WASHINGTON STATE UNIVERSITY EXTENSION

Knotweed biocontrol:

An upcoming management option?

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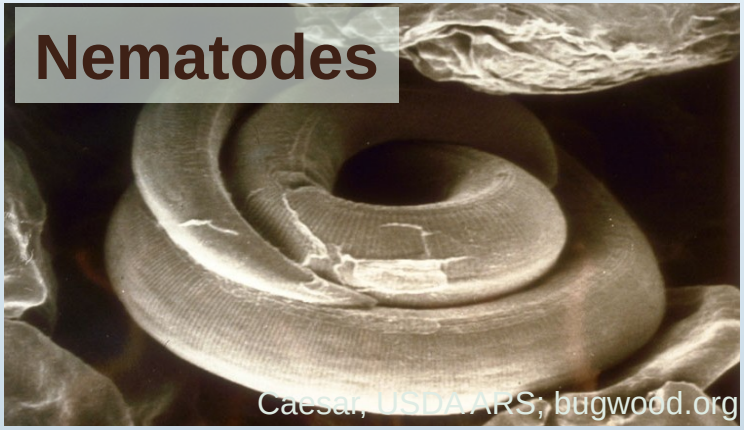
WSU Extension's Role

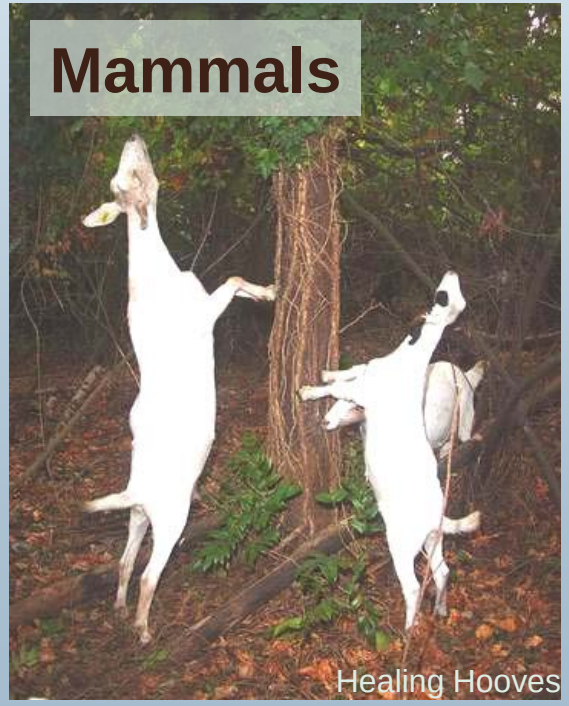
- State-wide program
- Provide biocontrol agents free of charge to land managers
- Education to land managers
- Expertise & on-site recommendations

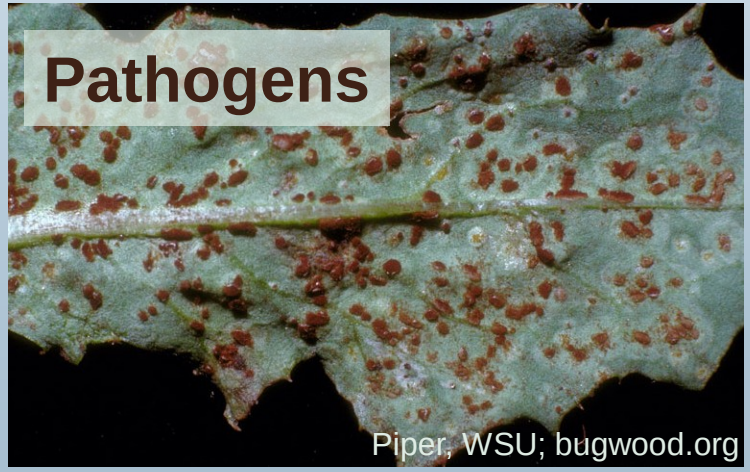
- Funded primarily by USFS & supplemental funding from County Noxious Weed Control Programs
  - ~ King, Pierce, Kitsap, Thurston, Yakima, Cowlitz

What is Biocontrol?

The intentional use of one living organism to control/suppress another organism, such as *noxious weeds*



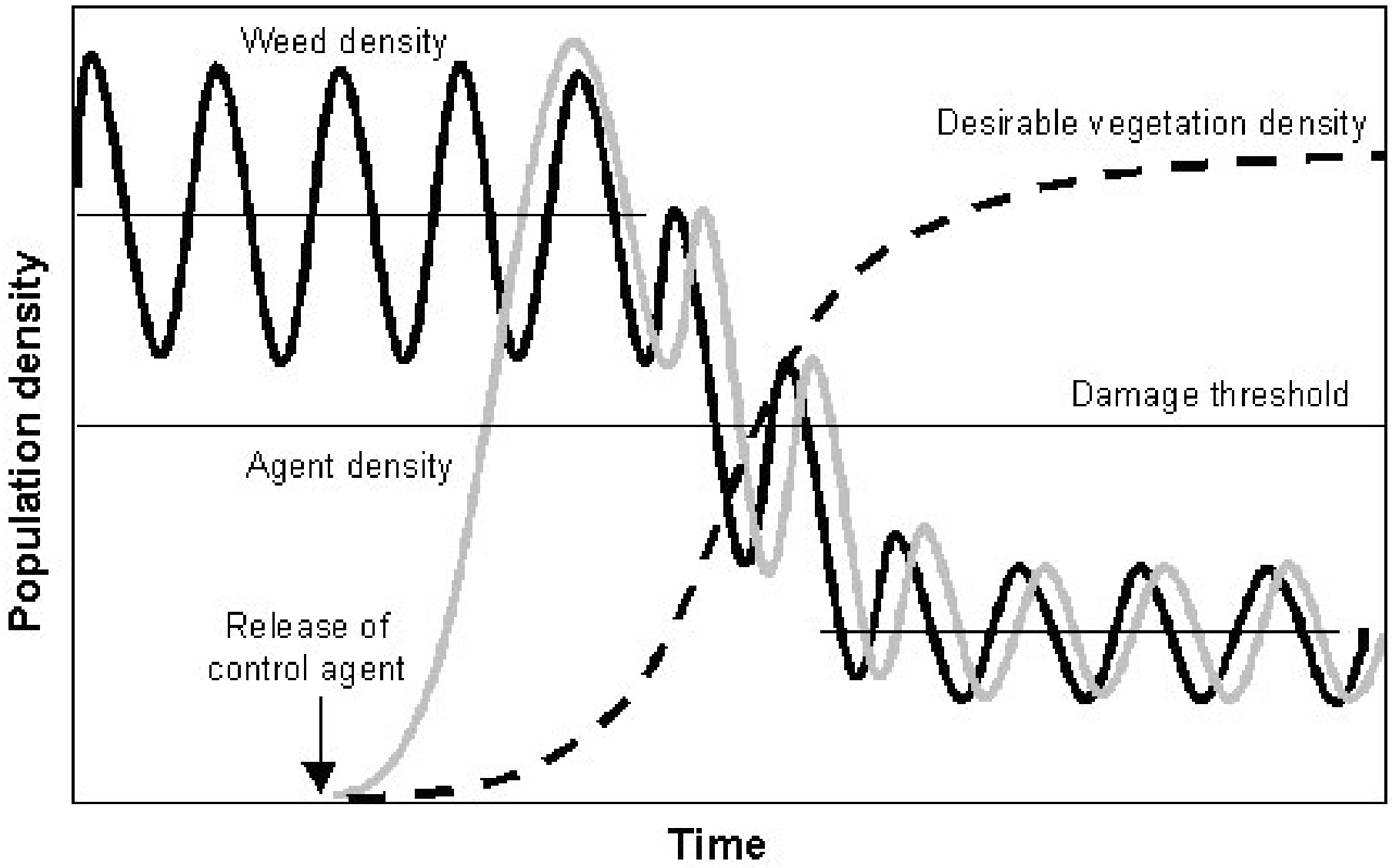




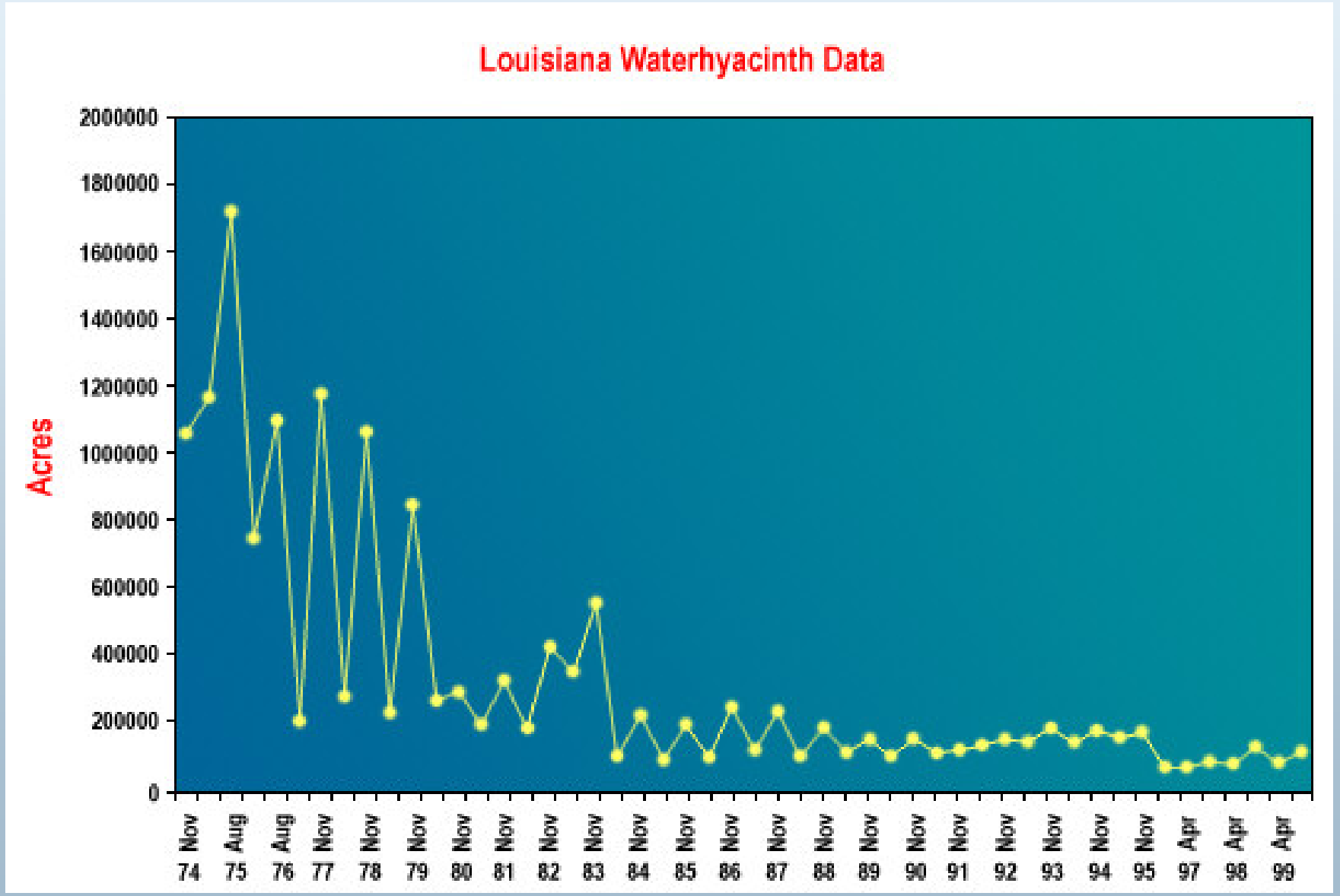
Classical Biocontrol

- Theory that explains why non-native plants are so good at invading
  - ~ plants are able to establish large infestations and become widespread in their introduced range because they are released from their natural enemies
- Classical biocontrol reunites a plant species with its natural enemies in hopes of achieving the balance found in the plant's native range.

Ideal Biocontrol Results



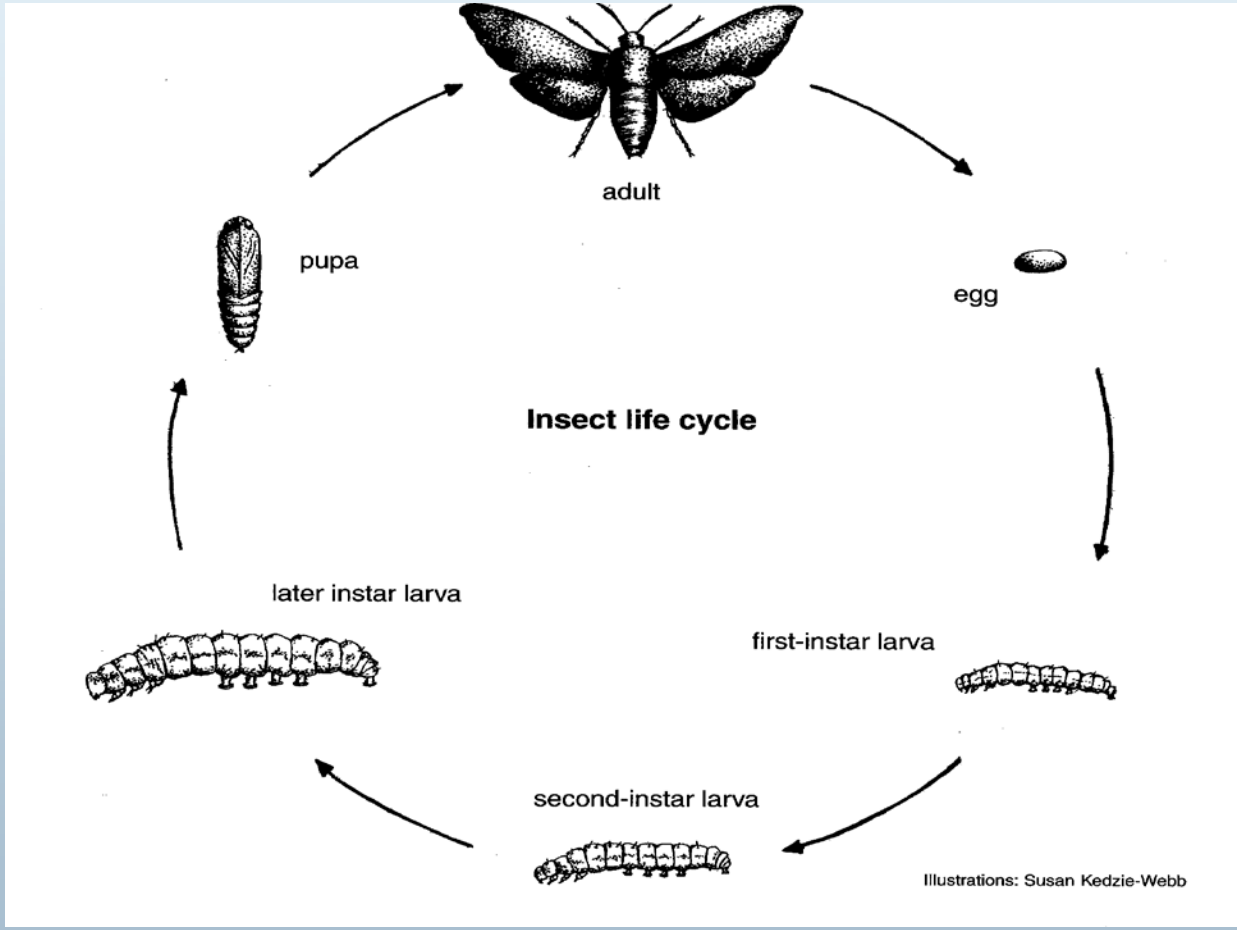
Water Hyacinth Example



USACE

Insect Life Cycle

- Beetles, flies, moths
- 4 distinct life stages (egg, larva, pupa, adult)
- Larval stage often inside plant



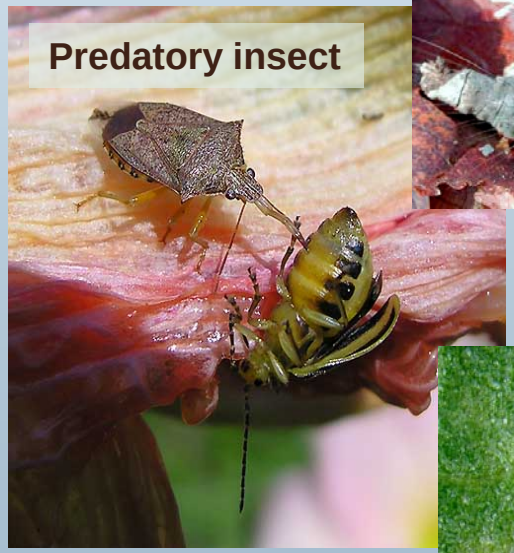
Advantages of Using Biocontrol

- Host-specific: USDA APHIS approves biological control agents before introduction into U.S.
- Ecologically desirable
- Resistance highly unlikely
- Excellent searching capabilities
- Long-term control

- Biocontrol agents are mobile & self-sustaining
- Cost effective particularly on low value land

Limitations of Using Biocontrol

- Long time to make impact
- Degree of control varies
- Subject to predators
- May not establish or thrive at some sites
- Limited availability of some agents
- Very slow approval of new agents
- **No eradication**



Weeds with Biocontrol Agents

- Scotch broom
- tansy ragwort
- diffuse knapweed
- spotted knapweed
- meadow knapweed
- Canada thistle
- bull thistle
- Dalmatian toadflax
- yellow toadflax
- St. Johnswort
- purple loosestrife
- bindweed
- yellow starthistle
- puncturevine
- rush skeletonweed
- Russian knapweed
- leafy spurge
- gorse
- Mediterranean sage

Knotweed Biocontrol

- 3 species
  - » Japanese
    - ~ *Fallopia japonica*
    - ~ *Polygonum cuspidatum*
  - » giant
    - ~ *Fallopia sachalinensis*
    - ~ *Polygonum sachalinense*
  - » Bohemian (hybrid)
    - ~ *Fallopia x bohemica*
    - ~ *Polygonum x bohemicum*
- makes it difficult to find effective agents
- genetic studies to improve selection of agents

Researchers

- Fritzi Grevstad
  - ~ Oregon State University
- Rob Bourchier
  - ~ Agriculture & Agri-Food Canada, Lethbridge AB
- Richard Shaw
  - ~ CABI, United Kingdom
- Paolo Sanguankeo
  - ~ formerly: Olympic Natural Resources Center, Forks WA
- Chislaine Cortat
  - ~ CABI, Switzerland

- John Gaskin
  - ~ lead for genetic studies
  - ~ USDA-ARS-NPARL, Sidney MT
- Richard Reardon
  - ~ USFS – FHTET, Morgantown WV

Insects Tested & Rejected

Ostrinia ovalipennis & O. latipennis

- stem-boring pyralid
- host range is too broad
- fed on *Rumex* spp., native *Fallopia* spp., *Rheum* sp. (rhubarb)
- REJECTED

Gallerucida bifasciata

- leaf-feeding beetle
- fed on *Rumex* spp., native *Fallopia* spp., *Rheum* sp. (rhubarb)
- REJECTED

Potential Pathogen

Mycosphaerella polygoni-cuspidati

- leafspot fungus
- only attacks Japanese
  - ~ questionable efficacy for North America
- testing continues in UK; Bill Bruckart (USDA-ARS) in US?
- complex lifecycle makes testing difficult

Aphalara itadori – Life History

- sap-sucking psyllid
  - ~ attack meristem tissue
- female lay 600-700 eggs on leaf surface
- 5 nymphal instars
- 1 generation takes 33 days
  - ~ expect 2 generations/year at 98% of sites
  - ~ partial 3rd generation at 13-15% sites at lower elevation
- overwinter as adults
  - ~ in conifer tree bark

Aphalara itadori - Damage

- nymphs can kill plants at high densities
- twist / bind leaves
- can kill plants quickly in lab
- plants do not grow back
- depletes energy supply =
  - ↓ growth
  - ↓ root storage
- leaf deformity =
  - ↓ leaf area
  - ↓ photosynthetic rate
  - ↓ growth
  - ↓ competitive ability

A. itadori – Range & Biotypes

- potential range
  - ~ central CA to Alaska
  - ~ Georgia to Newfoundland
- two biotypes (strains)
- southern strain
  - ~ Kyushu
  - ~ attacks Japanese & hybrid
  - ~ released in UK
- northern strain
  - ~ Hokkaido
  - ~ attacks giant
- crossing strains
  - ~ attack all 3 species

A. itadori – Host-range Testing

- 70 species tested
- marginal development on 3 nontarget species
  - ~ *Fallopia cilinodis* – eastern US native
  - ~ buckwheat (*Fagopyrum esculentum*) – crop
  - ~ *Muehlenbeckia axillaris* – minor ornamental
- nontarget outcome
  - ~ ↑ adult mortality
  - ~ unable to maintain populations
  - ~ no detectable impacts

A. itadori – Petition & Releases

- petition submitted to the TAG
  - ~ 2 October 2012
  - ~ likely 18 months to make a recommendation
- petition then submitted to USDA-APHIS
  - ~ timeline unclear – probably more than a year
- pre-release monitoring in 2014?

A. itadori – Monitoring

- initial releases on 4 sites (2 WA & 2 OR)
  - ~ release on isolated watersheds to track dispersal/spread
  - ~ potential sites based on knotweed species
- collect data
  - ~ plant - density, height, stem diameter, aerial photos
  - ~ insect - phenology, population increase, dispersal, nontarget
- don’t expect impacts for first few years

Biocontrol Expectations


CABI

- plants will likely be stunted, not killed
- biocontrol not appropriate for all sites, including:
  - ~smaller infestations
  - ~priority wetlands & rivers
  - ~dynamic river systems?
- establishment can take many years, impacts even longer

Knotweed Genetic Study

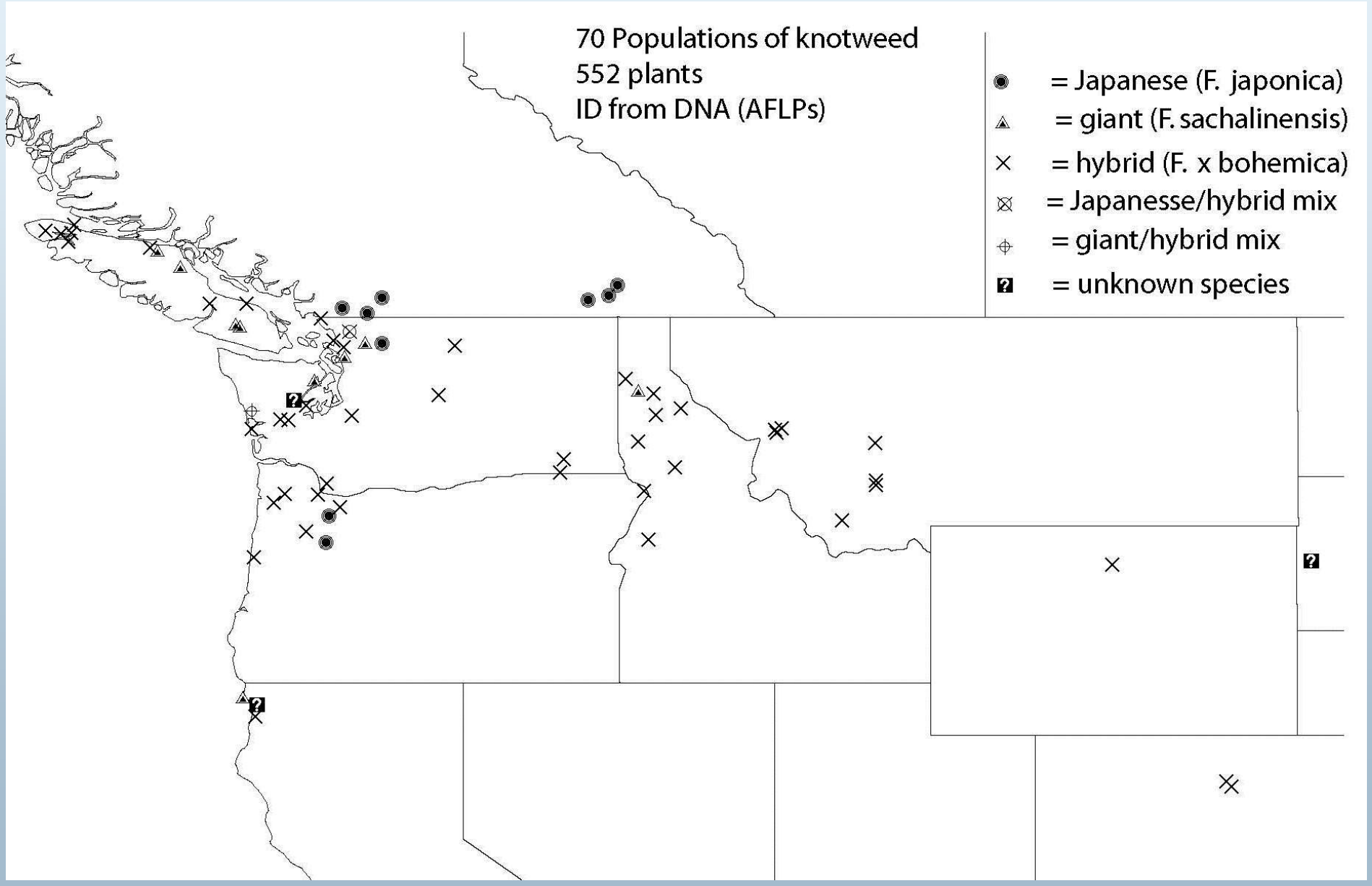
- most hybrids in our region hybridized a long time ago – before coming to US
- Japanese is one clone – same as UK
- giant differs by region but is same clone within region
- one Bohemian clone is more dominant than others
- MT clone is different than WA clone
- MT/ID almost all Bohemian

- Paper submitted (Gaskin et al.)

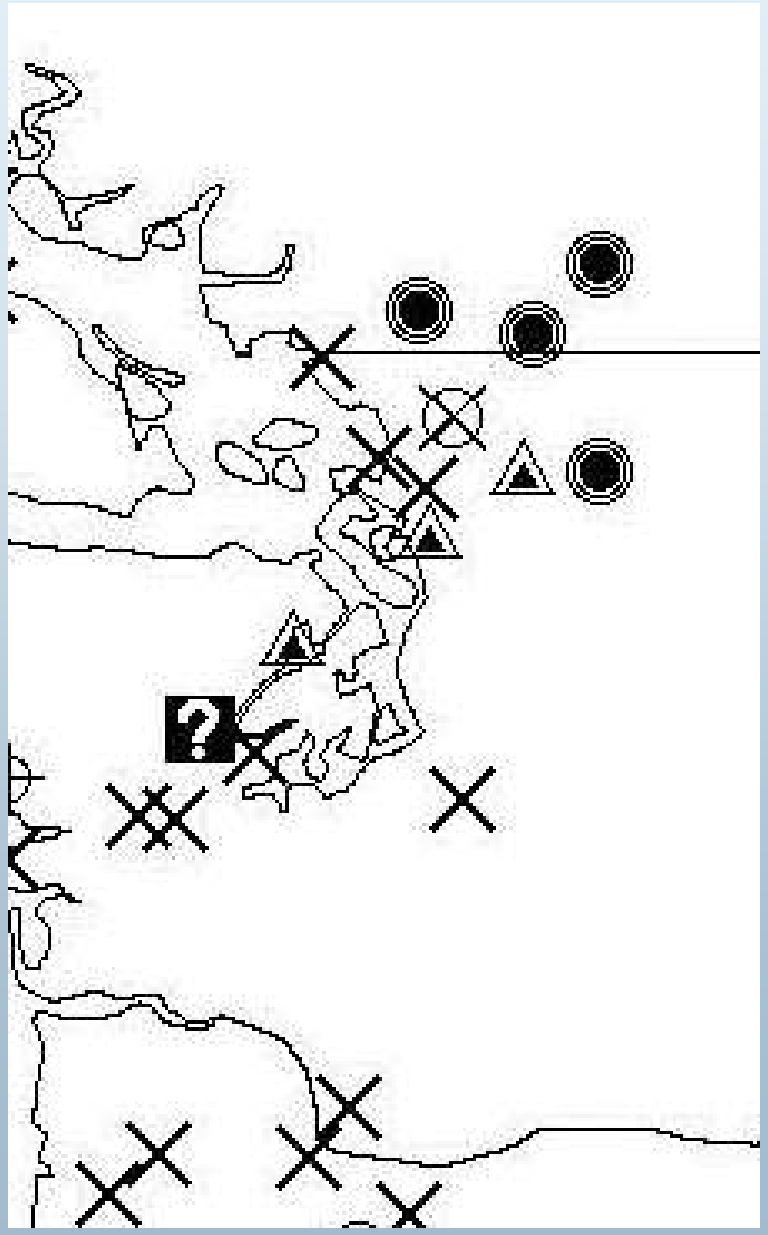
Knotweed Genetic Study

- western U.S.
  - ~ giant – approx. 15% field plants surveyed
  - ~ Japanese – approx. 15% field plants surveyed
  - ~ Bohemian (hybrid) – approx. 70% of plants surveyed
- northeastern U.S. (morphological ID?)
  - ~ greater proportion of Japanese
- British Columbia (morphological ID?)
  - ~ primarily Japanese, 10% giant & hybrid

Knotweed Genetic Study



Knotweed Genetic Study



- most WA rivers are diverse
  - ~ primarily Bohemian
  - ~ hybrids reproducing sexually & some seeds are establishing
  - ~ spreading by seed as long as more than 1 clone present in system
- giant more prevalent in coastal regions

= Japanese (F. japonica)
= giant (F. sachalinensis)
= hybrid (F. x bohemica)
= Japanesse/hybrid mix
= giant/hybrid mix
= unknown species

Thank You

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