WASHINGTON STATE UNIVERSITY EXTENSION

Biological Control of Noxious Weeds

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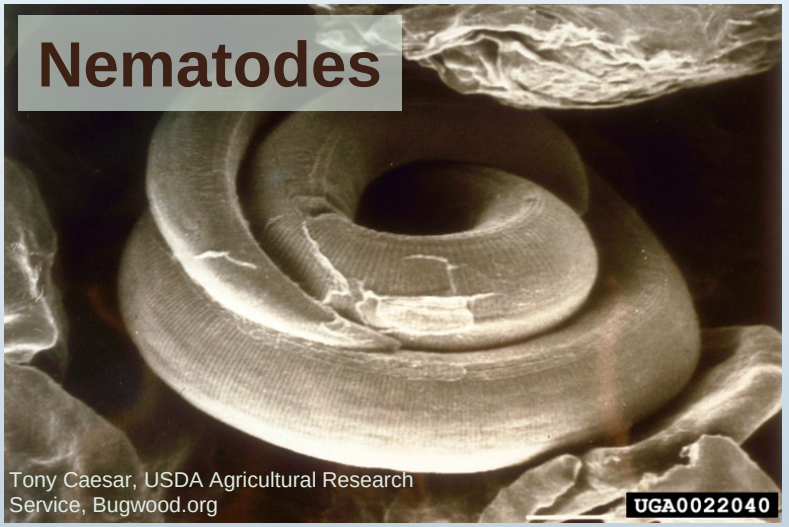
USDA WSDA Washington State Noxious Weed Control Board King County

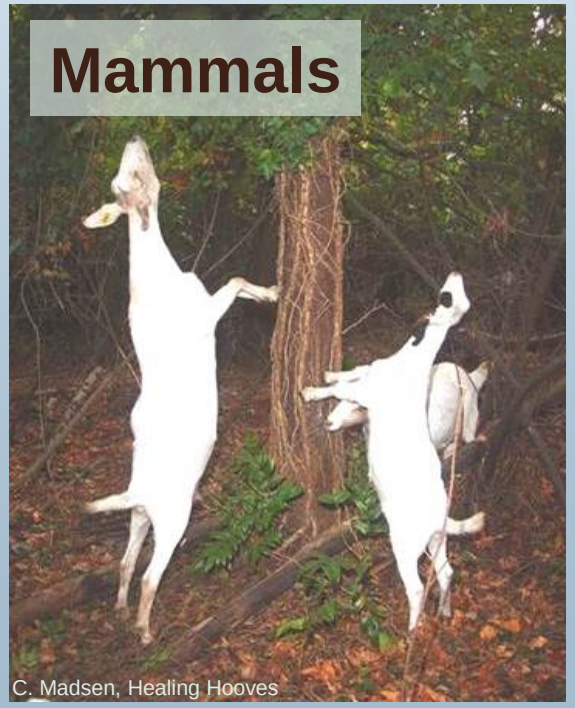
WSU Extension's Role

- State-wide program
- Provide biocontrol agents free of charge to land managers
  - private, city, county, state, federal, tribal, etc.
- Education to land managers
- Expertise & on-site recommendations
- Research projects
  - flowering rush, Scotch broom, knotweed
- Funded primarily by USFS & supplemental funding from WSDA, WSNWCB, WDFW, WDNR, Colville & Kalispel Tribes & County Noxious Weed Control Programs
  - King, Pierce, Kitsap, Yakima, Cowlitz, Franklin, Clark, San Juan

What is Biocontrol?

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



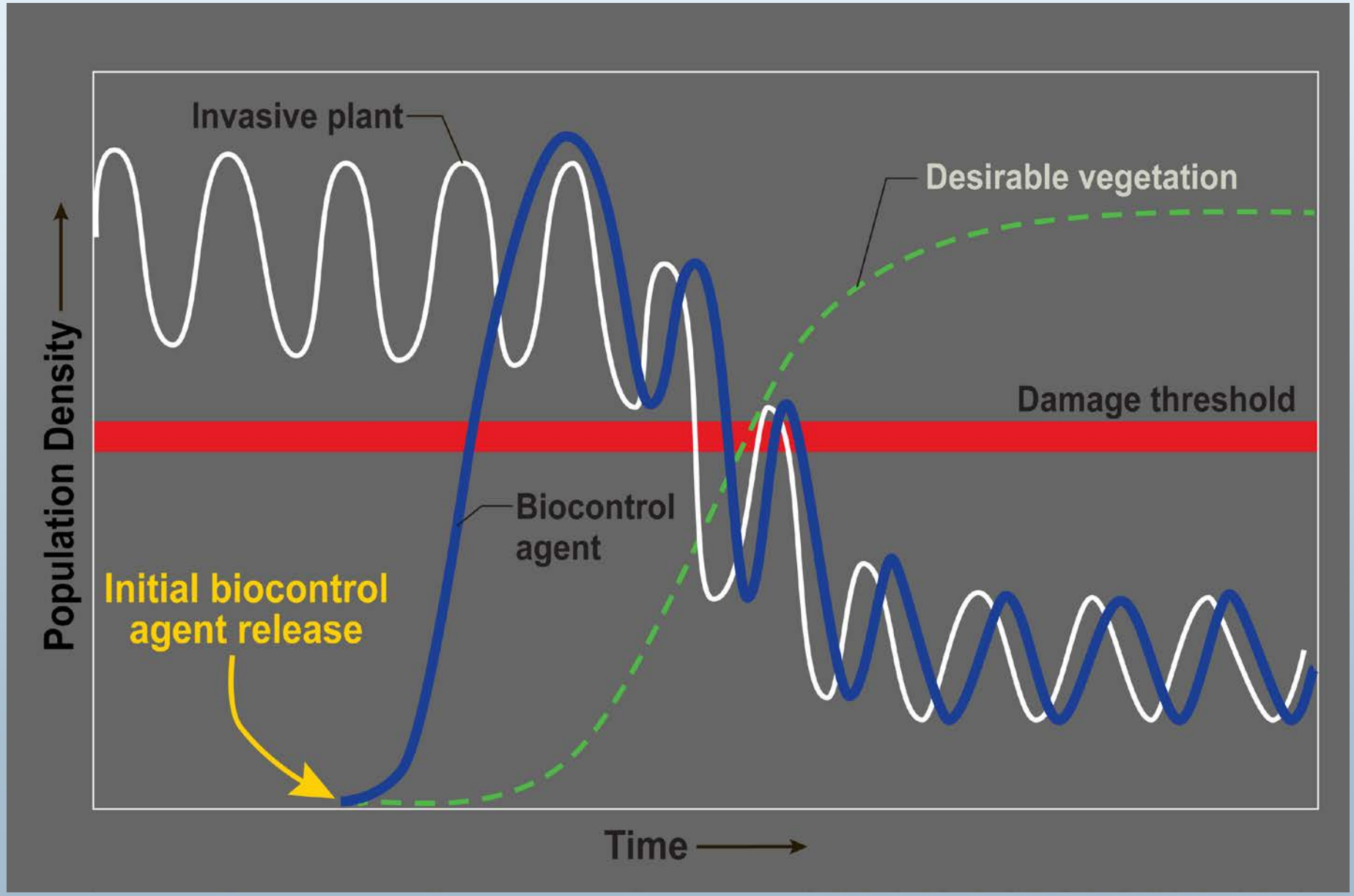


Classical Biocontrol

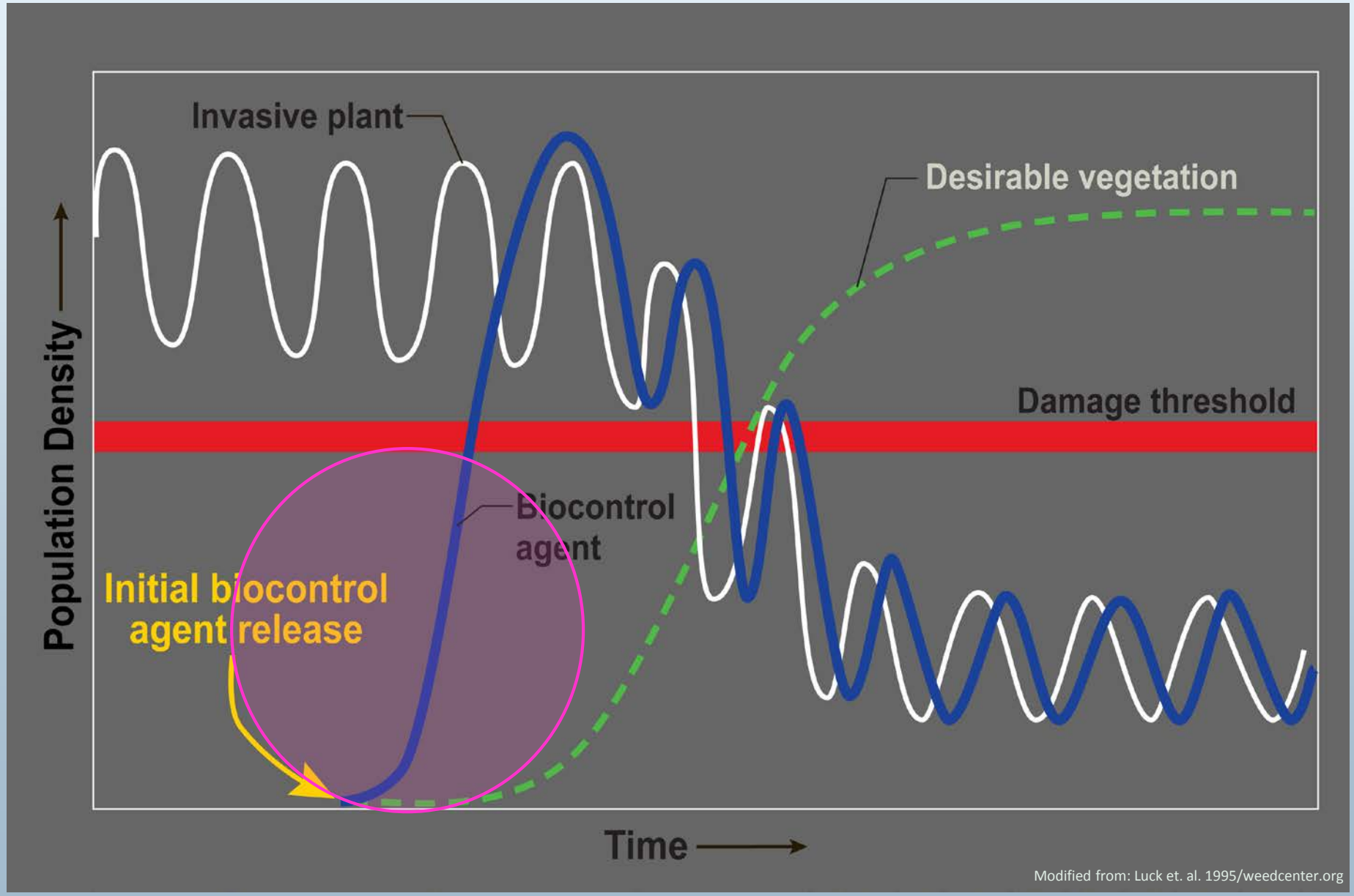
- Theory that describes why non-native plants are so good at invading
  - plants are able to establish large infestations & become widespread in their introduced range because they are released from their natural enemies
- Classical biocontrol reunites a plant species with its natural enemies in hopes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

Keane, R.M. & Crawley, M.J. 2002. Exotic plant invasions and the enemy release hypothesis. TRENDS in Ecology & Evolution 17(4): 164-170.

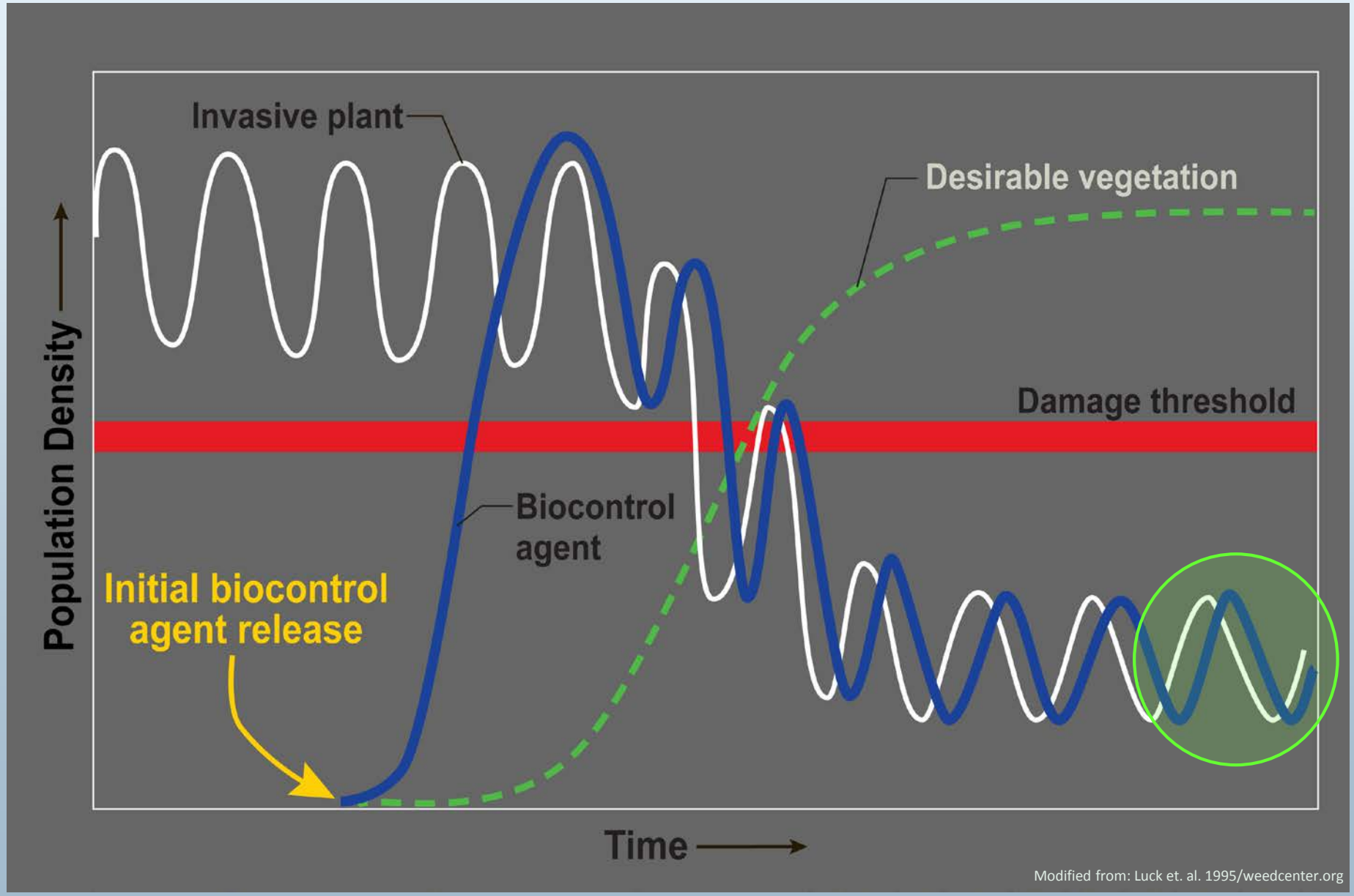
Ideal Biocontrol Results



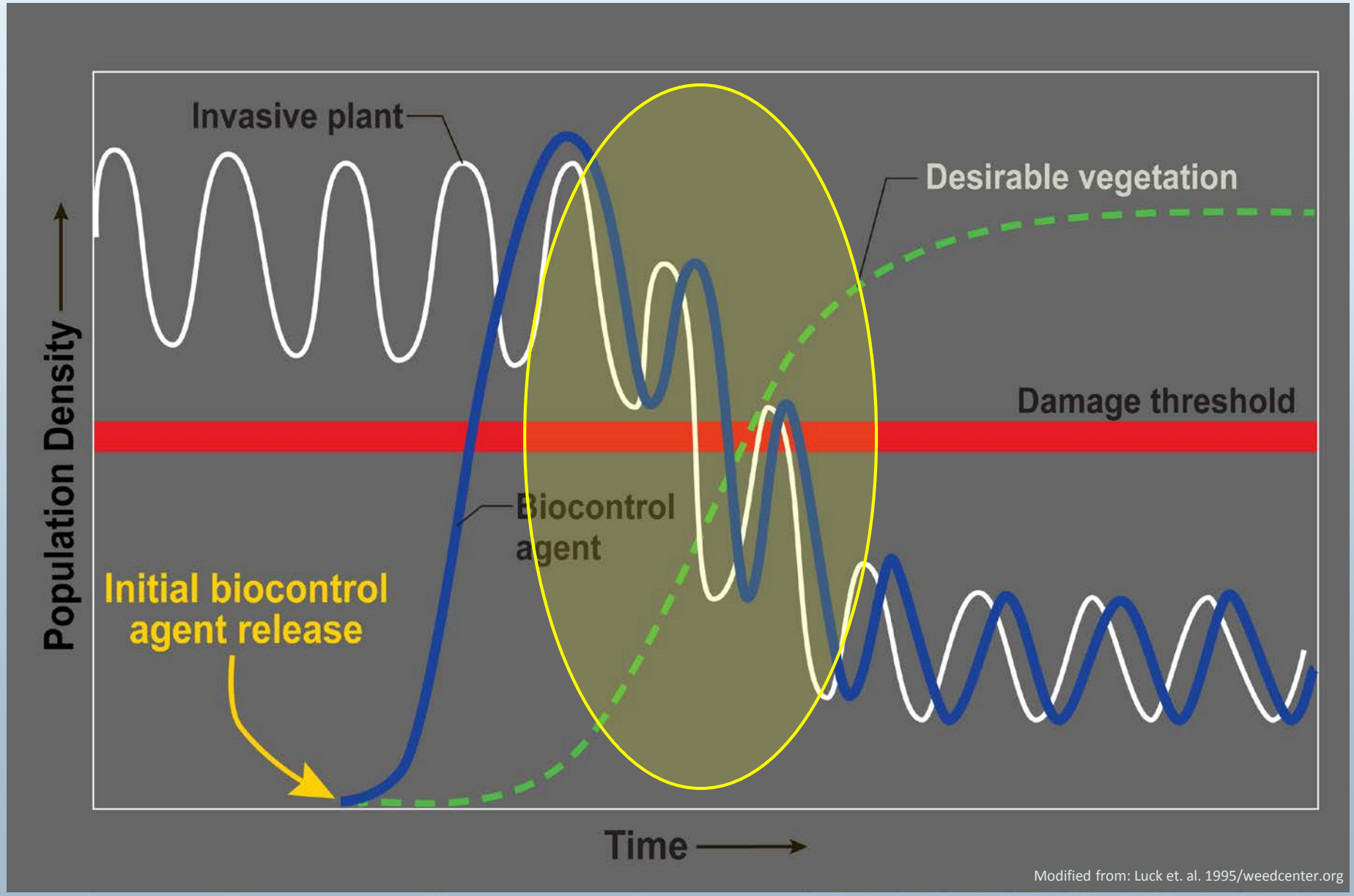
Biocontrol Results: Factor One



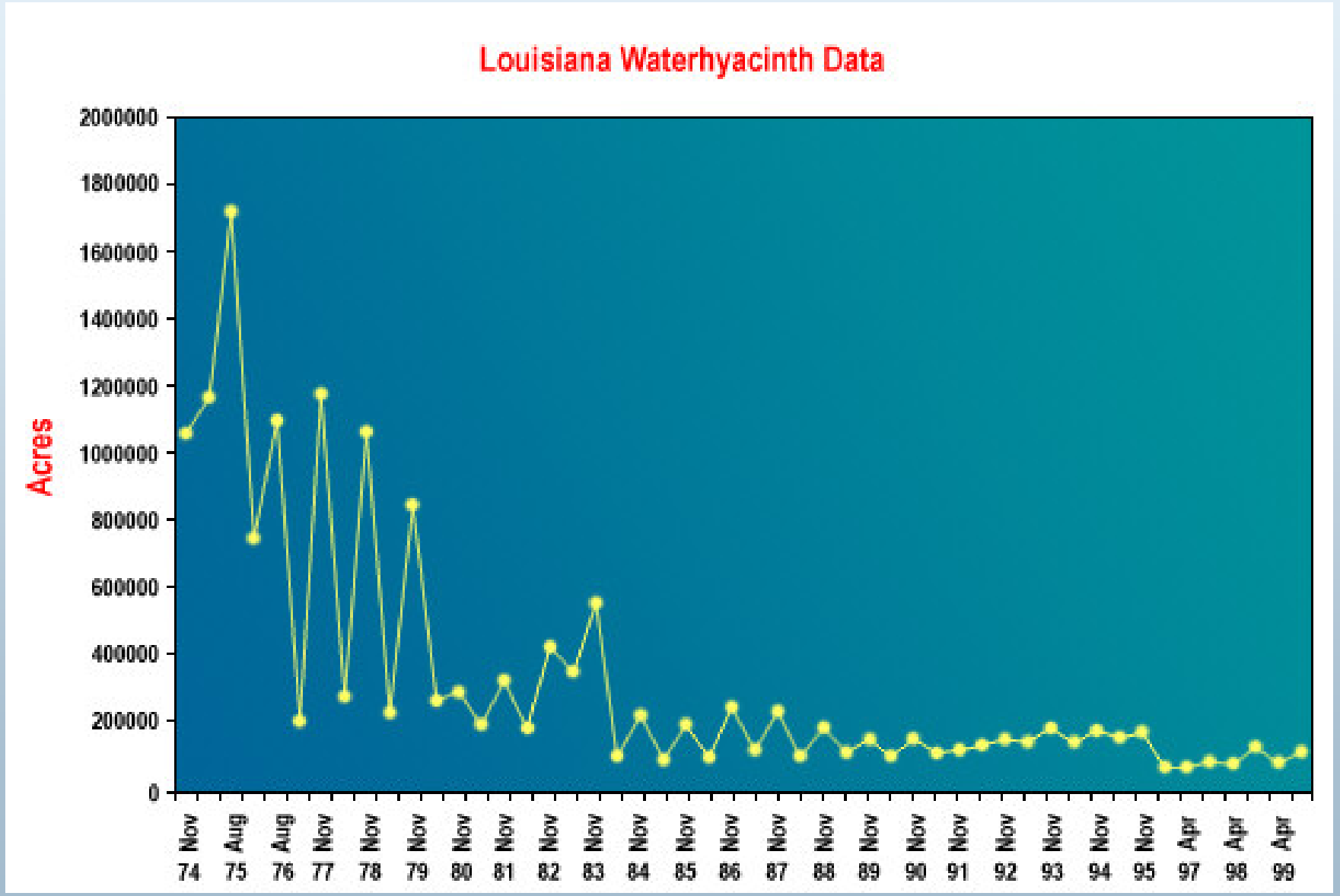
Biocontrol Results: Factor Two



Biocontrol Results: Factor Three



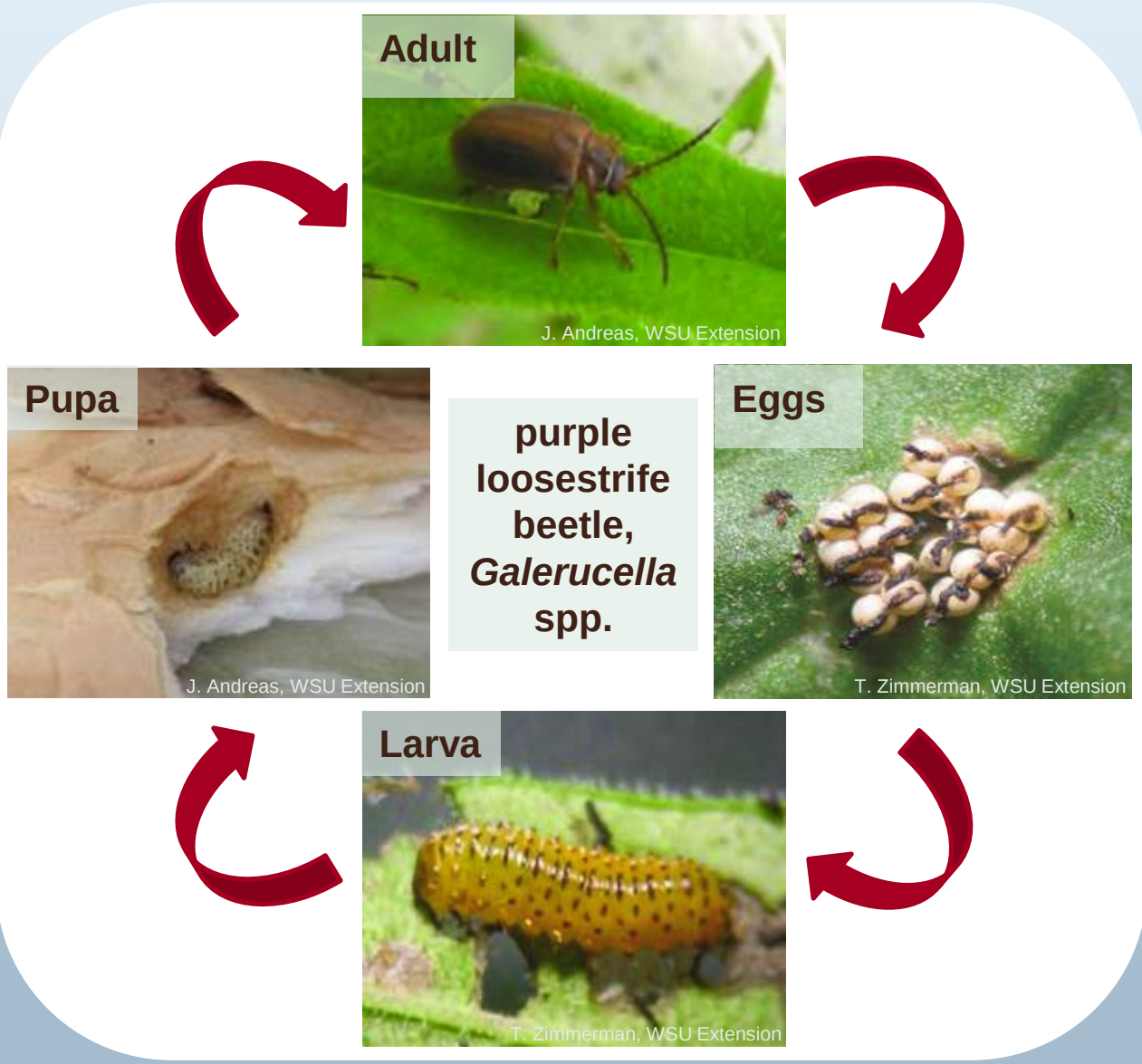
Water Hyacinth Example



USACE

Insect Life Cycle

- Most are beetles, flies, moths
- 4 distinct life stages (egg, larva, pupa, adult)
- Larval stage is often inside plant; may need to destructively sample plants to determine presence



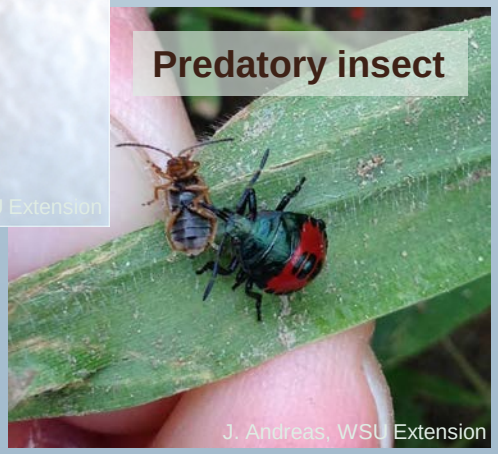
Advantages of Using Biocontrol

- Ecologically desirable
  - herbicide alternative
- Resistance highly unlikely
- Biocontrol agents are mobile
  - can move from site to site
- Long-term solution
  - will stay on site if weeds are present

- Cost effective particularly on low value land
- Safe – USDA APHIS approves biological control agents before introduction into U.S.
  - agents go through rigorous testing to ensure they don't attack native or crop species

Limitations of Using Biocontrol

- Long time to make impact
  - 4+ years
- Subject to predators
  - reduces effectiveness
- May not establish or thrive at some sites
  - impact effectiveness
- Limited availability of some agents
- Very slow approval of new agents
- **No eradication**
  - **not appropriate for sites if eradication is the goal**



Where To Use Biocontrol?

- Established, relatively large weed infestations
- Remote, inaccessible, less disturbed areas
- Areas not controlled by other means
- Environmentally sensitive sites

Where NOT To Use Biocontrol?

- Small or new infestations
- Highly disturbed areas
- Roads or traveled paths
  - site specific, acceptable for some sites
- Sites where using incompatible weed management tools
- On weeds with no approved agents
  - avoid moving insects that have not undergone testing for environmental safety

Unapproved Thistle Insects

Rhinocyllus conicus

Larinus carlinae (= *L. planus*)

Cassida rubiginosa

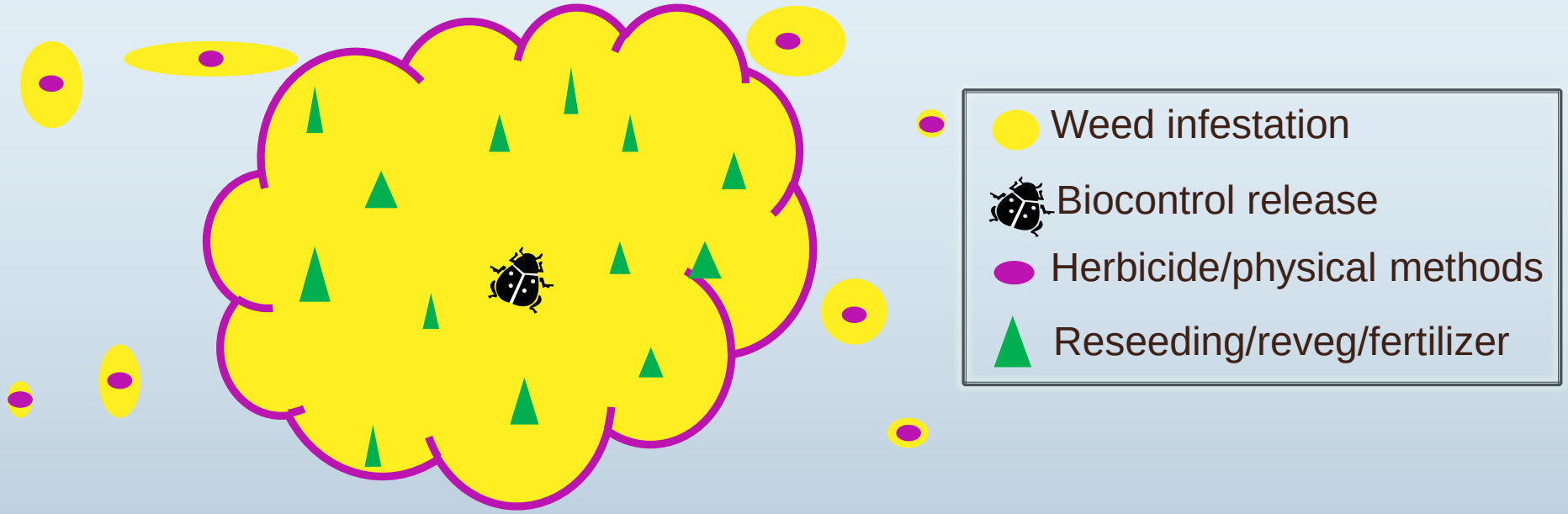
****Important****

- please avoid using beetles to control Canada thistle
- these beetles attack native plants & do not impact Canada thistle populations

Integrated Weed Management

- Biological
  - grazing, insect feeding, pathogen damage
- Physical/Mechanical
  - tilling, hand-pulling, mulching, burning, mowing
- Chemical
  - herbicide
- Cultural
  - reseeding/ revegetation, fertilization

Using Biocontrol in an IWM Strategy



- Use biocontrol & herbicide/physical control INDIRECTLY
  - release biocontrol in largest weed patch
  - spray/mow/dig satellite patches & weed edges to control spread
  - using physical/herbicide methods directly on the weed will likely kill the biocontrol agents
- Use biocontrol & cultural methods DIRECTLY
  - when biocontrol agents have started to reduce weed infestation, use cultural methods to increase plant competition

Weeds with Biocontrol Agents

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

Scotch Broom

Cytisus scoparius

– perennial shrub
– displaces forage & native species
– impacts timber, rangeland


J. Andreas, WSU Extension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Scotch Broom Biocontrol

Bruchidius villosus

- seed-feeding bruchid
- feed on developing seeds; ↓ seed production

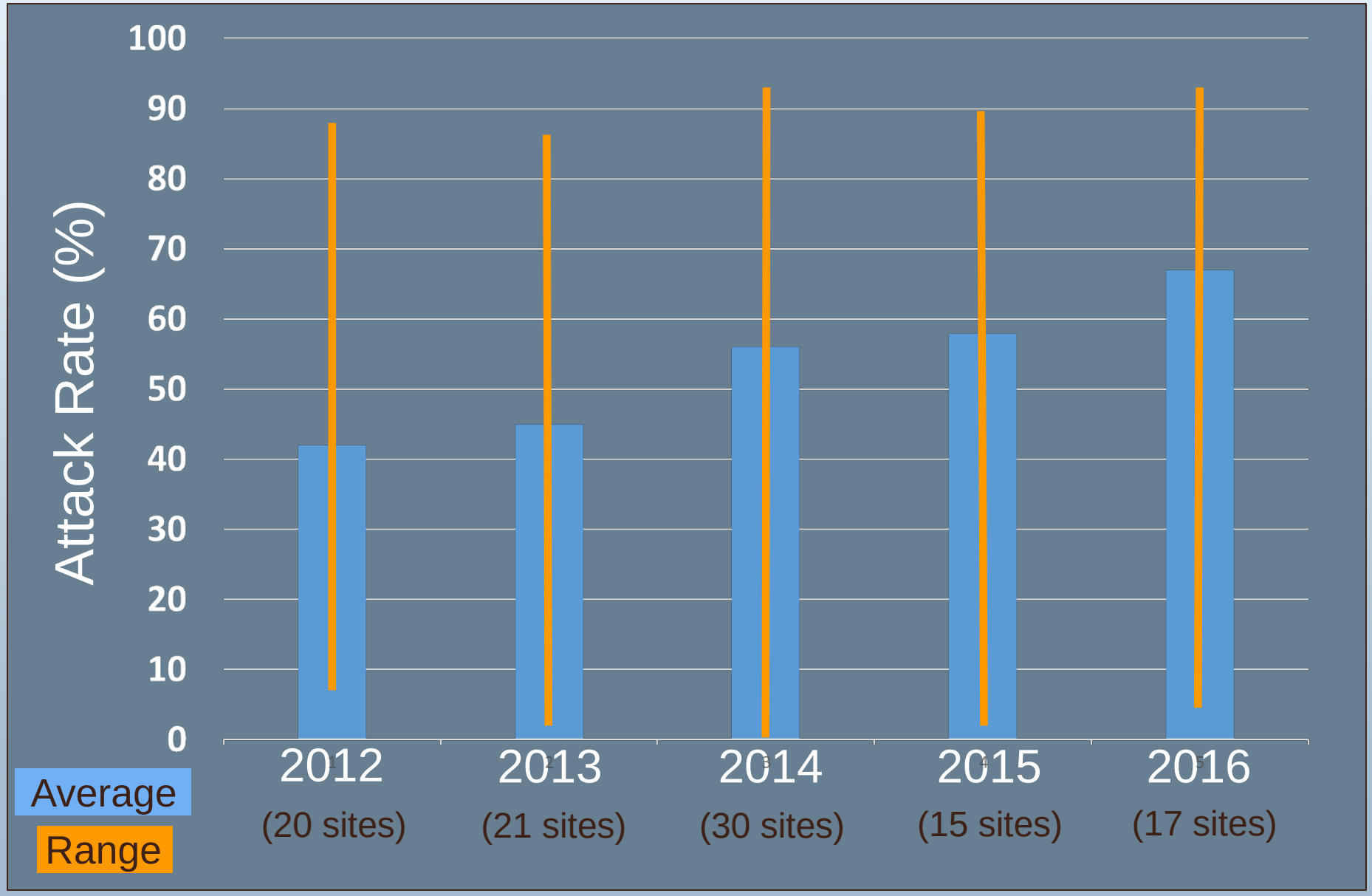
Exapion fuscirostre

- seed-feeding weevil
- widespread
- feed on developing seeds; ↓ seed production

****Important****

- these insects **DO NOT** impact current stands of Scotch broom
- not compatible with mowing/spraying/cutting

Washington SB Seed Attack



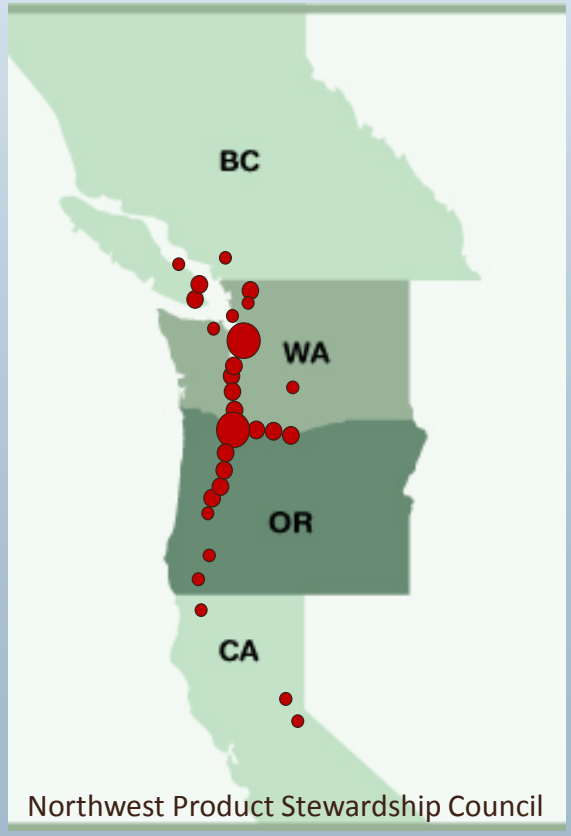
Scotch Broom Gall Mite

Aceria genistae

- accidentally introduced

SB Gall Mite – Observational Impacts

- appears to reduce seed production, biomass & may cause stem die-back



SB Gall Mite – Observational Impacts

- may cause stem die-back & plant mortality

SB Gall Mite – Research Study

- tested 24 nontarget species
  - greenhouse & field trials
  - field surveys
- data promising except *Lupinus densiflorus*
- too widespread?

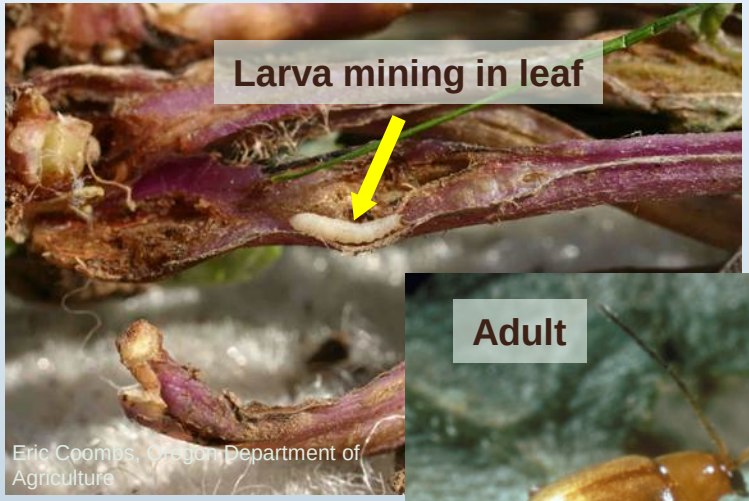
Tansy Ragwort

Senecio jacobaea

= *Jacobaea vulgaris*

- biennial, unless mowed/cut
- toxic to cattle & horses

Tansy Ragwort Biocontrol



Longitarsus jacobaeae

- root-feeding flea beetle
- excellent agent
- widespread
- look for shot-holes in rosette leaves
- find adults in fall

****Important****

- this is the primary agent recommended for tansy ragwort
- kills seedlings & small rosettes, unlikely to kill large rosettes

Tansy Ragwort Biocontrol

***Tyria jacobaeae* (cinnabar moth)**

- foliage-feeding moth
- effective in large numbers but plants are often able to flower & seed
- feed on native species; distribution not recommended
- adults found in early spring, larvae in summer

Botanophila seneciella

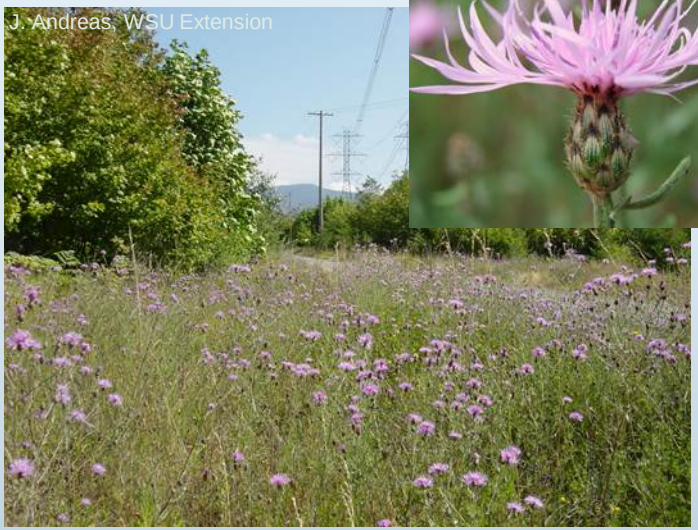
- seed-feeding fly
- widespread
- look for flowers with spittle in center; larva inside

Larvae consuming seeds

****Important****

- these insects are secondary agents

Knapweed Complex



spotted knapweed
(*Centaurea stoebe*)

diffuse knapweed
(*Centaurea diffusa*)

- spread by seed
- ↑ soil erosion
- ↓ biodiversity
- ↓ quality forage

meadow knapweed
(*Centaurea debeauxii*)

Knapweed Biocontrol

Larinus obtusus

- seed-head-feeding weevil
- attacks spotted, meadow & diffuse
- currently best agent for meadow
- ↓ seed production

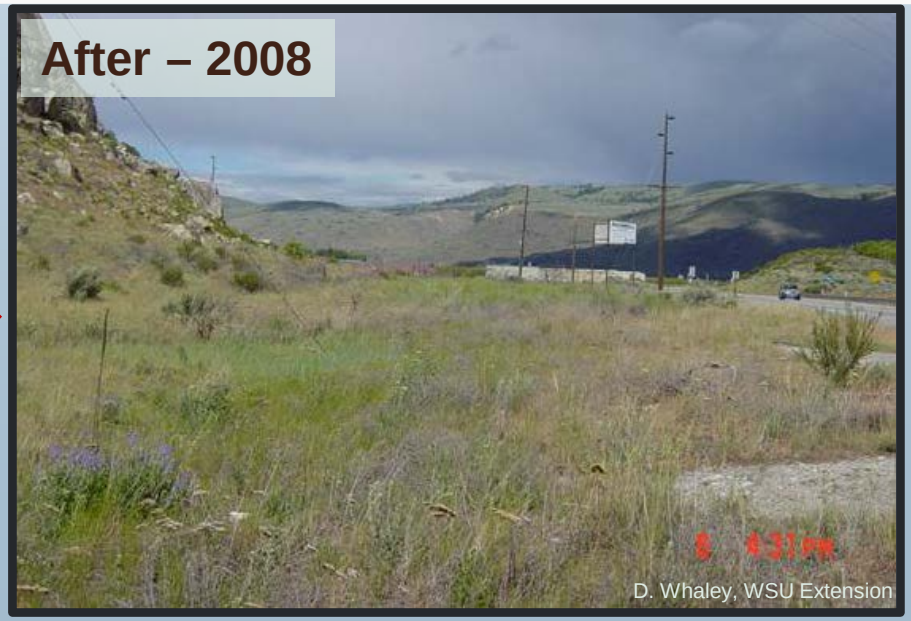
Larinus minutus

- seed-head-feeding weevil
- attacks diffuse, spotted & meadow
- strong impact on diffuse in eastern WA
- adults can defoliate plants
- ↓ seed production

****Important****

- mowing/spraying is not compatible with this agent
- **not** for Russian knapweed

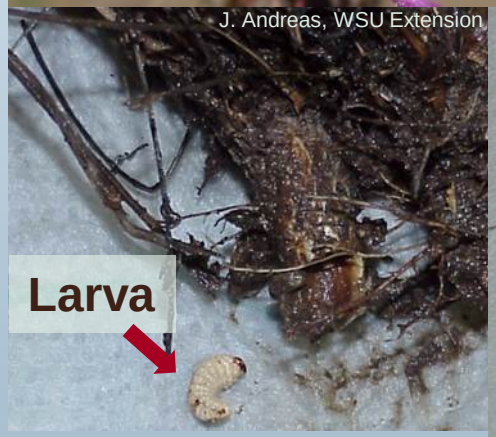
Larinus minutus – Before & After



Knapweed Biocontrol

Cyphocleonus achates

- root-feeding weevil
- attacks spotted & diffuse knapweed
- ↓ biomass & density
- can kill small plants
- adults found in August/September



****Important****

- not widely available
- mowing may be compatible with this agent
- spraying not compatible
- **not** for Russian knapweed

Canada Thistle Biocontrol

Cirsium arvense

- creeping perennial
- ↓ forage
- competes with crops

Urophora cardui

- stem-galling fly
- ↓ plant vigor
- works in conjunction with plant competition

****Important****

- appears to work best at sites where Canada thistle is not dense
- mowing/spraying is not compatible with this species

Canada Thistle: New Biocontrol Agent

Puccinia punctiformis

- naturalized rust fungus
- infects root system
- can see reductions in 3 years
- 1st releases in WA

2017

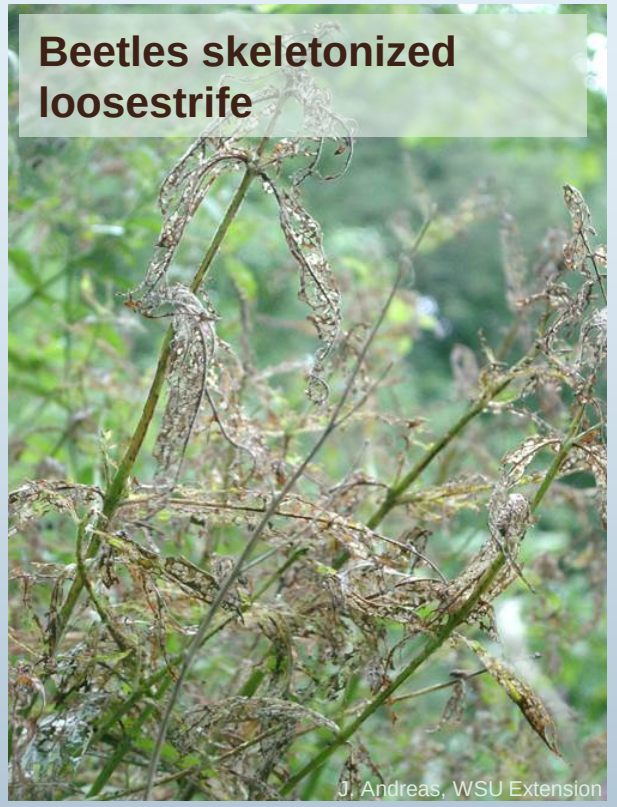
- 7 releases
- millions of spores

Purple Loosestrife

Lythrum salicaria

- herbaceous perennial
- aquatic, wetland sites
- displace native vegetation
- degrades wildlife habitat & hunting/ fishing areas
- ↓ water flow

Purple Loosestrife Biocontrol



Galerucella calmariensis* | *G. pusilla

- foliage-feeding beetles
- highly effective; larvae & adults consume foliage
- eggs, larvae & adults found from May-August

****Important****

- problems establishing in regularly fluctuating water
- not compatible with spraying/mowing but can clip seedheads

Galerucella spp. – Before & After

Purple Loosestrife Biocontrol

Hylobius transversovittatus

- root-feeding weevil
- best combined with leaf beetles
- can kill small roots within 2 years if several larvae present
- difficult to collect

****Important****

- lab reared; not easy to acquire, not widely available
- cutting may be possible

Bindweed Biocontrol

Convolvulus arvensis

– field bindweed

Calystegia sepium

– hedge bindweed

Aceria malherbae

– tiny mite, unlikely to see; will see gnarled, twisted leaves & stem damage
– best impact on hot, dry sites
– generally for field bindweed
– experimental use for hedge bindweed

****Important****

– spraying may be possible, worth exploring
– can be mowed

St. Johnswort

Hypericum perforatum

- perennial, rhizomatous
- causes sensitivity to sun
- now considered mainly a roadside or wasteland weed

- Almost 2.5 million acres in northern California infested in 1944

St. Johnswort Biocontrol

****Important****

- not compatible with mowing/cutting/spraying
- success appears to be site-dependent

***Chrysolina* spp.**

- foliage-feeding beetle
- adults found in May-June
- poster child for biocontrol success!

Knotweed – Upcoming Biocontrol?

- 3 species in North America & Europe
  - *Fallopia japonica*
  - *Fallopia sachalinensis*
  - *Fallopia x bohemica*
- *Aphalara itadori*
  - sap-sucking psyllid
  - southern strain: attacks Japanese & hybrid
  - northern strain: attacks giant
  - southern strain released in U.K. & Canada

Aphalara itadori – Damage

- can twist / bind leaves but doesn't always
- depletes energy supply =
  - ↓ growth
  - ↓ root storage
- leaf deformity =
  - ↓ leaf area
  - ↓ photosynthetic rate
  - ↓ growth
  - ↓ competitive ability

A. itadori – Petition & Releases

- Technical Advisory Group (TAG) recommended in November 2013
- Approval pending from APHIS PPQ
  - request for additional information
  - two supplemental documents submitted 2014 & 2015
- Potential releases in U.S. 2019
  - mass releases later

Biocontrol Expectations

- 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

Thank You!

Contact information:

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Bull Thistle Biocontrol

Cirsium vulgare

- biennial
- prevalent in heavily disturbed sites

Urophora stylata

- seed-feeding fly
- limited availability
- not compatible with mowing/cutting/spraying

Hawkweeds

Aulacidea subterminalis

- stolon tip-feeding wasp
- attacks mouseear, orange & whiplash hawkweed
- 1st release in WA on Gifford-Pinchot
- important release for U.S.

2017
- 1 release
- 50 galls