

FHTET

Biological Control Program:
Sponsored Projects

FHTET Biological Control Program

What we can do for you:

- Development and implementation of biological control to manage invasive species
- Sponsored training and workshops/meetings on biological control
- Coordinated and focused funding for biological control
- Up-to-date information on biological control projects via publications
- Recommendations on the restoration of native plant species
- For more information contact:
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What is biological control?

- The deliberate use of living organisms to limit the abundance of a target organism
- Natural enemies reduce the population of hosts; in turn, host abundance influences the population levels of natural enemies
- “Classical biological control” – reunites the target organism with natural enemies from its native range

Ongoing Projects

Insects

Emerald ash borer

(Agrilus planipennis)

Coleoptera: Buprestidae

- Widely distributed in Asia, Russian Far East.
- Since 2002 this invasive wood-boring beetle from northeastern Asia has killed millions of ash (*Fraxinus*) trees in the U. S. and has been detected in over 21 states
- Exploration for emerald ash borer natural enemies in China
- Three species of parasitoids from China have been released and recovered at selected sites in MI, OH, IL, WV, MD, VA, IN and KY: *Spathius agrili* (larval parasitoid); *Tetrastichus planipennis* (larval parasitoid) *Oobius agrili* (egg parasitoid)
- Effectiveness and spread of the three species of parasitoids being monitored at all release sites
- *Spathius galinae* (larval parasitoid) discovered in Russia, approved for release in the U.S., and releases initiated in 2015.



Hemlock woolly adelgid

(*Adelges tsugae*)

Hemiptera: Adelgidae

- Native to Asia and western North America. The population invasive in eastern North America originated in southern Japan.
- Hemlock dominated forests amount to approximately 2.3 million acres
- Hemlock woolly adelgid (HWA) is a serious pest of eastern hemlock (*Tsuga canadensis*) and Carolina hemlock (*Tsuga caroliniana*)
- Predator beetles, *Sasajiscymnus tsugae*, *Scymnus sinuanodulus*, *Laricobius osakensis* and *Laricobius nigrinus* (Seattle biotype and Inland biotype) released in numerous states
- *L. nigrinus* (Seattle and Inland biotypes) established at numerous sites in several states
- Other predators under evaluation are: *Leucopis argenticolis*, *L. piniperda* and *Scymnus camptodromus*
- The fungus *Lecanicillium muscarium*, recovered from HWA populations in the eastern U. S. and being evaluated for efficacy in ground and aerial application trials.
- In 2007, the HWA Predator Release and Recovery Database (PDB) was initiated.
<http://hwa.ento.vt.edu/hwa/hwa.cgi>



Sirex Woodwasp

(*Sirex noctilio*)

Hymenoptera: Siricidae

- Sirex woodwasp is one of the top 10 most serious insect pests in the world
- A native to northern Africa, Eurasia, and in New Zealand since 1990. It first appeared in the U. S. in 2004 and in 2005 in Ontario, Canada
- Females inject a toxic mucus and a fungus during egg laying in the bark of pine trees. The mucus kills tree cells, the fungus feeds on the dead tree cells and the larvae feed on the fungus
- *S. noctilio* has the potential to cause considerable damage to both natural pine forests and pine plantations worldwide
- Exploration for natural enemies indicated that the most effective species was a nematode, *Deladenus siricidicola* which sterilized female woodwasps
- Three native hymenopteran parasitoid species, *Megarhyssa nortoni*, *Rhyssa lineolate*, and *Ibalia leucospoides* attack *S. noctilio* with *Ibalia leucospoides* the most abundant



Winter Moth

(*Operophtera brumata*)

Lepidoptera: Geometridae

- Winter moth larvae feed in early spring mainly on a large number of deciduous trees, oaks are preferred
- Pupate in soil or litter mid May, adults emerge late fall/early winter (late November – January in northeastern US)
- Introduced into Nova Scotia before 1950, Oregon in the 1950s and Vancouver Island in the 1970s.
- A new outbreak occurred in eastern Massachusetts in 1990s, its range now extends from southeastern Maine to Long Island, NY.
- Native range includes all of Europe and much of Russia, including Russian Far East
- Surveys for natural enemies in native range began in France and Germany in 1950s
- The tachinid, *Cyzanis albicans* and the ichneumonid *Agrypon flaveolatum* were most abundantly collected parasitoids. The tachinid lays microtype eggs at edges of partially defoliated leaves. Eggs are consumed by winter moth larvae.
- *C. albicans* was released in MA, RI, CT, ME, NH and became established at numerous sites.



Completed Projects

Insects

Ambermarked birch leafminer (*Profenusa thomsoni*) Hymenoptera: Tenthredinidae

- European species, established eastern and western North America, Alaska in 1991.
- This sawfly is a serious pest of birches (*Betula* spp.) in western Canada and Alaska larvae feed inside the leaf causing the leaves to turn brown.
- A parasitic wasp, *Lathrolestes thomsoni*, reduces populations of the sawfly in North America
- *L. thompsoni* introduced and established at all release sites in Alaska
- Two native parasitoids, *L. soperi* and *Aptesis segnis* also parasitize Ambermarked birch leafminer
- Effectiveness and spread of three species of parasitoids being monitored through 2016 at all release sites



Beech scale

(Cryptococcus fagisuga)

Hemiptera: Eriococcidae

- Widely distributed in Europe, in Caucasus Mountains in Georgia, and in Asia.
- Beech bark disease has degraded 80% or more of American beech over much of its range
- Beech scale (*Cryptococcus fagisuga*) attacks the bark of American beech (*Fagus grandifolia*) introducing a fungus complex consisting of *Nectria coccinea* var *faginata* and sometimes *Nectria galligena*. The scale insect damages the bark, enabling *Nectria* infections followed by colonization by decay fungi.
- For beech scale, no parasitoids have even been recorded in North America or Europe
- Surveys for parasitoids conducted in both the Caucasus Mountains proper – Georgia and Azerbaijan and in the lesser Caucasus Mountains to the south – southern Georgia, Armenia, parts of Turkey and northern Iran. To date, no parasitoids recovered.



Elongate hemlock scale (*Fiorinia externa*) Hemiptera: Diaspididae

- Elongate hemlock scale (EHS) is an invasive pest of hemlock, *Tsuga* spp. and other conifers
- *Encarsia citrina* is the principal parasitoid of elongate hemlock scale in eastern North America
- Surveys in Japan for parasitoids of elongate hemlock scale
- Unique species of parasitoids attacking elongate hemlock scale in Japan recovered, but host range testing of these species not favorable for release.



Goldspotted oak borer (*Agrilus auroguttatus*) Coleoptera: Buprestidae

- Native to oak woodlands in southeastern Arizona and perhaps northern Mexico.
- Goldspotted oak borer (GSOB) attacks coast live oak (*Quercus agrifolia*), canyon live oak (*Q. chrysolepis*), and California black oak (*Q. kelloggii*).
- responsible for oak mortality (25,000 trees) in CA
- Initial collections suggest that GSOB from Mexico may be a separate species and a future potential invader of CA
- In 2009, initiated surveys for natural enemies in AZ and Chiapas and Oaxaca, Mexico
- Surveys in AZ and CA for host specific egg parasitoids, but none found
- Surveys for egg parasitoids continue in Mexico



Ongoing Projects Plants

Chinese privet (*Ligustrum sinense*)

- Introduced into the US in 1852 as an ornamental shrub, and by 1932 established throughout the Southeast
- Chinese privet is a shade-tolerant semi-evergreen that forms dense thickets
- Grows best on wet sites such as bottomland forests and river and stream floodplains
- Seeds easily dispersed by birds and other animals
- Spreads via root sprouts
- In later 1990s efforts, initiated in screening natural enemies on privet in China.
- In 2014, petition submitted to Technical Advisory Group (TAG) release of lace bug *Leptoypha hospita* (Hemiptera: Tingidae)



Garlic mustard

(Alliaria petiolata)

- Garlic mustard is native to Europe and first recorded in North America at Long Island, NY in 1868
- Garlic mustard is the only species of the genus *Alliaria* present in North America
- Garlic mustard is an invasive biennial plant (lives for two years) that rapidly outcompetes native plants. The plant overwinters as a rosette and leaves remain green throughout the winter
- Since 2000 it has spread to more than 37 states in the US and 6 Canadian provinces
- Four species of weevils, *Ceutorhynchus constrictus*, *C. alliariae*, *C. scrobicollis*, and *C. roberti* are being evaluated as biological controls. *C. scrobicollis*, a root crown feeder, is the most promising
- In 2008, petition submitted to TAG for the root crown mining weevil, *C. scrobicollis*, additional host range testing completed and petition resubmitted 2011, 2014 and 2016.



Japanese knotweed (*Fallopia japonica*)

- Native to Eastern Asia, introduced from Japan to North America in late 1880s
- Invasive knotweeds are a complex of species: Japanese, Giant and Bohemian.
- Japanese knotweed is an invasive plant of riparian areas and roadsides where it outcompetes native plants by forming dense thickets and an extensive root system
- Three insects and one pathogen were evaluated as potential biological control agents.
- *Aphalara itadori*, a sap-sucking psyllid the most promising
- In 2013, petition submitted to TAG and they recommended release *A. itadori* in the US. No subsequent action taken by USDA-APHIS.
- In 2015, initiated host range studies of mealybug
- Over 200 fungal isolates from symptomatic leaves



Japanese stiltgrass (*Microstegium vimineum*)

- First introduced to the US from southeast Asia in the early 1900s and had spread out to at least 14 eastern states by 1972
- Japanese stiltgrass is an annual grass that thrives in low-light conditions, displacing native plants.
- Plants spread by rooting at the nodes. Seeds are able to remain dormant for five years or more
- In 2014, risk assessment and feasibility study for biological control of Japanese stiltgrass prepared by Hough-Goldstein (University of Delaware), Ding (Chinese Academy of Sciences) and Qiang (Nanjing Agricultural University)
- In 2015, test plant list submitted to TAG for review



Tree-of-heaven

(*Ailanthus altissima*)

- Tree of heaven is a fast growing tree with numerous wind dispersed lightweight seeds. It outcompetes native plants by forming dense thickets and also produces chemicals that inhibit the growth of other plants.
- Native to central China. First introduced into eastern US in 1784 and areas of California in the mid 1800s
- In 2004, surveys initiated in China for natural enemies. The most promising, a weevil, *Eucryptorrhynchus brandti*, reared in quarantine and host range studies conducted
- In 2014, petition submitted to TAG for *E. brandti*, additional host range testing completed and petition resubmitted in 2016
- An indigenous vascular wilt fungus, *Verticillium nonalfalae* recovered from Tree-of-heaven and causing mortality at sites in PA, VA, and OH
- Host range testing and molecular characterization conducted for *V. nonalfalae*

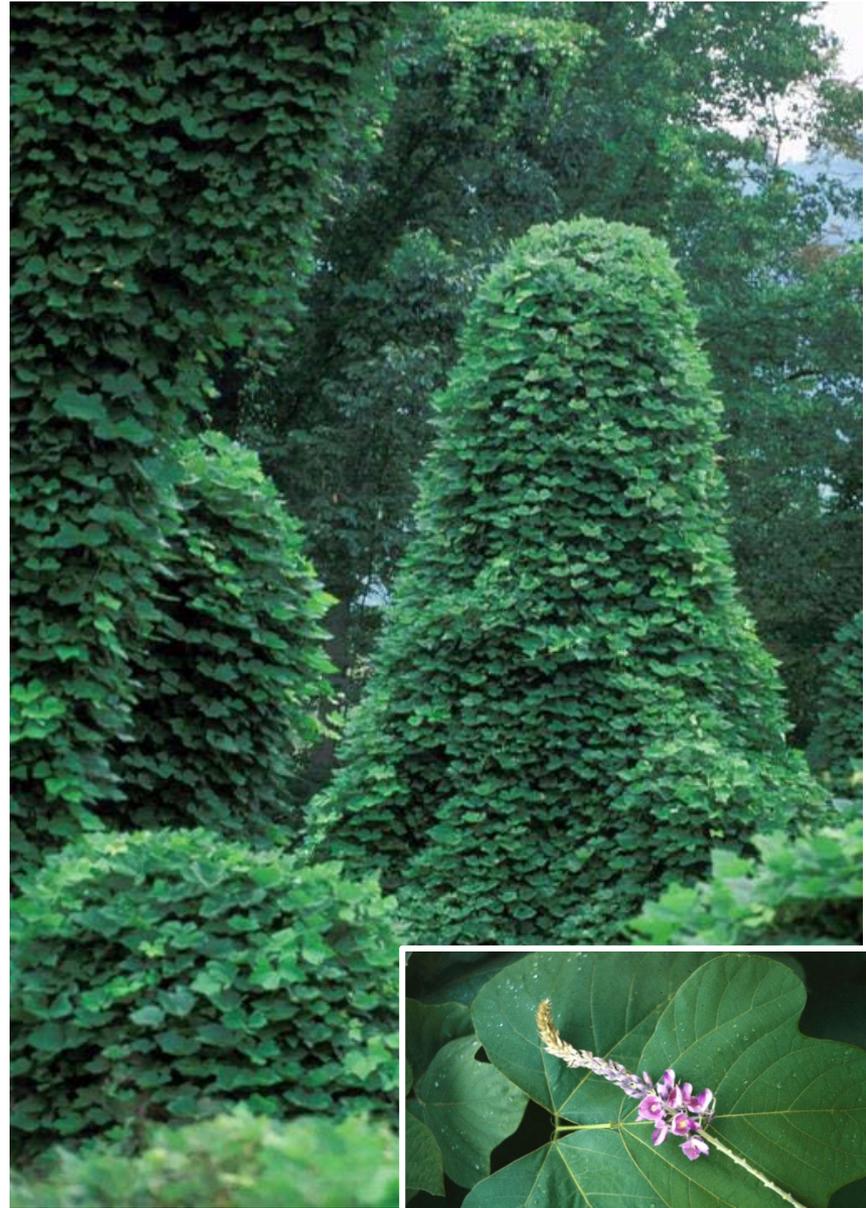


Completed Projects Plants

Kudzu

(Pueraria montana var. lobata)

- Kudzu is an invasive perennial vine introduced from Japan into the U S in 1876 as an ornamental but promoted as a forage crop and erosion control. Its vines, which may reach lengths of 100 feet grow over, often at 1 foot per day, smother and kill all other vegetation including trees
- Natural enemy surveys in China yielded more than 100 insects that feed on Kudzu
- Host range testing completed for several species of herbivores but all fed on soybeans; therefore, not considered for release.
- A host specific sawfly recovered, but in extremely low numbers and difficult to rear in quarantine. Preliminary host range testing indicates the sawfly is host specific and efforts continue to establish a colony in the laboratory.



Mile-a-minute (*Persicaria perfoliata*)

- Widely distributed India, Eastern Asia and the islands from Japan to the Philippines
- Introduced to the northeastern US in the mid 1930s from Japan
- Mile-a-minute is a rapidly growing annual vine that invades open, disturbed areas, such as fields, forest edges, roadsides and stream banks. It covers existing vegetation blocking sunlight and inhibits growth and regeneration of new plants.
- In 1996, surveys for natural enemies were initiated in China and in 2004 and 2005 in Japan. Out of more than 100 natural enemies collected in China, a stem-boring weevil, *Rhinocomimus latipes*, was determined to be the most promising biological control. The weevil has been mass-reared and released in 15 eastern states.
- The weevil has been recovered at all release sites and is spreading rapidly
- New Jersey Department of Agriculture rearing the weevil for distribution to cooperators

