

Status of Biocontrol Development for Several Invasive Plants

Brock Woods, Wisconsin Dept. of
Natural Resources and Univ. of
Wis. Extension

Yellow toadflax (also known as common toadflax, butter-and-eggs, wild snapdragon); *Linaria vulgaris*

- Annual or biennial forb that invades a variety of disturbed, somewhat mesic habitats such as pastures, rangeland, forest openings, roadsides, and croplands
- Spreads vegetatively to form dense infestations with a deep root system that makes it an effective competitor for water and nutrients
- Mildly poisonous to most grazing mammals



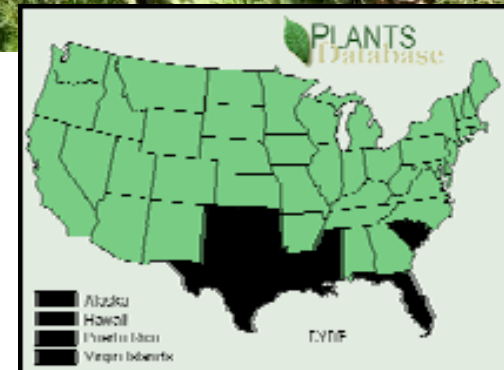
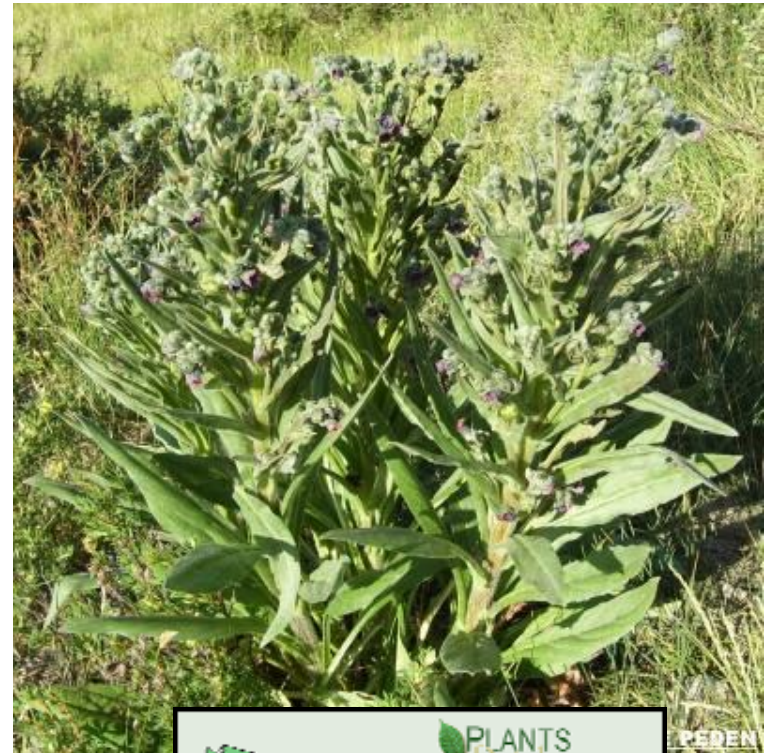
Yellow Toadflax Biocontrol

- Eight introduced insects: none are very effective
- Most promising is another stem-mining weevil, *Mecinus heydeni* that kills shoots
- Stem-galling weevil *Rhinusa hispida* also promising
- Funded by the North American 'toadflax consortium', with contributions from various governmental agencies



Houndstongue (also known as dog bur, gypsyflower); *Cynoglossum officinale*

- Biennial forb reproduces by seeds in barbed fruits
- Primarily a pest in the western US
- Invades disturbed, dry rangeland, pastures, roadsides, and abandoned crop fields
- Toxic to most domestic grazing mammals
- Effective competitor for scarce water on dry sites



Houndstongue Biocontrol

- Root-boring weevil *Mogulones cruciger* and the root-feeding flea beetle *Longitarsus quadriguttatus* introduced to W. Canada, not US, but likely to spread
- Seed-feeding weevil, *Mogulones borraginis* appears to be highly host specific
- In 2009 Three shipments of *M. borraginis* were made to North American quarantine facilities for additional host-specificity tests and rearing
- Additional insects are being raised and tested on NA plants at CABI



Canada thistle (also known as creeping thistle, California thistle); *Cirsium arvense*

- Spiny, perennial forb native to central Asia
- Reproduces by seeds and vegetatively
- One of the most widespread and damaging exotic weeds in the US
- Infests almost every type of natural and managed habitat
- Allelopathic
- Dense monocultures that usurp water, light, nutrients



Canada Thistle Biocontrol

- Root-crown weevil *Ceutorhynchus litura* and the stem gall fly *Urophora cardui* introduced
- Four other accidentally-introduced European thistle-feeding insects
- Biocontrol agents for musk thistle affect CT
- Additional insects possible, but not likely to be sufficiently host-specific for US
- CABI studying endemic Canada thistle natural enemies, especially bacteria: PST
- CABI also looking at co-evolved fungal pathogens since they are more host specific

Musk thistle (AKA nodding thistle); *Carduus nutans* (also known as *Carduus thoermeri*)

- Annual or biennial forb reproduces by seeds
- Widespread exotic now in 45 states
- Infests overgrazed grasslands and pastures, disturbed areas; also some undisturbed areas
- Adapted to somewhat mesic conditions and does poorly on very wet or very dry areas
- Limits livestock, native animals and recreation



Musk Thistle Biocontrol

- 4 European insects; 2 established:
- seedhead weevil *Rhinocyllus conicus* and the rosette weevil *Trichosiromus horridus*
- Both have spotty control and broad host ranges
- *Rhinocyllus conicus* attacks native thistles
- rust fungus, *Puccinia car-duorum*
- Bad press and additional BC unlikely

Common reed; *Phragmites australis*

- Large perennial grass that spreads locally by vegetative reproduction while producing seeds for long-distance dispersal
- Variety of habitats with standing water: saline, brackish, or fresh
- exotic genotype(s) are believed to be replacing native strains

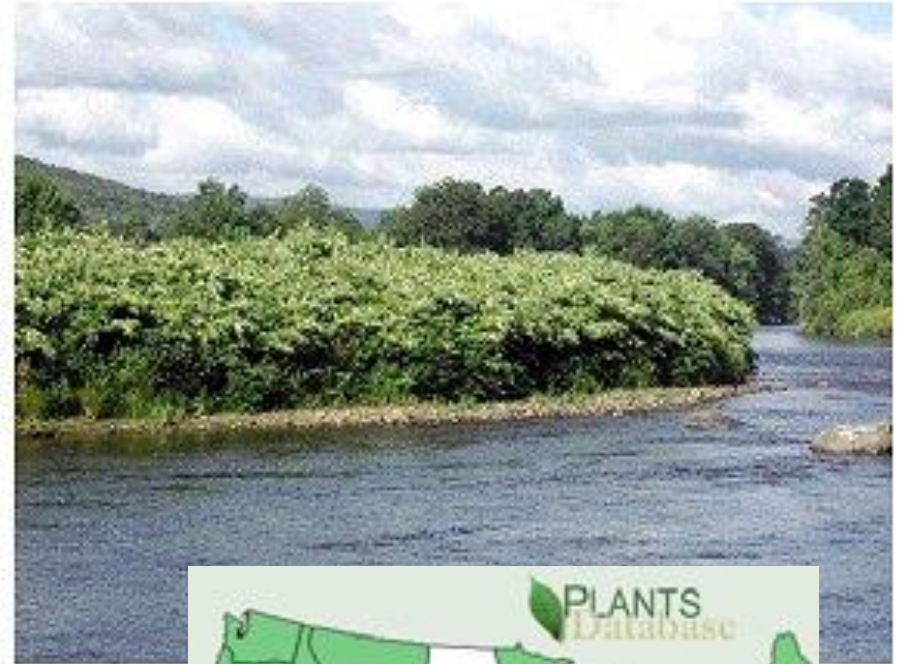


Common Reed Biocontrol

- No recognized biological control agents for invasive common reed in the US
- North American surveys have identified 2 native and 24 'accidentally' introduced Eurasian insects
- CABI conducting surveys and pre-release work
- CABI sent eggs of a stem-mining noctuid moth to US in 2009 for quarantine testing, and raising 4 species for testing
- BC considered difficult

Japanese knotweed (AKA Japanese bamboo, Mexican bamboo); *Polygonum cuspidatum* (AKA *Fallopia japonica* & *Reynoutria japonica*)

- Perennial forb or semi-woody plant reproduces via rhizomes and spreads over longer distances by plant fragments and seeds
- Pest of riparian areas and islands, and the margins of other wetland habitats
- Degrades native habitats
- Root system may also physically damage roads, trails, dams & other infrastructure



Japanese Knotweed Biocontrol

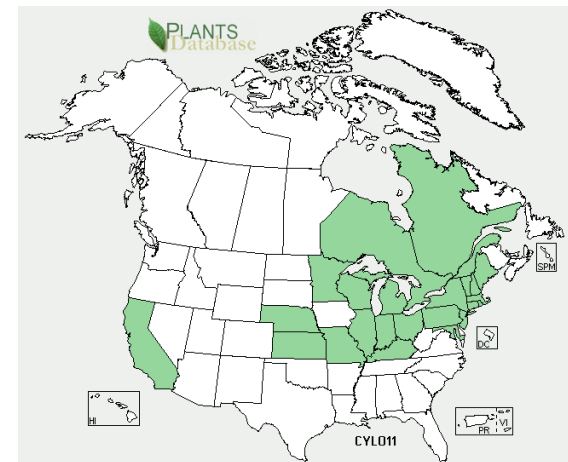
- Few useful endemic insects in US
- most promising biological control agents are psyllid *Aphalara itadori* and the leaf spot fungus (*Mycosphaerella polygoni-cuspidati*)
- In 2010 multiple-choice tests on 26 NA plant species showed 4 had psyllid eggs and 2 supported development to adult (*F. cilinodis* & *Muehlenbeckia axillaris*)
- Eggs layed on the 3 exotic species
- USDA funding has ceased



Swallow-worts; *Vincetoxicum* spp.

(Black SW previously *Vincetoxicum nigrum* and *Cynanchum nigrum*)

- Herbaceous, perennial, twining vines related to milkweeds
- Wind-borne seeds and rhizomes that form patches
- Invade upland habitats--sun and shade--including old fields, hedgerows, brushy areas and woodlands
- Form dense thickets that cover native vegetation
- Distinct association with limestone soils



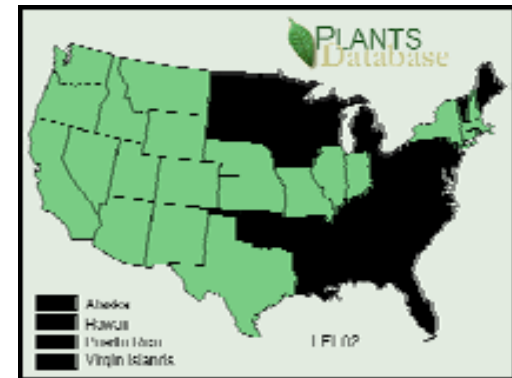
Swallow-wort Biocontrol

- Search for native predators in 2003
- Work at CABI began in 2006 with work on Chrysomelid beetle *Eumolpus asclepiadeus*, and seed feeding fly *Euphranta connexa*--continuing in 2010
- *E. asclepiadeus* collected in 2008-2009 were reared on 3 invasive *Vincetoxicum* species then transferred to 23 test plant species for emergence in 2011
- No-choice and single-choice tests done
- Insects take 1-3 years to develop
- Seed pods collected to acquire *E. connexa* from Switzerland, Ukraine, and France



Perennial Pepperweed (also known as tall whitetop, ironweed); *Lepidium latifolium*

- Perennial forb spreads locally via creeping roots
- Long-distance dispersal by seeds & root fragments
- infests many habitats, primarily moist sites along rivers, lakes, ditches, wet meadows, estuaries, wetlands, mesic rangeland, pastures, hay meadows, agricultural fields
- Rapid clonal reproduction, high density, and tall growth form
- Salt pump



Perennial Pepperweed Biocontrol in 2009 & 2010

- Collected gall-inducing weevil *Ceutorhynchus marginellus* and shoots containing larvae of *Phyllotreta reitteri*
- In no-choice tests many plant species mined & larvae produced
- *P. reitteri* weevils attacked 19 test plant species out of 32
- *C. marginellus* weevils attacked one *L. crenatum* and no *L. huberi* while 64% of *L. lepidium*



Buckthorns-Common & Glossy; *Rhamnus cathartica* & *Frangula alnus*

- *R. cathartica* - small, dioecious tree with many, bird-dispersed seeds; *F. alnus* – small shrub
- Invade various habitats forming dense thickets that block light; *F. alnus* wet areas
- Leaf out early and retains them late
- May alter soil nitrogen dynamics, reduces leaf litter
- May combine with earthworms to change soil characteristics

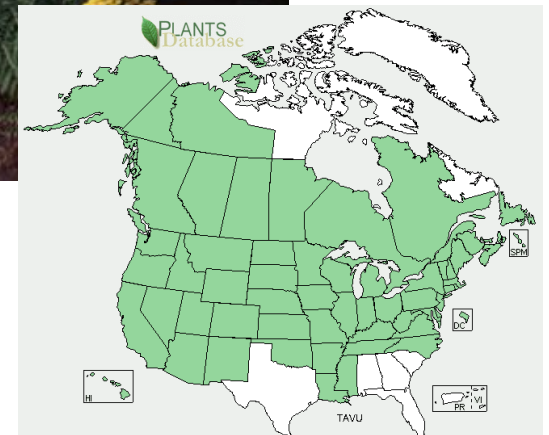


Buckthorn Biocontrol in 2009 and 2010

- Larvae of moth *Philereme vetulata* found in Germany and Switzerland, raised to adults that produced larvae on exotic species
- Larvae matured on exotic *Rhamnus* sp. And *R. alnifolia*
- Homopteran *Trichohermes walkeri* were collected and formed galls & larvae recovered only on *R. cathartica*
- Midges (*Wachtiella krumbholzi*) used in no-choice tests on *R. cathartica* and *F. alnus*
- CABI seeking MS student for negative plant-soil feedback work since seedling density much lower in Europe than in NA

Common Tansy; *Tanacetum vulgare*

- Loss of desirable vegetation
- Toxicity to humans and livestock & reduction in pasture carrying capacity
- Degradation of wildlife habitat
- Hinders reforestation and restoration efforts.



Common Tansy Biocontrol Insects

- Stem-mining weevil *Microplontus millefolii*
- Leaf-feeding beetle *Cassida stigmatica*
- Flea beetle *Longitarsus noricus*
- Stem and flower-bud mining moth *Isophrictis striatella*



Common Tansy Biocontrol

- bCABI collected stem-mining weevil *Microplontus millefollii*, cerambycid *Phytoecia nigricornis* and the leaf feeding beetle *Cassida stigmatica*
- No choice tests with *M. millefollii*
- No-choice tests with *C. stigmatica* on 25 plants, 13 NA species
- Only *T. parhtenium* and *Chamaemelum nobile* (NA species) had larval develop
- Flea beetle *Longitarsus noricus* tested on 12 NA plants



Additional Tansy Research

- Smith and Clasen (Univ. of Minnesota) are trying to determine how genetic diversity and plant invasiveness are related within introduced populations of common tansy in North America.
- Dr. John Gaskin with the USDA ARS is trying to understanding the phylogeny of related species to aid host specificity studies



Conclusions

- Biocontrol research often takes 10+ years
- Results are uncertain for many IS, especially those with many related natives
- BC will never be a panacea, only one method among others (but hopefully a mainstay!)
- Need to understand ASAP if BC is available to strategize long-term control effectively
- Support funding; on-going until exhaust potential control organisms
- Proceed now as if no BC possible
- Emphasize prevention!

Acknowledgements

- CABI annual reports and many individual investigators
- USDA-AHIS-PPQ Biocontrol Target Pest Canvassing and Evaluation 2005-2006
- Minnesota Dept. of Ag for Tansy info and photos
- Various web sites for photos and range maps
- Biological Control of Invasive Plants in the Eastern United States, various authors, 2002