes)* has been approved for use as an **insect biocontrol** and feeds exclusively on Mile-a-minute weed.

WINTER	SPRING
Broadcast sow treated sites with seeds of native species **or** treat with a pre-emergent herbicide.	Begin grazing or mowing. Pull small patches and isolated plants. Release weevils **or** apply herbicide as a foliar spray.
SUMMER	**FALL**
Continue grazing or mowing. Pull small patches and isolated plants. Release weevils.	Broadcast sow native seed over treated sites.

Japanese angelica tree
(*Aralia elata (Miq.) Seem.*)

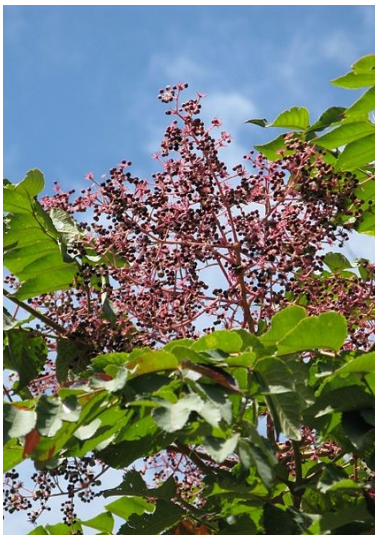
CRISP
Catskill Regional Invasive Species Partnership

Brief General Description:

Native to Eastern Russia, China, Korea, and Japan, Japanese angelica tree was introduced to the US in 1830 as an garden ornamental. It has a close lookalike in our native Devil's walking stick (*Aralia spinosa*), and it is thought that the spread of Japanese angelica may be underestimated due to difficulty telling them apart.

Birds can be a major vector for spread for this plant, and can form large thickets quickly through root sprouts.

Miya.m, Wikimedia Commons



KENPEI, Wikimedia Commons

Physical ID Characteristics:

A broadleaf deciduous tree, it can grow up to 40 feet tall with many stems per one individual tree. It features the same sharp prickles and spines as the native species.

Cultivar314, flickr.com

Its alternately-growing leaves are bi– or tripinnately compound and heavily serrated. They have a hairy underside and veins running to the ends of the serrations.

Large creamy white flowers appear in panicles at the from July-August, and can be told apart from the native by terminal flower stalk length—*A. elata* has a much shorter terminal flower stalk.

Likely Habitat:

Japanese angelica tree will grow most readily in full sun to partial shade, and prefers moist, well-drained soils. Typically it can be found at wood edges, open areas, and overtopping thickets.

Management techniques:

Young plants can be cut or dug up readily. General use herbicides are also effective when applied to either foliage or as a cut-stump formulation. Simple mechanical cutting without an herbicide application can result in aggressive resprouting.

Taranoki, Wikimedia Commons

Help DEC Track Beech Leaf Disease

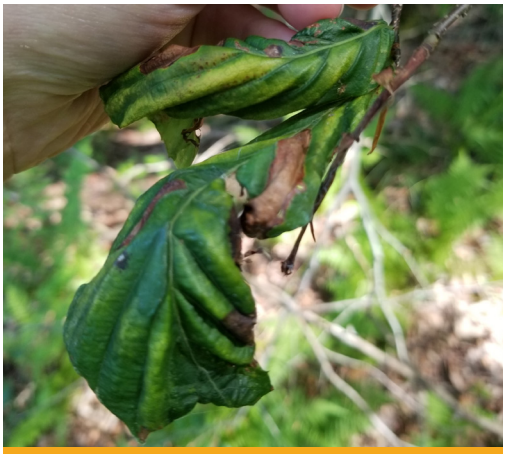
Report Sightings Using New York iMapInvasives

Beech leaf disease (BLD) can affect all beech tree species. It is associated with a nematode (worm), *Litylenchus crenatae mccannii*. BLD can kill mature beech trees in 6–10 years and young trees in as little as 2–3 years. Currently, there is no known way to manage it.

BLD has only been discovered in recent years and much about it is still unknown. DEC is collecting information on symptomatic beech trees to learn more about this disease and its distribution in New York. You can help!

What to Look For

Striping



Curling or leathery texture

Darkened stripes in canopy

BLD symptoms appear in the leaves and include striping, curling, or a leathery texture. These signs may be visible year-round, as some beech trees may hold their leaves in winter. Stripes are most noticeable on the underside of leaves and you may see them by looking up into the canopy or holding branches up to the light. Eventually, affected leaves wither, dry, and yellow.

How to Report

Download the free **iMapInvasives** app on your GPS-enabled smartphone or device. Use the app to submit a report and help us monitor BLD and other forest health issues in New York State.

If you do not have a smart device or iMap account, you can provide photos and location information to DEC at:

foresthealth@dec.ny.gov

1-866-640-0652

For more info on BLD, visit
https://www.dec.ny.gov/lands/120589.html

iMapInvasives

NEW YORK STATE | Department of Environmental Conservation

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ELM ZIGZIG SAWFLY (*Aproceros leucopoda)*

Gyorgy Csoka, Hungary Forest Research Institute, Bugwood.org

The elm zigzag sawfly is native to eastern Asia and has recently been found in Connecticut. The larvae feed upon elm (*Ulmus* spp.) leaves, which creates a "zigzag" formation that gives them their names. Damage caused by the sawfly can vary from minor to significant defoliation. Mortality from defoliation has not been observed in the US, but death of individual branches may result. Feeding may also weaken and stress elm trees.

Elm zigzag sawfly larvae are pale green with T-shaped markings on their legs and a black stripe on their head. The zigzag pattern of their feeding is diagnostic but may not be observable in later feeding stages. Entire leaves may be consumed, leaving only the veins. Larvae pupate in a silken, net-like case. The adults are black with yellow legs. Only females have been found in the US, and are able to reproduce parthenogenically, laying up to 60 eggs.

The introduction pathway is not yet known. It was first detected in Quebec in 2020 and was found in New York in 2022. Invasive insects can spread through the transport of infested plants. The adult sawfly is also capable of flying up to 56 miles a year.

Gyorgy Csoka, Hungary Forest Research Institute, Bugwood.org

Gyorgy Csoka, Hungary Forest Research Institute, Bugwood.org

Tom Macy, Ohio DNR Division of Forestry, Bugwood.org

Sources:
https://ag.umass.edu/landscape/fact-sheets/elm-zigzag-sawfly
Elm Zigzag Sawfly - SLELO PRISM

Knotweed Species

Reynoutria spp.

Origin: Eastern Asia

Introduction: Late 1800s

Propagation: Most commonly spread via root and stem fragments; plants also produce millions of seeds each year.

Dispersal: Seeds, rhizomes, and stem fragments are spread by water, wind, animals, & human activity, particularly mowing.

Persistence: Unknown; at least 1 year.

Life Cycle: Perennial

Description: A tall, semi-woody plant growing 3-15' tall; stout, hollow, ridged **stems** with reddish splotches & raised nodes superficially resemble bamboo; alternate **leaves** are broad (3-6" wide) with pointed tips & flat or heart-shaped bases; creamy-white **flowers** are borne in racemes or panicles; **fruits** are tri-winged achenes.

Phenology: Plants break dormancy in late March or early April; sprouts continue to emerge through mid-summer. Flowering occurs from June through August. Fruits begin to develop in late August, ripening in September. Leaves continue to photosynthesize until physically destroyed by multiple frost events.

Habitat: Knotweed is most often found along waterways and roadsides, where it is spread by erosion and mowers, respectively. Knotweed also commonly appears where "fill dirt" has been dumped. It easily grows through concrete and is a serious threat to infrastructure.

Look-alikes: Pokeweed *(Phytolacca americana)*; native knotweed *(Persicaria virginiana)* does not bear much resemblance to its invasive cousin.

ECOLOGICAL IMPACTS

Knotweed grows rapidly along streams, river banks, roadsides, and disturbed sites, permanently displacing native plant species through an aggressive rhizome network that can extend 65' laterally and 25' in depth. Large, course rhizomes encourage flooding & erosion, events that aid the spread of knotweed by sending rhizome and stem fragments downstream.

INTEGRATED MANAGEMENT OPTIONS

THIS SPECIES SPREADS PRIMARILY THROUGH STEM AND RHIZOME FRAGMENTS. BURN ALL HARVESTED PLANT MATTER.

Mechanical: FREQUENT CUTTING DOES NOT DAMAGE THIS PLANT AND WILL LIKELY RESULT IN THE SPREAD OF KNOTWEED. **Removing below-ground growth** is effective but often not practical, as rhizomes can extend 65' laterally and up to 25' in depth, depending on soil type. Digging several test pits to asses actual rhizome depth is recommended. Minimum effective excavation depth is at least 10' below the soil surface. Excavated plants and soil will need to be landfilled at a licensed facility which can be quite costly. DO NOT ALLOW EXCAVATED MATERIAL TO BE USED AS FILL DIRT.

Chemical: Broad-spectrum systemic herbicides are effective against most populations of knotweed. Use as a **foliar spray** on leaves and stems, apply to **cut stems**, or **inject stems** (most effective). First, cut plants to the ground in July and allow to regrow to deplete some underground energy reserves; then, in September, use herbicide as a foliar spray, apply to cut stems, or use as a stem injection. Treating stands while plants are going dormant ensures that herbicide is taken down to the rhizome network. Be sure to clean equipment and burn all cut plant material. Note that broad spectrum herbicides are non-selective and will also kill desirable plants. A permit is usually required to apply herbicides in wetland and riparian areas. Read labels and instructions thoroughly, follow all applicable laws and regulations, and wear protective gear when using herbicides. Repeat treatments annually until rhizome networks are exhausted.

WINTER	SPRING
If excavation is feasible, doing so in winter helps limit the possibility of spreading viable propagules.	If excavating a site, do so before above ground growth is substantial.
SUMMER	**FALL**
Cut plants in July; remove and burn all cut plant material and clean equipment thoroughly.	Apply herbicide as a foliar spray, cut stem treatment, or stem injection in the fall to ensure plants pull herbicide down to their rhizomes.

Japanese Stiltgrass

Microstegium vimineum

Origin: Caucasus mountains & E. Asia

Introduction: 1918 (Tennessee)

Propagation: Through seed; each plant is capable of producing 100-1000 seeds, though seed viability is low.

Dispersal: Seeds are spread by human activity, wind, water, & animals, particularly deer and earthworms.

Persistence: Seeds remain viable in soil for up to 10 years.

Life Cycle: Annual

Description: A prostrate, branching, sprawling grass; **stems** can be green, purple, brown, or red, and are wiry & thin with prominent nodes capable of forming adventitious roots; smooth, alternate **leaves** have distinctive silvery midveins, are relatively short & broad for a grass and superficially resemble those of bamboo; inflorescences are racemes with paired spikelets that take on a reddish color as **seeds** develop and ripen; the **roots** are stilted, shallow, branching, and come up easily when pulled.

Phenology: Seedlings emerge in late March and early April. Flowering occurs August to September. Seeds develop and mature September through October. Plants turn red and die as seeds ripen, leaving thick brown carpets of dead vegetation behind.

Habitat: Prefers the rich, moist soils of forest floors, floodplains, fields, and riparian areas. Proliferates quickly in anthropogenically disturbed sites, including lawns and roadsides. Grows well in deep shade and full sun.

Look-alikes: Whitegrass *(Leersia virginica)*.

ECOLOGICAL IMPACTS

Japanese stiltgrass is shade tolerant, a prolific seed producer, and unpalatable to deer, characteristics that allow it to form dense stands on forest floors and flood plains where it both chokes out native vegetation and causes native plants to become overgrazed. Plants also exude biochemical compounds that inhibit the growth of native plants & soil fungi and alter soil nutrient cycles.

INTEGRATED MANAGEMENT OPTIONS

Mechanical: Plants are extremely **easy to pull,** making stiltgrass a good target species for projects involving children. The best time to pull is in August when plants are tall but not yet dropping seed. Pulling earlier in the year may encourage the germination of dormant seeds. **Mowing** or **cutting** stiltgrass in August before seeds have developed is also an effective control strategy. Sow annual rye *(Lolium multiflorum)*, whitegrass *(Leersia virginica)*, and/or jewelweed *(Impatiens capensis)* over invaded sites to decrease stiltgrass stand density and seed production. Continue treating annually until seed bank is exhausted.

Chemical: Treat with a **broad-spectrum systemic** or **grass-specific systemic herbicide** applied as a **foliar spray.** The best time to apply herbicide is in late July or August before seeds have developed. Corn gluten meal (CGM) can be applied to soil before seeds germinate as a **pre-emergent herbicide:** note that pre-emergents will also kill the seeds of desirable species. A permit is usually required to apply herbicides in wetland and riparian areas. Read labels and instructions thoroughly, follow all applicable laws and regulations, and wear protective gear when using herbicides. Chemical treatments are most effective when combined with mechanical methods. Repeat treatments annually as necessary.

Biological: Sheep can be used to manage target populations. To avoid dispersing seeds in soil on hooves, do not allow grazers on infested sites when soil is wet.

WINTER	SPRING
If treating colonized sites with a preemergent herbicide like CGM, apply in mid-March.	Graze using sheep.
SUMMER	**FALL**
Pulling, mowing/ cutting, and treating with herbicide should all occur in early August before seeds develop. Continue grazing using sheep.	Sow annual rye, jewelweed, and/ or whitegrass over treated areas in early fall.

Slender False Brome

Brachypodium sylvaticum

Origin: Northern Africa & Eurasia

Introduction: 1930s (Oregon)

Propagation: Through seed; each plant produces 10-200 seeds.

Dispersal: Seeds spread by attaching to the feet and fur of animals and on shoes and vehicles.

Persistence: Unknown. For eradication efforts, assume several years.

Life Cycle: Perennial

Description: A dense perennial bunchgrass typically growing 1-3' tall; **stems** are upright and feature hairy nodes; **leaves** are lime green, sometimes with a yellowish tint, arching, often hairy, up to 12" long and 0.5" wide; flowering stalks are branchless and hollow, 2-3' long; **flower spikes** conspicuously drooping with 4-12 flower clusters per spike; **fruits** are caryopses with distinctive hairy tips.

Phenology: Plants break dormancy in late March; seedling emerge in late March to early April. Slender false brome flowers and sets seed from June through September. Plants often remain green through the winter.

Habitat: Slender false brome can occur in a wide range of habitats, from wet to dry, full shade to full sun. This includes marshy areas, streams, riverbanks, forest floors, open fields and pastures, roadsides and right-of-ways, and along foot and deer trails.

Look-alikes: Grass species in the genus *Bromus*.

ECOLOGICAL IMPACTS

Slender false brome forms dense monotypic stands that both physically smother other plants and monopolize soil resources, reducing plant biodiversity, hampering forest regeneration, and causing trophic cascades that harm native wildlife species. The enormous amount of leaf litter these plants produce may also increase the risk of fire.

INTEGRATED MANAGEMENT OPTIONS

Mechanical: Pull or **dig out** small patches in April or early May when soil is moist; be sure to remove all roots to prevent re-sprouting. If the site has been colonized for one or more growing seasons, subsequent treatments will be required to exhaust the seed bank. For larger invasions, **mowing** is an effective way to prevent seed development and will eventually exhaust the seed bank, but will not kill established plants and should be combined with an herbicide treatment. Mow frequently from April through July to prevent seeds from developing.

Chemical: Apply a **broad spectrum systemic herbicide** as a **foliar spray**. Apply to seedlings in spring and/or to established plants in June to prevent seed development; alternatively, mow patches several times in June and July and apply herbicide in late August or early September. Use a **pre-emergent herbicide** to prevent the germination of banked seeds; note that pre-emergent herbicides will kill all seeds in the seed bank and should only be used on large monotypic stands. A permit is usually required to apply herbicides in wetland and riparian areas. Read labels and instructions thoroughly, follow all applicable laws and regulations, and wear protective gear when using herbicides. Chemical treatments are most effective when combined with mechanical methods. Repeat treatments annually until the seed bank has been exhausted.

Biological: Slender false brome leaves often contain an alkaloid produced by a fungal symbiont that is toxic to mammals, so grazing is not recommended.

WINTER	SPRING
Broadcast sow seeds of native perennial forbs at invaded sites. Mulch treated sites to give native plants an advantage.	Hand pull or dig out small patches. Treat seedlings with herbicide. Mow established plants April-July to prevent seed development.
SUMMER	**FALL**
Apply herbicide to established plants in June to prevent seed development, OR continue mowing & treat with herbicide in August or September.	Large monotypic stands can be treated with a pre-emergent herbicide to kill dormant seeds.

Swallow-wort Species

Vincetoxicum spp.

Origin: Europe & northern Asia

Introduction: Mid–1800s

Propagation: Each plant is capable of producing dozens of seeds. Seed production is highly variable, with shaded plants producing considerably fewer seeds.

Dispersal: Seeds are dispersed by wind.

Persistence: Limited, likely < 5 years.

Life Cycle: Perennial

Description: An herbaceous vine, upright or twining, up to 6.5' tall, often found growing in dense patches; slender, green **stems** with milky sap; **leaves** opposite or whorled, elliptic to ovate, with pointed tips; small, star-like, 5-petaled **flowers**, maroon or various shades of purple, borne in cymes at leaf axils; **fruits** are 2-3" long pods that split to release seeds with hairy apical tufts that aid in wind dispersal.

Phenology: Plants break dormancy in April. Flowering occurs from May to late July. Fruits develop and mature from June to September, with seeds dispersing from July through October. Plants senesce in October.

Habitat: Abandoned fields, pastures, grasslands, roadsides and right-of-ways, disturbed sites, wetlands, riparian areas, forest edges, and openings. Swallow-wort is shade tolerant and can invade mature forests from edges and openings.

Look-alikes: Native honeyvine *(Cynanchum laeve).*

ECOLOGICAL IMPACTS

Swallow-wort grows & spreads rapidly, forming extremely dense, expansive stands that choke out native plants including its close relative, native milkweed. In areas where milkweed is absent, monarch butterflies lay eggs on swallowwort, which is toxic to insect larvae. Research suggests swallow-wort suppresses both insect populations and soil microbial communities.

INTEGRATED MANAGEMENT OPTIONS

Mechanical: Digging up isolated plants and small patches is effective as long as the entire root crown is removed. **Plowing** followed by the immediate **planting** of an annual cover crop annually for 5 years is effective, but not feasible in natural communities. **Planting** of broadleaf species that break dormancy in early spring and/or **mulching** may help to thin stands, but will not control populations. **Covering** with a thick black tarp for two years is very effective, but may not be practical for large invasions. Mowing or cutting are not effective and may increase stand density, though mowing once in late June or early July may prevent most plants from successfully seeding. Mulch treated sites to reduce seed germination. Repeat treatments annually for 2 or more years.

Chemical: Applying a **broad-spectrum systemic herbicide** as a **foliar spray** can be effective at reducing swallow-wort density, cover, and biomass and may prevent plants from seeding. The best time to apply herbicide is when plants are flowering but have not yet produced seed, in late June or early July. Note that broad-spectrum herbicides are non-selective and will also kill desirable plants. A permit is usually required to apply herbicides in wetland and riparian areas. Read labels and instructions thoroughly, follow all applicable laws and regulations, and wear protective gear when using herbicides. Repeat treatments as necessary.

Biological: Cattle have been observed to graze swallow-wort, but do not effectively control populations. Horses avoid swallow-wort, and it appears to be toxic to goats.

WINTER	SPRING
Broadcast sow treated sites with seeds of native broadleaf species. Cover with a deep layer of mulch.	Dig out small patches and isolated plants. Cover with mulch or a thick black tarp. Plow cultivated land and sow an annual cover crop.
SUMMER	**FALL**
Dig out small patches and isolated plants. Mow or apply herbicide as a foliar spray in late June or early July. Cover with a tarp or mulch.	Broadcast sow treated sites with seeds of native broadleaf species. Cover with a thick tarp or mulch. Plow cultivated land & sow a cover crop.

Giant Hogweed

Heracleum mantegazzianum

Origin: Caucasus mountains & SW Asia

Introduction: Early 1900s

Propagation: Through seeds; each plant can produce up to 50,000 seeds.

Dispersal: Seeds are dispersed primarily by moving water & human activity, and to a lesser extent by wind and animals.

Persistence: Seeds remain viable in soil for 3-7 years.

Life Cycle: Short-lived perennial

SAP ON STEMS & LEAVES CAUSES SERIOUS BURNS TO SKIN WHEN EXPOSED TO LIGHT.

Description: A very large, imposing plant of the carrot family (Apiaceae) often found growing in wet areas, measuring up to 20' tall when flowering; **stems** are stout, hollow and rigid, with hairy bristles and purple-to-reddish splotches, 2-4" in diameter; **leaves** are alternate, coarsely toothed, and pinnately compound, measuring 10' long and 5' wide; small white **flowers** in flat-topped, compound umbels about 2.5' in diameter; **fruits** are dry schizocarps.

Phenology: Plants typically emerge in March, growing rapidly from mid-May to mid-June. Flowering occurs in June and July. Fruits have typically ripened and dispersed by late August. Plants senesce in September and October.

Habitat: Roadsides & right-of-ways, grasslands, forest edges & openings, and riparian areas.

Look-alikes: Poison hemlock *(Conium maculatum),* Angelica *(Angelica archangelica),* Queen Anne's lace *(Daucus carota),* and cow parsnip *(Heracleum lanatum).*

ECOLOGICAL IMPACTS

Giant hogweed emerges very early in the spring, grows rapidly, and is a prolific seed producer, characteristics that allow it to form dense stands that choke out the native plant communities upon which wildlife depends. Monotypic stands that occur along banks and shorelines can cause erosion when plants go dormant and expose bare soil to late-season rain.

INTEGRATED MANAGEMENT OPTIONS

DO NOT TOUCH THIS PLANT

COVER ALL SKIN WITH PROTECTIVE WATER-RESISTANT CLOTHING & WEAR GOGGLES TO PREVENT BURNS FROM SAP.

Mechanical: Cut roots 4-10" below soil early in growing season and repeat in mid-summer. Deep tilling also works to kill roots and prevent germination of seeds. **Mowing** in early spring while plants are still short and repeating 2-3 times during the growing season for several years will eventually kill plants. **Cut flower umbels** to prevent seed development; continue cutting umbels as they develop throughout the growing season. Place cut umbels in black plastic bags and leave in direct sunlight to destroy developing seeds. Do not burn or compost stems, leaves, or roots.

Chemical: Treat with a **broad-spectrum systemic herbicide** during prolonged periods of dry weather; use as a **foliar spray** on stems and leaves. Apply herbicide at the beginning of spring and follow-up with a second treatment at the end of spring to kill any plants that germinated in response to the death of established plants. Note that broad-spectrum herbicides are non-selective and will also kill desirable plants. A permit is usually required to apply herbicides in wetland and riparian areas. Read labels and instructions thoroughly, follow all applicable laws and regulations, and wear protective gear when using herbicides. Chemical treatments are most effective when combined with mechanical methods. Repeat treatments annually as necessary.

Biological: Managed grazing using **sheep** or **cattle** is an effective management tool if initiated early in the spring and continued throughout the growing season.

WINTER	SPRING
Broadcast sow colonized sites with native perennial grasses and forbs.	Cut roots of plants. Mow in early spring and continue through growing season. Graze with cattle or sheep. Cut umbels. Treat with herbicide.
SUMMER	**FALL**
Treat seedlings with herbicide. Continue mowing until growth ceases. Cut umbels until flowering ceases. Continue grazing.	Sow invaded cropland with a cover crop immediately after harvest.